



# Climate change and child wellbeing: a systematic evidence and gap map on impacts, mitigation, and adaptation

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We developed a systematic evidence and gap map (2014–24) to assess how climate change impacts, mitigation, and adaptation affect the wellbeing of children aged 0–18 years globally, and discussed findings with the Children in All Policies 2030 Youth Advisory Board. Health was the most researched child wellbeing domain (84%; 948 of 1127 studies), followed by education (15%; n=171), and food security and nutrition (14%; n=160). Research on children's agency and resilience, displacement, socioeconomic distress, and safety received less attention. Health research gaps included limited studies on vector-borne diseases, children's mental health beyond post-traumatic stress disorder, and health outcomes for children aged 5–18 years. Mitigation and adaptation research focused largely on educational (45%; 114 of 252 studies) and behavioural changes (31%; n=79), with gaps in the evaluation of financing, infrastructure, technology, clean energy, and policy actions. Youth advisory board members emphasised the importance of schools, social media, and intergenerational dialogue in driving climate action while protecting children's wellbeing.

## Background

Half of the world's 2·2 billion children aged 0–18 years live in 33 countries that are deemed at extremely high risk from climate change.<sup>1</sup> Climate change impacts are worsening over time—under current policy pledges, children born in 2020 will experience a two-fold to seven-fold increase in extreme weather events across their lifetime compared with people born in 1960, highlighting major intergenerational climate justice.<sup>2</sup>

Rising temperatures increase the risk of preterm birth, low birthweight, and stillbirth.<sup>3,4</sup> Shifting temperature and precipitation patterns alter the spread of vector-borne diseases, including malaria, dengue virus, Zika virus, and chikungunya, all of which threaten children's health.<sup>5–7</sup> Heavy rainfall and intense droughts disrupt safe water access and food security, worsening child morbidity and mortality.<sup>8</sup> Poor air quality from increased concentrations of pollen, ozone, and wildfire smoke, together with emissions from vehicles, power generation, and industry, raises asthma and allergy risks.<sup>9</sup> Extreme weather events and environmental degradation contribute to injuries,<sup>10</sup> mental health problems,<sup>11,12</sup> undernutrition,<sup>13,14</sup> violence,<sup>15</sup> and education disruptions.<sup>16</sup> Climate change also undermines caregivers' ability to provide safe housing, food, and responsive care.<sup>17,18</sup> As a result of these intersecting threats, climate change is expected to worsen child health inequalities, both globally and locally.<sup>19</sup>

Existing syntheses on climate change and children have largely focused on single (eg, health) rather than multiple domains of wellbeing, despite recurrent calls to consider child wellbeing holistically.<sup>20,21</sup> The Nurturing Care Framework, for example, outlines five essential contributors to child wellbeing: good health; adequate nutrition; safety and security; responsive caregiving; and opportunities for early learning.<sup>22</sup> A WHO-supported adolescent wellbeing framework similarly includes: (1) good health and optimum nutrition; (2) connectedness, positive values, and contributions to society; (3) safety

and a supportive environment; (4) learning, competence, education, skills, and employability; and (5) agency and resilience (see the appendix [pp 1–4] for definitions of all terms).<sup>23</sup> These frameworks provide a scaffolding for examining the relationships between climate change and child wellbeing holistically, rather than within single domains.

Additionally, existing syntheses on climate change and children have focused on climate change impacts rather than mitigation and adaptation. A review of the effects of climate change mitigation policies on child health found 23 modelling studies showing that greenhouse gas mitigation policies would improve children's health by reducing air pollution, but little evidence for other cobenefits from mitigation.<sup>24</sup> Another review found no studies describing the effects of adaptation on child health.<sup>25</sup> As climate change intensifies, research on the potential of mitigation and adaptation actions to safeguard child wellbeing becomes ever more crucial.

Finally, few syntheses on climate change and child wellbeing have engaged children or young people themselves in discussing results and recommendations, despite a 2023 General Comment on the 1989 Convention on the Rights of the Child stipulating that children have the right to participate in decisions about climate change mitigation and adaptation.<sup>26</sup>

In this Review, we aimed to map evidence on how climate change and climate-related mitigation and adaptation affect the wellbeing of children aged 0–18 years globally to identify future research priorities for and with children.

