REVIEW

Connecting the dots: Researching intersectionality and health in the climate crisis

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ABSTRACT

Health systems need to reduce their environmental impact and adapt to changing circumstances, such as increasing health problems caused by the ecological crisis. Research into relationships between climate, environment, health and health care has delivered valuable insights and greatly contributed to increased awareness, knowledge and action. However, one major and serious gap exists when it comes to social justice: issues related to gender and diversity are rarely included in research questions, methodologies and analyses. This long-standing bias amplifies and reproduces unjust policies, prejudiced practices and health disparities. To deliver future-proof solutions in health care it is imperative to consider climate justice in health research. Integrating intersectionality-based research methodologies—including their correspondence with Planetary Health—generates meaningful, applicable knowledge that would otherwise remain neglected. In this paper, we present a preview of "Coloring Connections," a coloring book that seeks to provide researchers with tools, playful concepts, creative assignments and narratives to integrate gender and intersectionality amidst the climate crisis in their health research.

Key Words: Gender, Intersectionality, Planetary Health, Health care, Health research

1. INTRODUCTION

We live in turbulent times. The current global ecological crisis has led to the disruption of the biological and ecological systems life depends upon. The resulting health consequences affect societies in many ways. While industrialized high income countries (HIC) are largely responsible for historical greenhouse gas emissions and global warming, health and other impacts fall disproportionately on populations in low-resource settings. Healthcare has a dual mission of reducing its own contributions to the climate crisis to mitigate the health impacts of climate change for care recipients while at the same time adapt to these circumstances: "the unique climate problem" of healthcare.[1] Moreover, ill Planetary Health reproduces and exacerbates existing inequalities, leaving specific subgroups particularly at risk, as inequities implicate access to basic health care services. Consequences of these inequities are felt mostly by the elderly, people living in poverty, those living with chronic illness or disease, women, small children, gender and sexually diverse communities and racialized and marginalized communities. When societies, including health systems, do not manage the consequences of the climate crisis, for instance when supply chains are affected by extreme weather events, these groups are not only primarily affected, but health inequalities will further increase.

Inequalities in access and inequities in health outcomes are gradually being recognized within the Planetary Health paradigm but more, and ongoing, attention is needed. Considering equity in healthcare research is important not only in terms of social justice and research ethics but also to improve the quality of research and the quality of care.[2] Redesigning health systems to provide equitable, gender-sensitive and culturally safe health care in harmony with the natural environment will enhance the impact of research investment and reduce research waste. This is nothing less than a paradigm shift, in the Kuhnian sense.

The objective of this paper is to provide examples from the coloring book that we developed which demonstrates how intersectional methodologies can be integrated in public health research amidst the climate crisis, in particular the interface of sex and gender with other dimensions of diversity. Researchers habitually neglect gender analyses and intersectional approaches, finding it challenging to address their complexities.[3] We particularly aim to support young researchers with background knowledge, examples and practical assignments to address this omission and creatively embed gender, equity and intersectionality in their methodologies. This is especially timely as academic freedom is being subjected to increasing autocratic tendencies across the world, most recently from the United States, which has invested the most in research over decades.[4]

2. THE CURRENT STATE OF HEALTH RESEARCH

Against a backdrop of today's existential dangers—from climate disruption, nuclear war, soaring inequalities and unbridled use of artificial intelligence—education at all levels plays a critical role in determining our future, while also being under pressure itself. Beyond attacks from autocratic governments that interfere with academic freedom and disrupt developing critical thinking skills, the Anthropocene itself challenges the very definition of education and its fundamental goals.[5] How do we educate the new generation in the face of existential threat?

Knowledge creation for adapting to the unfolding collapse of Earth systems is long overdue. In their business operation universities in HIC are net emitters of greenhouse gases. Many heed the call and work to achieve international and national climate objectives or Sustainable Development Goals. Additionally, the academic community has a moral responsibility to call out to governments to address the need for effective climate policy and action, and to offer help and support in providing the best available knowledge. While "dancing on the volcano," researchers should go beyond conventional

models and practices of education and re-think their professional responsibilities.[6, 7] Hence scientists have engaged with calls to make their working environment more sustainable or take climate action, which may take many forms from signing a petition to peaceful civil disobedience.[8] Others develop innovative "pedagogies of collapse" to find courage and inspiration, and contribute to social impact now that ecological disruption is evolving into societal disruption.[9]

