POLICY STATEMENT Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

Climate Change and Children's Health: Building a Healthy Future for Every Child

Samantha Ahdoot, MD, FAAP,[a] Carl R. Baum, MD, FACMT, FAAP,[b] Mary Bono Cataletto, MD, FAAP, FCCP,[c] Patrick Hogan, MD,[d] Christina B. Wu, MD, MPH, FAAP,[e] Aaron Bernstein, MD, MPH, FAAP,[f] COUNCIL ON ENVIRONMENTAL HEALTH AND CLIMATE CHANGE; COUNCIL ON CHILDREN AND DISASTERS; SECTION ON PEDIATRIC PULMONOLOGY AND SLEEP MEDICINE; SECTION ON MINORITY HEALTH, EQUITY, AND INCLUSION

The warming of our planet matters to every child. Driven by fossil fuel-generated greenhouse gas emissions, climate conditions stable since the founding of modern pediatrics in the mid-nineteenth century have shifted, and old certainties are falling away. Children's physical and mental health are threatened by climate change through its effects on temperature, precipitation, and extreme weather; ecological disruption; and community disruption. These impacts expose and amplify existing inequities and create unprecedented intergenerational injustice. Fossil fuel extraction and combustion cause harm today and reach centuries into the future, jeopardizing the health, safety, and prosperity of today's children and future generations. Appreciating the unique vulnerability of their patients, pediatricians have become leading health advocates for climate actions necessary to protect all living and future children. Policies that reduce reliance on fossil fuels and promote cleaner air, facilitate walking and bicycling, encourage more sustainable diets, increase access to nature, and develop more connected communities lead to immediate gains in child health and equity, and build a foundation for generations of children to thrive.

INTRODUCTION

The warming of our planet matters to the health, well-being, and future of every child. Climate conditions stable since the founding of modern pediatrics in the mid nineteenth century have shifted, and old certainties are falling away.[1] Climate change causes profound shifts in temperature, precipitation, and ecosystems. These effects on earth systems compromise air and water quality, increase food insecurity, change the incidence of infectious diseases, intensify allergy seasons, and result in more devastating wildfires and hurricanes and more dangerous and

abstract

[a]*University of Virginia School of Medicine, Charlottesville, Virginia;* [b]*Section of Pediatric Emergency Medicine, Yale School of Medicine, New Haven, Connecticut;* [c]*Division of Pediatric Pulmonology and Sleep Medicine, Department of Pediatrics, New York University Long Island School of Medicine, Mineola, New York;* [d]*Pediatric Residency Program, Oregon Health & Science University, Portland, Oregon;* [e]*O'Neill Center for Global and National Health Law, Georgetown University Law Center, Washington, District of Columbia; and* [f]*Division of General Pediatrics, Boston Children's Hospital, and Center for Climate, Health, and the Global Environment, Harvard T.H. Chan School of Public Health, Boston, Massachusetts*

Drs Ahdoot, Baum, Cataletto, Hogan, Wu, and Bernstein drafted the original manuscript, considered input from all reviewers and the Board of Directors, revised the manuscript, approved the final document as submitted, and agree to be accountable for all aspects of the work.

This document is copyrighted and is property of the American Academy of Pediatrics and its Board of Directors. All authors have filed conflict of interest statements with the American Academy of Pediatrics. Any conflicts have been resolved through a process approved by the Board of Directors. The American Academy of Pediatrics has neither solicited nor accepted any commercial involvement in the development of the content of this publication.

Policy statements from the American Academy of Pediatrics benefit from expertise and resources of liaisons and internal (AAP) and external reviewers. However, policy statements from the American Academy of Pediatrics may not reflect the views of the liaisons or the organizations or government agencies that they represent.

To cite: Ahdoot S, Baum CR, Cataletto MB, et al; American Academy of Pediatrics, Council on Environmental Health and Climate Change; Council on Children and Disasters; Section on Pediatric Pulmonology and Sleep Medicine; Section on Minority Health, Equity, and Inclusion. *Pediatrics.* 2024; 153(3): e2023065504

Downloaded from http://publications.aap.org/pediatrics/article-pdf/doi/10.1542/peds.2023-065504/1599280/peds.2023-065504.pdf
by guest

frequent heat waves. The fundamental nature of climate change also presents risks to child health that may not yet be recognized or foreseen.

Appreciation of the unique vulnerability of children has placed pediatricians at the forefront of the response to climate change. The American Academy of Pediatrics (AAP) was the first medical organization in the United States to recognize the health consequences of climate change. The publication of the AAP policy statement[2] and technical report[3] on global climate change and children's health in 2007 marked a watershed moment in medicine, whereby a leading medical society acknowledged that its members must care for the planet to care for our patients. As signposts of the progress that has been made over the past 15 years across the fields of medicine, leading medical journals, such as *The Lancet* and the *New England Journal of Medicine*, have initiatives dedicated to climate and health; medical schools, often at the behest of their students, are more often teaching about climate and health[4]; and the nation's leading medical societies joined together in 2016 to form a consortium[5] dedicated to climate and health, with the AAP as a founding member. Across the nation, pediatricians are leading local, state, and national climate change advocacy campaigns aimed at curtailing greenhouse gas emissions in clinical practice, in their states, and nationally.

The scientific basis and current knowledge pertaining to the effects of higher concentrations of greenhouse gases (GHGs) on earth systems, as well as the child health impacts of climate change, are detailed in the technical report[6] accompanying this policy statement. This policy statement addresses 3 subjects.[7]

1. Children's physical and mental health are threatened by climate change through its effects on temperature, precipitation, extreme weather (eg, heat waves, wildfires); ecological disruption; and community disruption.
2. Climate change disproportionately burdens children in socially disadvantaged groups.[8] Climate change exposes and amplifies existing inequities and creates an unprecedented intergenerational injustice.
3. Climate change solutions, advanced through the collaborative work of pediatricians, health systems, communities, corporations, and governments, provide a new framework for child health promotion.

CLIMATE CHANGE THREATENS THE HEALTH OF CHILDREN

Having been trained to understand child health through the lens of a stable climate, pediatricians must now learn to recognize, predict, and prevent child health risks that result from climate change. To this end, the following sections provide an overview of relevant intersections of climate change and child health.