## Methods

### Search strategy and selection criteria

We developed a systematic evidence and gap map.<sup>27</sup> We identified climate-related studies with an early conceptual framework developed by *The Lancet Countdown on Health*

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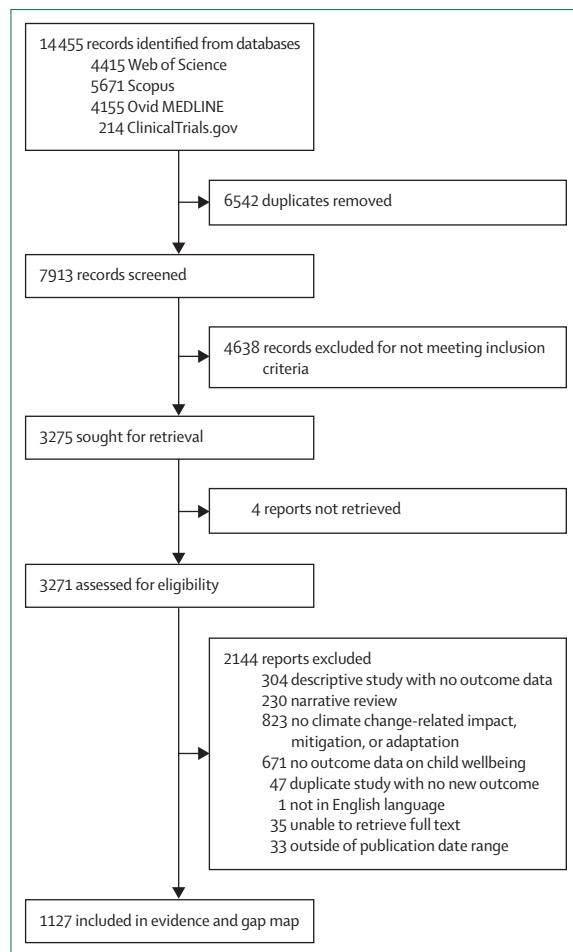


Figure 1: Study inclusion flowchart

and *Climate Change* to map direct effects of climate change through changes in temperature, humidity, and precipitation; extreme weather events; and marine effects; as well as indirect effects through changes in air pollution, vector patterns, ecosystem disruption, food insecurity, displacement, immobility, conflict, exploitation, and economic shocks.<sup>28</sup> Our category of direct impacts aligns with the Intergovernmental Panel on Climate Change (IPCC)'s concept of climate hazards within the Hazard, Vulnerability, and Exposure framework.<sup>29</sup> We used a modified IPCC taxonomy to characterise mitigation and adaptation actions.<sup>30</sup>

We used and expanded the Nurturing Care and WHO's Adolescent Wellbeing frameworks to define seven interlinked domains of child wellbeing in alignment with WHO's definition of wellbeing: (1) food security and nutrition; (2) education and employment; (3) displacement, immobility, and connectedness; (4) socioeconomic distress; (5) health; (6) safety, conflict, violence, and exploitation; and (7) agency and resilience.<sup>22,23,31</sup> Similar to the Nurturing Care Framework, we separated health from food security and nutrition to obtain a more precise picture

of research in each domain, and added socioeconomic distress because it appears as a key determinant of child health under climate change in existing literature.<sup>32</sup> We mapped health studies according to whether they focused on mortality, morbidity (using causes of disability-adjusted life-years [DALYs] from the 2021 Global Burden of Disease Level 2 classification system), or only general health care-seeking behaviour.<sup>33</sup> Some outcomes did not readily fit in this classification system. For example, we used the Institute for Health Metrics and Evaluation's DALY cause classification system to map studies focusing on mental health disorders (eg, depression or post-traumatic stress disorder [PTSD]), but placed other outcomes related to mental wellbeing (eg, negative climate emotions) in the other category within health outcomes. In both the gap map and in discussions with young people, we used WHO's definition of mental health 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".<sup>31</sup> Early childhood development outcomes were coded by relevance (eg, education for early learning outcomes, nutrition, and food security for anthropometric measures). A full dictionary of focus areas (direct and indirect impacts, mitigation, or adaptation) and child wellbeing outcomes, along with our search strategy, are available in the appendix (pp 5–7).

MM conducted database searches on Jan 19, 2023, in Ovid MEDLINE, Web of Science, Scopus, and ClinicalTrials.gov, and AP updated these searches on Jan 4, 2025. We included systematic and scoping reviews as well as original research with quantitative, qualitative, or mixed designs published Jan 1, 2014, to Dec 31, 2024, involving children aged 0–18 years and studies on climate change impact, mitigation, or adaptation. We included studies conducted in any country and of any sample size if they met one or more of the following criteria: 50% or more of the study population were children aged 0–18 years (including fetuses); 50% or more of the age range studied was between 0 years and 18 years; or if a child-specific subgroup analysis was conducted. We included studies on climate change impacts, mitigation, or adaptation of any type, intensity, duration, or complexity, across all sectors and administrative levels. Outcomes at any timescale related to child wellbeing were included, including those where exposure occurred in childhood and outcomes in adulthood. Pilot and ongoing studies were included. We also included scoping and systematic reviews based on whether the reviews themselves met the inclusion criteria, rather than whether their included studies met the criteria.

