

Climate Change, Child Health and Children's Rights: From Inequality to Inequity

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Abstract

Climate change is now recognized as the most significant global threat to child health and a major driver of inequity. The UNICEF Children's Climate Risk Index estimates that around one billion children are currently exposed to extremely high levels of climate and environmental risk, including heatwaves, air pollution, flooding, water scarcity, and vector-borne diseases. Children are biologically, developmentally, and socially more vulnerable than adults, and they will live longer into a warming world, accumulating a greater lifetime burden of exposure. At the same time, the countries where children are most at risk contribute only a small fraction of global greenhouse gas emissions, while high-emitting countries experience comparatively lower vulnerability. This mismatch between responsibility and impact exemplifies climate-related inequity and intergenerational injustice.

The 2025 Lancet Countdown confirms that children are increasingly exposed to extreme heat, air pollution, food insecurity, and climate-sensitive infectious diseases, with impacts that disproportionately affect the most vulnerable populations. These are not merely inequalities but structural inequities—avoidable and unjust differences arising from policy choices, governance gaps, and insufficient protection of children's rights. This narrative review synthesizes evidence on: [1] the dynamics of the climate crisis and its intersection with environmental pollution; [2] health effects across the paediatric life course; [3] mechanisms underlying children's unique vulnerability; and [4] the ways in which climate change undermines the rights set out in the UN Convention on the Rights of the Child, transforming inequalities into structural inequities. Finally, it outlines implications for paediatric practice, health systems, and climate governance, arguing that climate action must be explicitly child-centred and equity-oriented.

Introduction

Recent years were the warmest ever recorded, with global mean temperature approaching or exceeding 1.5 °C above pre-industrial levels. The 2024 report of the Lancet Countdown reported that in 2023, populations around the world experienced the highest levels of heat exposure ever recorded (1). Across all regions, the number of days with significant heat stress reached unprecedented levels, with elderly and children among the most affected and least protected groups. The 2025 report of the Lancet Countdown confirms that children are increasingly exposed to extreme heat, air pollution, food insecurity, and climate-sensitive infectious diseases, with impacts that disproportionately affect the most vulnerable populations (2). These are not merely inequalities but structural inequities, avoidable and unjust differences arising from policy choices, governance gaps, and insufficient protection of children's rights.

Europe is warming at roughly twice the global average, and extreme events - heatwaves, droughts, wildfires, storms, and floods - are increasing in frequency, intensity and duration. These changes, documented by the World Meteorological Organization, the Intergovernmental Panel on Climate Change (IPCC) and other agencies, demonstrate that anthropogenic climate change has entered a dangerous acceleration phase that affects ecosystems, economies and population health worldwide (3, 4).

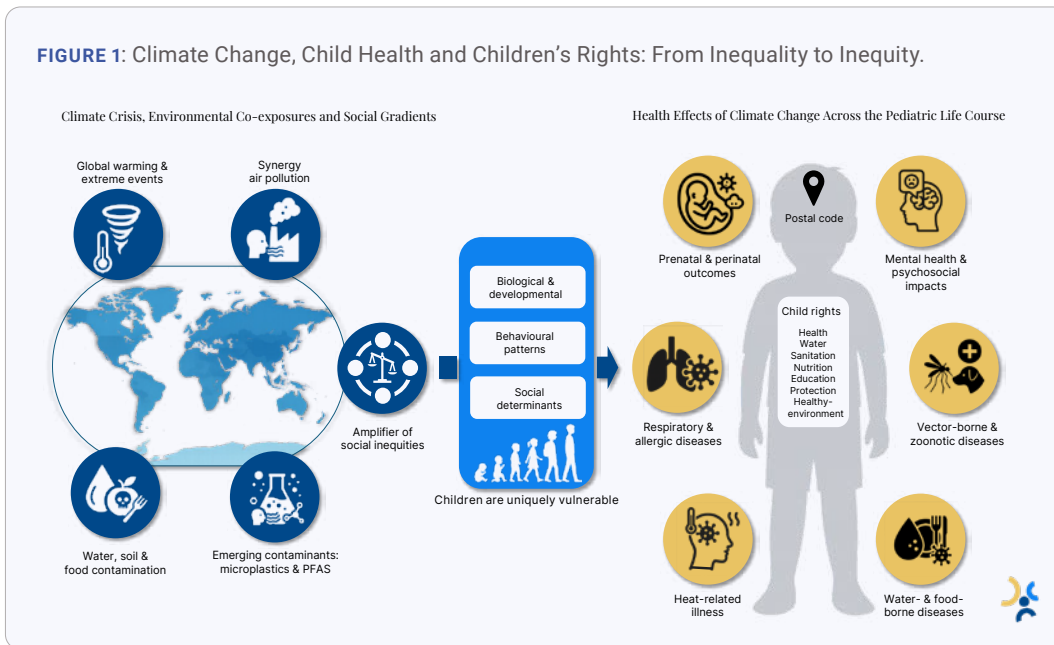
Among all demographic groups, children are disproportionately affected. Their developmental immaturity, higher exposure per body weight, physiological susceptibility and dependence on adults for protection lead to greater vulnerability (5-8). Moreover, children have the longest expected lifetime, so climate-related insults occurring during pregnancy, infancy and childhood can have irreversible and lifelong consequences.