Educational institutes have a historical responsibility in the making of this crisis, particularly in countries that have histories of colonisation, and continue to maintain systems of coloniality.[10] Here, as well, higher education institutes should acknowledge their role and responsibilities, as science itself has left a massive legacy of colonialism in our fundamental epistemologies and methodologies. To date, in medicine and in health sciences, researchers are trained in the ideology of "neutral" and "objective" science. This "value-free" enterprise continues to be based predominantly on white men's knowledge and assumes white male bodies and lives as "neutral." This knowledge is upheld as the best available knowledge, and is therefore extrapolated to the rest of humankind, across all sexes, genders, ethnicities, ages and body types.

Universities, and health care institutions, are de facto complicit in the reproduction of racism and other types of discrimination in their institutions, including in their knowledge base. By fostering competition and individualism, and valuing output over insight, academic practices and procedures hamper the much-needed co-creation and collaboration to resolve this long-standing misconception.[11, 12]

3. DEVELOPING A NEW RESOURCE FOR RESEARCHERS

Some countries and organisations now have policies to integrate analyses and considerations of sex and gender in health research. To advance policy aims of integrating sex and gender into health research, The Netherlands Organisation for Health Research and Development (ZonMw) funded the Dutch Society for Gender & Health (NVG&G) to develop a case study for researchers. With a team of experts in gender-and-health and healthcare as co-authors, and in collaboration with a designer, we developed the open-access coloring book, "Coloring connections." (The coloring book was commissioned by the ZonMw to the Dutch Society for Gender & Health. It can be downloaded through Zenodo-link `https://zenodo.org/records/14258538`, EU Open Research Repository.) Its aim is to support researchers, particularly those who are young/early career, with background knowledge, examples and practical assignments to respond to these

oversights and creatively embed gender, equity and intersectionality in their methodologies. It delivers a playful methodological toolkit that illustrates the urgency, relevance, possibility and necessity of gender and intersectional considerations in research on planetary and human health. Creative assignments in the book, co-developed with designer Katinka Feijs (The artwork in the coloring book was designed by Katinka Feijs `https://www.katinkafeijs.com/`), help to foster a deeper understanding of this topic (In November 2025, the book was downloaded 3,000+ times from the EU Open Research Repository Zenodo).

4. FIVE THEMES

In Coloring Connections our aim is to support academics who are integrating gender and intersectionality into human health research within the broader context of the Planetary Health crisis. The intention is to reduce bias and research waste, improve the quality of health knowledge, advance health equity—particularly for understudied populations— and accelerate knowledge creation for today's most urgent issues in Planetary and human health.

Coloring Connections is organised into 5 domains: Health Inequalities, Violence and Masculinities, Healthcare, Medical Education, and Public policy. Based on the authors' expertise in gender and health, and on existing health research literature, these domains were identified as most appropriate to illustrate how gender and intersectionality can be integrated into health and care research. Each domain (and relevant chapter) in "Coloring Connections" includes concepts, methodologies, tools and frameworks to guide research. Below, we provide some examples of these, as well as some of the inspiring studies and creative assignments included in each.

4.1 Health inequalities in heat stress

In this chapter, we describe health inequalities in relation to climate change, particularly heat stress. Equitable Planetary Health research including on heat stress combines geographical, sociodemographic, and health variables. Relatively newly developed statistical approaches to analyze inequalities in health and heat, such as multilevel analysis using a MAIHDA approach, are also introduced.

4.1.1 *Example of research: Heat stress and the gendered environment*

Mashhoodi studied environmental justice and gender inequality in the exposure to high temperature c.q. Land Surface Temperature (LST) in the Netherlands.[13] Studies were inconclusive about the prevalence of sex differences in mortality during heatwaves, and the female/male ratio varies across age groups. It was also unclear to what extent in-

equalities were the result of unequal exposure to LST. The Netherlands is a country characterized by flat terrain with most land situated 5 m above sea level, in a temperate climate zone. The built environment accounts for about 13% of the land(including roads, ports, and urban greens). Mashhoodi chose to investigate gender imbalance in residential zones as an independent variable, calculated by subtracting the percentage of men in a zone from the percentage of women. They found that the gender composition of residential zones alone, i.e., more women than men living in a residential zone, explained about 10% of LST variations, indicating that a 1% increase in gender imbalance corresponds with a rise of more than 0.1 degree Celsius in LST. Women were overexposed to LST in over half of the residential zones regardless of socioeconomic characteristics. More women, in particular older women, live in neighborhoods featuring poor quality housing, and a lack of water bodies, green spaces and trees. New forms of gender inequality such as access to air conditioning, shading and ventilation, clothing, indoor housework, or electricity demands may become an issue.

