

## RESEARCH ARTICLE

# Climate change, mental health, and reproductive decision-making: A systematic review

Hope Dillarstone<sup>1\*</sup>, Laura J. Brown<sup>1</sup>, Elaine C. Flores<sup>2,3</sup>

**1** Institute for Global Health, University College London, London, United Kingdom, **2** Centre on Climate Change and Planetary Health, London School of Hygiene and Tropical Medicine, London, United Kingdom, **3** Stanford Centre on Innovation in Global Health, Stanford University, Stanford, California, United States of America

☞ These authors contributed equally to this work.

\* [hope.dillarstone.21@ucl.ac.uk](mailto:hope.dillarstone.21@ucl.ac.uk)



## OPEN ACCESS

**Citation:** Dillarstone H, Brown LJ, Flores EC (2023) Climate change, mental health, and reproductive decision-making: A systematic review. *PLOS Clim* 2(11): e0000236. <https://doi.org/10.1371/journal.pclm.0000236>

**Editor:** Fanli Jia, Seton Hall University, UNITED STATES

**Received:** May 21, 2023

**Accepted:** October 2, 2023

**Published:** November 9, 2023

**Peer Review History:** PLOS recognizes the benefits of transparency in the peer review process; therefore, we enable the publication of all of the content of peer review and author responses alongside final, published articles. The editorial history of this article is available here: <https://doi.org/10.1371/journal.pclm.0000236>

**Copyright:** © 2023 Dillarstone et al. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

**Data Availability Statement:** All relevant data are within the paper and its [Supporting Information](#) files.

**Funding:** The authors received no specific funding for this work.

## Abstract

The impact of climate change on reproductive decision-making is becoming a significant issue, with anecdotal evidence indicating a growing number of people factoring their concerns about climate change into their childbearing plans. Although empirical research has explored climate change and its relationship to mental health, as well as the motivations behind reproductive decision-making independently, a gap in the literature remains that bridges these topics at their nexus. This review endeavours to fill this gap by synthesising the available evidence connecting climate change-related concerns with reproductive decision-making and exploring the reasons and motivations behind this relationship. A systematic review using six databases was conducted to identify relevant literature. Included studies reported quantitative, qualitative, and mixed-methods data related to: (1) climate change, (2) mental health and wellbeing concerns, and (3) reproductive decision-making. Findings were synthesised narratively using a parallel-results convergent synthesis design and the quality of studies was appraised using three validated assessment tools. Four hundred and forty-six documents were screened using pre-defined inclusion criteria, resulting in the inclusion of thirteen studies. The studies were conducted between 2012 and 2022 primarily in Global North countries (e.g., USA, Canada, New Zealand, and European countries). Climate change concerns were typically associated with less positive attitudes towards reproduction and a desire and/or intent for fewer children or none at all. Four themes explaining this relationship were identified: uncertainty about the future of an unborn child, environmentalist views centred on overpopulation and overconsumption, meeting family subsistence needs, and environmental and political sentiments. The current evidence reveals a complex relationship between climate change concerns and reproductive decision-making, grounded in ethical, environmental, livelihood, and political considerations. Further research is required to better understand and address this issue with an intercultural approach, particularly among many highly affected Global South populations, to ensure comparability and generalisable results.

**Competing interests:** The authors have declared that no competing interests exist.

## 1. Introduction

Climate change is often regarded as “*the biggest global health threat of the 21<sup>st</sup> century*” [1] [p.1693] due to the direct threat of rising average temperatures and climatic hazards, paralleled with indirect effects including water and food insecurity and changes to disease epidemiology. At the same time, tackling climate change is also posited as “*the greatest global health opportunity of this century*” [2] [p.1861], as mitigation and adaptation responses can reduce disease burdens, alleviate poverty, and confront global inequity. Climate change is already having a ubiquitous impact on human health, with adverse effects projected to increase even further, albeit with a degree of heterogeneity between countries and populations [3]. A recent emergence of studies and policy are exploring the link between climate change and mental health. This came to the fore with the coining of new concepts such as ‘eco-anxiety’, fast becoming a buzzword in public discourse as it describes the “*chronic fear of environmental doom*” [4] [p.29] that continues to proliferate in the minds of individuals worldwide [5]. Other analogous terms have also emerged including climate trauma [6], ecological grief [7], and solastalgia [8], which all describe a form of emotional response towards ecological issues associated with climate change.

Over the last decade, a novel connection has been formed between these psychological effects of climate change and human reproductive decision-making. Anecdotal evidence from news outlets, surfacing largely from countries in the Global North, has revealed a growing number of individuals reconsidering their reproductive decisions in light of their concerns about climate change [9, 10]. Yet, empirical research studying the intersection of climate change, mental health and wellbeing, and reproductive decision-making remains a nascent endeavour. It is important to note that although the Global North and Global South divide is critiqued for being oversimplistic [11], the terms are referred to throughout this review in favour of the ‘developed’ and ‘developing’ dichotomy that implies an inherent hierarchical nature.

This study aims to fill this gap by synthesising the current empirical evidence investigating the relationship between climate change-related concern and reproductive decision-making. As the health effects of climate change become ever more pervasive, it is logical to assume that these concerns will continue to diffuse among populations and potentially influence reproductive decisions [12]. Consequently, this matter has far-reaching implications across multiple disciplines including public health policy and environmental politics, emphasising the immediacy of this research. A systematic review was conducted and a total of thirteen studies were identified for inclusion (Fig 1 and S1 Checklist).

### 1.1 Climate change

The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as being, “*attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods*” [13] [p.7]. Despite ongoing debates in the media regarding the anthropogenic nature of climate change, the Intergovernmental Panel on Climate Change (IPCC) reported with 95% certainty that human activity is the primary cause [14], leading to a consensus that it is “*marked by human influence*” [15] [p.119]. Human activities, notably the burning of fossil fuels, have led to a significant increase in greenhouse gas (GHG) emissions, and consequently, the global surface temperature is currently averaging 1.2°C warmer compared to pre-industrial times (1850–1900) [3, 16]. With this alarming rise, climate change has been inextricably tied to the intensification and increased frequency of climatic hazards worldwide such as heatwaves, storms, drought, and flooding. Together with indirect effects including food and water insecurity and increased air pollution, climate change is having a detrimental impact on the social and environmental determinants of human health [17].

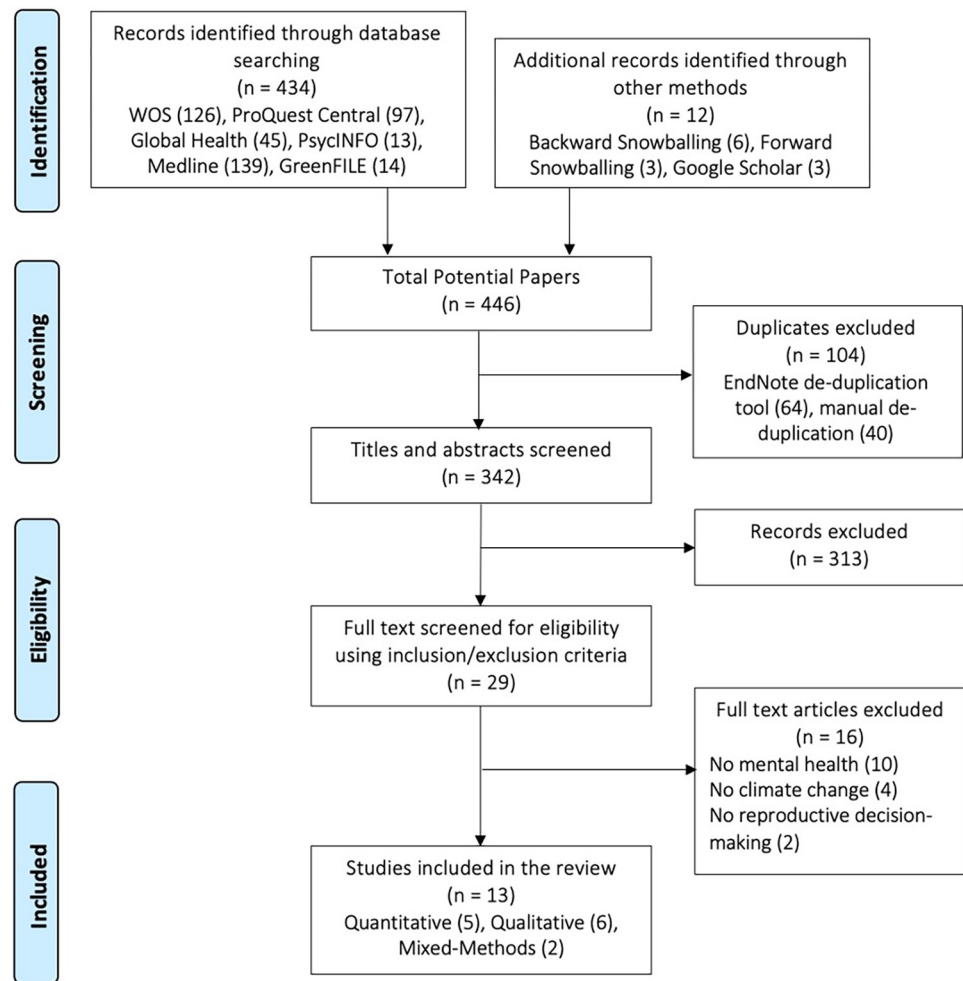


Fig 1. PRISMA diagram of study selection.

<https://doi.org/10.1371/journal.pclm.0000236.g001>

## 1.2 Climate change and mental health

Climate change has been expedited to one of the top priorities on the international political agenda over the last few decades following scientific evidence connecting it with adverse health outcomes [18]. These health effects are continuing to unfold across the globe with reported rises in premature deaths, infectious diseases, non-communicable diseases, and mental illnesses all attributed to climate change [2]. Whilst causality cannot be easily inferred as drivers of poor health are often complex and intertwined, the empirical evidence undoubtedly shows that climate change is a contributory exacerbating factor.

