

NO TIME FOR GAMES

-It's Time to Act!

Children's Health and Climate Change

Summary Report Update 2018



Contents

Introduction	3
<hr/>	
Background	4
<hr/>	
Australia’s current greenhouse gas emissions commitment	4
<hr/>	
Climate change and the health of children	5
<hr/>	
Key points	
Increased temperatures and heat waves	6
Extreme weather events	6
Air pollution, asthma, and allergens	7
Food and nutrition	7
Diarrhoeal disease	8
Vector-borne disease	9
Mental health	9
Impacts on the health of Aboriginal and Torres Strait Islander peoples	10
Impacts on rural health	11
Impact on healthcare infrastructure	12
Population displacement and conflict	12
Child protection issues	13
Injustice/inequity	13
<hr/>	
What the health profession is already doing	15
<hr/>	
Support the No Time For Games pledge	16
<hr/>	
References	17
<hr/>	
Contact Us	23

Introduction

Climate change is *the* greatest threat to human health in the current century, with our children living in a world of rising temperatures and increasing extreme weather events. Children are especially vulnerable and face growing threats from communicable diseases (diarrhoea, vector-borne diseases) and non-communicable diseases (asthma, malnutrition), injuries, and mental health impacts because of the changing climate and related extreme weather events.

Climate change amplifies inequity both in Australia and globally, so people already at greater risk of ill-health are likely to suffer disproportionately more of the negative health consequences, compared to those who are better resourced and/or have easier access to health, economic, and social services.

In Australia, rural communities and Aboriginal and Torres Strait Islander populations are at risk of greater adverse impacts from climate change. Disruptive changes in global climate may have dramatic impacts on large populations, leading to large scale migration with the growing potential for conflict and associated health risks.

Mitigating climate change through reducing greenhouse emissions is now urgent, as is adequate adaptation aiming to minimise the impacts of climate change through planning, preparation and investment of resources.

Health professionals have important roles to ensure that they are well-informed, demonstrate personal and professional action to reduce emissions, advocate for protection from and minimising climate change related adverse health impacts, and promote the health co-benefits of reducing emissions such as cleaner air and active transport. Health professionals are well placed to use their knowledge and standing to advocate for policies that meet greenhouse gas emission targets and for adaptation plans to reduce the health impacts on present and future generations from predicted changes in our climate. The future of our children's health depends on it.

"Failure to act responsibly on climate change will have dire consequences for our children's well being and the impacts of inadequate action for their children verge on the apocalyptic and are too scary to contemplate."

"it is our children who despite being the least responsible for causing it will unfairly bear the brunt of the impacts."

Former Australian of the Year, Professor Fiona Stanley

No Time For Games; background

When Doctors for the Environment Australia (DEA) first published *No Time for Games: Children's Health and Climate Change* (NTFG) in the lead up to the Paris 2015 United Nations (UN) Climate Change Conference (COP 21), it was much more than just a report. It was an urgent appeal to protect the health of our children (*DEA 2015*).

NTFG made it clear that we must make much deeper greenhouse gas emission cuts if we are to be serious in our duty to protect children's health from climate change, and to take full advantage of the health and economic benefits this brings while avoiding the costs associated with failure to act.

The purpose of this update is to appraise new information about the impacts on child health from climate change in Australia and globally since the original 2015 report, to re-emphasise and elaborate upon the vulnerabilities of certain groups of children already mentioned in the original report, and to encourage the widespread engagement of health professionals.

Australia's current greenhouse gas emissions commitment

In 2015, Australia committed to reducing its greenhouse gas emissions by 23-28% below 2005 levels by 2030, as its contribution to the Paris Agreement.

This commitment, however, has been deemed insufficient for Australia to fulfil its global responsibility to keep warming to less than 2°C above pre-industrial levels and thereby avoid irreparable damage to our health and wellbeing, economy, and security (*Climate Change Authority 2015*).

Alarmingly the Intergovernmental Panel for Climate Change (IPCC) is now recommending a more stringent target - that global warming be contained to 1.5°C - citing that impacts to natural and human systems are already widely observed, and that the difference between a 2°C versus 1.5°C threshold translates into several hundreds of millions of people living in climate-related poverty (*IPCC 2018*).

This will require that the global population reduce its emissions by 45% (of 2010 levels) by 2030 and reach zero net emissions by 2050 (*IPCC 2018*).