4.1.2 *Example of methodologies: MAIHDA analysis and intersectionality*

To illustrate the study of heat stress from an intersectional perspective, we introduced the MAIHDA analysis. This is a relatively new statistical tool for analyzing inequalities. Among the tenets of intersectionality is social justice, the understanding that individuals are defined by complex combinations of identities, and that health inequities may rise from these combinations.[14] As an overarching framework or meta-theory, intersectionality has been largely used in qualitative research, but has been a challenge in quantitative research, mainly due to small (subgroup) sample sizes in multilevel analysis. Recently, researchers have begun to combine multilevel analysis of individual heterogeneity and discriminatory accuracy (MAIHDA) with intersectionality.[15] As a statistical analysis, MAIHDA assumes individuals are nested within intersectional strata that are unique combinations of individuals' intersections. It allows for identifying disadvantaged groups, and may help uncover inequalities among multi-category subgroups, even within relatively small sample sizes. To incorporate environmental justice, geographical MAIHDA extends this approach by also examining geospatial and social inequities in environmental health hazards. For instance, Holman and colleagues integrated "place" as an aspect of intersectionality within neighborhoods in their study of how "social causes get under the skin."[16]

4.1.3 *Example of a creative assignment: Connecting the dots*

Included in the chapter on heat stress is an assignment for researchers to connect the dots between heat stress, social

identities, and the environment (see Figure 1 Connect the dots).

4.2 Violence and masculinity

To introduce researchers to approaches that study gender and intersections with other social identities, we chose to describe patriarchal relations and hegemonic masculinities as patterns of practice that organize gender relations in societies.
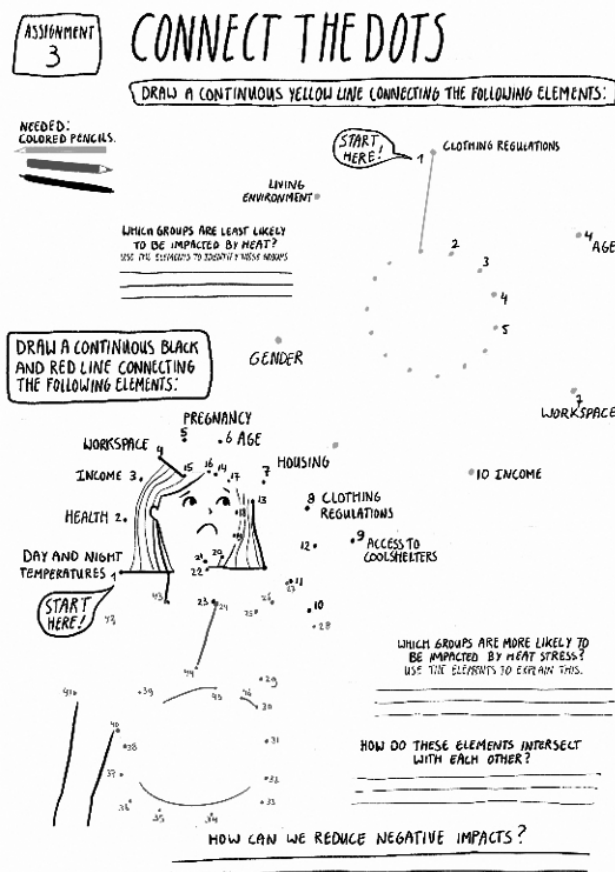

Figure 1. Heatwave assignment: Connect the dots

4.2.1 *Example of creative assignment: Petromasculinity*
In the debate about gender and the Planetary Health crisis, "gender" is often synonymous with the idea of "women as victims," while the relationship between "masculinity" and "climate change" requires more nuance, including the concept of "petromasculinity."[17] This refers to a construction of masculine identity shaped by conservative ideologies, misogyny, and climate denial. One assignment (see Figure 2) invites researchers to explore petromasculinity and its relation to health.