Changing Temperature, Precipitation, and Extreme Weather Patterns

Rising atmospheric concentrations of GHGs have resulted in average US warming and more extreme weather, including severe heat events.[9] Extreme heat is projected to increase even more than average temperature.[9] Heat exposure can have broad child health effects that begin in the prenatal period. Maternal heat exposure is associated with adverse birth outcomes including preterm birth, with higher risk observed in Black mothers, although causal relationships have not been identified.[10] Studies from numerous countries including the United States have found infants to be at particularly elevated risk of heat-related mortality.[11,12] Heat mortality risk generally is region specific and has been correlated to average regional temperatures, demonstrating adaptation to local climates.[13]

All children are at risk for heat-related illness, which describes a continuum from mild illness (heat cramps, stress, and syncope) to potentially fatal heat stroke. Extreme heat exposure also contributes to excess health care utilization for a variety of causes among children.[14] Children who exercise outdoors in the summer months are at high risk for heat-related illness, particularly football players,[15] young military recruits,[16] and child agricultural workers.[17] Exposure to higher temperature has been associated with reduced cognitive function[18] and educational achievement. The effect of heat on achievement was found to be roughly 3 times larger for Black* and Hispanic students than for white students, likely associated in part with unequal investment in school air conditioning.[19] The built environment strongly influences heat exposure. Less green space and more dark, synthetic surfaces contribute to greater absorption of heat and higher temperatures within cities, known as the "urban heat island" effect.[20] Varying degrees of tree cover and building density associated with the historically racist housing policy of redlining can cause temperatures to vary within a single urban region by as much as 7.4°C.[21]

Extreme weather events, including severe storms, floods, and wildfires, cause child injuries and, rarely, death. The harms of such events extend well beyond these immediate risks. Flooding events have resulted in greater exposure among children to toxicants, including carbon monoxide poisoning[22] and infectious pathogens in contaminated waters.[23] Hurricane Harvey, for example, delivered the highest total rainfall in US history, when 19 trillion tons of water, equivalent to 1 year of rainfall, fell in the Houston area over a few days.[24] This storm overwhelmed wastewater facilities for an extended period, leading to unprecedented sewer overflows and hazardous material spills.[24]

* All terms referring to race and ethnicity are based on terminology in primary cited document other than capitalization, which is made consistent throughout this document.

Downloaded from http://publications.aap.org/pediatrics/article-pdf/doi/10.1542/peds.2023-065504/1599280/peds.2023-065504.pdf
by guest

Climate change also fuels catastrophic wildfires, a rising global health concern. Less precipitation, longer warm seasons, and more heat extremes all promote wildfire risk.[25] Exposure to wildfire smoke is a well-established cause of respiratory health effects including asthma exacerbations.[26] Particulate matter less than 2.5 microns ($PM_{2.5}$) from wildfire smoke has been found to be as much as 10 times more harmful to children's respiratory health than $PM_{2.5}$ from other sources, particularly for children younger than 5 years.[27] Wildfire smoke exposure has been associated with adverse birth outcomes including preterm birth and reduced birth weight.[28] Higher temperatures also promote ground-level ozone formation. Ozone is a potent lung irritant that causes asthma exacerbations and reduced lung function in children.[29] Fossil fuel combustion, which emits most of the world's GHG emissions, also is responsible for air pollutants that have broad child adverse health effects with racial and socioeconomic disparities in exposure.[30]

Wildfires and other weather disasters are life-altering and traumatic events that exact mental health and learning harms.[31] Native American populations have particularly elevated wildfire risk associated with historical forced concentration onto reservation land with greater wildfire hazard and higher social vulnerability.[32] Exposure to natural disasters represents significant trauma that, in the absence of supportive caregivers, can contribute to toxic stress. This toxic stress may lead to a range of negative psychosocial and physical health effects that can extend into adulthood.[33] Extreme weather events widen existing social and health disparities. Households with lower wealth and people in minoritized racial/ethnic groups may experience greater physical and mental health effects and displacement after disasters as a result of poor-quality housing; lack of access to emergency communications; reduced access to transportation and resources for relocation, health care services, and medications; and limited or no health and property insurance.[34] Children dependent on medical technologies powered by electricity are particularly vulnerable to events that interrupt power supplies.[35]

Ecologic Disruption

Direct Effects of Rising Carbon Dioxide

Climate change alters natural systems that support children's health. Rising atmospheric carbon dioxide (CO_2) concentration, increasing temperature, and earlier growing seasons are causing an advancement and intensification of the pollen allergy season. The onset of pollen season has advanced by approximately 20 days in North America since 1990. Approximately 50% of this advancement can be attributed to human-caused warming.[36] Very early spring onset has been associated with increased asthma hospitalizations.[37]

Elevated CO_2 also can reduce the iron, protein, and zinc content of plants, including rice, wheat, and soybean, thus increasing the risk of nutrient deficiency in vulnerable regions.[38] Climate change poses risks to food security via other pathways including extreme heat, drought, and severe storms, which can affect crop growth, food safety, and food transport. These factors threaten increases in global child malnutrition, which remains a profound child health concern.[39]

Effects on Pathogens

Warming temperature has been associated with range expansion, disease spread, and earlier incidence for diseases transmitted by vectors, including tickborne infections, such as Lyme disease and spotted fever group rickettsioses.[40–42] Between 2004 and 2016, the number of annual reports of tickborne bacterial and protozoan diseases in the United States more than doubled, with Lyme disease accounting for 82% of all tickborne disease reports.[43] The *Aedes aegypti* and *Aedes albopictus* mosquitoes and the diseases they carry, including dengue and chikungunya, have rapidly expanded their range in the past decade and currently inhabit the widest global distribution ever recorded.[44] The influence of climate change on mosquitoborne diseases has been heavily debated. Climate influences the ecology of mosquitoborne diseases, as well as land-use patterns, vector-control measures, and socioeconomic factors.

Elevated temperature has also been associated with increased incidence of enterovirus-mediated hand, foot, and mouth disease,[45] and disease caused by *Escherichia coli*,[46] *Salmonella* species,[47] *Campylobacter* species,[48] and *Vibrio* species.[49]

Community Disruption

Healthy child development relies on stable and supportive relationships for children with their families, schools, and neighborhoods. Extreme weather, sea level rise, food and water insecurity, and degraded ecosystems put community economic welfare, health care access and delivery,[50] education,[51] and mental health at risk.[52] At a broader scale, these weather extremes can lead to population displacement and migration[53] and threaten global security.[54]

CLIMATE JUSTICE

In the United States, climate change stands to worsen child health disparities. Harms from heat, air pollution, and extreme weather disproportionately affect children in Black and ethnically and racially diverse communities.[8] Investigating why a given group is more or less likely to live in a climate-sensitive area is beyond the scope of this report. Regardless of race, children and families who have low wealth have fewer resources to prepare for and respond to climate-related shocks. Weather extremes or chronic environmental stressors associated with climate change can lead to loss of basic resources, including food, water, and shelter, as well as economic hardship, forcing

Downloaded from http://publications.aap.org/pediatrics/article-pdf/doi/10.1542/peds.2023-065504/1599280/peds.2023-065504.pdf
by guest

people to relocate. For families with limited means and those affected by decades of structural racism, such losses can widen disparities. The voices of marginalized children and families are often excluded from decisions surrounding the adaptation and mitigation policies necessary to address climate change.[55] Furthermore, those who are most harmed by climate change in the United States and across the world are least responsible for the problem.[56] For example, temperature variability in tropical countries in coming decades will be greatest in Southeast Asian, Amazonian, and Southern African Nations, which have contributed very little to global GHG emissions.[57]

