Review

Examining the Impact of Climate Change Risks on Pregnancy through a Climate Justice Lens: A Review

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Abstract: Climate change impacts such as climate-amplified weather events are increasing in intensity, frequency, and severity. Despite climate change affecting areas all around the world, the adverse impacts of climate change are unequally distributed, causing specific populations to be more susceptible to the impacts of climate change. Addressing climate inequalities in health research requires a climate justice approach, which prioritizes recognitional, distributional, and procedural justice in research and intervention design. Pregnant individuals are particularly vulnerable to climate change impacts since pregnancy represents a time of both psychological and physiological change that can be extremely sensitive to the environment. Nevertheless, there are few studies examining the association between pregnancy health and climate justice. This review evaluates the status of climate change impacts and pregnancy health outcomes through recognitional, distributive, and procedural justice definitions. We identify four themes already present in the literature: 1. Vulnerable Populations Within an Already Vulnerable Population, 2. Need for More Ecological-level Studies, 3. Addressing the Structural Factors that Drive Climate Injustice, and 4. Community-Centered Solutions Moving Forward. Our findings emphasize the importance of transdisciplinary, participatory, and multisectoral collaboration to improve climate-related pregnancy health interventions.

Keywords: pregnancy; maternal health; climate justice; environmental justice; climate change

1. Introduction

The effects of climate change are complex and all-encompassing. They include a rise in global temperatures, increased extreme weather events, loss of biodiversity, and exacerbation of air pollution (e.g., wildfire smoke, airborne allergens, increased ground-level ozone and particulate matter due to rising temperature and precipitation) [1,2]. Therefore, in the 21st century, climate change has been repeatedly declared as the greatest health threat to humanity [3–6]. Adverse health outcomes related to heat, extreme weather, biodiversity loss, and air pollution have been shown to exacerbate non-communicable diseases such as cardiovascular disease and asthma, as well as communicable diseases such as vector-borne illnesses [7,8].

Populations at risk of climate change effects are well defined in the literature and global climate reports. Although all people will be impacted by climate-amplified weather events, certain populations around the world are more at risk for adverse health outcomes due to climate change, particularly populations in the global South [9]. In the United States, populations more at risk of adverse health outcomes due to extreme weather and air pollution include communities of Black, Indigenous, and People of Color (BIPOC) and individuals with low socioeconomic status (SES) [10]. For example, in the United States, Black and African American individuals are 40% more likely to live in areas with the highest projected increases in extreme heat-related deaths [11]. There are additional groups

that are clinically vulnerable to climate change impacts, including young children, the elderly, and pregnant people [4,5].

Research that embodies a climate justice approach recognizes the unequal distribution of climate harm to populations that often have the least impact on the climate, and works to build equitable and participatory solutions [12,13]. Climate justice is a response to the environmental justice movement, which is a social movement that formally began in the United States in the 1980s as a reaction to hazardous waste landfills in a Black community in Warren County, North Carolina [13]. The environmental justice movement has paved the way for understanding the overlapping theories and movements that inform climate justice, such as environmental racism, feminist theory, postcolonialism, and intersectionality [14].

Environmental and climate justice scholarship has consistently embodied three types of justice within a justice-oriented framework: recognitional, distributive, and procedural justice [12,15–17]. Recognitional justice is acknowledging who is at increased risk for climate harm and understanding how populations differ in risk [18]. Distributive justice is focused on redistributing climate burdens and benefits, which requires reckoning with the historical and current structural factors that drive injustice [16]. Finally, procedural justice devises climate-resilient solutions that include impacted communities in climate intervention decision-making through fair, equitable, and participatory practices [19].

Adverse pregnancy outcomes have been associated with climate-amplified extreme weather such as extreme heat events, flooding events, and excessive air pollution exacerbated by climate change [20]. Pregnancy represents a time of unique physiological and psychological change—changes that can be particularly susceptible to the climate. For example, an increase in adverse pregnancy outcomes has been associated with extreme heat due to increased risk for dehydration and subsequent release of prostaglandin or oxytocin, low amniotic fluid, and other pre-birth complications [21–23]. Climate projections have predicted as great as 250,000 lost days of gestation per year due to heat alone by the end of the 21st century [24]. Pregnant individuals from vulnerable groups, such as Black individuals and individuals with low SES (i.e., racial minority status, low SES), have also been linked to increased risk of adverse pregnancy outcomes from environmental and climate exposures compared to White individuals and individuals with high SES [21,25].

Nevertheless, the association between adverse pregnancy health outcomes and climate justice ideals is seldom made explicitly. Therefore, we undertook an exploratory analysis of the medical literature that evaluated pregnancy health outcomes due to climate change through a climate justice lens. We classify important themes that exist in the literature and where they fit within climate justice frameworks to guide climate researchers and health practitioners to restoring climate justice for vulnerable pregnant individuals.