Whilst impacts to physical health have historically been the focus of academic inquiry, climate change also impacts mental health both directly, from exposure to climatic hazards, and via numerous indirect pathways including loss of livelihood, displacement and forced migration, and armed conflict and interpersonal violence [19, 20]. These risk factors can lead to the onset of mental health conditions and adverse psychosocial outcomes such as depression, anxiety, substance use, and suicidal actions, or have a compounding effect for those already living with these conditions [21]. Moreover, these effects are experienced disproportionately by the most disadvantaged members of society including people with pre-existing chronic disease(s)

and/or disability as well as minority groups, people with low-incomes, and women and children. Adopting an intersectionality lens, which considers the systems of privilege and oppression resulting from the intersection of an individual's multiple social identities [22], serves as a reminder that many people occupy a combination of these marginalised identities which may work in tandem to further increase their vulnerability to climate change [23].

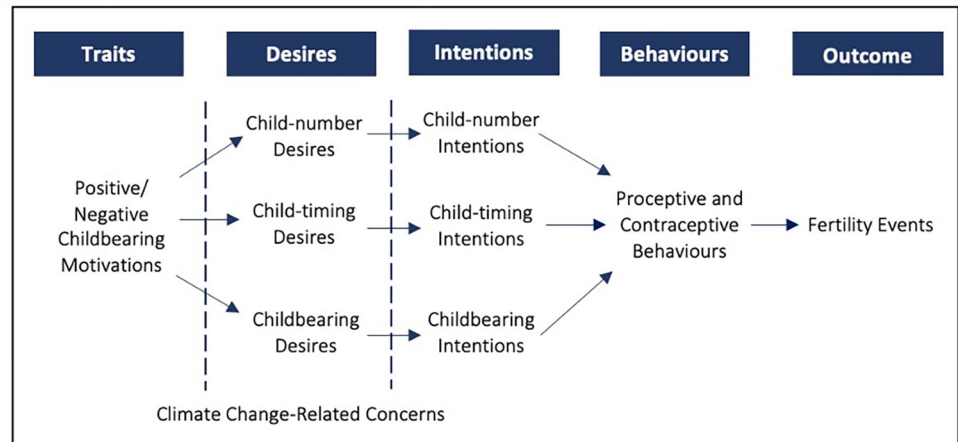
Mental health is broadly defined as “*a state of mental well-being that enables people to cope with the stresses of life, realize their abilities, learn well and work well, and contribute to their community*” [24] [para.1]. Under this comprehensive definition, contemporary climate change research is also beginning to take heed of less pathological responses arising from an awareness of the slow and gradual changes to environmental conditions [25]. This phenomenon is now commonly referred to as ‘eco-anxiety’, which encompasses a range of negative emotional responses including fear, anger, guilt, dread, and anxiety itself towards the climate crisis and ensuing environmental deterioration [25]. One international study on climate anxiety surveyed 10,000 16-25-year-olds in ten countries (Australia, Brazil, France, Finland, India, Nigeria, Philippines, Portugal, the UK, and the USA). They found that over 50% of respondents felt one or more of the following negative emotional responses towards climate change: feeling afraid, sad, anxious, angry, powerless, helpless, and/or guilty [26]. Alternative terminology has also emerged to describe this affective dimension of climate change including solastalgia, which describes “*the distress that is produced by environmental change impacting on people while they are directly connected to their home environment*” [8] [p.S95], and ecological trauma which is the “*experience of witnessing—consciously or not—the pervasive abuse and destruction of the natural world*” [27] [para.2]. Whilst these new concepts are gaining traction within public discourse, there is still limited empirical evidence that can verify the true extent or prevalence of these psychological effects, particularly within Global South settings.

Attempting to quantify and measure emotional responses to climate change is not a simple feat considering the diverse array of mental health outcomes. However, one framework is prominent in the literature—the New Ecological Paradigm (NEP). The NEP is a widely adopted measure of an ‘ecological worldview’ that uses a Likert-type scale containing fifteen questions related to environmental concern [28]. This framework has been used to investigate the relationship between climate change concern and shifts in individual and collective behaviour as whilst some individuals may become paralysed by their feelings, others are galvanised into action, and modify their behaviour accordingly [29]. These may include changes to ‘everyday’ behaviours such as recycling, diet, or consumption patterns, but potentially could influence behaviours of even greater magnitude, such as reproductive decisions.

### 1.3 Reproductive decision-making

Reproductive decision-making “*involves decisions about parenthood (whether and when to be a parent, and the number and spacing of children one wishes to have), including decisions around contraceptive usage and fertility*” [30] [p.2]. These decisions are often multi-factorial, in flux, and consequently made over time [31]. The T-D-I-B model is a theoretical framework of reproductive decision-making, breaking down the process into a five-step psychological sequence [32, 33] (Fig 2). These discrete steps are, however, often incorrectly used interchangeably in analyses of environmental concern and reproductive decision-making, particularly with ‘desire’ and ‘intention’. Whilst both terms describe psychological states, desires represent what someone hopes or wishes for, whilst intentions represent desires evaluated with respect to what is achievable in reality [32].

Over the last half-century, changes in childbearing patterns, most noticeably observed in the Global North, have seen a greater proportion of adults now choosing to abstain from



**Fig 2. A model of reproductive decision-making combining the T-D-I-B model with climate change concerns.** Note. Adapted from: Miller [32, 33]. The dashed line represents the possibility of climate change-related concern acting as an intervening variable, mediating the transition between traits and desires, and desires and intentions respectively.

<https://doi.org/10.1371/journal.pclm.0000236.g002>

parenthood and remain voluntarily childfree [34]. These demographic shifts have been linked to macro-level social changes such as the 1970s feminist movement that expanded women's reproductive rights, as well as individual-level decision-making, with many citing freedom from childcare responsibility, and maintaining close relationships with their partner as determinants of their decision to remain childfree [35]. These decisions are inherently shaped by normative pressures and structural constraints that are culturally dependent, and variation both within and between Global North and Global South contexts is therefore likely.

The term 'childfree' is isolated as a distinct concept from 'childless', where the former refers to the ability to have children but choosing not to as a result of sociocultural shifts in societal norms, whilst the latter simply refers to an inability to reproduce despite wishing to have children [31]. This dichotomy is problematised as many describe feeling forced into the decision due to their climate change concerns which does not resonate with the typically voluntary nature of choosing to remain childfree [36]. This subset of individuals will therefore be referred to using more specific nomenclature, 'environmentally childfree', defined as "*not hav[ing] children or restrict[ing] reproduction. . . partly or fully out of environmental concerns*" [37] [p.201].

**1.3.1 Reproductive decision-making in response to climate change.** Oposing theoretical stances exist that posit the causal relationship between climate change and childbearing decisions. Demand theories of fertility propose that a better quality of immediate environment is conducive to larger populations due to an abundance of natural resources [38]. This is reversed if the environment deteriorates, as in the case of climate change, where limited availability of resources means that some people may opt to control and limit their reproduction. However, critiques of this position propose a decline in agricultural productivity will lead people to increase their crop cultivation to fulfil their subsistence needs [39]. Consequently, families may decide to have more children to have a larger labour force, leading to a 'vicious circle' that will further exacerbate the existing pressures that climate change imposes on the environment [38]. Whilst the direction of the links between climate change and reproductive decision-making is contested, less academic attention has been paid to the role of mental health and wellbeing in shaping these decisions.

## 1.4 The current study

### 1.4.1 Climate change, mental health, and reproductive decision-making at the nexus.

The three broad themes of climate change, its impact on mental health and wellbeing, and reproductive decision-making have been united as a topic garnering significant public attention within media polls, blog posts and, more colloquially, in conversations amongst friends and family [36]. In 2018, a nationally representative New York Times survey distributed to 1,858 childfree American men and women aged 20–45 found that 33% of participants selected the response ‘worried about climate change’ as a reason for remaining childfree [40]. Perhaps most visibly, this nexus was spotlighted with the recent emergence of three collectives: Conceivable Future in the United States (US), BirthStrike in the United Kingdom (UK), and No Future No Children in Canada, comprised of individuals who are reconsidering or refusing to have children due to the ongoing effects of climate change. These activist interventions seek to ring an “*existential alarm*” [36] [p.1], by using their reproductive power politically to galvanise governments into taking the necessary action for climate change mitigation and adaptation.

**1.4.2 The research gap.** Despite becoming an advocacy priority, relevant empirical research on this topic is still in its infancy. Given that climate change, mental health, and reproductive decisions affect everyone, and that their nexus is attracting increasing attention in public discourse, further empirical investigation is necessary. This phenomenon also has far-reaching implications for environmental politics and public health policy. Firstly, the emergence of collectives including BirthStrike moved this topic into the realm of politics by exerting pressure on governments to prioritise climate change within their agendas. Within public health policy, greater resource investment into global mental healthcare will be crucial as the continuing effects of climate change predict a surge in common mental health disorders and feelings of eco-anxiety [41]. Consequently, this review enters the field at a critical juncture for gaining a greater understanding of reproductive decision-making in response to climate change concerns.

**1.4.3 Research question, aims, and objectives.** Research question. ‘How do climate change-related concerns affect individuals’ reproductive decision-making?’

For the purposes of this review, ‘concern’ is defined as a worried or anxious feeling, rather than its more neutral definition of a matter of interest or importance. Despite its ambiguity, this word was chosen as it is used widely in the literature and allowed for more relevant negative mental health emotions to be included. ‘Climate change-related concern’ specifically refers to any negative emotional response towards events associated with the anthropogenic root causes of climate change, in addition to previously witnessed and future projected consequences of climate change. This phrase will be used interchangeably with ‘environmental concern’ in accordance with the literature and for the purposes of brevity.

*Aims.* To understand how climate change-related concerns are linked to reproductive decision-making, and to explore the reasons and motivations behind this relationship.

*Objectives.*

1. To summarise the available quantitative, qualitative, and mixed-methods evidence investigating how climate change-related concerns link to reproductive decision-making
2. To explore the specific environmental concerns and factors shaping people’s reproductive attitudes and decisions
3. To make future recommendations for research, policy, and practice priorities in the field



## 2. Methodology

This section will provide a detailed outline of the systematic approach to selecting, appraising, and synthesising the studies identified for inclusion in this review. By detailing the specific steps that were employed, this section ensures methodological rigour, transparency, and reproducibility, providing a basis for the robustness of this review's results and recommendations.

### 2.1 Ethics statement

Ethics approval and informed consent were not required for this systematic review as it uses published literature and data already available in the public domain.