The disproportionate risks to Native American children warrant particular attention. Native American populations often have greater exposure to environmental hazards, because resource extraction and transportation (eg, pipelines), dump sites, and weapons-testing facilities have been sited on their lands.[58] Centuries of trauma, displacement, and discrimination have led to increased underlying health comorbidities that increase vulnerability to climate hazards.[59] Climate change is destroying first foods (those foods that were eaten by Indigenous people before contact with outside civilizations) that are essential to traditional nutritious diets, as well as the spiritual health of Native American people.[58] Historical and contemporary land rights and sovereignty conflicts have led to increased environmental injustice.[60]

Fossil fuel extraction and combustion cause harm today and reach centuries into the future, jeopardizing the health, safety, and prosperity of today's children and future generations. Many young people view themselves as betrayed by governmental policies that inadequately protect the planet or their future, a source of widespread youth distress[61] and the foundation for the rising youth climate movement.[62]

CLIMATE SOLUTIONS AS THE COMPASS FOR 21ST CENTURY CHILD HEALTH

Climate change solutions are child health and equity solutions. Policies that promote cleaner air, facilitate walking and bicycling, encourage more sustainable diets, increase access to nature, and develop more connected communities can lead to enormous gains in child health and equity (Fig 1). Climate actions matter most to disadvantaged children such as those with chronic medical conditions, those living in low-wealth households, or children experiencing discrimination.

Clean Electricity and Transportation

Fossil fuel-related air pollution is a major, underappreciated cause of noncommunicable disease in the United States and the world.[63] For children, air pollution from burning fossil fuels contributes to asthma, hypertension, and neurocognitive disorders, among other harms.[30] Air pollution exposure during pregnancy has also been associated with adverse birth outcomes.[10] Neonates born to parents living in areas where oil and gas extraction is occurring may have lower birth weights and increased risk of preterm birth.[64,65] An analysis of US census tract data and all sources of $PM_{2.5}$ pollution found significant differences in exposure, with people of color experiencing overall 14% greater exposure than the population average.[66]

Electricity generation and transportation are the 2 largest contributors to air pollution and GHG emissions in the United States.[67] Approximately 60% of US electricity is produced from combustion of fossil fuels, 20% from nuclear, and 20% from renewable energy sources, primarily hydroelectric, wind, and solar energy.[68] To limit warming to less than 2°C, deep reductions in CO_2 and other GHG emissions are required in the coming decades.[69] This requires rapid replacement of fossil fuel use in electricity production with low- or no-carbon energy sources such as wind, solar, hydropower, and nuclear, and likely the implementation of CO_2 removal.[70]

Transportation-focused climate actions can reduce traffic-related air pollution and promote child physical activity and the many benefits that come from healthier body weights. Improving access and safety of bicycling, walking, and other modes of active transportation may promote healthier BMIs and cardiorespiratory fitness.[71] Public transportation can decrease traffic congestion and time spent sitting in vehicles and improve air quality.[72]

Green Building

Green building design can improve energy efficiency and indoor environmental quality and provide a range of climate and child health benefits. Buildings require energy for heating, cooling, and electricity, contributing nearly one-third of GHG emissions in the United States.[73] Lower energy consumption reduces outdoor air pollution, as well as utility costs. The lower operating costs of more energy-efficient, low-income residential buildings can buffer against housing insecurity that contributes to more health care use.[74] Green buildings often have better air quality indoors because of the building materials used and ventilation systems installed, and are associated with improved occupant health.[75]

Plant-Rich Diets

Childhood diets are a major cause of the obesity epidemic that now afflicts nearly 1 in 5 children on average, with higher rates in Hispanic and non-Hispanic Black children.[76] Expert guidance on healthy childhood diets emphasizes eating plants, especially vegetables, whole grains, healthy proteins, and fruits, with reduced emphasis on meats.[77] Such diets can contribute to healthier body weights, have substantially lower carbon footprints than the average obesogenic diet that tends to have high amounts of processed sugars and

Downloaded from http://publications.aap.org/pediatrics/article-pdf/doi/10.1542/peds.2023-065504/1599280/peds.2023-065504.pdf
by guest