Of note, Australia has the highest per capita emissions amongst all of the Organisation for Economic Co-operation and Development (OECD) countries and is the 16th highest greenhouse gas emitter in the world (Garnaut 2008, CCA 2014, IEA Energy Atlas 2018).

Climate change and the health of children

Climate change has been labelled by the Lancet as "*the biggest health threat of the 21st century*" (Lancet 2009).

It increasingly threatens the very foundations of children's health - clean air and water, adequate food, control of infectious disease, and social and economic stability.

Climate change is already responsible for an estimated 250,000 to 400,000 deaths per year (DARA 2012, WHO Quant risk assessment 2014), of which almost 90% are children (McMichael & Campbell-Ledrum 2004, Zhang 2007).



Children are more vulnerable than adults to environmental risk factors and fluctuations, including extreme heat, floods, infectious diseases, food insecurity, poorer water quality, and increased air pollution and allergens (Bunyavich 2003, AAP COEH 2015).

Children are smaller than adults, and their different and more sensitive physiological, behavioural, and developmental requirements increase their exposure and risk of both acute and long-term adverse impacts on their health.

Key and updated points from DEA's 2015 *No Time For Games* report

Increased temperatures and heat waves

- The number of days >35°C expected to increase 2.5- to 20-fold across Australia by 2100 (*Garnaut 2008, CSIRO 2008*).
- Rates of emergency department presentations increase 6- to 25-fold during heatwaves for fever, gastroenteritis, asthma, hormone and metabolic diseases and nervous system diseases (*Lam, 2007; Xu et al., 2014*).
- The risk of preterm birth increases during extreme heat events, with greatest effect during late-pregnancy (*Wang et al 2013, Strand et al 2012, Mathew et al 2017*).
- Extreme temperatures affect children's (and adult's) ability to engage in outdoor activities and exercise, further exacerbating Australia's obesity epidemic.
- Extreme temperatures has also been demonstrated to decrease learning productivity and lead to poorer exam scores at school (*Goodman et al 2018*)
- Climate change-related recurrent illness, undernutrition, psychological stress, and ultraviolet radiation exposure may all lead to impaired paediatric immune function (*Swaminathan et al 2014*).

Extreme weather events

- The number of reported weather-related natural disasters globally has tripled since the 1960s (*WHO 2014*), with an estimated 60,000 deaths (in all age groups) and 175 million children affected annually (*Save the Children 2007*).
- In 2016, an estimated 23.5 million people were displaced from their homes due to extreme weather events (*Internal Displacement Monitoring Centre 2017 Global Report*).
- Australia is one of the most climate vulnerable countries of the developed world according to the *Fragile Planet* report released by global bank HSBC (March 2018), based on World Bank and International Disaster Database data. It concludes that Australia had the largest

percentage rise of death attributable to extreme weather events in the developed world over the past 20 years, whilst at the same time the proportion of the population impacted has surged from 3.25 to 15.2/1,000 (*HSBC 2018*).

- Following weather related or other natural disasters, mental and emotional distress experienced by children and adolescents include post-traumatic stress disorder and higher rates of sleep disturbance, bedwetting, aggressive behaviour and sadness. Exacerbations in depression, anxiety and stress have also been observed (*Abramson, Garfield, & Redlener, 2007; Ahern et al., 2005*).

Air pollution, asthma, and allergens

- **93%** of the world's children currently breathe polluted air and live in areas that exceeds WHO's ambient air pollution (PM_{2.5}) air quality guidelines.
- Asthma is the most common long-term medical condition in Australian children, with 1 in every 9 children suffering from the disease (*AIHW 2009, AIHW 2011*). The current global increase in childhood asthma could be partly explained by increased exposure to allergens in the air as a result of climate change (*Beggs & Bambrick, 2005*), as well as current levels of air pollution.
- Fossil fuel-generated air pollution is estimated to cause 1,500 premature deaths across all age groups and approximately 1,250 emergency department presentations or hospital admissions for childhood asthma or respiratory illness every year in Australia's four biggest cities alone (*Morgan, Broome & Jalaludin, 2013*).
- Traffic-related air pollution is associated with reduced foetal growth, low birth weight (*Li 2017, Rich 2015*), slower attainment of developmental milestones and reduced cognitive function (*Sunyer 2015, Grineski 2016*).
- A 2018 study in the US revealed that children in prams and strollers are exposed to up to 60% more traffic-related air pollution compared with adults because of their height in relation to vehicle exhaust systems (*Sharma 2018*).