2. Materials and Methods

We screened the literature to define themes at the nexus of climate change impacts, climate justice, and pregnancy-related health outcomes within the medical literature.

We undertook an exploratory narrative review where we iteratively examined relevant peer-reviewed manuscripts based on themes related to the research topic. The narrative review search was done on PubMed and Elsevier ScienceDirect, which were chosen as two of the leading search engines in medical research [26]. The search was done to identify the populations that are most affected by climate and environmental injustice using key terms such as "environmental justice", "climate justice", "pregnancy", and "maternal health". A total of 788 titles and abstracts were screened for the explicit description of climate or environmental justice, pregnancy health outcomes, and at least one climate change-related environmental effect. Twelve papers met all three of our requirements and were included in the final full-text review.

We recognize the expanse of literature in each respective field, so our goal was not to be necessarily comprehensive but rather to explore the state of the research on climate justice and pregnancy-related health outcomes within medical literature. Therefore, it may be worth noting that there are more studies that evaluate pregnancy health outcomes

associated with justice-related factors (e.g., race, SES, social determinants of health) but that do not explicitly describe or mention environmental or climate (in)justice and were therefore not included in this analysis.

3. Results

We settled on 12 papers that evaluated pregnancy health outcomes from climate change exposures through an explicitly environmental/climate justice approach [7,20,21,25,27–34]. Pregnancy-related health outcomes in the included papers were: maternal hypertensive disorders, postpartum depression, low birth weight, preterm birth, infant mortality, adverse lung and respiratory effects, spontaneous abortion, placental abruption, gestational diabetes, and fetal growth restriction [27–30].

Our narrative review search found four themes within the literature focused on climate change effects and pregnancy health outcomes aligned with a climate justice approach. Each theme is described in detail below, as well as how it fits within a climate justice framework.

3.1. Vulnerable Populations within an Already Vulnerable Population

Recognitional justice within a climate justice approach recognizes that inequalities are present in the distribution of climate risks, and recognizes which populations are unequally affected. Most of the papers we examined were focused on recognitional justice such as identifying pregnant populations vulnerable to adverse pregnancy outcomes. All pregnant people are already vulnerable to the effects of climate change, but some individual clinical and social factors further increase the risk of adverse pregnancy outcomes. In the papers we examined, individuals such as those who are Black and Asian/Pacific Islander often show an increased risk for adverse pregnancy outcomes due to greater exposure to climate harms such as air pollution [25,29,30,33]. For example, Payne-Sturges et al. (2022) examined term birthweight and gestational particulate matter (PM) pollutant exposures and found that children of Asian/Pacific Islander mothers had significantly lower birthweights compared to mothers of other races/ethnicities [25]. Thayamballi et al. (2021) similarly examined the association between PM exposure during pregnancy and adverse birth outcomes (e.g., reduced birthweight) and found that Black mothers both had higher rates and increased doses of PM exposure in addition to delivering children with reduced birthweight [33]. Heo et al. (2019) conducted a systematic search on the risk of particulate matter on birth outcomes and also found that Black/African American individuals were at higher risk of particulate matter exposure, preterm birth, and low birth weight [29]. Additionally, Willis et al. (2023) found that despite the absolute exposure to climate harms such as air pollution decreasing over time within racial categories, the improvements in air pollution exposure were consistently lower for minoritized pregnant individuals (Black, Asian and Pacific Islander, Hispanic or Latinx) over time, emphasizing the persistence of relative disparities in exposure to climate harms [30].

Aside from air pollution exposures, Oberlin and Wylie (2023) reviewed the literature on global climate change, vector-borne diseases, and perinatal health and emphasized the disparity between exposure to vector-borne diseases among global populations: individuals in low- to middle-income countries in Africa and South-East Asia and individuals in poor and marginalized communities in high-income countries are more at risk for vector-borne diseases [7]. The above findings are in line with most climate justice-focused studies in general—BIPOC individuals and individuals with low SES are more at risk for adverse health outcomes due to climate-amplified extreme weather, pregnant or not [10].

3.2. Need for More Ecological-Level Studies

Recognitional justice also recognizes how populations facing climate injustice are affected; in other words, what makes someone more at risk of climate harm? Often, individual-level factors are used to determine who is vulnerable to climate change impacts (i.e., race, SES, housing status, clinical status). Current climate and health literature has found that ecological-level impacts and damages may also be indicators of individual health outcomes [35,36].