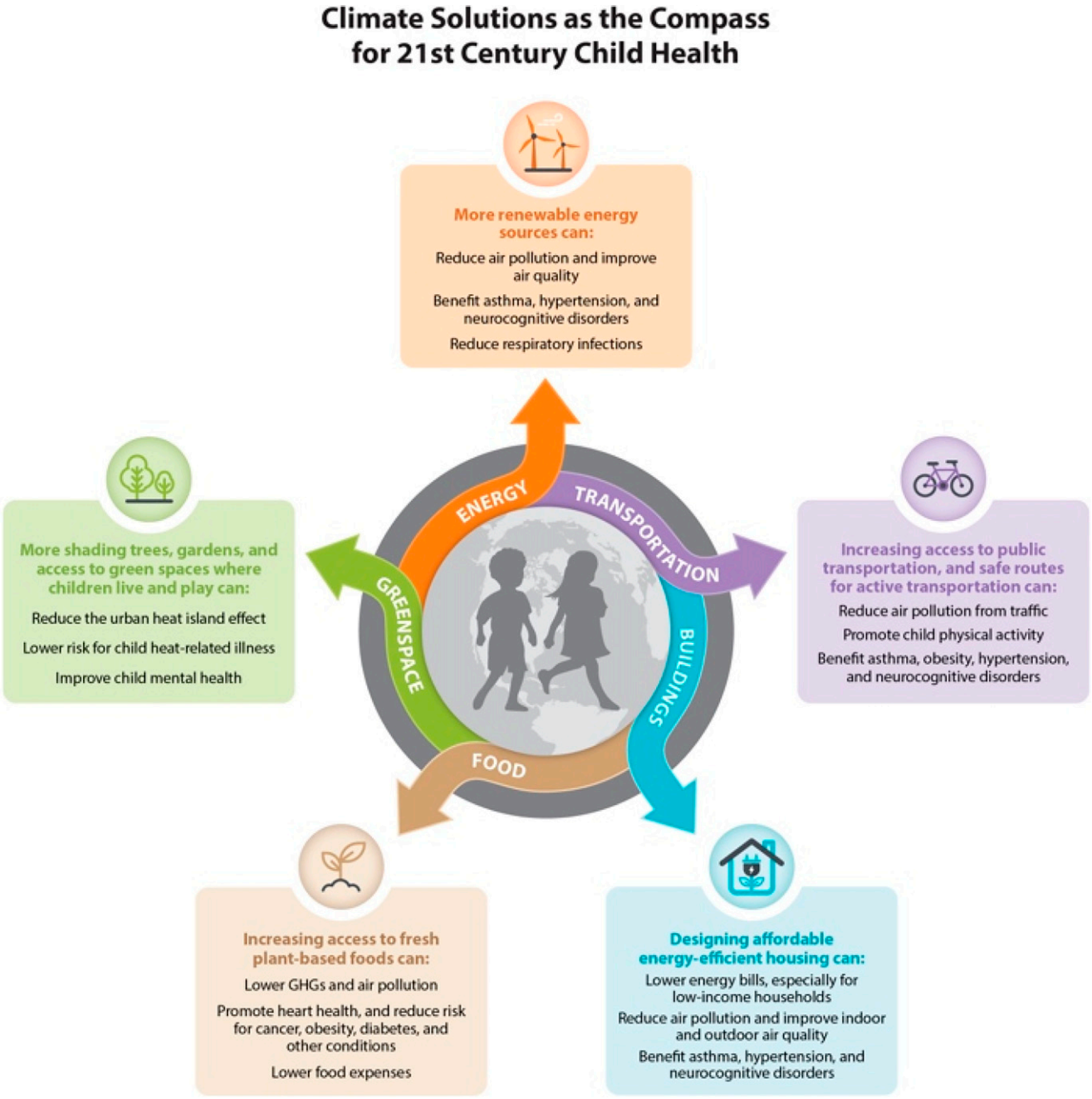


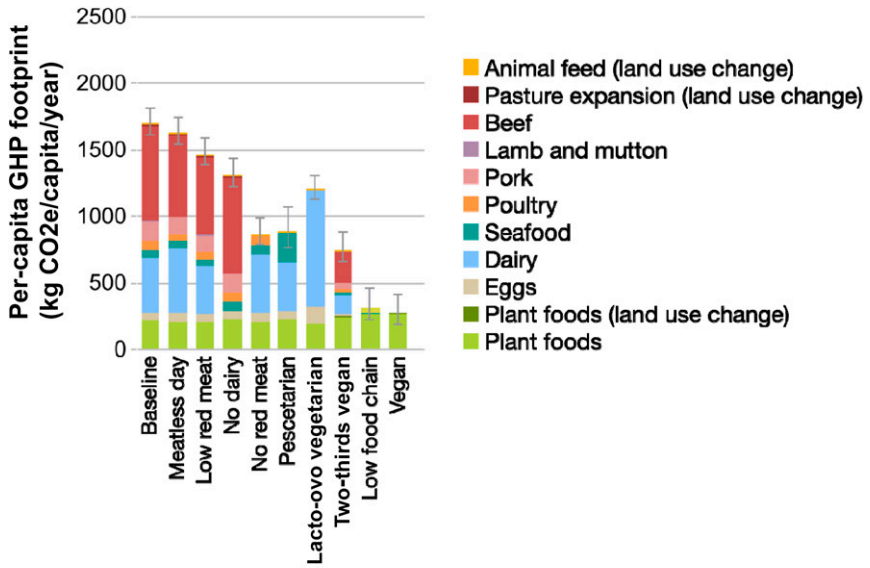
FIGURE 1
Climate solutions as the compass for 21st century child health. Image source: Wendy Cook, E-mail: wc@wendycook.design.

meats, and be achieved while preserving cultural acceptability, affordability, and nutritional adequacy.[78]

Food production accounts for approximately 10% of GHG emissions in the United States (Fig 2).[67] About half of these emissions are derived from the application of nitrogen-based fertilizers to soil and another quarter are from ruminant livestock, primarily cows. Inventories of the carbon intensity of diets show that, pound for pound, the mean GHG emissions for beef production globally are 4.5 times higher than for cheese, 8.7 times higher than for poultry, 25 times higher than for tofu, and 167 times higher than for nuts. In the United States, where per-capita meat consumption is 3 times the global average, dietary change has the potential to reduce emissions from food production by 61% to 73%.[79]

Livestock also contributes to air and water pollution. Agricultural air pollution near livestock farms can affect children who may be exposed to a host of other toxicants.[80] A shift from current diets to diets high in plant-based and low in animal-based foods would both reduce sources of pollution and promote health.[81]

Downloaded from http://publications.aap.org/pediatrics/article-pdf/doi/10.1542/peds.2023-065504/1599280/peds.2023-065504.pdf
by guest



Adapted from Kim et al. *Global environmental change* 62 (2020):101926. (CC BY-NC-ND 4.0)

FIGURE 2

Per-capita diet-related US GHG footprints by diet and food group. Most items shown here are broadly grouped (eg, plant foods). Error bars show interquartile ranges and are designed to capture the distribution of item footprint values from the literature. The GHG intensity of dairy foods accounts for the higher footprint of the modeled lacto–ovo vegetarian diet relative to diets in which reduced amounts of animal protein were consumed. Adapted from Kim BF, Santo RE, Scatterday AP, et al. *Glob Environ Change*. 2020;62:101926.[93]

Climate Resilience

Adaptation to climate change can also benefit child health. Urban green space, for example, can reduce the urban heat island effect. Areas of cities that have more dark surfaces absorb more heat and become hotter than greener ones.[82] These heat islands are more often found in communities of color and those with low income.[21] Planting trees, rooftop gardens, and other greenery in these areas can reduce heat exposure. Exposure to green space has also been associated with profound child mental health benefits.[83] Indigenous ecological knowledge[†] can provide innovative and novel approaches to protect from climate-related hazards.[84]

RECOMMENDATIONS TO PEDIATRICIANS AND THE HEALTH SECTOR

Pediatricians have a long history of advocating for policies that protect the health and welfare of children. Informed by an understanding of the threat that climate change poses to their patients, pediatricians serve as a voice for children in the societal response to this global challenge. The following are recommendations to help achieve this goal.

1. Incorporate climate change counseling into clinical practice. Assess climate risks and recommend climate solutions when screening for and addressing social determinants of health such as energy, food, and housing security.[85] Educate families on regional climate and health risks and protective strategies. Use existing anticipatory guidance as a framework for discussing climate change solutions. For example, encourage active modes of transport or promote consumption of plant-based proteins to reduce carbon emissions and promote health. Encourage family choices that reduce fuel consumption and promote mobility, such as utilization of public and active transportation, and fuel-efficient vehicles.
2. Incorporate climate, health, and equity curricula into medical school, residency, continuing education, and board examinations to prepare pediatricians to adequately provide health care for children.
3. Reduce carbon emissions from the health sector through operating facilities on carbon-free energy sources; improve energy, water, and other resource efficiency in health care buildings and health care product manufacture; transition to zero-emission vehicles and promote active and public transportation for patients and employees to hospitals and clinics; minimize medical waste, including pharmaceutical waste; serve sustainably grown food and eliminate food waste; use telehealth when appropriate; include climate resilience in facility design and disaster preparedness efforts; and invest in climate and health innovation.[86] On the basis of accepted clinical performance measures, incentivize decarbonization through

[†] Indigenous ecological knowledge is acquired by Indigenous and local peoples over hundreds of years through direct contact with the environment. This knowledge is location-specific and includes relationships between plants, animals, natural phenomena, landscapes, and timing of events that are used for lifeways, including but not limited to hunting, fishing, trapping, agriculture, and forestry (definition from US Fish and Wildlife Service).