Food and nutrition

- Increasingly frequent and severe heatwaves, extreme weather events, and drought are already having a significant effect on food prices and production in Australia, with climate change affecting the overall quality and availability of a wide range of staple foods (*Climate Council 2015*).

For example:

- Between 2005-2007 the price of vegetables and fruits increased by 33% and 43% respectively in Australia due to drought and extreme weather events (*ABS, 6401.0 Consumer Price Index, Australia, September 2007*).
 - Cyclone Larry (2006) destroyed 90% of the North Queensland banana crop, affecting supply for nine months and increasing prices by 500%.
 - Heat stress has been shown to reduce cow milk yield by 10-25% and up to 40% in extreme heatwave conditions.
 - Australia is facing its smallest winter crop in 2018 in 10 years (e.g., wheat and other cereal grains, pulses, canola), with a 23% reduction nationally compared to last year, an average of 30 to 50% reduction in yields in areas of eastern Australia where there are yields at all, and a 50% reduction in exports (*Rabobank 2018*).
- Presently 11% (815 million) of the global population is undernourished and 25% of children (155 million) are stunted (*FAO 2017*). An estimated 25+ million more children are expected to be undernourished with 95,000 additional child deaths annually and 7.5 million children stunted by 2030-2050 (*Lloyd et al 2011, IFPRI 2009, WHO Quant Risk Assess 2014*).

Diarrhoeal disease

- Persistent associations have been demonstrated between increased temperatures and increased rates of childhood diarrheal illness in Australia and globally (*Ghazani 2018, Xu 2014, Carlton 2016*).
- The World Health Organization (WHO) estimates an additional 48,000 deaths from diarrhoea annually by 2030-2050, most of which will be in children (*WHO Quant Risk Assess 2014*).
- The future health cost of Salmonellosis is expected to increase from AUD\$29.9 million without climate change to AUD\$31.9 million under climate change scenarios in Central QLD from 2016 to 2036 (*Stephen 2017*).
- Under predicted increases in temperature due to climate change, cases of food-borne bacterial gastroenteritis (e.g., *Salmonella*, *Campylobacter* and *E. coli*) are expected increase up to 60% (from 205,000 to 335,000 cases annually) in Australia by 2050, of which many will be children (*Bambrick et al. 2008*).

Vector-borne disease

In Australia, the risk of vector-borne diseases such as dengue, Ross River virus, and Barmah Forest Virus, Murray Valley, Hendra, and Australian bat lyssavirus is expected to increase or vary from their current geographic distributions due to changes in temperature, precipitation and humidity, leading to increased rates of encephalitis and systemic illness (*Naish 2014, Naish 2013, Britton 2016*).

- Worldwide, experts anticipate increased transmission of vector-borne and viral diseases such as malaria, dengue, Zika virus, West Nile, influenza, SARS, MERS, avian flu, amoebic meningoencephalitis, and coccidioidomycosis, which will lead to increased rates of encephalitis, respiratory disease, and systemic illness (*AAP 2015, McMichael and Lindgren 2011, Naish 2014, Naish 2013, Mirsaedi 2016*).
 - 70-85% of malaria deaths already occur in children under the age of 5 years (*WHO World Malaria Report 2011-2017*).
 - An estimated 60% of the world's population will live in a malaria-transmission zone by 2100 (*WHO World Malaria Report 2011-2017*).
 - Child mortality from malaria is predicted to increase by up to 20% by 2100 (*Dasgupta 2018*) with the WHO estimating an additional 60,000 deaths from malaria annually by 2030-2050 (*WHO Quant Risk Assess 2014*).
- Dengue is the fastest growing vector-borne disease, with half of the world's population currently at risk (*WHO 2015*). This is anticipated to increase to 5 billion people by 2050 with continued climate change. The burden of disease and the majority of deaths are highest among children (*Akachi 2009*).

Mental health

The WHO reports that between a third and half of all the people (including children) exposed to natural disasters or conflict will develop mental distress such as post-traumatic disorder (PTSD), depression, anxiety, panic disorders, sleep disturbances, learning difficulties, and substance abuse (*WHO 2001, Garcia et al 2016, Kar et al 2009*).

Children's ongoing brain development makes them more vulnerable to emotional trauma and mental health effects of climate change-related bushfires, floods and droughts. Their mental distress tends to last longer and can be much worse than the direct physical effects (*Ahern et al 2005*).