### 2.2 Databases

The literature search was conducted on the 11<sup>th</sup> of July 2022 and the following databases/platforms were searched to provide comprehensive coverage of the relevant literature: Web of Science Core Collection (WOS) (1990–present), ProQuest Central (1806–present), OvidSP Global Health (1973–present), OvidSP PsycINFO (1967–present), OvidSP MEDLINE (1946–present), and EBSCO GreenFILE (1913–present). WOS and ProQuest Central are multidisciplinary and include literature encompassing the cross-disciplinary themes of climate change, mental health, and reproductive decision-making within the research question. Global Health is a public health database which also includes articles discussing these three themes. The final three databases were selected as they each specialise in one of these disciplines: PsycINFO provides an index of literature from psychology and was relevant to the mental health branch; MEDLINE is a biomedical database exploring medicine and the healthcare system and provided insight into reproduction; and finally, GreenFILE covers publications focussing on human impact on the environment.

Additional relevant papers were found by handsearching the reference lists of included papers (backward snowballing) and reviewing publications that have cited them (forward snowballing) [42]. Google Scholar was also used to ensure a fully comprehensive search for all relevant literature.

### 2.3 Search strategy

The initial search strategy was formulated on WOS and then adapted to fit the formatting guidelines of the other databases. The search strategy consisted of three separate strands that were combined together to identify studies that focussed on (1) climate change, (2) mental health and wellbeing concerns, and (3) reproductive decision-making. On an initial exploratory search, the search terms included neutral 'mental health' terms and broader 'climate' and 'environment' synonyms. However, upon finding a large quantity of unrelated articles, these were refined to ensure the search had a narrower focus, specific to the research question. As well as synonyms, the search also incorporated Boolean terms, wildcards, truncations, and medical subject headings (MeSH) to ensure that all appropriate terminology was captured (S1 and S2 Tables).

### 2.4 Eligibility criteria

As research in this field is still incipient, exclusion criteria were not extensive (S3 Table). Firstly, no limits were placed on geographical location to allow for critical reflection on any discernible differences between countries or geographical gaps in current research. The search was also not limited by study design resulting in a review with methodologically triangulated data. Based on the population, exposure, outcome (PEO) framework, during initial abstract

screening, articles on plant or animal reproduction were excluded. At full-text screening, literature exploring retrospective reproductive decision-making and/or the intersection of climate change and fertility outcomes, without also addressing mental health concerns, were also excluded. Primary studies, books, and book chapters were all eligible for inclusion as long as they included empirical methodology and findings. Newspaper, magazine articles, and blog posts were excluded but student theses were included to try and capture more empirical research. Peer-reviewed journals are less likely to publish studies with null results, whilst the opposite is true for statistically significant findings [43]; student theses were therefore also included to mitigate this publication bias to some extent. As the lead author of this review only speaks English, all papers that were published in a language other than English were excluded. Additionally, any study that was not available as open access or accessible through university library e-resources was excluded from analysis. Finally, no documents were excluded based on date of publication as this may have unnecessarily restricted the scope of included literature.

## 2.5 Data extraction and synthesis

Data from the included studies were identified and extracted into a detailed spreadsheet. This included information on the article (first author, publication year, and title), measurement tools, location, participant information (sample size and demographic characteristics), reproductive focus, and key findings. Given the variation in exposure and outcome measurement, a meta-analysis was not feasible, and findings were instead described narratively in accordance with Popay et al.'s [44] guidance. Findings were analysed using a parallel-results convergent synthesis design [45] in which the quantitative, qualitative, and mixed-methods data were initially analysed independently before being consolidated in the discussion and interpretation of the results.

## 2.6 Risk of bias assessment and quality appraisal

The quality of included studies was assessed using peer-reviewed checklists to inform the final analysis and interpretation of the data (no studies were excluded based on quality). Different checklists were used according to study design: the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies [46], the Critical Appraisal Skills Programme (CASP) Qualitative checklist [47], and the Mixed Methods Appraisal Tool (MMAT) [48] for the quantitative, qualitative, and mixed-methods studies respectively.

## 3. Results

446 articles were identified and uploaded to EndNote for screening. 104 duplicates were removed and a further 313 papers were excluded following screening of titles and abstracts for relevance. Lastly, full texts of remaining papers were single screened for eligibility, leaving a final total of 13 studies to be included within this review (Table 1).

### 3.1 Quantitative results

**3.1.1 Study characteristics.** Table 1 presents the study characteristics of five included quantitative studies. All studies were cross-sectional, used surveys, and were conducted in denominated Global North countries (Canada and 27 EU countries) (Fig 3). Measurement instruments were heterogeneous, with four different tools, and one single-item measure used to assess environmental concern. In total, 10,788 participants were included, none of whom identified as gender-diverse, defined as “*people on the continuum between binary male and female*” [61] [p.82] (although information on gender was unattainable for one study [50]).



Table 1. Summary of characteristics from included studies.

1 <sup>st</sup> Author (Year)	Title	Measurement Tools	Location	Participants	Reproductive Focus	Key Findings	Quality Appraisal
<b>QUANTITATIVE RESULTS</b>							
Arnocky, et al. (2012) [49]	Environmental concern and fertility intentions among Canadian university students	Cross-sectional survey (using NEP <sup>1</sup> , PHC <sup>2</sup> , and RAS <sup>3</sup> )	Canada (Ontario)	N: 139 (undergraduate students) Women: 90, Men: 49 Aged 17–44 (mean = 20.26)	Reproductive intention (child-number) and attitudes	<ul style="list-style-type: none"> <li>• General environmental concern (<math>r = -0.34^{**}</math>) and pollution-related health concern (<math>r = -0.25^{**}</math>) negatively correlated with pro-reproductive attitudes.</li> <li>• Pollution-related health concern negatively correlated (<math>r = -0.18^*</math>) with increased reproductive intention (mediated by attitude towards reproduction).</li> </ul>	Medium X Inclusion criteria not clearly defined
Davis et al. (2019) [39]	The Problem of Overpopulation: Proenvironmental Concerns and Behavior Predict Reproductive Attitudes	Cross-sectional survey (using NEP <sup>1</sup> , ECS <sup>4</sup> , EBS <sup>5</sup> , and RAS <sup>3</sup> )	Canada (Ontario)	N: 200 (undergraduate psychology students) Women: 167, Men: 30 Aged 18–48 (mean = 20.21)	Reproductive attitudes	<ul style="list-style-type: none"> <li>• General environmental concern negatively correlated (<math>r = -0.31^{**}</math>) with pro-reproductive attitudes.</li> <li>• Egoistic (<math>r = 0.28^{**}</math>) and altruistic (<math>r = 0.27^{**}</math>) concerns positively correlated with pro-reproductive attitudes, whilst biospheric concern was inversely correlated (<math>r = -0.18^*</math>).</li> </ul>	High X Unclear is outcome measured in valid/reliable way
De Rose et al. (2013) [50]	Climate Change and Reproductive Intentions in Europe	Cross-sectional survey (from 2011) (using single item measures of environmental concern and reproductive intention)	European Union (EU Member States (27 countries))	N: 8278 Gender balance unknown Aged 20–45 (mean = 33)	Reproductive intention (child-number)	<ul style="list-style-type: none"> <li>• Regardless of parity, climate change concerns were not significantly associated (at <math>\alpha = 0.05</math>) with additionally intended number of children.</li> <li>• Weak evidence (at <math>\alpha = 0.10</math>) of a positive association amongst those with one existing child, for whom strong climate change concerns were associated with a (slightly) larger intended family size (+0.19 children in the fully adjusted model).</li> </ul>	Medium X Exposure not measured in valid/reliable way X Outcome not measured in valid/reliable way
Musialczyk (2020) [51]	Attitudes towards having Children in View of Climate Change	Cross-sectional survey (using NEP <sup>1</sup> and RAS <sup>3</sup> )	Ireland	N: 135 Women: 69, Men: 66 Aged 18–45 (mean = 30.33)	Reproductive attitudes	<ul style="list-style-type: none"> <li>• General environmental concern was negatively associated (<math>\beta = -0.38^{**}</math>) with pro-reproductive attitudes.</li> </ul>	High X Unclear if outcome measured in valid/reliable way

(Continued)

Table 1. (Continued)

1 <sup>st</sup> Author (Year)	Title	Measurement Tools	Location	Participants	Reproductive Focus	Key Findings	Quality Appraisal
Szczuka (2022) [52]	Climate Change Concerns and the Ideal Number of Children: A Comparative Analysis of the V4 Countries	Cross-sectional survey (from 2011) (using single item measures of environmental concern and reproductive intention)	The Visegrád Four (V4) Countries (Czech Republic, Hungary, Poland, and Slovakia)	N: 2036 Women: 1006, Men: 1030 Aged 18–45 (estimated mean = 31.64)	Reproductive intention (child-number)	<ul style="list-style-type: none"> <li>For families generally, climate change concerns were positively associated with decreased reproductive intention in Hungary (<math>\beta = 0.886^{**}</math>) but negatively associated in Slovakia (<math>\beta = -1.124^{**}</math>).</li> <li>For individuals personally, climate change concerns were negatively associated with increased reproductive intentions in Slovakia (<math>\beta = -0.748^*</math>), with weak evidence (at <math>\alpha = 0.10</math>) of a positive association in the Czech Republic (<math>\beta = 0.520</math>).</li> </ul>	Medium X Exposure not measured in valid/reliable way X Outcome not measured in valid/reliable way
<b>QUALITATIVE RESULTS</b>							
Helm et al. (2021) [53]	No future, no kids–no kids, no future? An exploration of motivations to remain childfree in times of climate change	Content analysis and semi-structured interviews	NZ (Auckland and Christchurch) and US (Tucson)	Study 1 –N: 1157 (reader comments from topical online news articles) Study 2 –N: 24 Women: 17, Men: 4, Non-binary/Genderqueer: 3 Aged 19–35 (mean: 27.63)	Reproductive attitudes, desires, and intention (childbearing)	<ul style="list-style-type: none"> <li>Participants were concerned about future children contributing to overpopulation and overconsumption: “<i>I don’t need to be adding another person into the world who would consume resources</i>” [p.118].</li> <li>Participants felt guilty about bringing a child into a world that is ‘doomed’ from climate change: “<i>it does feel like kind of a gamble bringing a very young person into a world that you really are very unsure about the future of</i>” [p.119].</li> </ul>	Medium X Relationship between researcher and participant not considered X Ethical issues not considered
Krähenbühl (2022) [54]	‘Environmental Childlessness?’: Reproduction and (Im) Possible Futures amidst Environmental Crises	Semi-structured in-depth interviews (IDIs) & private group discussions and one collective group discussion	Switzerland (Lausanne)	N: 14 Women: 7, Men: 6, Non-binary: 1 Aged 21–48 (mean: 29.07)	Reproductive intention (childbearing) and behaviour	<ul style="list-style-type: none"> <li>Pathways towards ‘environmental childlessness’ were two-fold:</li> <li>Limiting ecological footprint: “<i>the decision not to have children is intertwined with... trying to minimise... our impact on the environment</i>” [para.100]</li> <li>Uncertainty of child (ren)’s future: “[W]hat is my responsibility to want to give life to someone who is going to struggle...?” [para.133]</li> </ul>	Medium X Ethical issues not considered X Can’t tell if recruitment strategy appropriate to aims & if results will help locally