We excluded studies describing impacts, mitigation, or adaptation actions not related to climate change; narrative reviews; descriptive studies without outcome data; case reports; books; conference papers; editorials; commentaries; errata; corrections; animal studies; non-English literature; and studies without full text.

### Screening and data extraction

MM and Heather Chesters (University College London Institute of Child Health [London, UK]) imported records into EndNote (version 21) and removed duplicates. MM and AP performed title and abstract screening, followed by full-text reviews using EPPI-Reviewer.<sup>34</sup> MM created a screening and data extraction tool. Reviewers (MM, SR, and AP) independently conducted full-text reviews and data extraction, with an interim analysis on 10% of studies to reconcile differences and refine coding tools. Figure 1 shows the study inclusion flowchart.

For each study, we extracted data on impacts, mitigation, and adaptation; child wellbeing outcomes; publication year; WHO region (ie, Africa, Americas, Eastern Mediterranean, Europe, South-East Asia, and Western Pacific); country (including whether identified as at extremely high risk from the impacts of climate change by the Children's Climate Risk Index, as detailed in the appendix [pp 9–10]); setting (urban, rural, or mixed); sex (male, female, or both); age of participants; and study design (systematic review, scoping review, randomised controlled trial, quasi-experimental study, qualitative study, mixed methods, observational study, modelling study, or other).

We classified quasi-experimental studies as such if they used the label “quasi-experimental” in the title, abstract, or methods sections, or if they used labels relating to non-randomised studies (ie, non-randomised controlled trials, natural experiment, instrumental variable analysis, interrupted time series, or case-crossover).<sup>35</sup> Due to the large number of included studies, we did not assess their quality. Results were reported using the PRISMA framework (see the appendix [pp 14–17] for the PRISMA checklist).

### Data mapping and analysis

We used EPPI-Mapper to chart studies by focus and child wellbeing outcome, identifying research concentrations and gaps.<sup>36</sup> As studies could investigate multiple focus areas and child wellbeing outcomes, some appear in multiple cells. We summarised findings for each intersection. Several studies examined both mitigation and adaptation actions—eg, community-based projects that promoted renewable energy and heat adaptation—so we grouped them under one category.

### Collaboration with youth advisory board

We collaborated with four youth advisory board members (SA, EL, AM, and KM) aged 16–17 years from the Children in All Policies 2030 project. The board consisted of 22 young people aged 13–18 years from 17 countries recruited via online platforms. We invited board members to discuss climate change and spoke to all four members who volunteered. We asked about the impacts of climate change on children's wellbeing, their views on the gap map findings, and future research priorities. AP conducted online discussions, summarised findings, and contacted participants to review these summaries and the overall study discussion. We received approval from University College London's Research Ethics Committee (reference number 1881/011) for engaging with young people.

### Results

Our evidence and gap map included 1127 individual studies: 1027 primary studies, 30 scoping reviews, and 70 systematic reviews. Figure 2 is a heatmap of studies by country. Many primary studies used data from the USA (22%; n=226), China (14%; n=148), India (6%; n=64), and Australia (6%; n=61). 19% (n=198) of primary studies had