Downloaded from http://publications.aap.org/pediatrics/article-pdf/doi/10.1542/peds.2023-065504/1599280/peds.2023-065504.pdf
by guest

incorporating the carbon intensity of services into value-based health care metrics.[87] US health sector GHG emissions exceed those of any other nation in both absolute and per-capita terms, and are projected to increase significantly without climate action within and outside the health sector.[86]

4. Serve as a role model in your personal and professional community for practices that promote sustainability. For example, embrace active transportation, reduce home energy use, transition to clean electricity sources, reduce air travel, and adopt a more plant-based diet.[88] Actions to reduce personal carbon footprint can increase the efficacy of messaging and advocacy efforts.[89]
5. Advocate for equitable climate solution policies at the local, state, national, and international level. Pediatricians are ideal advocates with whom to partner and uplift youth and community voices working to advance zero-carbon energy policy and climate justice.[90] Educate elected officials and health insurance entities on the risks that climate change poses to child health and the benefits of local solutions, including improved air quality, safe streets, tree canopy and green space, and access to affordable fresh fruits and vegetables. Engage with the community by speaking at public hearings, providing expert testimony, and writing letters to the editor. Maximize impact by working with other health care professionals in an organization focused on climate and health.
6. Bring the child health voice to coalitions working to address climate change. Pediatricians are well positioned to collaborate with health departments, universities, and research facilities to enhance surveillance, analysis, and reporting of climate-sensitive health effects and vulnerable communities. Develop local, regional, and national preparedness measures that protect the best interests of children from current and future harm. Prioritize engagement with members of communities at highest risk as a result of historical underinvestment and racist policies.

RECOMMENDATIONS TO GOVERNMENT

Consistent with scientific assessments of the United States' responsibility to meet our obligation under the Paris Agreement, policies should be put in place that reduce GHG emissions to net-zero by 2050.[91] Policies also must be enacted that promote climate resilience, especially for children. Stakeholders can act to:

1. Promote energy efficiency and renewable energy production at the federal, state, and local levels. Preserve essential public health protections in the Clean Air Act. Establish an effective and equitable carbon pricing regimen that reflects the health costs of fossil fuel reliance and ensures a positive impact on communities affected by environmental injustice and energy sector dependence. End federal subsidies and tax incentives for production and consumption of carbon-intensive fuels.
2. Establish laws or regulations that transition on road vehicles, the leading source of GHG emissions in the United States,[67] to zero carbon emission at a rate consistent with attaining our obligations under the Paris Agreement. Expand public transportation, increase construction of safe bikeways and walkways, and support urban planning designs that reduce dependence on automobile transit.
3. Promote more plant-based diets with reduced red meat and sugar consumption in line with current dietary guidelines and associated with reductions in both GHG- and diet-related disease risks in children.[81] Improve food security through incentivizing crop and soil resilience, regenerative agriculture, and reduced GHG contributions from livestock.
4. Increase urban green space, safe routes for walking and biking, and access to mass transit where appropriate. Invest in strategies that reduce heat islands in communities that experience higher temperatures. Prioritize support for communities that have experienced historical underinvestment.
5. Positively incentivize the health care sector through payment reforms, grants, value-based initiatives, or other mechanisms to improve energy efficiency, reduce waste, and increase reliance on clean energy. Support resilience of hospitals and health systems to climate shocks.
6. Expand and develop pediatric research and climate change related public health adaptation, mitigation, and resilience measures to protect children, with a focus on vulnerable communities and environmental justice.[92] Deploy early-warning systems for extreme weather events that include health care professionals and that reflect the specific needs of children. Improve surveillance of climate-associated infectious diseases, including new and emerging pathogens.
7. Promote enhanced, localized community resilience with active engagement and support of impacted communities. Promote environmental justice through investments in communities that have historically been overburdened by pollution. Direct public housing and school infrastructure funding to incorporate green building design.
8. Advance global actions to decarbonize through setting sound domestic climate policies and supporting international efforts to reduce greenhouse gas emissions among all nations.

LEAD AUTHORS

Samantha Ahdoot, MD, FAAP
Carl R. Baum, MD, FACMT, FAAP
Mary Cataletto, MD, FAAP, FCCP
Patrick Hogan, MD
Christina B. Wu, MD, MPH, FAAP
Aaron Bernstein, MD, MPH, FAAP

Downloaded from http://publications.aap.org/pediatrics/article-pdf/doi/10.1542/peds.2023-065504/1599280/peds.2023-065504.pdf
by guest

COUNCIL ON ENVIRONMENTAL HEALTH AND CLIMATE CHANGE EXECUTIVE COMMITTEE, 2021–2022

Aparna Bole, MD, FAAP, Chairperson
Sophie J. Balk, MD, FAAP
Lori G. Byron, MD, FAAP
Gredia Maria Huerta-Montañez, MD, FAAP
Philip J. Landrigan, MD, FAAP
Steven M. Marcus, MD, FAAP
Abby L. Nerlinger, MD, FAAP
Lisa H. Patel, MD, FAAP
Rebecca Philipsborn, MD, FAAP
Alan D. Woolf, MD, MPH, FAAP
Lauren Zajac, MD, MHP, FAAP

LIAISONS

Kimberly A. Gray, PhD – National Institute of Environmental Health Sciences
Jeanne Briskin – US Environmental Protection Agency
Nathaniel G. DeNicola, MD, MSc – American College of Obstetricians and Gynecologists
CDR Matt Karwowski, MD, MPH, FAAP – Centers for Disease Control and Prevention National Center for Environmental Health and Agency for Toxic Substances and Disease Registry
Mary H. Ward, PhD – National Cancer Institute

STAFF

Paul Spire

COUNCIL ON CHILDREN AND DISASTERS, 2021–2022

Steven E. Krug, MD, FAAP, Chairperson
Sarita Chung, MD, FAAP, Vice Chairperson
Carl R. Baum, MD, FACMT, FAAP
Deanna L. Dahl-Grove, MD, FAAP
H. Dele Davies, MD, MS, MHCM, FAAP
Eric J. Dziuban, MD, DTM, CPH, FAAP
Aaron H. Gardner, MD, MS, FAAP
Stephanie E. Griese, MD, MPH, FAAP
Scott M. Needle, MD, FAAP
David J. Schonfeld, MD, FAAP
Joelle N. Simpson, MD, MPH, FAAP

STAFF

Stephanie Smiley, MA

SECTION ON PEDIATRIC PULMONOLOGY AND SLEEP MEDICINE, 2021–2022

Richard M. Kravitz, MD, FAAP, Chairperson
Rajeev Bhatia, MD, FAAP
Theresa W. Guilbert, MD, FAAP
Brooke Gustafson, MD FAAP, Fellowship Trainee
Binal Kancherla, MD, FAAP
Benjamin Kopp, MD, FAAP
Susan L. Millard, MD, FAAP, FCCP
Rebekah J. Nevel, MD, FAAP
Andrew G. Sokolow, MD, FAAP
Kristin Van Hook, MD, FAAP, Past Chairperson