4.2.2 *Example of research: Hegemonic masculinities after forced migration*
In gender politics among men, and between men and women, violence is evident in armed conflict, assault, or domestic violence. Violence is a way to establish and maintain masculinity.[18] Gender relations and masculine identities are disrupted in forced displacement. In new environments, new relations must be negotiated, and masculine identities may change. In resettlement countries, refugee women are often portrayed as victims of patriarchal systems and violence from "dangerous Other men." As a consequence, refugee men are frequently framed as dangerous rather than as in danger, or as vulnerable themselves. In a qualitative study, Huizinga and Van Hoven interviewed male refugees in the Netherlands, most of whom identified as Muslim.[19] For older male refugees, particularly those who were highly educated, masculinities were challenged by status loss and downward mobility in the Dutch labor market. They often felt stripped of privileges associated with their class and citizenship positions and were systematically being associated with low socio-economic class and oppressive gender norms. Comparatively, younger men could convert their physical capital more easily into economic capital, particularly in the construction sector. The researchers suggest that male refugees may adhere to more traditional gender beliefs in relation to experienced racism and exclusion.
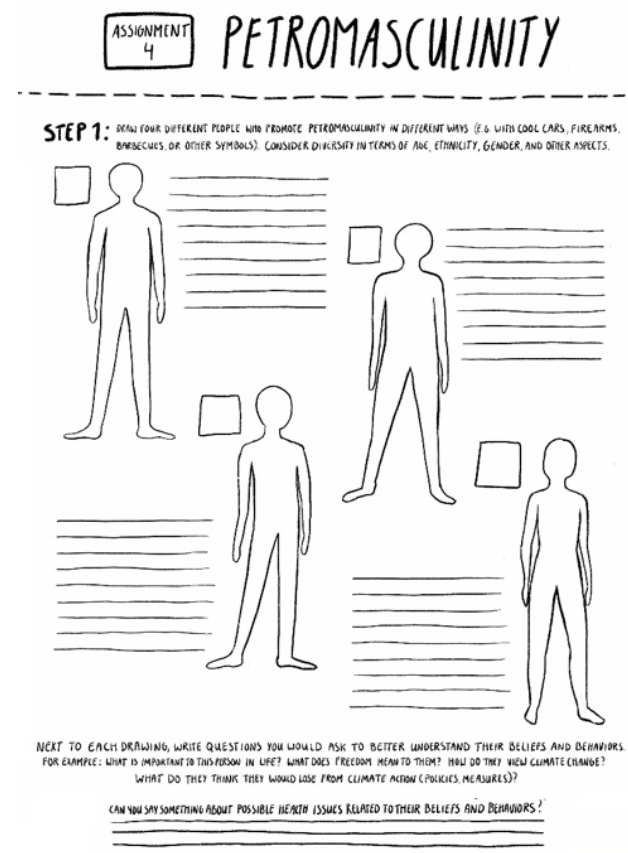

Figure 2. Considering the relationship between petromasculinity and health

4.3 Healthcare and Planetary Health

Health systems face numerous challenges from staff shortages and rising costs to addressing gendered and intersectional health inequities to unique climate problems and their connections. In the chapter about healthcare and Planetary Health, we introduce researchers to integrating Planetary Health and inequalities in the study of health care. We present challenges for healthcare and provide examples of inspiring research and participatory methodologies.

4.3.1 *Example of research: Preparing the Australian health system for climate change*

The Australian Climate and Health Alliance, a national coalition of health stakeholders, guided the development of a policy framework for a National Strategy on Climate, Health, and Well-being.[20] The framework was developed for all government levels from several years of consultation rounds with health stakeholders, policymakers, and various communities of practice. It was endorsed by 70+ health and medical organizations nationwide. In 2021, the strategy was updated by placing Aboriginal and Torres Strait Islander knowledges of custodianship at the center of the climate-health strategies. Custodianship refers to the many forms of First Nations communities' close affiliation with the land, and their cultural responsibilities of caring for country. The researchers concluded that incorporating First Nations knowledge systems should be seen as an act of self-preservation, and not only as an act of reconciliation and justice.

4.3.2 *Example of methodologies: Participatory health research*

A range of transformative and social action-oriented research practices exist such as action research, community-based participatory research, or feminist participatory action research.[3, 21] In participatory health research (PHR), those who are affected participate as much as possible in all stages of the research process. PHR combines social change with scholarly understanding, incorporates and amplifies participants' voices, experiences and knowledges, connects these to theory, and fosters agency.[22] By combining various sources of knowledge, creative expression and art-based methods such as photography or drawing, inclusion is enhanced. Joint methodological reflections are part of the research process.[21]

4.4 Medical education and Planetary Health equity

To transition healthcare and prepare health professionals to engage with unequal challenges of the Planetary Health crisis, medical education requires reform guided by implementation research. In medical education research, few studies are published on integrating health equity and Planetary Health. In this chapter, we describe frameworks for integrating health equity and for assessing social accountability.