(Continued)

Table 1. (Continued)

I <sup>st</sup> Author (Year)	Title	Measurement Tools	Location	Participants	Reproductive Focus	Key Findings	Quality Appraisal
Nakkerud (2021) [37]	'There Are Many People Like Me, Who Feel They Want To Do Something Bigger': An Exploratory Study of Choosing Not to Have Children Based on Environmental Concerns	Semi-structured interviews	Norway (Oslo, Agder, Innlandet, & Viken)	N: 20 (including 3 couples) Women: 7, Men: 12, Non-binary: 1 Aged 20–59 (mean unavailable– 55% aged 30–39)	Reproductive intention (childbearing) and behaviour	<ul style="list-style-type: none"> <li>• Two climate change-related concerns factoring into reproductive decisions:</li> <li>• Ecological impact: <i>“the child would contribute to destroying biological diversity by being a consumer”</i> [p.204]</li> <li>• Uncertain future: <i>“it could be dangerous for a child to grow up in a world where all species die, and the climate gets warm”</i> [p.204]</li> </ul>	High X Relationship between researcher and participant not considered
Rosen et al. (2021) [55]	”Burnt by the scorching sun”: climate-induced livelihood transformations, reproductive health, and fertility trajectories in drought-affected communities of Zambia	Semi-structured IDIs, key informant interviews and focus group discussions (FGDs)	Zambia (Chroma, Mazakuba, Mongu, Kalomo, & Senanga)	FGDs–N: 145 Women: 75, Men: 70 Age: 19–49 (median: 34) IDIs–N: 20 Women: 20 Aged 22–44 (median: 32) Informant interviews–N: 16 (stakeholders) Women: 7, Men, 9 Aged: 25–73 (median: 34)	Reproductive desire and intention (child-number)	<ul style="list-style-type: none"> <li>• Participants desired smaller families to meet their subsistence needs: <i>“The 6 children I desire to have may not have enough food to eat”</i> [p.8]</li> <li>• This conflicted with recognition of children as a source of household support: <i>“My desire was to have 10 children so that some of them can help me because no one knows what the future holds”</i> [p.8].</li> </ul>	High X Relationship between researcher and participant not considered
Rovin et al. (2013) [56]	Linking Population, Fertility, and Family Planning with Adaptation to Climate Change: Perspectives from Ethiopia	Semi-structured IDIs and FGDs	Ethiopia (Oromia and Southern Nations, Nationalities and People’s Regions)	FGDs (12)–N: 96 Women: 48, Men: 48 (Age range unavailable) IDIs–N: 42 (community members, leaders, and policymakers)	Reproductive desire and intention (child-number)	<ul style="list-style-type: none"> <li>• Participants were concerned about their ability to subsist with large family sizes: <i>“everyone needs to have children based on the resources [they have], and I feel two to four children are enough”</i> [p.25]</li> </ul>	Medium X Relationship between researcher and participant not considered X Ethical issues not considered X Data analysis not sufficiently rigorous
Smith et al. (2022) [57]	Pregnancy Intentions of Youth in the Era of Climate Change: A Qualitative Auto-Photography Study	Auto-photography and IDIs	Canada (British Columbia)	N: 7 (nulliparous individuals with 33 photographs) Women: 7 (assigned female at birth) Aged 18–25 (mean unavailable)	Reproductive intention (childbearing) and behaviour	<ul style="list-style-type: none"> <li>• 6/7 participants stated that climate change has already or may affect their reproductive decision-making: <i>“I wouldn’t want to have children... because of just the dire future that I’m predicting”</i> [p.5]</li> <li>• Five themes in participants’ narratives: planning for a ‘dire future’, experiencing anxiety, calls for systemic change, catalysing events, and feeling like an outlier.</li> </ul>	High X Can’t tell if recruitment strategy appropriate to aims

MIXED-METHODS RESULTS

(Continued)

Table 1. (Continued)

1 <sup>st</sup> Author (Year)	Title	Measurement Tools	Location	Participants	Reproductive Focus	Key Findings	Quality Appraisal
Schneider-Mayerson (2022) [58]	The environmental politics of reproductive choices in the age of climate change	Survey (16 open-ended questions & 24–31 multiple choice questions) (same data set as Schneider-Mayerson & Leong, 2020)	US	N: 607 ('climate-concerned' individuals) Women: 446, Men: 131, Gender-diverse: 30 Aged 27–45 (mean unavailable)	Reproductive intention (childbearing) and behaviour	<ul style="list-style-type: none"> <li>• Parental investment in environmental politics and children as future environmentalists reported as reasons to have children, e.g. "I thought about how I will raise my kids to be educated about climate change and how they can be a force for good, for fighting it" [p.163].</li> <li>• Opportunity cost of parenting and fertility as a socio-political tool reported as reasons not to have children, e.g. "I am relieved that I did not have a child because this choice gives me more time to dedicate to political activities and activism" [p.164]</li> </ul>	High X Unclear if quantitative components adhere to quantitative quality criteria
Schneider-Mayerson et al. (2020) [59]	Eco-reproductive concerns in the age of climate change	Survey (16 open-ended questions & 24–31 multiple choice questions)	US	N: 607 ('climate-concerned' individuals) Women: 446, Men: 131, Gender-diverse: 30 Aged 27–45 (mean unavailable)	Reproductive intention (childbearing)	<ul style="list-style-type: none"> <li>• 96.5% of respondents 'extremely' or 'very' concerned about the impacts of climate change on their child (ren)'s health and wellbeing: "I don't want to birth children into a dying world" [p.12].</li> <li>• 59.8% of respondents 'extremely' or 'very' concerned about the carbon footprint of reproduction: "I cannot produce another person that will continue to destroy the planet, as they will inherit my first world lifestyle" [p.9].</li> </ul>	High X Unclear if quantitative components adhere to quantitative quality criteria

Note. <sup>1</sup>New Environmental Paradigm (NEP)

<sup>2</sup>Pollution-related Health Concern (PHC)

<sup>3</sup>Reproductive Attitudes Scale (RAS)

<sup>4</sup>Environmental Concern Scale (ECS)

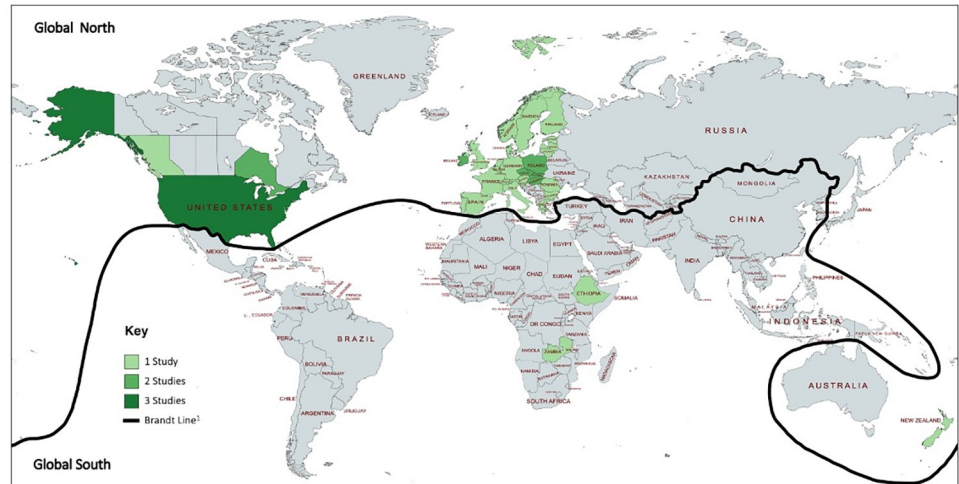
<sup>5</sup>Environmental Behaviour Scale (EBS)

\*  $p < 0.05$

\*\*  $p < 0.01$

<https://doi.org/10.1371/journal.pclm.0000236.t001>

**3.1.2 Quality appraisal.** Two studies were deemed high quality and three medium quality using the JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies [46] (Table 1 and S4 Table). The rigour with which confounding factors were controlled for varied, ranging from two to seven identified variables between studies. Limitations were described in every study with a key commonality being the inability to infer causation owing to cross-sectional



**Fig 3. A map showing the geographical distribution of included studies.** Note. <sup>1</sup>The Brandt Line is “a way of visualising the world that highlights the disparities and inequalities between the wealthy North and the poorer Global South” [60] [p.85]. It is critiqued for being outdated; however, it is still regarded as a useful way to visualise economic inequities in world politics. Base layer of map available from: <https://www.mapchart.net/>.

<https://doi.org/10.1371/journal.pclm.0000236.g003>

study designs. Only one study [50] reported any acknowledgment of bias, yet all studies used self-report surveys which are prone to social desirability bias and acquiescent responding [62].

**3.1.3. Narrative synthesis.** A narrative synthesis was appropriate due to the heterogeneity in reported outcome measures. The studies are categorised into those investigating reproductive intentions (measured by ideal number of children) and reproductive attitudes (positive and negative evaluations towards having children). One study [49] reported on both outcomes and thus the findings were separated into both groups.