Key findings from the 2025 Lancet Countdown Report on Health and Climate Change indicate that 12 out of 20 climate-related health indicators have reached an alarming level. Heat-related deaths have increased by 23% since the 1990s, reaching 546000 annually, and infants and the elderly being particularly vulnerable.

Droughts exacerbated food insecurity for 124 million people in 2023. Economic impacts reached \$1.09 trillion in lost productivity due to heat exposure. Governments allocated \$956 billion to fossil fuel subsidies, more than three times the climate finance pledged. Conversely, climate action yielded benefits, preventing 100000 premature deaths annually from cleaner air and creating 16 million jobs in renewable energy by 2022. The report underscores the need for urgent, health-centric climate initiatives.

UNICEF has framed the climate crisis as a *child-rights crisis* (9). The Children's Climate Risk Index (CCRI) combines indicators of hazard exposure (heat, cyclones, riverine and coastal flooding, water scarcity, vector-borne disease risk, air pollution) with indicators of child vulnerability (poverty, access to water and sanitation,

FIGURE 1: Climate Change, Child Health and Children’s Rights: From Inequality to Inequity.



health care, nutrition, education and social protection). The index shows that nearly half of the world’s children live in “extremely high-risk” countries, most of which have contributed minimally to global emissions. This transforms climate change from a generic environmental problem into a central issue of children’s rights, inequality and inequity with a life-long effect.

Climate Crisis, Environmental Co-exposures and Social Gradients

Dynamics of global warming and extreme events

Current warming is driven primarily by greenhouse gas emissions from fossil-fuel combustion, intensive agriculture, industrial processes and deforestation (3, 4). The resulting climate instability manifests in more frequent heatwaves, prolonged droughts, heavy precipitation and floods, rising sea level and increased wildfire activity. These phenomena occur in combination with urban heat island effects and land-use changes, further increasing local exposure, particularly in densely populated low-income areas (10, 11).

Synergy with air pollution

Climate change and air pollution are tightly interlinked. High temperatures accelerate photochemical reactions that generate secondary pollutants such as ozone and peroxyacyl nitrates. Periods of heat and atmospheric stagnation trap particulate matter and nitrogen oxides near the ground, increasing population exposure (12, 13). Pollutants can bind to aeroallergens, potentiate inflammatory responses and lengthen pollen seasons, thereby worsening asthma and allergic disease in children (14, 15).

Water, soil and food contamination

Extreme rainfall and flooding can mobilize heavy metals, pesticides, per- and polyfluoroalkyl substances (PFAS), hydrocarbons and microbial pathogens from industrial and agricultural sites into drinking-water systems; droughts concentrate contaminants in shrinking water sources (16, 17). Soil accumulation of pesticides, persistent organic pollutants and microplastics further contaminates the food chain. Climate-related stress on agriculture—heat, drought and altered humidity—reduces yields and increases mycotoxin formation and pesticide use, undermining both food quantity and quality (18).

Emerging contaminants: microplastics and PFAS

Micro- and nanoplastics are now ubiquitous in air, water and soil. Experimental and early epidemiological data suggest they can cross biological barriers, alter gut microbiota and carry endocrine-disrupting or toxic substances, with potential effects on immune and metabolic development (19). PFAS, highly persistent “forever chemicals,” have been associated with immune suppression, endocrine disruption, dyslipidaemia and adverse pregnancy outcomes. Climatic events that disturb soils and water

systems may enhance the dispersion and human uptake of these contaminants.