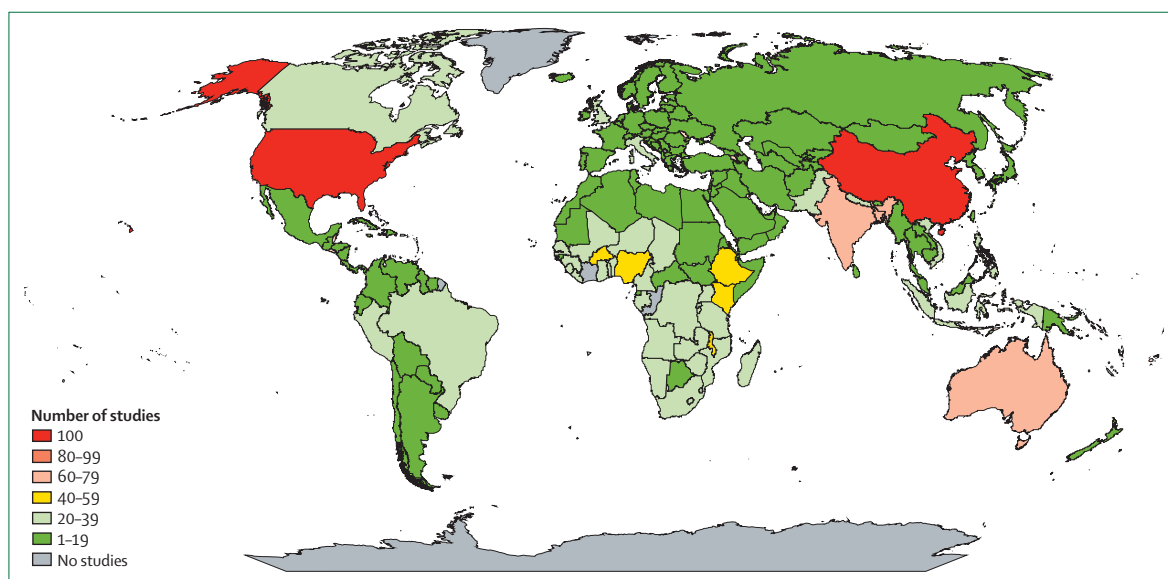


Figure 2: Heatmap of studies on climate change and child wellbeing by country

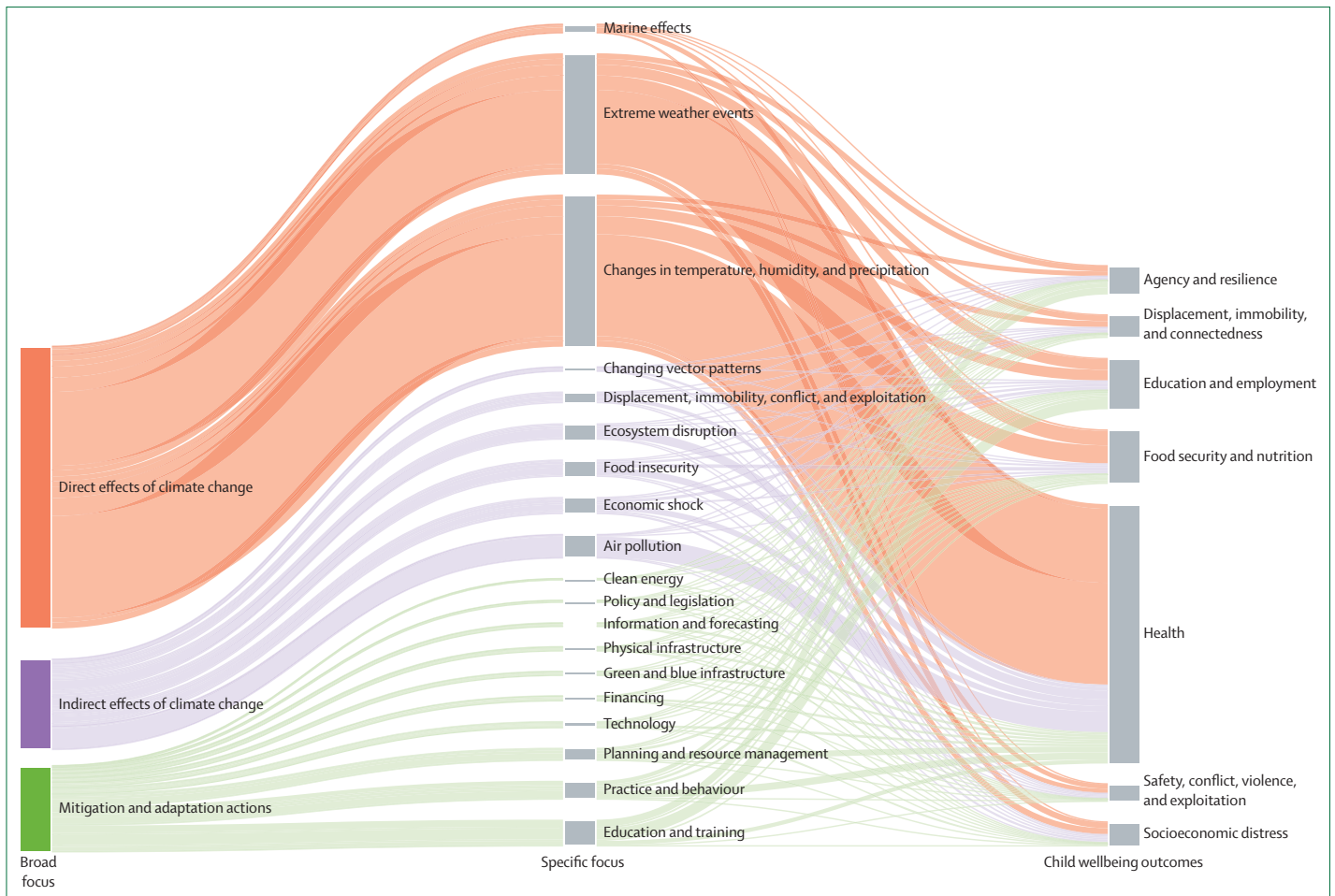


Figure 3: Sankey diagram of study focus areas and child wellbeing outcomes

For more on the full evidence and gap map see <https://cap-2030.org/evidence-map/cap-2030-evidence-gap-map.html>

data from the 33 countries identified by UNICEF as at extremely high risk from climate change. Among these, Bangladesh (6%; n=62), Kenya (5%; n=49), and Nigeria (4%; n=40) were the most represented.