4.4.1 *Example of research: Arts-based medical education*

Using the Depth of Field methodology, Brand et al. conducted research in Australia employing narrative portraits and arts-based education strategies to design health education resources.[23] Poetry and artwork can foster critical thinking and challenge hierarchies. They emphasized acknowledging Indigenous knowledges and promoting an understanding of the intricate connections between environmental sustainability, social determinants of health, and cultural diversity.

4.4.2 *Creative assignment: Critical reflection training*

In one assignment, we provide steps for critically reflecting on personal frames of reference in relation to health and healthcare research, exploring the intersections of health, climate justice, and First Nations knowledge systems, and engaging with perspectives such as the Seventh Generation Principle, Ubuntu, and Buen Vivir.[24] Coming from different parts of the world, these knowledge systems engage with health in broader and holistic ways. Literature, activities and question cards are provided for first exploration of Indigenous knowledge systems.

4.5 Public policy, intersectionality, and healthy cities

Projections indicate that by 2050 more than two-thirds of the global population will live in urban areas. Since public policy influences health determinants, large populations will reap the equity and health co-benefits of climate mitigation and adaptation policies of cities. In this chapter, we look at examples of cities that centered inequities in their public policies.

4.5.1 *Example of research: Lessons from the city of Barcelona*

The Spanish city of Barcelona is an early adopter of "intersectional climate justice" policies.[25] The municipality aimed to build resilience to climate change while addressing structural inequalities in accessing the built environment, health services, energy, housing, and transportation. The city used a "feminist urbanism" perspective, by recognizing and rectifying the gendered allocation of time for work, family, socializing, resting, and caregiving. Since the city acknowledges that climate challenges are intertwined with social justice concerns, its efforts can be categorized as "climate connected" according to Bulkeley's framework.[26] Communities were involved in planning and citizen participation was maximized.

4.5.2 *Example of creative assignment: Design an inclusive city*

In this assignment researchers are invited to take the perspective of a community nurse who has to do her job during

a heatwave (see Figure 3). What does she need to provide healthcare in people's homes, one client after the other?
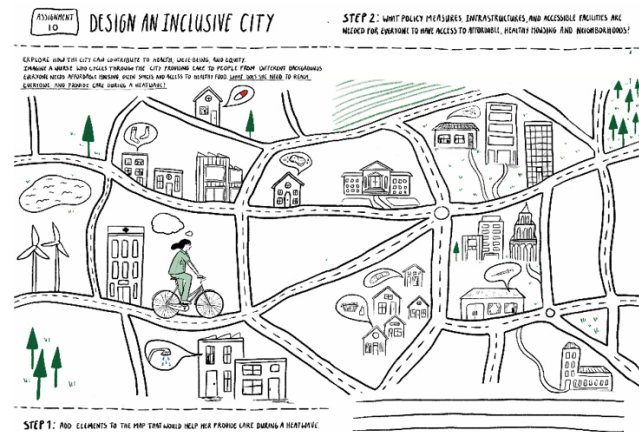

Figure 3. Design an inclusive city

5. CONCLUSION

The root causes of and the health and system challenges posed by the Planetary Health crisis are connected: power structures including, but not limited to, patriarchy and (post-)colonialism exacerbate the ecological crisis and related health problems. We must quickly transform health research, health care and public policies to contribute to a fairer and healthier world, take responsibility for the urgency of this crisis, and engage health researchers and professionals. Health researchers and professionals have the authority and societal trust to call out their governments and their institutions. They need knowledge and skills to fulfill this enormous task, which is why we created Coloring Connections. As the Planetary Health crisis unfolds before our eyes, research efforts should be directed towards structural transformation of societies including the health care sector, mitigate what is possible, adapt to what is inevitable, prepare societies to be responsive to and resilient after future crises, and contribute to better health for all.

CONFLICTS OF INTEREST DISCLOSURE

The authors declare no conflicts of interest.

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Obtained.

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DATA SHARING STATEMENT

No additional data are available.

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