Climate as an amplifier of social inequities

Climate-related hazards do not act on a level social playing field. Children in poverty, informal housing, crowded urban heat islands, polluted industrial corridors or climate-sensitive rural livelihoods face overlapping exposures to heat, pollution, unsafe water, malnutrition and inadequate health care (5, 20). Migrants, displaced families, children with disability and those in conflict-affected or poorly governed contexts are particularly at risk. The American Academy of Pediatrics and other professional bodies emphasize that climate change magnifies existing inequities and constitutes a form of intergenerational injustice.

Health Effects of Climate Change Across the Paediatric Life Course

Prenatal and perinatal outcomes

Maternal exposure to ambient and household air pollution is associated with low birthweight, intrauterine growth restriction, preterm birth, impaired lung development, and neurodevelopmental disorders including ADHD and autism spectrum disorder (8). Indoor biomass combustion and second-hand smoke substantially increase the risk of pneumonia and respiratory mortality in children under five. Heat stress during pregnancy is linked to preterm birth, stillbirth, and congenital anomalies, mediated by placental inflammation, oxidative stress, and epigenetic changes.

Respiratory and allergic disease

Children’s higher ventilation rates and narrower airways increase susceptibility to pollutants. Exposure to particulate matter (PM_{2.5}), ozone, and nitrogen oxides during gestation and early childhood elevates risks of asthma onset, wheezing, reduced lung function, and respiratory infections (11-13). Climate-driven increases in wildfire smoke, ozone episodes, and pollen loads contribute to acute asthma exacerbations. Elevated CO₂ enhances pollen production, and pollutant-coated pollen grains increase allergenicity, leading to severe allergic rhinitis, asthma, and atopic dermatitis (14).

Heat-related illness

Children are physiologically vulnerable to heat stress due to immature thermoregulation. Heatwaves are associated with dehydration, electrolyte imbalance, heat exhaustion, heat stroke, renal stress, and increased hospital admissions. Heat exposure also impairs sleep and cognitive performance and worsens behavioural and attention problems.

Water- and food-borne disease

Floods and heavy rainfall contaminate water supplies, increasing rates of gastrointestinal illness, skin and eye infections, cholera, and leptospirosis (16). Drought and high temperatures reduce hygiene practices, facilitating transmission. Food insecurity and nutritional stress contribute to undernutrition, which interacts with infection to drive morbidity and mortality. Malnutrition during the first 1000 days has lifelong impacts on growth, cognition, and metabolic disease risk.

Vector-borne and zoonotic diseases

Shifts in vector distribution and seasonality have expanded transmission of dengue, chikungunya, West Nile virus, and Lyme disease into new regions (21). Children are at increased risk of infection and severe disease due to greater outdoor exposure and thinner skin.

Mental health and psychosocial impacts

Climate-related disasters, displacement, and community disruption are associated with post-traumatic stress disorder, anxiety, depression, sleep disturbance, and behavioural problems. Even without direct disaster exposure, children may experience eco-anxiety, grief, and feelings of helplessness, particularly those with pre-existing vulnerabilities (22).

Why Children Are Uniquely Vulnerable

Biological and developmental factors

Children inhale more air, drink more water and consume more food relative to their body weight than adults, leading to higher

internal doses of pollutants and toxicants. Immature detoxification and excretory systems slow elimination, while rapidly developing organs—especially the brain, lungs and immune system—are more easily disrupted (6, 7).

Critical developmental windows during gestation, infancy and early childhood determine the long-term architecture of the nervous, respiratory, endocrine and immune systems. Exposures during these windows can induce epigenetic modifications, alter organ structure and function, and change disease susceptibility across the lifespan (15).

Behavioural patterns

Children's exploratory behaviour increases exposure: they play close to the ground, engage in hand-to-mouth activities, and spend substantial time outdoors, often in polluted or overheated environments. Adolescents may engage in strenuous physical activity outdoors, increasing inhaled doses of pollutants during exercise (5, 14).