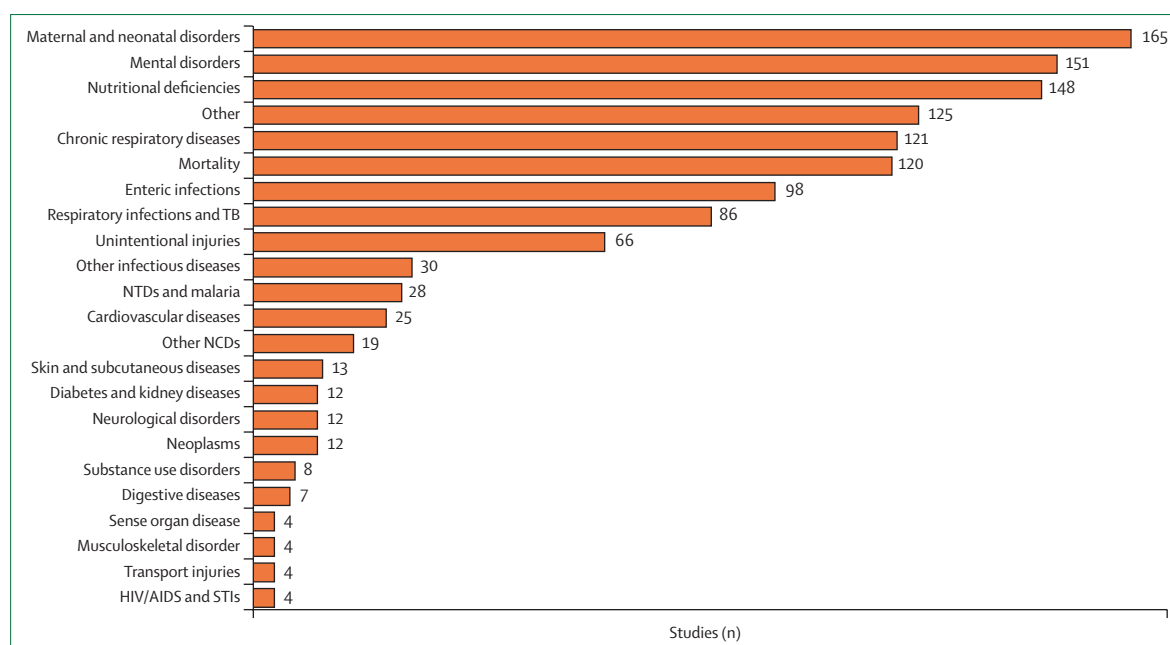
Figure 3 is a Sankey diagram showing the focus areas for all 1127 studies. The full evidence and gap map can be filtered by country, WHO region, child age, and study design. Health (84%; n=948) was the most researched child wellbeing domain; followed by education and employment (15%; n=171); food security and nutrition (14%; n=160); agency and resilience (9%; n=99); displacement, immobility, and connectedness (5%; n=61); socioeconomic distress (5%; n=59); and safety, conflict, violence, and exploitation (4%; n=47).

Figure 4 describes the main child health outcomes studied. 13% (120 of 948 studies) of studies across the health domain included mortality outcomes, and 84% (n=797) focused on DALY-related outcomes. Of these 797 studies, maternal and neonatal disorders (21%; n=165) were the most researched cause of DALYs. Other major DALY causes researched included mental disorders (19%; n=151, including 44 studies on PTSD), chronic

respiratory diseases (15%; n=121), and enteric infections (12%; n=98). Fewer studies focused on respiratory infections and tuberculosis (11%; n=86), unintentional injuries (8%; n=66), other infectious diseases (4%; n=30), or neglected tropical diseases and malaria (4%; n=28). There were 20 or fewer studies on other DALY causes, such as skin diseases (2%; n=13), diabetes and kidney diseases (2%; n=12), self-harm and violence (1%; n=9), or transport injuries (<1%; n=4). 124 (16%) studies had outcomes that could not be classified using the DALY system: 34 (27%) examined developmental outcomes, 20 (16%) examined climate-related anxiety, 14 (11%) examined general psychological distress, and seven (6%) examined on sleep-related outcomes.

#### Impacts of climate change on child wellbeing: research gaps

84% (n=952) of all studies focused on the impacts of climate change rather than actions of mitigation or adaptation, or both. 77% (n=864) assessed direct impacts. Of these 864 studies, 88% (n=763) examined impacts through changes in temperatures, humidity,



**Figure 4: Focus of health outcomes studies**

TB=tuberculosis. NTD=neglected tropical disease. NCD=non-communicable disease. STI=sexually-transmitted disease.

and precipitation, 66% through extreme weather events (n=574), and 4% (n=38) through marine effects.