STAFF

Laura N. Laskosz, MPH

SECTION ON MINORITY HEALTH, EQUITY, AND INCLUSION, 2021–2022

Nia Heard Garris, MD, MSc, FAAP, Chairperson
Kimberly Brown, MD, FAAP
Nathan Chomilo, MD, FAAP
Nathaniel Jones, MD
Patricia Rodriguez, MD, FAAP
Valencia Walker, MD, FAAP

STAFF

Ngozi Onyema-Melton

ABBREVIATIONS

AAP: American Academy of Pediatrics
CO_2: carbon dioxide
GHG: greenhouse gas
$PM_{2.5}$: particulate matter less than 2.5 microns

The guidance in this statement does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

All policy statements from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

DOI: https://doi.org/10.1542/peds.2023-065504

Address correspondence to Samantha Ahdoot, MD. E-mail: SAhdoot@pedsalex.com

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

Copyright © 2024 by the American Academy of Pediatrics

FUNDING: No external funding.

Downloaded from http://publications.aap.org/pediatrics/article-pdf/doi/10.1542/peds.2023-065504/1599280/peds.2023-065504.pdf
by guest

FINANCIAL/CONFLICT OF INTEREST DISCLOSURES: Dr Baum has disclosed an editorial board member relationship with the Pediatric Emergency Care editorial board, a financial relationship with toxED.com which is a product of the Elsevier editorial board, a financial relationship with the American Board of Pediatrics as an ABP appointee to the Medical Toxicology sub-board, and an advisory board member relationship with the National Biodefense Science Board (US DHHS). Any relevant disclosures have been mitigated through a process approved by the AAP Board of Directors.

COMPANION PAPER: A companion to this article can be found online at www.pediatrics.org/cgi/doi/10.1542/peds.2023-065505.

REFERENCES

1. Beck U. *The Metamorphosis of the World.* Polity; 2016
2. Committee on Environmental Health. Global climate change and children's health. *Pediatrics.* 2007;120(5):1149–1152
3. Shea KM. American Academy of Pediatrics Committee on Environmental Health. Global climate change and children's health. *Pediatrics.* 2007;120(5):e1359–e1367
4. Rabin BM, Laney EB, Philipsborn RP. The unique role of medical students in catalyzing climate change education. *J Med Educ Curric Dev.* 2020;7:2382120520957653
5. Medical Society Consortium on Climate & Health. Available at: https://medsocietiesforclimatehealth.org/. Accessed March 3, 2022
6. Ahdoot S, Baum CR, Cataletto M, et al. Technical report. Climate change and children's health: building a healthy future for every child. *Pediatrics.* 2024;153(3):e2023065505
7. Currie J, Deschenes O. Children and climate change: introducing the issue. *Future Child.* 2016;26(1):3–9
8. Environmental Protection Agency. *Climate Change and Social Vulnerability in the United States: A Focus on 6 Impacts.* Environmental Protection Agency; 2021
9. Hayhoe K, Wuebbles DJ, Easterling DR, et al. Our changing climate. In: Reidmiller DR, Avery CW, Easterling DR, et al, eds. *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Vol. II.* U.S. Global Change Research Program; 2018:72–144
10. Bekkar B, Pacheco S, Basu R, DeNicola N. Association of air pollution and heat exposure with preterm birth, low birth weight, and stillbirth in the United States: a systematic review. *JAMA Network Open.* 2020;3(6):e208243
11. Son J, Lee J, Bell ML. Is ambient temperature associated with risk of infant mortality? A multicity study in Korea. *Environ Res.* 2017;158:748–752
12. Schinasi LH, Bloch JR, Melly S, Zhao Y, Moore K, De Roos AJ. High ambient temperature and infant mortality in Philadelphia, Pennsylvania: a case-crossover study. *Am J Public Health.* 2020;110(2):189–195
13. Guo Y, Gasparrini A, Armstrong B, et al. Global variation in the effects of ambient temperature on mortality: a systematic evaluation. *Epidemiology.* 2014;25(6):781–789
14. Xu Z, Sheffield PE, Su H, Wang X, Bi Y, Tong S. The impact of heat waves on children's health: a systematic review. *Int J Biometeorol.* 2014;58(2):239–247
15. Kerr ZY, Yeargin SW, Hosokawa Y, Hirschhorn RM, Pierpoint LA, Casa DJ. The epidemiology and management of exertional heat illnesses in high school sports during the 2012/2013–2016/2017 academic years. *J Sport Rehabil.* 2020;29(3):332–338
16. Armed Forces Health Surveillance Branch. Update: Heat illness, active component, U.S. Armed Forces, 2018. *MSMR.* 2019;26(4):15–20
17. Arcury TA, Arnold TJ, Quandt SA, et al. Health and occupational injury experienced by Latinx child farmworkers in North Carolina, United States. *Int J Environ Res Public Health.* 2019;17(1):248
18. Cedeño Laurent JG, Williams A, Oulhote Y, Zanobetti A, Allen JG, Spengler JD. Reduced cognitive function during a heat wave among residents of nonair-conditioned buildings: an observational study of young adults in the summer of 2016. *PLoS Med.* 2018;15(7):e1002605
19. Park RJ, Goodman J, Hurwitz M, Smith J. Heat and learning. *Am Econ J Econ Policy.* 2020;12(2):306–339
20. Ziter CD, Pedersen EJ, Kucharik CJ, Turner MG. Scale-dependent interactions between tree canopy cover and impervious surfaces reduce daytime urban heat during summer. *Proc Natl Acad Sci U S A.* 2019;116(15):7575–7580
21. Hoffman JS, Shandas V, Pendleton N. The effects of historical housing policies on resident exposure to intra-urban heat: a study of 108 US urban areas. *Climate.* 2020;8(1):12
22. Waite T, Murray V, Baker D. Carbon monoxide poisoning and flooding: changes in risk before, during and after flooding require appropriate public health interventions. *PLoS Curr.* 2014;6:ecurrents.dis.2b2eb9e15f9b98278493880358448 7f1
23. Erickson TB, Brooks J, Nilles EJ, Pham PN, Vinck P. Environmental health effects attributed to toxic and infectious agents following hurricanes, cyclones, flash floods, and major hydrometeorological events. *J Toxicol Environ Health B Crit Rev.* 2019;22(5-6):157–171
24. Texas Commission on Environmental Quality. Sanitary sewer overflows from Hurricane Harvey. Available at: https://wayback.archive-it.org/414/20210527065441/https://www.tceq.texas.gov/response/hurricanes/sanitary-sewer-overflows. Accessed March 3, 2022
25. Vose JM, Peterson GM, Domke CJ, et al. Forests. In: Reidmiller DR, Avery CW, Easterling DW, et al, eds. *Impacts, risks, and Adaptation in the United States: Fourth National Climate Assessment, Vol. II.* U.S. Global Change Research Program; 2018:232–267
26. Reid CE, Maestas MM. Wildfire smoke exposure under climate change: impact on respiratory health of affected communities. *Curr Opin Pulm Med.* 2019;25(2):179–187
27. Aguilera R, Corringham T, Gershunov A, Leibel S, Benmarhnia T. Fine particles in wildfire smoke and pediatric respiratory health in California. *Pediatrics.* 2021;147(4):e2020027128
28. Heft-Neal S, Driscoll A, Yang W, Shaw G, Burke M. Associations between wildfire smoke exposure during pregnancy and risk of preterm birth in California. *Environ Res.* 2022;203:111872