Social determinants and structural vulnerability

Children are completely dependent on adults and social systems for protection. Household income, caregiver education, housing quality, access to health care, urban planning, and the presence or absence of green spaces all shape exposure and resilience. Climate change interacts with these determinants, concentrating risks in those who are already disadvantaged.

In many low- and middle-income countries, health, WASH (water, sanitation and hygiene), food and social-protection systems are fragile. Floods, droughts and storms damage infrastructure, interrupt services and deplete already limited resources (16, 17, 23). Educational systems are also affected, with school closures, heat-related learning impairment and reduced attendance during climate shocks, which in turn perpetuate social inequities.

From Inequality to Inequity: A Child-Rights Perspective

Climate change is one of the biggest threats to children worldwide, and its impact particularly affects the most vulnerable families (9, 24). Children are not small adults: their bodies and minds are still developing, which makes them extra sensitive to air pollution, extreme heat and lack of water. The consequences are multifaceted and serious. Infectious diseases spread faster, crop failures lead to malnutrition and rising food prices, and extreme weather events cause trauma and mental health problems. In addition, millions of children lose access to education every year due to climate-related disasters, putting further pressure on their prospects.

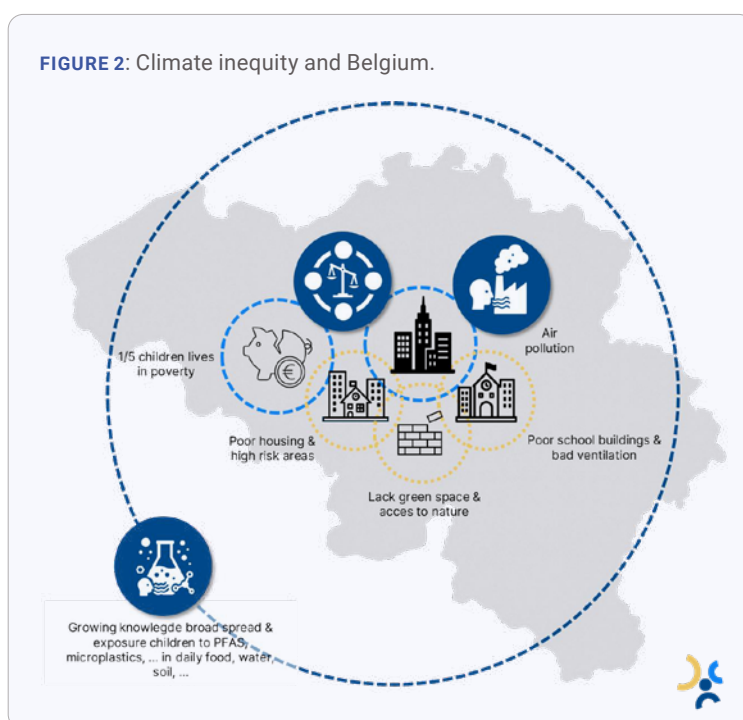
Unequal geographies of risk

UNICEF's CCRI shows that 850 million children are exposed to four or more hazards simultaneously, and that 33 countries—mainly in Sub-Saharan Africa, South Asia and small island states—are classified as "extremely high risk" (25). These same countries collectively account for only a small fraction of global emissions, whereas the ten highest-emitting countries produce most of the total. This "exported risk" encapsulates the transformation of geographic inequality into moral and political inequity.

Child rights under the Convention on the Rights of the Child

The UN Convention on the Rights of the Child (CRC) codifies children's rights to life, survival and development; the highest

FIGURE 2: Climate inequity and Belgium.



attainable standard of health; adequate nutrition; safe water and sanitation; education; protection from harm; and a standard of living adequate for development (26). Climate change threatens each of these domains:

- **Right to health:** increased burden of respiratory disease, heat-related illness, infectious diseases, injuries and mental-health disorders (14, 21, 22, 27, 28).
- **Right to water and sanitation:** droughts and floods compromise safe water and sanitation infrastructure, increasing diarrheal disease and other infections (29, 30).
- **Right to nutrition:** climate-related food insecurity and micronutrient loss threaten growth and development (18).
- **Right to education:** damage to schools, displacement and heat-related learning difficulties disrupt education.
- **Right to protection:** climate-related migration and instability increase risks of exploitation, violence and trafficking (2).
- **Right to a healthy environment:** although not explicitly named in the CRC, a safe, clean and sustainable environment is increasingly recognized as a prerequisite for all other rights (25).