*Reproductive intentions.* Three studies tested the relationship between environmental concerns and participants’ reproductive intentions, and the findings were contradictory. Arnocky et al. [49] reported that stronger pollution-related health concerns correlated with diminished reproductive intentions, mediated by participants’ attitude towards reproduction. However, De Rose et al. [50] found no significant association between climate change concerns and (additionally) intended number of children, although weak evidence suggested an association between stronger concerns for people with one existing child and a larger intended family size. Finally, Szczuka’s [52] findings were mixed in the fully-adjusted models; for a family generally, stronger environmental concerns were positively associated with lower reproductive intentions in Hungary, but negatively associated in Slovakia. For participants’ own preferred number of children, stronger environmental concerns were negatively associated with increased reproductive intentions in Slovakia, with weak evidence of a positive association in Czech Republic.

*Reproductive attitudes.* Three studies explored the link between reproductive attitudes and climate change concerns. Across all three studies, stronger concerns were significantly associated with less favourable attitudes towards having children. Additional findings from Davis et al. [39] were unique to their research aims as they disaggregated environmental concern into three subscales: egoistic (concern for the self), altruistic (concern for humanity), and biospheric (concern for the environment). Higher egoistic and altruistic concern positively correlated with pro-reproductive attitudes whilst an inverse correlation was found for biospheric concern, meaning the concerns of participants with positive attitudes towards having children were centred on the repercussions of climate change for themselves and their community, rather than for the environment itself.

## 3.2 Qualitative results

**3.2.1 Study characteristics.** Table 1 presents the study characteristics of six included qualitative studies. Four studies used IDIs and are therefore expected to have obtained richer data [63], but semi-structured interviews were suitable to the studies' aims nonetheless. Supplementary tools were used in three cases including focus group discussions (FGDs) and auto-photography, strengthening the validity of the results by employing methodological pluralism [64]. Geographical location was diverse, with data obtained from six different countries: four in the Global North, and two in the Global South (Fig 3).

384 participants were recruited in total (in addition to 1,157 online comments), including 181 women, 140 men, and 5 gender-diverse participants (the gender of 58 participants is unknown). Some studies recruited 'young adults' aged 18–35, whilst others included older individuals, in one case up to 59-years-old. This difference might be partially explained by the ambiguity surrounding the end of 'childbearing age', but relevant justification was provided for the age ranges selected.

**3.2.2 Quality appraisal.** Three studies were deemed high quality and three medium quality using the CASP Qualitative Checklist [47] (Table 1 and S5 Table). Only two authors [54, 57] engaged in a critical examination of reflexivity and their potential to be biased throughout the research process. Given this topic is conducive to highly subjective opinions, the four studies failing to include this reflection were weakened as a result.

**3.2.3 Thematic synthesis.** The qualitative findings all sought to understand the motivating factors behind participants' reproductive decision-making in light of their climate change-related concerns. These were synthesised, grouped into themes, and are discussed in turn below.

*Uncertainty of an unborn child's future.* In four studies, participants were concerned about their child(ren)'s health and wellbeing in an uncertain future, confronted by the effects of climate change. This was reflected in reader comments from topical online news articles, with many predicting the quality of life for unborn children as 'bleak' or 'doomed' [53]. Projections of a 'dire' future were expressed in Smith et al. [57], with some participants feeling out of control of the future state of the planet and disappointment that the ability to enjoy aspects of nature such as "kayaking, or hiking, or snowboarding" [p.6] may no longer be accessible to future generations. In Nakkerud [37] and Krähenbühl [54], participants were concerned that societies were heading towards collapse and therefore did not want the responsibility of raising a child in their envisioned uninhabitable world.

*Ecological impact of reproduction.* Three studies highlighted environmentalist concerns related to the ecological contributions of reproduction to overpopulation and overconsumption. In Helm et al. [53], a number of commentators believed that refraining from having children was the best course of action for reducing one's carbon footprint. Participants in Krähenbühl [54] differentiated between concerns of the direct (overpopulation) and indirect (overconsumption) impacts of children on the environment, with the latter situated in their rejection of capitalist society and its materialist values. A unique finding in Nakkerud [37] was participants' concerns for the "flourishing of non-human species" [p.203], aside from the environment as a whole.

*Meeting family subsistence needs.* In Zambia [55] and Ethiopia [56], participants' concerns centred around their families' ability to subsist in a context of seasonal droughts and dependence on rain-fed agriculture. The dominant narrative in both studies was that smaller families are better positioned to support themselves during adverse environmental conditions, meaning participants desired fewer children to meet their household's essential needs. This led to heightened demand for family planning services in these areas. However, the direction of this



relationship was diametric in Rosen et al. [55] as some respondents noted that a greater number of children is an asset as they provide agricultural and pastoral labour that can be used to acquire more resources. This emerged as a secondary theme with only a few male participants still holding this view.

*Tensions between societal norms and individual beliefs.* All six studies cited competing tensions within participants' narratives related to normative societal expectations and cultural pressures to have children. Rosen et al. [55] highlighted the gendered social obligations for Zambian men to have a large number of children, while Rovin et al. [56] commented on the same expectation for Ethiopian women who are granted prestige in the community if they have more children. In Switzerland, participants' decisions were fraught with pronatalist norms that underline the centrality of the nuclear family, and consequently participants felt a social pressure to have children: "*there's the 'are you sure you won't regret it later when you're old'*" [54] [para.152]. This was also noted by Nakkerud [37] and Helm et al. [53] with participants describing the consistent challenging they faced from others as to their environmental reasons for choosing a childfree lifestyle, and consequent belief that their minds would change as they aged. In Smith et al. [57], some participants described feeling like an outlier from their contemporaries, whilst others recounted the support they felt from friends and family who shared their environmental concerns.

An additional tension centred around participant's individual preferences and beliefs. Two studies [53, 57] discussed participants' reflections on the relatively minimal impact of their individual environmental behaviours against a need for systemic intervention. Some participants felt frustration towards companies who have "*turned it towards the individual consumer and said that it's more our fault*" [53] [p.121], whilst two participants in Smith et al. [57] continued to call for policy change and government action. Another site of individual tension rested in some participants' views of reproduction as an inherently positive experience and a desire to "*experience the joy, hope, and happiness associated with having children*" [53] [p.122]. Other reproductive considerations included financial concerns or partner's reproductive preferences and thus climate change was seldom the only factor shaping reproductive decision-making for participants.

### 3.3 Mixed-methods results

**3.3.1 Study characteristics.** Table 1 presents the study characteristics of two included mixed-methods studies. Both studies utilised the same dataset from the US, albeit for responding to different research aims, and thus the characteristics are homogeneous aside from the reproductive focus and key findings. Participants were disproportionately represented by women (n = 446), followed by men (n = 131), and gender-diverse people (n = 30).

**3.3.2 Quality appraisal.** Mixed-methods studies were appraised using the MMAT [48] and both deemed high quality (Table 1 and S6 Table). Mixed-methods were appropriate as the quantitative multiple-choice questions captured discrete answers, whilst the open-ended qualitatively designed questions provided further detail for answering the research question. A key limitation was the non-randomised selection of participants, resulting in an inability to generalise findings to all Americans factoring climate change into their reproductive plans. Additionally, the use of self-report measures leads to the same response biases as previously discussed [62].

**3.3.3 Narrative synthesis.** Given only two mixed-methods studies were acquired, it was not necessary to categorise them into distinct groups. However, the findings are discussed in turn due to heterogeneous research aims and findings. Participants in Schneider-Mayerson et al. [59] were primarily concerned about the impacts of climate change on the health and

wellbeing of their existing and/or hypothetical children, with concerns related to the carbon footprint of procreation emerging as a secondary finding. In Schneider-Mayerson [58], findings were divided between respondents who were already parents and/or planning to have children versus those who were environmentally childfree or undecided. The former group believed that parents are more invested in environmental politics due to their connections to a distant future, on the part of their children, and viewed their (future) parenting as contributing to a better world through supporting their children to become environmentalists. On the other hand, the latter group commented on the opportunity cost of parenting, meaning the energy required for raising a child would be taken “*from the project of fighting climate change*” [p.164]. Additionally, reproduction was viewed as a socio-political tool that could be leveraged to influence environmental attitudes among family members specifically.

## 4. Discussion

### 4.1 Summary of evidence

Thirteen studies detailing how climate change-related concerns link to reproductive decision-making were narratively synthesised. The majority of studies (12/13) reported that stronger environmental concerns are associated with less favourable reproductive attitudes and a diminished desire and intention to have children. However, weaker evidence from four studies suggested climate change concerns may be associated with *increased* reproductive intention for some. Four key areas of concern were identified: uncertainty of an unborn child’s future, ecological impact of reproduction, meeting family subsistence needs, and contributing to environmental politics. The qualitative, quantitative, and mixed-methods findings are consolidated in this section, and contextualised in relation to other literature, to answer the research question and objectives of this review.

### 4.2 Complex relationship between climate change concerns and reproductive decision-making

The findings revealed a complex relationship between climate change-related concerns and reproductive decision-making. In all but one study, stronger concerns were associated with a desire for a smaller number of children or simply none at all. This accords with a recent cross-country study [26] involving 10,000 16-25-year-olds reporting that four in ten participants were hesitant to have children as a result of climate change. Additionally, these concerns sparked the inception of political movements such as BirthStrike, with Blythe Pepino, the founder of this collective stating, “*we feel too afraid to have kids because we feel that we’re heading toward civilization breakdown as a result of the environmental crisis*” [36] [p.2].

However, results were mixed; two quantitative studies in EU countries [50, 52] suggested that climate change concern may be associated with an *increased* desire for children for some. These studies, however, used a single item measure of concern as opposed to the NEP, and dichotomised environmental concern on a binary scale from ‘strong concerns’ to ‘no strong concerns’. This ignores the continuous nature of mental health issues and meant a considerable amount of this variable’s information was lost, reducing its statistical power [65]. However, one qualitative study [55] found that some Zambian men desire more children during times of environmental degradation, and in one mixed-methods study [58] environmental concerns were justified as a reason to *have* children.

Additionally, participants’ narratives were not so clear-cut as they explained their process of decision-making was often fraught with competing tensions from societal norms and divergent individual attitudes towards reproduction. This idea is grounded in the Theory of

Planned Behaviour (TPB), which proposes that behavioural intentions are determined by personal attitudes, subjective norms, and the degree of control over the behaviour [66]. In the context of reproductive decision-making, climate change concerns compete with pro-reproductive attitudes and normative expectations to bear children, as well as the ability or inability to control reproductive trajectories in many settings.