Downloaded from http://publications.aap.org/pediatrics/article-pdf/doi/10.1542/peds.2023-065504/1599280/peds.2023-065504.pdf
by guest

29. Gauderman WJ, Urman R, Avol E, et al. Association of improved air quality with lung development in children. *N Engl J Med.* 2015; 372(10):905–913

30. Brumberg HL, Karr CJ. Council on Environmental Health. Ambient air pollution: health hazards to children. *Pediatrics.* 2021;147(6): e2021051484

31. Orengo-Aguayo R, Stewart RW, de Arellano MA, Suárez-Kindy JL, Young J. Disaster exposure and mental health among Puerto Rican youths after Hurricane Maria. *JAMA Netw Open.* 2019;2(4):e192619

32. Davies IP, Haugo RD, Robertson JC, Levin PS. The unequal vulnerability of communities of color to wildfire. *PLoS One.* 2018;13(11):e0205825

33. Shonkoff JP, Garner AS. The lifelong effects of early childhood adversity and toxic stress. *Pediatrics.* 2012;129(1):e232–e246

34. Flores AB, Collins TW, Grineski SE, Chakraborty J. Disparities in health effects and access to health care among Houston area residents after Hurricane Harvey. *Public Health Rep.* 2020;135(4):511–523

35. Jan S, Lurie N. Disaster resilience and people with functional needs. *N Engl J Med.* 2012;367(24):2272–2273

36. Anderegg WRL, Abatzoglou JT, Anderegg LDL, Bielory L, Kinney PL, Ziska L. Anthropogenic climate change is worsening north American pollen seasons. *Proc Natl Acad Sci U S A.* 2021;118(7):e2013284118

37. Sapkota A, Dong Y, Li L, et al. Association between changes in timing of spring onset and asthma hospitalization in Maryland. *JAMA Netw Open.* 2020;3(7):e207551

38. Zhu C, Kobayashi K, Loladze I, et al. Carbon dioxide (CO_2) levels this century will alter the protein, micronutrients, and vitamin content of rice grains with potential health consequences for the poorest rice-dependent countries. *Sci Adv.* 2018;4(5):eaaq1012

39. Myers SS, Smith MR, Guth S, et al. Climate change and global food systems: potential impacts on food security and undernutrition. *Annu Review Public Health.* 2017;38:259–277

40. Kilpatrick AM, Dobson ADM, Levi T, et al. Lyme disease ecology in a changing world: consensus, uncertainty and critical gaps for improving control. *Philos Trans R Soc Lond B Biol Sci.* 2017; 372(1722):20160117

41. Dahlgren FS, Paddock CD, Springer YP, Eisen RJ, Behravesh CB. Expanding range of Amblyomma americanum and simultaneous changes in the epidemiology of spotted fever group rickettsiosis in the united states. *Am J Trop Med Hyg.* 2016;94(1):35–42

42. Levi T, Keesing F, Oggenfuss K, Ostfeld RS. Accelerated phenology of blacklegged ticks under climate warming. *Philos Trans R Soc Lond B Biol Sci.* 2015;370(1665):1–8

43. Rosenberg R, Lindsey NP, Fischer M, et al. Vital signs: trends in reported vectorborne disease cases–United States and territories, 2004–2016. *MMWR Morb Mortal Wkly Rep.* 2018;67(17):496–501

44. Kraemer MUG, Sinka ME, Duda KA, et al. The global distribution of the arbovirus vectors Aedes aegypti and Ae. albopictus. *ELife.* 2015;4:e08347

45. Coates SJ, Davis MDP, Andersen LK. Temperature and humidity affect the incidence of hand, foot, and mouth disease: a systematic review of the literature–a report from the International Society of Dermatology Climate Change Committee. *Int J Dermatol.* 2019; 58(4):388–399

46. Philipsborn R, Ahmed SM, Brosi BJ, Levy K. Climatic drivers of diarrheagenic Escherichia coli incidence: a systematic review and meta-analysis. *J Infect Dis.* 2016;214(1):6–15

47. Jiang C, Shaw KS, Upperman CR, et al. Climate change, extreme events and increased risk of salmonellosis in Maryland, United States: evidence for coastal vulnerability. *Environ Int.* 2015;83:58–62

48. Yun J, Greiner M, Höller C, Messelhäusser U, Rampp A, Klein G. Association between the ambient temperature and the occurrence of human Salmonella and Campylobacter infections. *Sci Rep.* 2016; 6(1):28442

49. Baker-Austin C, Trinanes J, Gonzalez-Escalona N, Martinez-Urtaza J. Noncholera Vibrios: the microbial barometer of climate change. *Trends Microbiol.* 2017;25(1):76–84

50. Luna-Pinto SC, Rivera A, Cardona I, et al. Restoring immunization services provided by the vaccines for children program in Puerto Rico after hurricanes Irma and Maria, 2017–2019. *J Public Health Manag Pract.* 2021;27(6):E228–E235

51. Hallegatte S, Vogt-Schilb A, Bangalore M, Rozeberg J. *Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters.* World Bank Publications; 2017

52. Burke SEL, Sanson AV, Van Hoorn J. The psychological effects of climate change on children. *Curr Psychiatry Rep.* 2018;20(5):35

53. Uddin R, Philipsborn R, Smith D, Mutic A, Thompson LM. A global child health perspective on climate change, migration, and human rights. *Curr Probl Pediatr Adolesc Health Care.* 2021; 51(6):101029

54. National Security, Military, and Intelligence Panel on Climate Change, Center for Climate and Security. A security threat assessment of global climate change: how likely warming scenarios indicate a catastrophic security future. The Center for Climate and Security, an Institute of the Council on Strategic Risks; 2020

55. McDonald YJ, Grineski SE, Collins TW, Kim Y. A scalable climate health justice assessment model. *Soc Sci Med.* 2015;133:242–252

56. Levy BS, Patz JA. Climate change, human rights, and social justice. *Ann Global Health.* 2015;81(3). DOI: 10.1016/j.aogh.2015.08.008

57. Bathiany S, Dakos V, Scheffer M, Lenton TM. Climate models predict increasing temperature variability in poor countries. *Sci Adv.* 2018;4(5):eaar5809