When predictable, preventable harms systematically fall on children—especially those in low-emission, low-resource settings—climate change becomes a structural violation of child rights and an archetype of intergenerational inequity (24, 31).

Climate crisis and child inequity

Climate change is one of the biggest threats to children worldwide, and its impact particularly affects the most vulnerable families. Children are not small adults: their bodies and minds are still developing, which makes them extra sensitive to air pollution, extreme heat and lack of water. The consequences are multifaceted and serious. Infectious diseases spread faster, crop failures lead to malnutrition and rising food prices, and extreme weather events cause trauma and mental health problems. In addition, millions of children lose access to education every year due to climate-related disasters, putting further pressure on their prospects.

What makes this crisis particularly poignant is the inequality that goes with it. UNICEF points out that one billion children worldwide live in an extremely high risk situation (25). They are often located in countries with weak health care, limited access to clean water and poor infrastructure. The irony is that it is precisely these countries that have contributed the least to greenhouse gas emissions. The distribution of international climate finance also reflects this inequality: only a fraction, about 2.4 percent, is focused on child-specific projects. This makes it clear that the interests of children are structurally neglected.

Concrete examples illustrate this reality. In Zambia, drought has plunged millions of families into food insecurity, leaving children malnourished and jeopardizing their development. In Bangladesh, severe air pollution causes respiratory problems and increases the mortality rate from lung diseases in children. In Cambodia, floods have closed schools and increased the risk of water-related diseases. These situations show that climate change is not only an ecological crisis, but also a children's rights crisis.

Focussing on Western Europe, and Belgium in particular, climate inequity is also a growing problem here (32). Extreme heat waves are becoming more frequent and intense and air pollution remains a persistent problem: in cities such as Brussels and Antwerp, children breathe air rich in particulate matter every day, impacting their health.

Implications for Paediatric Practice and Health Systems

Paediatricians, especially in primary care, are key actors in recognizing, documenting and mitigating climate-related risks (19, 33).

- **Environmental history-taking** should be integrated into routine visits, including questions on indoor air quality, smoking, heating and cooking sources, water supply, housing quality, heat exposure, proximity to major roads or industry, and use of plastics and chemicals.
- **Climate-sensitive counselling** can provide families with practical strategies for exposure reduction and climate resilience: ventilation and smoke-free homes, hydration and cooling during heatwaves, safe outdoor activity based on air-quality indices, plant-rich diets, and preparation for extreme weather events (18, 21, 27).
- **Communication should emphasise co-benefits:** cleaner air reduces asthma attacks; active transport improves cardiovascular health; sustainable diets support growth; green spaces enhance mental health and provide heat protection (2, 27, 34).
- **Professional leadership** includes advocating for clean-air policies, green urban planning, safe school environments, decarbonization of the health sector and inclusion of climate and planetary health in medical curricula.

Health systems themselves contribute significantly to greenhouse-gas emissions (35). Decarbonizing health care—through energy efficiency, low-carbon procurement, sustainable waste management and telehealth where appropriate—offers an additional avenue to protect child health while aligning practice with advocacy.

Practical and quickly applicable tips for paediatricians and teams

As a paediatrician, major climate actions may be beyond your own control. Nevertheless, you can still play a significant role in climate change mitigation and in raising awareness locally and in daily work.

The examples below focus on three themes: (A) clinical care and medication use, (B) daily operations, waste & waste management, and (C) team/organization & education. The advice is practical, evidence-based where possible and immediately implementable.

A: Clinical care & drug consumption

- **Medication stewardship and rational prescribing**
Conduct short periodic audits of prescribing patterns (antibiotics, inhalers, medications). Reduce overtreatment where clinically safe (antibiotic stewardship). This reduces resistance and the ecological footprint of production and waste.
- **Think about the choice of inhaler for asthma**
Where clinically justified and following shared patient/family decision-making, propellant-free inhalers (DPIs) or lower-GWP options can greatly reduce the carbon footprint of inhalation treatments. Use the existing decision-making tools (NICE/NHS guides) and make sure that patient safety and inhalation skills remain a priority. Return used inhalers for proper disposal (no household waste) (36).
- **Avoid wasting medicines**
Give only the dose/amount that is needed; promote the reuse of unopened stock within guidelines; implement secure return and destruction routes via the pharmacy.