The specific impacts of trauma on child development are multifactorial, and depend on pre-existing coping

mechanisms, support structures, and the timing and age of exposure.

- A study of children and adolescents following a Category 5 cyclone demonstrated that almost 20% of children and 8% of adolescents were still suffering moderate-severe symptoms of PTSD 18 months after the event (*McDermott 2014*).
- In the US, a longitudinal study of children who were affected by a natural disaster (fire, tornado, flood, hurricane, earthquake) before age 5 years showed increased risk of mental health disorders in adulthood, particularly anxiety disorders (*Maclean 2016*).
- Cobham et al. confirm that parent-related variables and family environment were likely to be risk or protective factors for children (e.g., parental adaptive vs maladaptive coping mechanisms) following extreme weather events (*Cobham et al 2016*).
- Childhood stress and traumatic events have been demonstrated to have adverse long-term effects on cognitive functioning, learning ability, and academic achievement (*Pfefferbaum et al 2016, Sprung 2008, Pynoos et al 2006*).
- Disaster-related prenatal maternal stress is increasingly associated with cognitive, motor, and speech delay in infancy and early childhood (*King and Laplante 2005, King et al 2012, Moss et al 2017*).

Impacts on the health of Aboriginal and Torres Strait Islander peoples

Aboriginal and Torres Strait Islander communities face continued significant health inequities, brought to prominence by Australia's *Closing the Gap* campaign.

The poorer health outcomes of these groups are well documented and widespread, including lower life expectancy and higher rates of mental illness, non-communicable chronic disease, infant mortality, nutritional issues, and infectious disease (*AIHW 2018*).

Lower socioeconomic conditions, poorer access to health services, and stronger traditional/cultural ties to the land and natural environment (i.e., connection to country) make Aboriginal and Torres Strait Islander communities uniquely vulnerable to the impacts of climate change (*Green 2014, Bowles 2015*).

- There have been very few studies to date examining climate change health impacts specifically on these populations and even fewer amongst their children. Those that exist demonstrate:
 - Diarrheal admissions are estimated to increase by 10% amongst Aboriginal children

in central Australia by 2050 (*McMichael et al, 2003*).

- Hot or cold temperature extremes have differing effects on hospitalisation for respiratory illness between Indigenous and non-Indigenous people, and that increased vulnerability to climate change arises from an increased underlying risk to respiratory disease and an already existing greater health burden (*Green et al 2015*).

More research in this area is needed if we are to adequately address this health equity gap that will inevitably widen with increasing climate change.

Impacts on rural health

As with Aboriginal and Torres Strait Islander communities, rural and remote communities will be disproportionately affected by climate change, which will compound the inequities they already experience (*Berry et al. 2011a, Hughes and McMichael for the Climate Commission 2011*).

Rural, regional and remote communities (particularly the agricultural and mining industries) rely more heavily on the land and natural environment for their livelihoods as compared with those living in cities, so those living in these areas (including children) are more likely to be exposed and vulnerable to the increasing climatic risks of storms, floods, heatwaves, fires, and drought, and their consequences.

- Climate change is expected to heighten the impact of aeroallergen and allergic respiratory illness from either heat or flooding (pollens and/or moulds), zoonotic and rodent-borne illnesses, and helminthic and diarrheal disease in children living in rural areas (*International Public Health Journal special issues on Climate Change and Rural Child Health 2011*).
- While rural communities have proved resilient over time in the face of disaster and drought, recent experiences in relation to the prolonged drought have shown that climate variability contributes to significant mental health vulnerability (*Berry et al., 2011b, Hughes and McMichael for the Climate Commission 2011*).
- Research into developing rural community health risk assessments for climate change demonstrated that bushfires, depression and waterborne diseases were identified by community members in rural Tasmania as their greatest health concerns (*Bell et al 2015*). In South Australia, the concern about extreme heat events predominates (*Williams et al 2013*).
- Adolescents living in drought-affected rural areas are particularly exposed to (*Stain et al 2011*):

- poor educational, social, and health outcomes due to disintegration of social circles as friends migrate to urban areas;
- sacrificing educational opportunities viewed as too costly;
- the relative lack of mental health services in remote areas.

Impact on healthcare infrastructure

Increasing burden of disease requires added services from our health system, leading to higher demands on mental health, primary care, and hospital services. Healthcare facilities, their staff and the services they provide are also at risk in extreme weather events.