To explain these contradictory findings, it is important to discuss the various concerns that motivate these shifts in reproductive decision-making.

### 4.3 Explanations for factoring climate change concerns into reproductive decision-making

Participants' climate change concerns factoring into their reproductive decisions are divided into four themes. Firstly, participants worried about the quality of their child(ren)'s life in a future affected by climate change. These are altruistic environmental concerns, according to Davis et al. [39], as they consider the impacts to others, in this case one's children, and embody a "degree of nature-self overlap" [p.95] by placing them within an interdependent environment. This narrative is echoed in Dow's [67] conceptualisation of an ecological ethic of reproduction which encourages prospective parents to look beyond their individual nuclear family to the broader environment, representing the conditions into which a child will be born.

Dow's [67] theory also naturally intersects with the second theme, participants' concerns of their ecological impact, as it proposes a reconsideration of "*bring[ing] future generations into a world with stretched and unequally distributed resources*" [p.653]. Participants feared that having children would contribute to overpopulation and overconsumption, which corresponds to recent calculations of the ecological cost of reproduction. Wynes et al. [68], for example, concluded that having one fewer child is the highest impact action one can take to reduce personal emissions. Interestingly however, these concerns were not expressed by participants in the Global South, which may reflect their relatively negligible involvement in overconsumption practices [1]. Whilst the fertility rate in many Global South countries has historically been higher than their Global North counterparts, focussing on overpopulation discourses has been critiqued as reductive and racist as consumption, aggravated by a capitalist way of living, is considered the primary anthropogenic driver of climate change [69].

The third and fourth themes were reported to a lesser extent, in two studies each. In Zambia and Ethiopia, participants desired fewer children to meet subsistence needs during periods of declining agricultural productivity. However, this competed with the lived reality of shortages in contraception provision which epitomises the distinction between 'desire' and 'intention' in Miller's [32] T-D-I-B model. Given this finding was unique to the studies from the Global South, this may imply that the transition from desires to intentions is more challenging in these countries with generally weaker sexual and reproductive health (SRH) service provision, and where reproductive rights is, at times, still a taboo subject [70]. Contextualising this within broader discourses of reproductive freedom, it is important to remember that many people may not have the ability or privilege to choose whether, or how many children they have. Consequently, this highlights the highly situated nature of environmentally childfree behaviour as organised along social class hierarchies that are prevalent both within and between Global North and Global South settings [54].

The final theme explored environmental political concerns in some individuals' decisions to restrict their reproduction. Participants in Schneider-Mayerson [58] believed that the energy required for parenting would detract from their personal endeavours to mitigate climate change. This parallels Blackstone's [35] research suggesting that childfree individuals wish to "*leave a legacy*" [p.76] by making a positive mark on the world through philanthropic

work, civic engagement, and in this case, climate change activism. Reproduction was also seen as a socio-political tool in participants' private lives, although interestingly only two participants across all studies reported their refusal to have children on a more public scale, as a method of 'striking' until systemic change was enacted. This is surprising given the prominence of BirthStrike, Conceivable Future, and No Future No Children that had this notion at the very core of their movements.

These final two themes were also articulated in participants' intentions for a greater number of children within two studies. Firstly, participants in Zambia were concerned about their ability to support their family without the household labour provided by additional children. This idea supports demand theories of fertility previously mentioned and is observed in other Global South countries including Bangladesh and Nepal where children are seen as "*helping hands during difficult times*" [71] [p.105] to support with domestic work as well as water and fuel wood collection [72]. These concerns may also be reasonably linked to demographic theories of 'insurance' births, whereby women in unfavourable environmental conditions have more children to compensate for the risks to child mortality [73]. Consequently, this is another example in which the transition from reproductive desires to intentions may be more challenging in Global South countries with a dependency on children to provide support. Regarding environmental politics, participants responses were reflective of a political fertility gap in the US, with statistics from the 2006 General Social Survey highlighting a 41% increase in numbers of children had by 'conservative' adults than 'liberal' adults [74]. Participants feared that this gap would widen if they, as liberal and environmentally conscious individuals, chose to have fewer children which could further exacerbate the climate crisis.

These studies have therefore highlighted a complex and multidimensional relationship between climate change concerns and reproductive decision-making. This contrasts with an oversimplified depiction of this relationship within the media that has typically only highlighted people's concerns of the quality of a child's life in a climate-changed future as a factor in their reproductive decisions. Additionally, important distinctions were found between, as well as within, Global North and Global South countries, adding further complexity to the relationship as climate change concerns and their impact on reproductive decision-making were not generalisable on a global scale. Finally, the scope of this review limited a detailed analysis of competing reproductive tensions from social norms and conflicting individual beliefs that may obscure the relationship between participants' climate change concerns and reproductive decisions.

## 4.4 Recommendations

**4.4.1. Recommendations for research.** Due to the incipient nature of this topic, this review has a number of suggestions for future research directions. Firstly, greater attention should be paid to the impact of climate change concerns on reproductive timing to provide a comprehensive view on reproductive decision-making as a whole according to the T-D-I-B model. Given concerns of overpopulation featured as a dominant theme, age at first birth as well as birth spacing may be an additional reproductive consideration, warranting further inquiry. Secondly, this topic ought to be investigated further within Global South settings. Differences in structural constraints from the Global North have been highlighted and are expected to predict heterogeneous responses to environmental concerns and reproductive decisions between, as well as within, this binary geographical divide. Additionally, given reproductive decision-making is multifaceted and influenced by social, cultural, economic, and personal factors, understanding how climate change concerns are situated among these competing factors is necessary to provide a more detailed analysis. Greater efforts to recruit

and retain gender-diverse participants are also needed as they are particularly vulnerable to both the effects of climate change and adverse mental health [75, 76]. Finally, with respect to study design, longitudinal cohort studies would be advantageous to explore causality of this relationship and whether it is subject to change over an individual's life course.

**4.4.2 Recommendations for policy and practice.** The wider implications of this review highlight some important recommendations for policy and practice. Firstly, evidence has shown that public concern towards climate change in the UK has grown considerably over the last decade [77, 78]. Acknowledging this suggests an evident need for increased resource investment into mental health service provision and policymakers should endeavour to use co-production methods that consult mental health service users and acknowledge their lived experience expertise. Additionally, greater prioritisation of climate change within political agendas may help mitigate public anxiety and relieve some of the burden on mental healthcare providers. Further research is required to explore the trend in public concern towards climate change in countries outside of the UK. Secondly, promotion of family planning services coupled with subsidised, readily available access to contraception presents a key opportunity for fostering climate resilience within the Global South, allowing individuals to control their own reproductive trajectories. Finally, as researchers and policymakers continue to seek ways to curb the environmental consequences of climate change, understanding the reasons why some people choose to adjust their reproductive intentions may prove instrumental for shaping public policy. At the very least, this review underscores a need for collaboration among policymakers to incorporate local-level environmental concerns within national and international climate change, mental health, and SRH policies.

## 4.5 Limitations

This review has identified a gap in the literature and provided key recommendations to be taken forward into the field, however, some limitations remain. Firstly, as the screening of databases was conducted in July 2022, potentially relevant studies published after this date were not included. This temporal limitation emphasises the evolving nature of research and serves to encourage future updates that incorporate the latest research findings. Other relevant studies may also have been omitted as only English language papers were eligible for inclusion. Additionally, the inclusion of different study designs resulted in inconsistencies in the quality appraisal as three separate tools had to be used. However, not limiting by study design was justified as it facilitated methodological pluralism which is useful, not only for neutralising the limitations inherent in a single method, but also for gaining a more holistic analysis that is not achievable through the use of just one study design [79]. The narrative synthesis approach is often critiqued for lacking transparency [80] and an in-depth description of the process was beyond the scope of this review. However, synthesis was conducted in line with Popay et al. [44] and we have provided detailed information on the review's methods to ensure utmost transparency and reproducibility of findings. This detail was also provided to offset the risk of selection bias resulting from the single screening of articles as much as possible [81].

The included studies were all appraised as either high ( $n = 7$ ) or medium quality ( $n = 6$ ), enhancing the strengths of the conclusions drawn. However, there was significant variability in sample sizes with three qualitative studies recruiting only 7, 14, and 20 participants, resulting in low statistical power. All quantitative studies were cross-sectional, leading to an inability to infer a temporal relationship or to evaluate any changes prospectively. However, confounding factors were identified and adjusted for, and the qualitative and mixed-methods studies supported a directional relationship from climate change concern (exposure) to reproductive decision-making (outcome), making it unlikely that the inverse was true for the quantitative

studies. Finally, there was significant geographical homogeneity in the data, with 85% (n = 11) of studies conducted in Global North countries, limiting the generalisability of these findings to the Global South.

## 5. Conclusions

This review has revealed a complex relationship between climate change-related concerns and reproductive decision-making. The findings support anecdotal evidence that climate change is factoring into people's reproductive decision-making, with the majority of studies suggesting that many people are choosing to forego childbearing or reduce the number of children they have as a result. However, a relatively simplistic overview of this relationship, grounded in environmental ethics, is illuminated in public discourse. This review has revealed a more intricate account of how and why people are beginning to reconsider their childbearing and child-number decisions based on their climate change concerns. Whilst many participants' narratives were rooted in ethical considerations, including concern for their child(ren) in an uncertain future and the ecological impact of reproduction, other considerations that do not appear so readily in public discourse were environmental political considerations and meeting family subsistence needs. These two concerns were also justified, albeit to a lesser degree, as reasons for a *greater* number of children, further complicating the relationship. The lack of Global South representation in the literature is highlighted as one among a number of gaps still remaining in the field with others including a relative absence of gender-diverse participants' voices and no consideration of the effect of climate change concern on reproductive timing. Given the multidisciplinary implications of this research for public health policy and environmental politics, these all represent necessary avenues for future research. This review therefore serves as a call to action for greater research into the climate change, mental health, and reproductive decision-making nexus.