In our review, we found one paper that assessed ecological-level effects on pregnancy outcomes through an environmental justice approach [28]. Del Pozzo et al. (2024) used an Environmental Justice Index, which quantifies environmental burden and social vulnerability rank at the census tract, to assess adverse pregnancy outcomes [28]. The authors found an increased risk of adverse pregnancy outcomes associated with environmental burdens at the neighborhood level [28]. Individual-level factors such as individual clinical or social characteristics more strongly predicted adverse pregnancy health outcomes, but the authors suggested that ecological-level factors may have a synergistic and highly correlated effect with individual-level factors, such that they exacerbate adverse individual outcomes rather than if they existed in isolation [28]. In other words, adverse pregnancy health outcomes may increase with individual risk factors, such as race, SES, comorbidities, and familial history, but individual risk may also increase with neighborhood risk factors such as widespread property damage, reconfiguration of public infrastructure, and environmental destruction. Even if an individual does not experience, for example, personal property damage after an extreme weather event, they may still be in an area with widespread property damage, which may impact their health outcomes as well [36].

3.3. Addressing the Structural Factors That Drive Climate Injustice

Distributional justice is understanding the structural factors, or the macro-level forces, that create and perpetuate current distributions of climate injustice. For example, climate inequalities are often the result of historical redlining, environmental racism, and other systemic injustices. Willis et al. (2023) found that BIPOC pregnant people in Texas were exposed to increased traffic-related air pollution over a 20-year period, which can adversely impact pregnancy outcomes such as gestational hypertension and preterm birth [30]. Importantly, the authors of this paper connected their results to large-scale transportation infrastructure projects that historically displaced and disinvested in communities of color in the cohort studied [30]. Outside of the United States, Guidice et al. (2021) evaluated the impacts of climate change on maternal health and examined a case study of climate (in)justice in the Philippines, describing how the Philippines is a disaster-vulnerable country prone to climate-amplified hazards such as cyclones, floods, sea level rise, drought, and heat; the most common health impact from these events is undernutrition. The health of pregnant people can be greatly affected by undernutrition and is therefore affected disproportionately among Filipino pregnant people compared to other parts of the world, despite the Philippines contributing little to anthropogenic climate change compared to high-income countries [20]. Aguilera et al. (2023) reviewed the status of the literature on air pollution and pregnancy, and similarly emphasized the importance of recognizing the disproportionate exposure to and impacts of climate change-related air pollution for communities that are socioeconomically disadvantaged due to factors such as housing conditions, lack of access to healthcare, and heightened industrial burdens [27].

3.4. Community-Centered Solutions Moving Forward

Procedural justice is building climate-resilient solutions alongside impacted communities, and thoughtfully involving community values and lived experiences in decision-making. Four studies in our review highlight the importance of building climate-resilient solutions. Aguilera et al. (2023) devised mitigation and adaptation solutions to reduce adverse pregnancy health outcomes from air pollution, including alert systems, clean energy policies, alternative modes of transportation, and increased greenspace [27]. Pandipati et al. (2023) recommended resources for clinicians to navigate patient interactions in the age of climate change, emphasizing important summary points on climate change, Internet resources, and examples of electronic medical record (EMR) climate change messaging examples for clinicians [31]. Another paper, Ye et al. (2024), specifically examined the relationship between exposure to greenspace and pregnancy outcomes, and found a significant link between increased maternal greenspace exposure to decreased preterm birth risk, importantly emphasizing greenspace solutions as a climate-resilient solution [34].

Atkin et al. (2023) designed a screening tool for clinicians in identifying patients at risk of heat-related adverse pregnancy outcomes, as well as heat mitigation education materials for clinicians to pass along to at-risk patients [21].

Only one paper included highlighted the importance of community lived experiences for climate-resilient solutions. Scorgie et al. (2023) conducted qualitative interviews with pregnant individuals and their communities in Kilifi, Kenya to understand the lived experience of pregnancy in extreme heat [32]. The authors found that cultural factors influenced pregnant individuals' ability to avoid heat exposure; pregnant people in the study often had to continue strenuous household chores even in extreme heat due to a combination of gender dynamics, cultural understandings of the body during pregnancy, and familial duty [32]. Through this study, the authors emphasize the importance of community-based participatory design in climate change risk reduction strategies, and how risk reduction strategies may vary from place to place.

4. Discussion

In this narrative review, we utilized the climate justice framework to examine themes related to climate change and pregnancy health outcomes. Our narrative review found 4 overall themes in papers examining climate change and pregnancy health with a climate justice approach: 1. Vulnerable Populations Within an Already Vulnerable Population, 2. Need for More Ecological-level Studies, 3. Addressing the Structural Factors that Drive Climate Injustice, and 4. Community-Centered Solutions Moving Forward. The themes discussed can be associated with the three main types of justice within climate justice scholarship: recognitional, distributive, and procedural justice. Within the literature we examined, the largest gap for climate justice in pregnancy is in building community participatory design strategies and promoting community health advocacy.