- Vaccination and prevention
Optimize vaccination programs and preventive care: this prevents diseases, hospital admissions and thus indirect CO₂ emissions from care pathways.

B: Waste, consumption & pollution (quickly applicable)

- Reduce single-use where safe
 - Evaluate clinical procedures where reusable instruments (autoclavable) can be applied safely and cost-effectively. Start with a small pilot project (e.g. in outpatient clinic).
 - Network and look beyond your own hospital walls. Good (inter)national examples exist, such as in the Netherlands, where parents no longer have to wear surgical suits and hats when briefly accompanying their child in the operating theatre. In ordinary clothing, the contact is more natural and more comfortable for children; it is also better for the environment because protective surgical clothing is made of plastic and is single-use (37).
- Dispose of medicine and chemical waste correctly
Ensure there are clear protocols and visible instructions for safe take-back of remaining medicines and used inhalers; train reception and waste management staff.
- Smart waste separation system
Place clearly separated waste streams (infectious, pharmaceutical, recycling, residue) with simple instructional labels at workstations. Monitor monthly reduction.
- Reduce energy and water use
Small measures: LED lighting, optimizing thermostat settings, timers on appliances, water-saving taps in waiting rooms. These actions are cheap and cost-effective with quick return on investment.

C: Team, education and policy

- Create a 'green team'
Appoint a small team (2–4 people) that identifies monthly quick wins, starts small and makes successes measurable.
- Education of patients and families
Integrate short messages into consultations: why return old inhalers, safe medication use and simple energy/resource-saving tips for use at home.
- Telemedicine where appropriate
Use teleconsultations for routine check-ups when physical assessment is not necessary – reduces travel and therefore emissions. Make sure vulnerable families are not excluded.
- Reporting monitoring
Measure and report simple indicators: number of unnecessary prescriptions, inhalers returned, and waste reduction. Short, data-driven cycles support ongoing improvement.
- Advocacy and collaboration
Collaborate with local pharmacies, hospital sustainability/landscaping programs, and public health to support systemic improvements (e.g., green logistics, sustainable procurement).

Paediatricians are in a crucial position: they treat the direct and acute consequences in individual children and can achieve local CO₂ reductions and health gains through practice, patient education and collaboration. Through rational use of medicines, careful waste management, conscious choices in inhalation therapy and organisational improvements, paediatric care can both reduce the climate impact and improve the quality of care. The rationale is clear and the actions concrete and achievable – start small, measure progress and scale up similar successes. Important international reviews and reports (WHO, IPCC, UNICEF, Lancet Countdown, NHS/NICE practice guidelines) support both the urgency and practical interventions described above.

Conclusions

Climate change is both a paediatric health emergency and a *child-rights and equity crisis*. Children are more exposed, more vulnerable and affected for a longer portion of their lives than adults. The heaviest burdens fall on those who have contributed least to the problem—children in low-emission, structurally disadvantaged settings—transforming climatic inequalities into profound, preventable inequities.

Finally, this review outlines implications for paediatric practice, health systems, and climate governance, arguing that climate action must be explicitly child-centred and equity-oriented.

Indeed, differences in the impacts of climate change on children's health are not simply inequalities due to chance or geography; they are largely inequities—avoidable, preventable, and the result of policy decisions, economic models, and institutional arrangements that distribute risks and protections unequally.

The child-rights-based approach allows us to move from an epidemiological to a normative perspective: if a risk is created or not mitigated by human choices, it becomes a violation of children's rights.

Therefore, children are not only more vulnerable; they are more exposed and less protected due to systems that fail to guarantee their fundamental rights (health, a clean environment, social protection, education, participation).

Climate change is transforming pre-existing inequalities into structured forms of injustice.

This is not only due to its effects on health, but also to a systemic failure to guarantee the rights and protections that all documents and reports from major international agencies recognize as children's due.



A child-centred, equity-driven approach to climate policy, health-system planning and paediatric practice is therefore essential. Integrating child-rights impact assessments into climate governance, prioritizing child health in adaptation finance and empowering paediatricians as advocates are critical steps. Protecting children from the harms of climate change is not only an environmental necessity; it is a legal and ethical obligation under the CRC and a prerequisite for sustainable development and intergenerational justice.

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