- In Brisbane, paediatric and adult emergency department visits are expected to increase by up to 2,300 and 1,200 visits respectively by 2060 due to an increased number of hot days, with excess costs of AU\$120,000-\$1,200,000 (aged 0-64 years) and AU \$96,000-\$786,000 (aged >65 years) (*Toloo 2015*).
- The thunderstorm asthma event in Melbourne Nov 2016 saw a 75% increase in ambulance call-outs with approximately 80% being highest acuity ('Code 1'), 60% increase in presentations and 670% increase in respiratory-related presentations to hospital Emergency Departments, leading to an almost 1000% increase in asthma-related admissions (*Vic DHHS 2017 report*).
- The Queensland 2010/2011 floods required the Queensland and federal governments to provide \$18.1 million to repair damage to health facilities (*Queensland Health 2011*).

Population displacement and conflict

Military and security experts now recognise the impact of climate change on population movements and on global stability, with approximately 70% of nations explicitly citing climate change as a national security concern (*Environmental Justice Foundation 2017 Beyond Borders, Australian Senate Report 2018*).

- Climate change is predicted to become the biggest driver of population displacement by mid-century, forcing an estimated 150 to 200 million people to move by 2050 (*C. McMichael, Barnett & McMichael 2012*).
- As stated earlier, an estimated 23.5 million people were displaced from their homes due to extreme weather events in 2016 (*Internal Displacement Monitoring Centre 2017 Global Report*).

- While perhaps not caused directly by climate change, disputes over scarce water, food and arable land resources can be aggravated by climate change, escalating political instability and conflict (*Bowles 2015*).
 - The ongoing conflicts in the Darfur region of Sudan, Arab Spring in 2010, and the current Syrian civil war all have roots in drought, poor agricultural yields, and/or tensions over inhabitable land.
 - Globally, there have been 115 conflicts over water rights since 2010 (*Pacific Institute, <http://worldwater.org/water-conflict/>*).
 - 2017 saw a record number of people (almost 70 million) forcibly displaced by conflict as refugees, asylum seekers, and internally displaced persons, of whom 52% were children (*UNHCR Global Trends 2017*).

The current degree of population movement has already caused significant social, political, and economic upheaval for both source countries and those countries hosting migrants worldwide, which is predicted to worsen with ongoing climate change.

For children, tremendous physical and mental health problems arise from displacement, disruption to family, home, and schooling, conflict and war (*C. McMichael et al. 2012*).

Child protection issues

Child protection issues are under-recognised as a negative consequence of climate change:

- Studies from both industrialised and low-middle income countries demonstrated increased rates of physical, emotional, and sexual abuse, maltreatment, and neglect after extreme weather events (*Bartlett 2008, Rezaeian 2013, Keenan 2004, Biswas 2010*).
- Girls are particularly affected, as they are often subject to sexual harassment and abuse in the chaos following extreme weather events. They often give up educational opportunities for more immediate low-income labour and activities and are often sold into early marriage (in low-middle income countries) or turn to other occupations such as the sex industry to help relieve family financial pressures (*Plan 2011*).

Injustice/inequity

Children face the biggest climate change related injustice - a transgression of intergenerational equity. Their growing bodies and minds make them more vulnerable to their surrounding environment, while their

bodies are less able to cope with physical and psychological stresses and harms.

Children are the least responsible for greenhouse gas emissions, are least able to influence action on climate change, and yet they will be exposed to its impacts for the duration of their lifetimes. Not only do children have the most to lose in terms of present and future health, and quality of life standards, but they will also inherit a world which has been diminished in terms of resources, safety, and opportunity, unless effective swift action is taken to address our climate change emergency and protect their future.



What the health profession is already doing

Doctors for the Environment Australia (DEA) has advocated for mitigation of greenhouse gas emissions and highlighted the health impacts of climate change and environmental degradation for almost 18 years. Following its Mission to 'Protect health through care of the environment', DEA has produced the 2015 *No Time For Games* Report as well as several related Fact Sheets; *Climate change and health in Australia*; *Heatwaves and health in Australia*; *Severe storms, floods and your health*; *Bushfires and health in a changing environment* (DEA 2015, DEA16, DEA17).