## Supporting information

**S1 Checklist. PRISMA checklist 2020.** Note. Template available from: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021; 372: n71. (DOCX)

**S1 Table. Search terms for search strategy conducted on WOS database.** Note. The symbols and wildcards included in this table will differ according to each database. For WOS: \* = any group of characters or no character, \$ = zero or one character, "" = searching for an exact phrase, near/x = connected terms are within x number of words from each other. <sup>1</sup> The term 'natural disaster' is fraught with academic critique; however, it is also a buzzword in the literature and is therefore included within the search terms in order not to omit any key literature. (DOCX)

**S2 Table. MeSH terms used for search strategy.** Note. Exp = the term was exploded to include all narrower subject headings associated with the broader concept, / = used to distinguish MeSH terms from keywords. (DOCX)

**S3 Table. Inclusion/exclusion criteria for study selection.** (DOCX)

**S4 Table. Quality appraisal for quantitative studies using the JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies.** (DOCX)



**S5 Table. Quality appraisal for qualitative studies using the CASP Qualitative Checklist.**  
(DOCX)

**S6 Table. Quality appraisal for mixed-methods studies using the MMAT.**  
(DOCX)

## Acknowledgments

We would like to thank Ms. Heather Chesters, the Deputy Librarian at the UCL Great Ormond Street Institute of Child Health Library, for supporting with the identification of appropriate search terms for this review. We would also like to thank Dr. Ilan Kelman, Professor of Disasters and Health at the UCL Institute for Risk and Disaster Reduction and the UCL Institute for Global Health, for his feedback in the initial stages of the conceptualisation of this study.

## Author Contributions

**Conceptualization:** Hope Dillarstone, Laura J. Brown, Elaine C. Flores.

**Methodology:** Hope Dillarstone.

**Supervision:** Laura J. Brown, Elaine C. Flores.

**Writing – original draft:** Hope Dillarstone.

**Writing – review & editing:** Laura J. Brown, Elaine C. Flores.

## References

1. Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R, et al. Managing the health effects of climate change. *The Lancet*. 2009; 373(9676): 1693–1733.
2. Watts N, Adger WN, Agnozzi P, Blackstock J, Byass P, Cai W, et al. Health and climate change: policy responses to protect public health. *The Lancet*. 2015; 386: 1861–1914. [https://doi.org/10.1016/S0140-6736\(15\)60854-6](https://doi.org/10.1016/S0140-6736(15)60854-6) PMID: 26111439
3. Romanello M, McGushin A, Napoli CD, Drummond P, Hughes N, Jamart L, et al. The 2021 report of the Lancet Countdown on health and climate change: code red for a healthy future. *The Lancet*. 2021; 398(10311): 1619–1622. [https://doi.org/10.1016/S0140-6736\(21\)01787-6](https://doi.org/10.1016/S0140-6736(21)01787-6) PMID: 34687662
4. Clayton S, Manning CM, Krygsmann K, Speiser M. Mental health and our changing climate: impacts, implications, and guidance. Washington D.C.: American Psychological Association and ecoAmerica; 2017.
5. Thompson HE. Climate “psychopathology”: The intersection of mental and physical health in the climate emergency. *European Psychologist*. 2021; 26(3): 195–203.
6. Woodbury Z. Climate Trauma: Toward a New Taxonomy of Trauma. *Ecopsychology*. 2019; 11: 1–8.
7. Cunsolo A, Landman K. (Eds.). *Mourning Nature: Hope at the Heart of Ecological Loss and Grief*. Montreal: McGill-Queen’s University Press; 2017.
8. Albrecht G, Sartore G-M, Connor L, Higginbotham N, Freeman S, Kelly B, et al. Solastalgia: the distress caused by environmental change. *Australasian Psychiatry*. 2007; 15: S95–S99. <https://doi.org/10.1080/10398560701701288> PMID: 18027145
9. Shead S. Climate change is making people think twice about having children. CNBC. 2021 Aug 12 [Cited 2022 Jul 09]. Available from: <https://www.cnbc.com/2021/08/12/climate-change-is-making-people-think-twice-about-having-children.html>.
10. Carrington D. Climate ‘apocalypse’ fears stopping people having children—study. *The Guardian*. 2020 Nov 27 [Cited 2022 Jul 09]. Available from: <https://www.theguardian.com/environment/2020/nov/27/climate-apocalypse-fears-stopping-people-having-children-study>.
11. Haug S. ‘What or where is the ‘Global South’? A social science perspective. 2021 Sept 28 [Cited 2022 Aug 21]. In: LSE Blogs. Available from: <https://blogs.lse.ac.uk/impactofsocialsciences/2021/09/28/what-or-where-is-the-global-south-a-social-science-perspective/>.

12. IPCC (Intergovernmental Panel on Climate Change). Climate Change 2022: Impacts, Adaptation and Vulnerability [Summary for Policy Makers]. 2022 [Cited 2022 Aug 01]. Available from: <https://www.ipcc.ch/report/ar6/wg2/>.
13. UNFCCC (United Nations Framework Convention on Climate Change). United Nations Framework Convention on Climate Change. Bonn: UNFCCC; 1992.
14. IPCC (Intergovernmental Panel on Climate Change). (2019) Special Report: Global Warming of 1.5°C [Summary for Policy Makers]. 2019 [Cited 2022 Jul 20]. Available from: <https://www.ipcc.ch/sr15/chapter/spm/>.
15. Kelman I. 'Climate Change and the Sendai Framework for Disaster Risk Reduction', *International Journal of Disaster Risk Science*. 2015; 6: 117–127.
16. UN (United Nations). Causes and Effects of Climate Change. [Cited 2023 Aug 27]. Available from: <https://www.un.org/en/climatechange/science/causes-effects-climate-change>
17. WHO (World Health Organization). Gender, Climate Change and Health. 2014 [Cited 2022 Jul 11]. Available from: <https://apps.who.int/iris/handle/10665/144781>.
18. Corfee-Morlot J, Maslin M, Burgess J. Global warming in the public sphere. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*. 2007; 365(1860): 2741–2776. <https://doi.org/10.1098/rsta.2007.2084> PMID: 17666388
19. Palinkas LA, Wong M. Global climate change and mental health. *Current Opinion in Psychology*. 2020; 32: 12–16. <https://doi.org/10.1016/j.copsyc.2019.06.023> PMID: 31349129
20. Charlson F, Ali S, Benmarhnia T, Pearl M, Massazza A, Augustinavicius J, et al. Climate Change and Mental Health: A Scoping Review. *International Journal of Environmental Research and Public Health*. 2021; 18(9): 4486. <https://doi.org/10.3390/ijerph18094486> PMID: 33922573
21. Usher K, Durkin J, Bhullar N. Eco-anxiety: How thinking about climate change-related environmental decline is affecting our mental health. *International Journal of Mental Health Nursing*. 2019; 28(6): 1233–1234. <https://doi.org/10.1111/inm.12673> PMID: 31724833
22. Bowleg L. The Problem with the Phrase Women and Minorities: Intersectionality—An Important Theoretical Framework for Public Health. *American Journal of Public Health*. 2012; 102(7): 1267–1273. <https://doi.org/10.2105/AJPH.2012.300750> PMID: 22594719
23. Kaijser A, Kronsell A. Climate change through the lens of intersectionality. *Environmental Politics*. 2014; 23(3): 417–433.
24. WHO (World Health Organization). Mental health: strengthening our response. 2022 Jun 17 [Cited 2022 Jul 29]. Available from: <https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response>.
25. Coffey Y, Bhullar N, Durkin J, Islam MS, Usher K. Understanding Eco-anxiety: A Systematic Scoping Review of Current Literature and Identified Knowledge Gaps. *The Journal of Climate Change and Health*. 2021; 3(100047): 1–6.
26. Hickman C, Marks E, Pihkala P, Clayton S, Lewandowski RE, Mayall EE, et al. Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey. *The Lancet Planetary Health*. 2021; 5(12): e863–3873. [https://doi.org/10.1016/S2542-5196\(21\)00278-3](https://doi.org/10.1016/S2542-5196(21)00278-3) PMID: 34895496
27. Weyler R. 'Ecological Trauma and Common Addiction'. 2019 Jun 12 [Cited 2022 Aug 01]. Available from: <https://www.rexweyler.ca/ecologue/2019/6/11/ecological-trauma-and-common-addiction>.
28. Dunlap RE, Van Liere K, Mertig AG, Jones RE. Measuring endorsement of the new ecological paradigm: A revised NEP scale. *Journal of Social Issues*. 2000; 56(3): 425–442.
29. Clayton S. Climate anxiety: Psychological responses to climate change. *Journal of Anxiety Disorders*. 2020; 74: 1–7. <https://doi.org/10.1016/j.janxdis.2020.102263> PMID: 32623280
30. Willan S, Gibbs A, Petersen I, Jewkes R. Exploring young women's reproductive decision-making, agency, and social norms in South African informal settlements. *PLoS ONE*. 2020; 15(4): e0231181. <https://doi.org/10.1371/journal.pone.0231181> PMID: 32348303
31. Blackstone A, Stewart MD. "There's More Thinking to Decide": How the Childfree Decide Not to Parent. *The Family Journal*. 2016; 24(3): 296–303.
32. Miller WB. Childbearing motivations, desires, and intentions: a theoretical framework. *Genetic, Social, and General Psychology Monographs*. 1994; 120(2): 223–258. PMID: 8045374
33. Miller WB. Differences between fertility desires and intentions: implications for theory, research, and policy. *Vienna Yearbook of Population Research*. 2011; 9: 75–98.
34. Blackstone A. Childless... or childfree?. *Contexts*. 2014; 13: 68–70.
35. Blackstone A. *Childfree by choice: the movement redefining family and creating a new age of independence*. New York: Dutton; 2019.