58. Vickery J, Hunter LM. Native Americans: where in environmental justice research? *Soc Nat Resour.* 2016;29(1):36–52

59. Gamble JL, Balbus J, Berger M, et al. 2016: Ch. 9: Populations of concern. In: *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment.* US Global Change Research Program; 2016:247–286

60. Burns J, Angelino AC, Lewis K, et al. Land rights and health outcomes in American Indian/Alaska Native Children. *Pediatrics.* 2021; 148(5):e2020041350

61. Hickman C, Marks E, Pihkala P, et al. Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey. *Lancet Planet Health.* 2021;5(12): E863–E873

62. Skillington T. *Climate Change and Intergenerational Justice,* 1st ed. Routledge; 2019

Downloaded from http://publications.aap.org/pediatrics/article-pdf/doi/10.1542/peds.2023-065504/1599280/peds.2023-065504.pdf
by guest

63. Landrigan PJ. Air pollution and health. *Lancet Public Health*. 2017; 2(1):e4–e5

64. Tran KV, Casey JA, Cushing LJ, Morello-Frosch R. Residential proximity to oil and gas development and birth outcomes in California: a retrospective cohort study of 2006–2015 births. *Environ Health Perspect*. 2020;128(6):67001

65. Cushing LJ, Vavra-Musser K, Chau K, Franklin M, Johnston JE. Flaring from unconventional oil and gas development and birth outcomes in the eagle ford shale in South Texas. *Environ Health Perspect*. 2020;128(7):77003

66. Tessum CW, Paolella DA, Chambliss SE, Apte JS, Hill JD, Marshall JD. $PM_{2.5}$ polluters disproportionately and systemically affect people of color in the United States. *Sci Adv*. 2021;7(18):eabf4491

67. US Environmental Protection Agency. *Inventory of US Greenhouse Gas Emissions and Sinks: 1990–2019*. US Environmental Protection Agency; 2021

68. US Energy Information Administration. Monthly energy review: December 2023. Available at: https://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf. Accessed November 1, 2021

69. Intergovernmental Panel on Climate Change. Summary for policymakers. In: Masson-Delmotte VP, Zhai A, Pirani SL, et al, eds. *Climate Change 2021: The Physical Sciences Basijs Contribution Of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press; 2021:1–32

70. Intergovernmental Panel on Climate Change. Summary for policymakers. In: Masson-Delmotte V, Zhai P, Portner HO, et al, eds. *Global Warming of 1.5° C: An IPCC Special Report on the Impacts of Global Warming of 1.5° C Above Preindustrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*. Intergovernmental Panel on Climate Change; 2018

71. Lubans DR, Boreham CA, Kelly P, Foster CE. The relationship between active travel to school and health-related fitness in children and adolescents: a systematic review. *Int J Behav Nutr Phys Act*. 2011;8(1):5

72. Centers for Disease Control and Prevention. Public transportation system: introduction or expansion. Available at: https://www.cdc.gov/policy/hst/hi5/publictransportation/index.html. Accessed November 1, 2021

73. Leung J. Center for Climate and Energy Solutions. Climate innovation 2050: decarbonizing US buildings. 2018

74. Sandel M, Sheward R, Ettinger de Cuba S, et al. Unstable housing and caregiver and child health in renter families. *Pediatrics*. 2018; 141(2):e20172199

75. Wilson J, Jacobs D, Reddy A, Tohn E, Cohen J, Jacobsohn E. *Home Rx: The Health Benefits of Home Performance*. National Center for Healthy Housing, US Department of Energy; 2016

76. Centers for Disease Control and Prevention. Childhood obesity facts. Available at: https://www.cdc.gov/obesity/data/childhood.html. Accessed November 1, 2021

77. Harvard T.H. Chan School of Public Health. Kid's healthy eating plate. Available at: https://www.hsph.harvard.edu/nutritionsource/kids-healthy-eating-plate/. Accessed November 1, 2021

78. Eustachio Colombo P, Patterson E, Schäfer Elinder L, et al. Optimizing school food supply: integrating environmental, health, economic, and cultural dimensions of diet sustainability with linear programming. *Int J Environ Res Public Health*. 2019;16(17):3019

79. Poore J, Nemecek T. Reducing food's environmental impacts through producers and consumers. *Science*. 2018;360(6392):987–992

80. Karr C. Children's environmental health in agricultural settings. *J Agromed*. 2012;17(2):127–139

81. Springmann M, Godfray HCJ, Rayner M, Scarborough P. Analysis and valuation of the health and climate change cobenefits of dietary change. *PNAS*. 2016;113(15):4146–4151

82. US Environmental Protection Agency. Heat island effect. Available at: https://www.epa.gov/heatislands. Accessed November 1, 2021

83. McCormick R. Does access to green space impact the mental well-being of children: a systematic review. *J Pediatr Nurs*. 2017; 37:3–7

84. Schramm PJ, Al Janabi AL, Campbell LW, Donatuto JL, Gaughen SC. How Indigenous communities are adapting to climate change: insights from the climate-ready tribes initiative. *Health Aff (Millwood)*. 2020;39(12):2153–2159

85. Philipsborn RP, Cowenhoven J, Bole A, Balk SJ, Bernstein A. A pediatrician's guide to climate change-informed primary care. *Curr Probl Pediatr Adolesc Health Care*. 2021;51(6):101027

86. Karliner J, Roschnik S, Boyd R, Ashby B, Steele K, Guinto R. *Global Road Map for Health Care Decarbonization. A Navigational Tool for Achieving 0 Emissions With Climate Resilience And Health Equity*. Health Care Without Harm and Arup; 2021

87. Hoban E, Haddock R, Woolcock K. *Deeble Issues Brief No. 41: Transforming the Health System for Sustainability: Environmental Leadership Through a Value-Based Health Care Strategy*. Deeble Institute for Health Policy Research; 2021

88. Maibach E, Frumkin H, Ahdoot S. Health professionals and the climate crisis: trusted voices, essential roles. *World Med Health Policy*. 2021;13(1):137–145

89. Attari S, Krantz D, Weber E. Climate change communicators' carbon footprints affect their audience's policy support. *Clim Change*. 2019;154(3):529–545

90. Gutschow B, Gray B, Ragavan MI, Sheffield PE, Philipsborn RP, Jee SH. The intersection of pediatrics, climate change, and structural racism: ensuring health equity through climate justice. *Curr Probl Pediatr Adolesc Health Care*. 2021;51(6):101028

91. National Academies of Sciences, Engineering, and Medicine. Accelerating decarbonization of the US energy system. 2021

92. US Department of Health & Human Services. *2021 Climate Action Plan*. US Department of Health & Human Services; 2021

93. Kim BF, Santo RE, Scatterday AP, et al. Country-specific dietary shifts to mitigate climate and water crises. *Glob Environ Change*. 2020;62:101926

Downloaded from http://publications.aap.org/pediatrics/article-pdf/doi/10.1542/peds.2023-065504/1599280/peds.2023-065504.pdf
by guest