Most of the 952 studies on the direct impacts of climate change on child wellbeing focused on children's health (83%; n=790). Fewer studies examined direct impacts on food security and nutrition (14%; n=135), and education and employment (10%; n=91). Research on the direct impacts of climate change on children's socioeconomic distress (5%; n=47); displacement, immobility, and connectedness (5%; n=46); agency and resilience (5%; n=43); and safety, conflict, violence, and exploitation (4%; n=37) was even more limited.

Less than a quarter (23%; n=263) of all studies focused on the indirect impacts of climate change on child wellbeing. Of these, 55% (n=145) explored impacts through the exacerbation of air pollution, with fewer studies examining ecosystem disruption (25%; n=65); food insecurity (21%; n=54); economic shocks (21%; n=54); displacement, immobility, conflict, or exploitation (14%; n=37); or changing vector patterns (6%; n=16).

47% (n=445) of the 948 studies on the impacts of climate change on child health focused on children younger than 5 years, while research on other wellbeing domains mostly focused on children aged 5–18 years (74%; 208 of 280 studies).

Of the 790 studies on direct impacts of climate change on child health, 59% (n=470) were observational, 23% (n=179) were quasi-experimental (mainly case-crossover designs), 4% (n=35) were qualitative, and 2% (n=17) were mixed methods. Other domains had more varied designs. Among the 41 empirical studies on displacement, immobility, and connectedness, 17 were

qualitative; 16 were observational; five were mixed methods; and three were quasi-experimental.

### Impacts of climate change mitigation and adaptation on child wellbeing: research gaps

Less than a quarter (22%; n=252) of all studies focused on the effects of mitigation or adaptation, or both, actions on child wellbeing. Of these, 45% (n=114) examined the effects of education and training, 31% (n=79) examined practice or behaviour, and 19% (n=31) examined planning or resource management. Fewer studies explored the effects of technology (12%; n=31), physical infrastructure (9%; n=23), financing (9%; n=22), information and forecasting (8%; n=21), green and blue infrastructure (7%; n=18), policy and legislation (4%; n=11), or clean energy (3%; n=7).

55% (n=138) of research on climate change mitigation and adaptation focused on child health, with 22% (n=31) of these studies addressing mental health. Smaller groups examined effects on education and employment (38%; n=95) and agency and resilience (27%; n=68), often evaluating education interventions on climate-related knowledge and skills.<sup>34,35</sup> There were substantial gaps in research on the effects of physical infrastructure, technology, green and blue infrastructure, clean energy, and policy and legislation across all child wellbeing domains.

Research on mitigation and adaptation tended to focus on children younger than 5 years for health and nutrition, and on school-aged children (5–16 years) for other domains. Studies used experimental and quasi-experimental designs to evaluate the effects of mitigation



### Panel: Young people's priority areas for research and action

#### Impacts of climate change on socioeconomic distress, migration, and mental health

Young people were surprised by the relatively small number of studies examining the contributions of climate change to socioeconomic distress, migration, and mental health beyond post-traumatic stress disorder (PTSD). One member of the youth advisory group noted, "The fact that there's not a lot about socioeconomic distress surprises me because we know that climate change and climate disasters destroy infrastructure, crops, and other valuables. So...that's obviously going to cause socioeconomic distress. And it's important for families and people to be able to rebuild from those disasters." Young people also commented on the limited research on children's displacement due to climate change, which concerned them given the frequent media discussions about the potential effects of temperature and sea level rise on migration. All of the young people we interviewed discussed anxiety related to climate change. Some were surprised that mental health research mainly focused on mental disorders, such as PTSD, rather than day-to-day feelings of sadness or anxiety. They also commented on the fact that the anxiety was appropriate: "you know, the anxiety is there for a reason, climate is in the news for a reason. Water supplies are going to be an issue, it's going to affect our food supplies..."

#### Knowledge, skills, and infrastructure for mitigation and adaptation

Young people felt that schools could strengthen climate change and sustainability education, and said they had variable experiences of such education in formal school settings. One young person said, "We have some knowledge about impacts [of climate change]. But how are children and young people going to have the skills they need and the infrastructure they need to survive in a changed world?" Another shared, "We did learn the Sustainable Development Goals; we were forced to memorise all of them!...We take a scientific approach to understanding how climate change or global warming takes place, but we don't really talk about the societal consequences of what that might do to people and how they might react... that aspect is completely non-existent." Schools could also model mitigation and adaptation actions. One young person shared, "I am part of a club...we did have a tree planting session at the beginning of the year. We planted around 20 trees around campus, and we have solar panels installed in and around our campus, so that kind of helps I guess." Another young person had set up a climate and sustainability forum for schools with help from other students, local government, and teachers, and felt that monitoring reductions in schools' carbon footprint over time was encouraging and inspiring.