36. McMullen H, Dow K. Ringing the Existential Alarm: Exploring BirthStrike for Climate. *Medical Anthropology*. 2022; 41(6–7): 659–673. <https://doi.org/10.1080/01459740.2022.2083510> PMID: 35704672
37. Nakkerud E. ‘There Are Many People Like Me, Who Feel They Want To Do Something Bigger’: An Exploratory Study of Choosing Not to Have Children Based on Environmental Concerns. *Ecopsychology*. 2021; 13(3): 200–209.
38. Ghimire DJ, Mohai P. Environmentalism and Contraceptive Use: How people in less developed settings approach environmental issues. *Population and Environment*. 2005; 27(1): 29–61.
39. Davis A, Arnocky S, Stroink M. The Problem of Overpopulation: Proenvironmental Concerns and Behavior Predict Reproductive Attitudes. *Ecopsychology*. 2019; 11(2): 92–100.
40. Miller CC. (2018) Americans are having fewer babies: They told us why. *The New York Times*. 2018 Jul 05 [Cited 2022 Jul 07]. Available from: <https://www.nytimes.com/2018/07/05/upshot/americans-are-having-fewer-babies-they-told-us-why.html>.
41. Helm SV, Pollitt A, Barnett MA, Curran MA, Craig ZR. Differentiating environmental concern in the context of psychological adaption to climate change. *Global Environmental Change*. 2018; 48: 158–167.
42. Wohlin C. Guidelines for Snowballing in Systematic Literature Studies and a Replication in Software Engineering. *Ease '14: Proceedings of the 18<sup>th</sup> International Conference on Evaluation and Assessment in Software Engineering*. 2014; 38: 1–10.
43. Adam J, Hillier-Brown FC, Moore HJ, Lake AA, Araujo-Soares V, White M, et al. Searching and synthesising ‘grey literature’ and ‘grey information’ in public health: critical reflections on three case studies. *Systematic Reviews*. 2016; 5(164): 1–11.
44. Popay J, Roberts H, Sowden A, Petticrew M, Arai L, Rodgers M, et al. *Guidance on the Conduct of Narrative Synthesis in Systematic Reviews: A product from the ESRC Methods Programme*. Lancaster: Lancaster University; 2006.
45. Noyes J, Booth A, Moore G, Flemming K, Tuncalp Ö, Shakibazadeh E. Synthesising quantitative and qualitative evidence to inform guidelines on complex interventions: clarifying the purposes, designs and outlining some methods. *BMJ Global Health*. 2019; 4: e000893. <https://doi.org/10.1136/bmjgh-2018-000893> PMID: 30775016
46. JBI (Joanna Briggs Institute). *Critical Appraisal Checklist for Analytical Cross-Sectional Studies*. [Cited 2022 Aug 04]. Available from: <https://jbi.global/critical-appraisal-tools>.
47. CASP (Critical Appraisal Skills Programme). *Qualitative Studies Checklist* [online]. 2022 [Cited 2022 Jul 21]. Available from: <https://casp-uk.net/casp-tools-checklists/>.
48. Hong QN, Fàbregues S, Bartlett G, Boardman F, Cargo M, Dagenais P, et al. The Mixed Methods Appraisal Tool (MMAT) version 2018 for information professionals and researchers. *Education for Information*. 2018; 34(4): 285–291.
49. Arnocky S, Dupuis D, Stroink M. Environmental concern and fertility intentions among Canadian university students. *Population and Environment*. 2012; 34(2): 279–292.
50. De Rose A, Testa M. *Climate Change and Reproductive Intentions in Europe*. Vienna Institute of Demography–VID. 2013; 1: 1–20.
51. Musialczyk E. *Attitudes towards having Children in View of Climate Change*. BA Thesis, National College of Ireland. 2020. Available from: <https://norma.ncirl.ie/4828/>.
52. Szczuka B. *Climate Change Concerns and the Ideal Number of Children: A Comparative Analysis of the V4 Countries*. *Social Inclusion*. 2022; 10(3): 206–216.
53. Helm S, Kemper J, White S. No future, no kids—no kids, no future? An exploration of motivations to remain childfree in times of climate change. *Population and Environment*. 2021; 43(1): 108–129.
54. Krähenbühl M. “Environmental Childlessness?: Reproduction and (Im)possible Futures amidst Environmental Crises”. MA Thesis, Geneva Graduate Institute. 2022. Available from: <https://books.openedition.org/iheid/8842?lang=en>.
55. Rosen JG, Mulenga D, Phiri L, Okpara N, Brander C, Chelwa N, et al. “Burnt by the scorching sun”: climate-induced livelihood transformations, reproductive health, and fertility trajectories in drought-affected communities of Zambia. *BMC Public Health*. 2021; 21(1501): 1–14. <https://doi.org/10.1186/s12889-021-11560-8> PMID: 34344335
56. Rovin K, Hardee K, Kidanu A. Linking population, fertility, and family planning with adaptation to climate change: perspectives from Ethiopia. *African Journal of Reproductive Health*. 2013; 17(3): 15–29. PMID: 24069764
57. Smith DM, Sales J, Williams A, Munro S. Pregnancy intentions of young women in Canada in the era of climate change: a qualitative auto-photography study. *BMC Public Health*. 2023; 23(766): 1–13. <https://doi.org/10.1186/s12889-023-15674-z> PMID: 37098525

58. Schneider-Mayerson M. The environmental politics of reproductive choices in the age of climate change. *Environmental Politics*. 2022; 31(1): 152–172.
59. Schneider-Mayerson M, Leong K. Eco-reproductive concerns in the age of climate change. *Climatic Change*. 2020; 163(2): 1007–1023.
60. Lees N. The Brandt Line after forty years: The more North-South relations change, the more they stay the same?. *Review of Intersectional Studies*. 2021; 47(1): 85–106.
61. van Daalen K, Jung L, Dhatt R, Phelan AL. Climate Change and Gender-Based Health Disparities. *The Lancet Planetary Health*. 2020; 4(2): E44–45. [https://doi.org/10.1016/S2542-5196\(20\)30001-2](https://doi.org/10.1016/S2542-5196(20)30001-2) PMID: 32112742
62. Krietchmann RS, Abad FJ, Ponsoda V, Nieto MD, Morillo D. Controlling for Response Biases in Self-Report Scales: Forced-Choice vs. Psychometric Modelling of Likert Items. *Frontiers in Psychology*. 2019; 10(2309): 1–12.
63. Morgan G. Semi-structured, narrative, and in-depth interviewing, focus groups, action research, participant observation. 2016 [Cited 2022 Jul 29]. Available from: <https://www.healthknowledge.org.uk/public-health-textbook/research-methods/1d-qualitative-methods/section2-theoretical-methodological-issues-research>.
64. May EM, Hunter BA, Jason LA. Methodological pluralism and mixed methodology to strengthen Community Psychology research: An example from Oxford House. *Journal of Community Psychology*. 2017; 45(45): 100–116.
65. Altman DG, Royston P. The cost of dichotomising variables. *BMJ*. 2006; 332(7549): 1080.
66. Ajzen I. The theory of planned behaviour. *Organizational Behaviour and Human Decision Processes*. 1991; 50(2): 179–211.
67. Dow K. What gets left behind for future generations? Reproduction and the environment in Spey Bay, Scotland. *Journal of the Royal Anthropological Institute*. 2016; 22(3): 653–669.
68. Wynes S, Nicholas KA. The climate mitigation gap: education and government recommendations miss the most effective individual actions. *Environmental Research Letters*. 2017; 12(7): 074024.
69. Mayhew-Bergman M. Should I have children? Weighing parenthood amid the climate crisis. *The Guardian*. 2021 Nov 13 [Cited 2022 Jul 11]. Available from: <https://www.theguardian.com/lifeandstyle/2021/nov/13/children-parenthood-climate-crisis>.
70. DeMaria LM, Smith KV, Berhane Y. Sexual and reproductive health in Ethiopia: gains and reflections over the past two decades. *Reproductive Health*. 2022; 19(Suppl1): 175. <https://doi.org/10.1186/s12978-022-01464-0> PMID: 35945542
71. Haq SMA, Vanwing T, Hens L, Hussain AHMB, Akhataruzzaman M, Chowdhury T, et al. Perception of Environmental Degradation and Family Size: A Comparative Study on Married Man and Women (Indigenous People) in Bangladesh. *OIDA International Journal of Sustainable Development*. 2010; 1(6): 33–41.
72. Biddlecom AE, Axinn WG, Barber JS. Environmental Effects on Family Size Preferences and Subsequent Reproductive Behaviour in Nepal. *Population and Environment*. 2005; 26(3): 183–206.
73. Sellers S, Gray C. Climate Shocks Constrain Human Fertility in Indonesia. *World Development*. 2019; 117: 357–369. <https://doi.org/10.1016/j.worlddev.2019.02.003> PMID: 31213734
74. Tapper J, Evans S. The Political Fertility Gap. *ABC News* [online]. 2006 Aug 23 [Cited 2022 Aug 05]. Available from: <https://abcnews.go.com/GMA/Politics/story?id=2344929&page=1>.
75. Simmonds KE, Jenkins J, White B, Nicholas PK, Bell J. Health impacts of climate change on gender diverse populations: A scoping review. *Journal of Nursing Scholarship*. 2022; 54(1): 81–91. <https://doi.org/10.1111/jnu.12701> PMID: 34693643
76. Newcomb ME, Hill R, Buehler K, Ryan DT, Whitton SW, Mustanski B. High Burden of Mental Health Problems, Substance Use, Violence, and Related Psychosocial Factors in Transgender, Non-Binary, and Gender Diverse Youth and Young Adults. *Archives of Sexual Behaviour*. 2020; 49(2): 645–659.
77. DECC (Department of Energy and Climate Change). DECC Public Attitudes Tracker—Wave 1: Summary of Key Issues. 2012 [Cited 2022 Aug 13]. Available from: <https://www.gov.uk/government/statistics/survey-tracking-public-attitudes-wave-1>.
78. BEIS (Department for Business, Energy, and Industrial Strategy). BEIS Public Attitudes Tracker: Net Zero and Climate Change Spring 2022, UK. 2022 Jun 16 [Cited 2022 Aug 13]. Available from: <https://www.gov.uk/government/statistics/beis-public-attitudes-tracker-spring-2022>.
79. Bailie J, Cunningham F, Abimbola S, Laycock R, Bainbridge R, Bailie R, et al. Methodological pluralism for better evaluations of complex interventions: lessons from evaluating an innovation platform in Australia. *Health Research Policy and Systems*. 2022; 20(14): 1–14. <https://doi.org/10.1186/s12961-022-00814-5> PMID: 35090472

80. Snilstveit B, Oliver S, Vojtkova M. Narrative approaches to systematic review and synthesis of evidence for international development policy and practice. *Journal of Development Effectiveness*. 2012; 4(3): 409–429.
81. Waffenschmidt S, Knelganen M, Siebem W, Bühn S, Pieper D. Single screening versus conventional double screening for study selection in systematic reviews: a methodological systematic review. *BMC Medical Research Methodology*. 2019; 19(132): 1–9. <https://doi.org/10.1186/s12874-019-0782-0>  
PMID: [31253092](https://pubmed.ncbi.nlm.nih.gov/31253092/)