As described previously, recognitional justice identifies pregnant populations at risk for climate harm and what factors influence increased risk. Most of the papers we examined were focused on this—evaluating climate exposures such as heat, air pollution, and extreme weather and the groups associated with higher risk of adverse pregnancy outcomes. Almost always, higher risk was associated with BIPOC and socioeconomically disadvantaged communities. This pattern in pregnant populations is consistent with vulnerable groups across the board, such as the elderly and young children. BIPOC and socioeconomically disadvantaged communities are consistently reported to have an increased risk of adverse health outcomes due to climate change.

As researchers coming from the disaster literature space, we appreciate the insight provided by ecological-level analyses and the importance it may have in further quantifying climate-amplified risk for pregnancy outcomes. While individual-level factors influencing pregnancy outcomes are well studied (i.e., clinical factors, race, SES), there is very little research on environmental justice-centered ecological-level analyses. Ecological analyses reveal how the environment around the individual affects not just the individual, but subgroups who are more prone to adverse health outcomes. Furthermore, while ecological-level analyses may not be the only predictor of health risk, there are likely synergistic effects between individual and ecological effects [28]. For example, ecological-level environmental burdens such as lack of greenspace or proximity to heavy industry may affect health impacts, which may be exacerbated by SES or race. Utilizing both ecological and individual-level measures can help tell the full story of climate impacts. Lastly, and perhaps most importantly, all policy interventions are ecological in nature; therefore, more ecological studies can help inform potential interventions.

It is one thing to identify groups facing climate injustice, and to quantify their individual- and ecological-level risks, but it is another to understand the historical and systemic influences that shape current distributions of harm. Climate justice approaches must embody distributional justice and expose the root of inequalities. Often, current distributions of environmental and climate harm are driven by histories of environmental racism, colonialism, redlining, and other forms of systemic injustice. Climate injustices may also be compounded by other forms

of structural injustice. For example, Black pregnant individuals experience disproportionate adverse pregnancy outcomes, including maternal mortality, due to a history of medical racism and non-medical social determinants of health [37].

Therefore, climate justice is also focused on righting wrongs—we must aim to establish solutions that 1. address climate adaptation and mitigation strategies for climate resilience, 2. establish multisectoral collaboration between health practitioners, governments, and climate researchers, and 3. facilitate community-based participatory design that prioritizes the lived experience of pregnant people.

The current literature is particularly lacking in the third point: solutions that embrace community participatory design and advocacy for pregnant people. Pregnancy represents a unique, complex, and vulnerable time for individual health; therefore, pregnant people must be included in climate resilience decision-making. As researchers, this will require challenging traditional hierarchies of knowledge, and prioritizing lived experience, like Scorgie et al. (2023).

This study is limited in that the narrative review conducted was not systematic; therefore, a few studies may have been missed in the final review. Additionally, the literature, particularly related to environmental and climate justice, is robust and papers from other databases outside of the medical literature may have been missed as well. That said, the goal of this review was not to be comprehensive but rather to identify major themes in this topic within medical literature and take one step closer to bridging gaps between health, social science, and climate disciplines.

5. Conclusions

Our study examined the literature at the nexus of pregnancy health outcomes, climate change, and climate justice. All researchers should be climate-justice-focused and should identify individual- and ecological-level impacts and their impacts on vulnerable populations. Additionally, researchers should attempt to explain the drivers of current distributions of justice in order to work towards equitable and community-centered solutions. As the effects of climate change worsen, the importance of protecting pregnant people comes at an urgent time. Additionally, adverse pregnancy outcomes have intergenerational impacts. Environmental exposures can have long-lasting impacts on mother and child; for example, recent evidence has suggested that epigenetic changes induced by heat may adversely affect maternal and newborn health years beyond pregnancy [38]. Thus, upholding the health of mothers who are pregnant today has the potential to improve the health of the generations of tomorrow.

6. Future Directions

Future research is needed to examine the relative influence of different climate change impacts on pregnancy health per region, as well as the uncertainty of risk per group for ecological risks [39], so interventions can be tailored to the needs of specific pregnant populations. Research and intervention design should also strive to involve all types of justice: recognitional, distributive, and procedural. In particular, it should be transdisciplinary, multisectoral, and community centered. Multiple sectors such as healthcare systems, obstetricians, climate researchers, and governments will need to work together to address climate-related pregnancy problems and restore climate justice. Additionally, while many sectors should be involved, pregnant community members should be at the center of decision-making. The solutions that come out of multi-sectoral and community collaboration need to be transdisciplinary, in that they transcend disciplinary bounds. Climate justice has its foundational papers in social science journals and pregnancy health outcomes are often found in health-related journals. The important findings in all disciplines need to be collaboratively pieced together to produce solutions to protect the climate resilience and the health of our mothers, and therefore our world.

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