#### Social media as both a source of anxiety and a resource for climate activism

Young people discussed the benefits of using social media for climate change education and activism: "You can make your voice heard where perhaps it wasn't before"; but also the anxiety it can produce: "When I first found out about how climate change is progressing and how terrible the climate conditions are right now, I kind of felt powerless in an existential kind of way because we can't technically stop climate change and because our decision makers and policy makers are not taking it as seriously as they should. My anxiety went through the roof." Some young people also encountered contradictory information about climate change on social media. For example, one young person whose family was from a rural, agricultural area was targeted with posts denying climate change or stating that climate action would disrupt farming, but also followed young climate activists offering different perspectives. They had to navigate these contradictory views on their own, as they were not taught how to engage with social media critically. Another participant confirmed that media literacy needed addressing: "Algorithms can be really, really very harmful to kids... especially when [social media] is their first source of information and schools [are] not...able to provide them with...information on what they should consider, how to use sources and how to get information from sources...I think this should be something that should be integrated very early on in, in children's education."

#### Mechanisms to foster intergenerational dialogue for climate action and policy making

Young people discussed the lack of sympathy from some governments towards children's climate activism, especially when it interfered with education. One young person recalled the Fridays for Future school strikes in their country: "[Our] prime minister was like, 'You kids need to go back to school, this is unacceptable', so not very sympathetic to what children are going through...It seems like the higher [up] you go, the less people care about our voice." Young people suggested that normalising intragenerational dialogue among children and young people from different backgrounds as well as intergenerational dialogue between children and policy makers was key: "There's a very, very big gap in what policy makers consider to be important for the youth and what youth consider to be important for themselves in terms of their personal experiences and how their experiences are being reflected into policies...The main way to bridge that gap is through dialogue."

and adaptation on child health more often versus other domains. For example, the eight studies on safety, violence, and exploitation used qualitative (four studies), mixed methods (three studies), or quantitative observational (one study) designs.

#### Learning from young people

We discussed the results of our evidence gap map with four members of the youth advisory board for the Children in All Policies 2030 project. They identified four main areas for research and action (panel).

## Discussion

We created the first global map of evidence on climate change and children's wellbeing and discussed it with young people from different countries. Only a fifth of studies focused on the 33 countries at extremely high risk from climate change. Most research examined children's health, followed by education, and food security and nutrition, whereas other areas, such as children's agency and resilience, displacement, socioeconomic distress, and safety, received less attention. Research on climate change mitigation and adaptation actions was also limited. Three key issues warrant further discussion.

First, there are evidence gaps on the impacts of climate change for topics, world regions, and groups of children that should be high priorities. Many studies on children's mental health focused on PTSD following extreme weather events in high-income countries, with less attention on depression and anxiety—two leading causes of illness in children and adolescents—globally, including in low-income and middle-income countries. This gap has also been identified in recent reviews on climate change and mental health.<sup>37,38</sup> We also found few studies linking climate change to children's risk of contracting neglected tropical diseases and malaria. This finding is surprising given the known impacts of climate change on vector-borne disease patterns, but confirms the results from a gap map on climate change and child health published in 2024.<sup>39</sup>

Existing research has overlooked specific groups of children. Few studies have examined the impacts of climate change on the health, food security, and nutrition of children aged 5 years and older. Although young children face heightened risks during the perinatal period and early years,<sup>40,41</sup> middle childhood and adolescence are also sensitive developmental periods in which the impacts of climate change need exploration.<sup>42,43</sup> There are also few studies on fetal outcomes, such as size or estimated weight, despite the known risks that extreme heat and other climate-related hazards pose for pregnant people.<sup>44</sup> Additionally, few studies consider children's intersectional characteristics and how age, gender, and other factors interact to shape children's specific sensitivities to climate change.<sup>45</sup> Some studies in this Review provide methodological examples exploring how these factors interact. An epidemiological study in Pucallpa, Peru found that young children, girls, and those in a specific district experienced increased dengue incidence after a 1°C increase in weekly mean temperature.<sup>46</sup> Similarly, qualitative research found that refugee Rohingya adolescent boys in Bangladesh were highly exposed to the consequences of climate change due to the interactions of limited education, livelihood opportunities, and inadequate housing, placing them at increased risk of being trafficked for work in other countries.<sup>47</sup> Such intersectional approaches are crucial to help identify and support children most in need of support.

Second, our map shows growing but limited evidence on the effects of mitigation and adaptation actions across all domains of child wellbeing. Expanding this evidence base could address current policy gaps.<sup>48</sup> An analysis of 160 national adaptation plans found that 28% of plans did not mention children, while 31% of plans mentioned only one child-related domain (typically awareness).<sup>49</sup> The same analysis also flagged positive initiatives that included a wide range of children in policy development, leveraging their insights and capabilities. For example, a Norwegian county council organised a climate workshop for children and youth with a range of creative methods to seek their inputs on the selection and implementation of climate mitigation actions.<sup>50</sup>

There is a gap in qualitative research on mitigation and adaptation efforts for and with children. Our map identified several such qualitative studies from education, agroecological, and livelihood programmes. These studies provided insights into enablers of mitigation and adaptation, such as the value of intergenerational, place-based learning;<sup>51</sup> the role of autonomous adaptation (ie, action taken without external support);<sup>52</sup> and how children and families often see mitigation and adaptation as part of broader, place-based efforts to promote wellbeing within socioecological systems, rather than as discrete actions that can readily be transposed from one place to another.<sup>53</sup> Synthesising these qualitative insights could inform future research and action.

Finally, we found considerable evidence gaps on the climate change impacts on children's socioeconomic distress, safety, exposure to conflict, violence, and exploitation, as well as their agency and resilience. Studies from economics, geography, and political science provided useful examples for future research. For instance, an economic analysis using panel survey data on educational achievement for over 4·5 million primary school children in India found that high temperatures were associated with reduced mathematics and reading test scores, with agricultural income loss during the growing season probably driving this relationship. A workfare programme, which provided support for economically disadvantaged people, substantially weakened the link between temperature and test scores.<sup>54</sup> Such research provides information on the impacts, pathways to impact, and potential adaptation strategies.

The youth advisory board members in our study confirmed some of these gaps and highlighted additional priorities. They noted that climate change education often overlooks societal impacts and solutions, suggesting that calls for “participatory, interdisciplinary, creative, and affect-driven approaches to climate change education”<sup>55</sup> still need to be heeded globally.<sup>56</sup> They also stressed the importance of social connection through peers, schools, and activism to counteract the negative emotions generated by climate change. These observations align with existing qualitative literature on how children and young people cope with climate-related emotions.<sup>57</sup> The

youth advisory board members also discussed the mixed role of social media. Observational studies of children's social media use in relation to climate change echo this ambivalence. Some members highlight the benefits of finding like-minded peers and facilitating digital or analogue activism, whereas others suggest that exposure to negative content on climate change could increase anxiety.<sup>58</sup> This literature is fast evolving,<sup>59</sup> and there is a need for more rigorous and systematic studies to understand why, for whom, and in what context climate-related social media engagement benefits children, including features of social media apps and how they are used by children.

Our evidence and gap map has several limitations. The direct impacts we reviewed—such as changes in precipitation, temperature, and humidity—were not studied over long enough time periods (ie, over 30 years) to directly attribute them to climate change,<sup>60</sup> which might have led to the over-attribution or under-attribution of impacts to climate change. Although we included non-health-related databases, the high proportion of health-focused studies might be an artifact of database selection. Including additional databases (eg, the Expert Recommendations for Implementing Change taxonomy for education) or grey literature might have enriched our findings in non-health-related fields. Our search terms for resilience, immobility, and mobility were not exhaustive, potentially omitting relevant studies.<sup>61</sup> Study design classifications were sometimes challenging, with overlap between observational and quasi-experimental studies. We did not separate mitigation and adaptation interventions, as many studies examined both (eg, educational programmes addressing behavioural changes to reduce household-level emissions and reduce climate-related anxiety, or infrastructure initiatives promoting both emission reduction and thermal comfort). Some health studies were classified under other outcomes, including those reporting unspecified psychological distress, climate-related emotions, sleep, or brain development, which did not fit the DALY system.<sup>62</sup> Studies were coded by a single reviewer, which might have introduced bias. We did not appraise study quality due to the large number of included studies. Lastly, although some youth advisory board members had experience in countries at high risk from climate change, most were from high-income settings, meaning their views might not represent those of young people from other contexts.

## Conclusion

The evidence and gap map in this Review found that most research to date has focused on the direct and indirect impacts of climate change on child health, education, food security, and nutrition. Substantial scope is available for new research on the impacts of climate change on displacement, immobility, and connectedness; socioeconomic distress; safety; conflict; violence; and exploitation; as well as agency and resilience. There is

also considerable scope for research on the impacts of climate mitigation and adaptation actions on all domains of child wellbeing. Future work should ensure that children and young people are included in prioritising research and action.

## Contributors

MM and AP conceptualised the study. MM developed the research question, search strategy, participated in data extraction, interpretation, and wrote the first draft of the publication. AP carried out data extraction, interviewed members of the Children in All Policies 2030 (CAP-2030) Youth Advisory Board, wrote additional sections of the publication, and edited the final version. SR carried out data extraction, helped interpret the findings, made the first version of the gap map, and proposed including the CAP-2030 Youth Advisory Board in the study. SA, EL, AM, and KM contributed data as members of the CAP-2030 Youth Advisory Board and reviewed the manuscript. AC, AMcG, BJ, LB, NS, NW, SR, SLD, SA-K, and SS reviewed and edited the manuscript. All authors had full access to all the data in the study and had final responsibility for the decision to submit for publication.

## Declaration of interests

We declare no competing interests.

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