Also, in Australia, the Australian Medical Association (AMA), the Royal Australasian College of Physicians (RACP) and the Royal Australasian College of Surgeons (RACS) have all issued statements recognising climate change as a threat to human health and calling for action (AMA 2018, RACP 2016, RACS 2018). The Council of Presidents of Medical Colleges distributed a communique in 2018 *Managing and Responding to Climate Risks In Healthcare* endorsed by eleven medical colleges (CPMC 2018). Australia's Climate and Health Alliance (CAHA) has developed a Framework for a National Strategy on Climate, Health and Wellbeing for Australia (CAHA 2017).



The negative health impacts of climate change have also been recognised by other distinguished medical organisations globally such as the American Academy of Pediatrics (AAP), American College of Physicians (ACP), UK National Health Service, the Canadian Medical Association and Health Canada, the Lancet and British Medical Association, the British Medical Journal (BMJ), the UK Health Alliance of Climate Change, the US Medical Society Consortium on Climate and Health and others (*The Lancet* 2017, *BMJ* 2018).

DEA is asking health professionals across Australia to support the No Time For Games pledge

To protect the health of current and future generations of children, we need to prevent the projected future escalation of climate change by taking urgent action now to reduce greenhouse gas emissions.

Pledge to support:

- An urgent, far more proactive, effective and whole of government approach to climate mitigation to ensure significant health benefits for children.
- Strengthening our primary, emergency, rural and mental health services to increasingly be able to respond to children affected by climate change (eg during heatwaves).
- Greening our health care systems, in which health professionals are well placed to be a driving force to significantly reduce greenhouse gas emissions and waste.
- Considering divestment as an effective tool for diverting funds away from fossil fuel-related activities which undermine the fundamentals of health, towards cheaper alternatives such as renewable energies.

"We hope that this document, which like the original No Time For Games report is based on evidence and reason and motivated by justice and duty to protect our children's health from climate change, will empower doctors and students to use their voice."

#NoTimeForGames Campaign Coordinator (2018), Dr Ingo Weber

References

- Abramson D, Garfield R, & Redlener I. (2007). The recovery divide: Poverty and the widening gap among Mississippi children and families affected by Hurricane Katrina. Columbia University, New York: Mailman School of Public Health. Available from http://www.ncdp.mailman.columbia.edu/files/recovery_divide.pdf
- Ahern M, Kovats RS, Wilkinson P, Few R, & Matthies F (2005). Global Health Impacts of Floods: Epidemiologic Evidence. *Epidemiologic Reviews*, 27(1), 36-46. doi: 10.1093/epirev/mxi004
- Akachi Y, Goodman D, Parker D (2009). Global Climate Change and Child Health: A review of pathways, impacts and measures to improve the evidence base. Innocenti Discussion Paper No. IDP 2009-03. Florence: UNICEF Innocenti Research Centre.
- American Academy of Pediatrics Council on Environmental Health. Global climate change and children's health. *Pediatrics*. 2015; 136(5):992-7.
- Australian Bureau of Statistics, 6401.0 Consumer Price Index, Australia, September 2007
- Australian Institute of Health and Welfare (AIHW) (2009). Asthma in Australian Children: Findings from Growing up in Australia, the Longitudinal Study of Australia Children. Canberra: Australian Government Department of Health, 2009.
- Australian Institute of Health and Welfare (AIHW) (2011). Asthma in Australia 2011. Canberra: Australian Government Department of Health.
- Australian Institute of Health and Welfare (AIHW). Australia's health 2018. Australia's health series no. 16. AUS 221. Canberra: AIHW, 2018.
- Australian Medical Association (AMA). Act now on climate change and health, 10 October 2018. <https://ama.com.au/ausmed/act-now-climate-change-and-health>
- Bambrick, H., Dear, K., Woodruff, R., Hanigan, I., & McMichael, A. (2008). Garnaut Climate Change Review: The impacts of climate change on three health outcomes: temperature related mortality and hospitalisations, salmonellosis and other bacterial gastroenteritis, and population at risk from dengue. <http://www.garnautreview.org.au/CA25734E0016A131/pages/all-reports--resources-commissioned-reports.html>.
- Bartlett, Sheridan. "The Implications of Climate Change for Children in Lower-Income Countries." *Children, Youth and Environments*, 2008;18(1): 71-98
- Beggs, P. J., & Bambrick, H. J. (2005). Is the Global Rise of Asthma an Early Impact of Anthropogenic Climate Change? *Environmental Health Perspectives*, 113(8), 915-919. doi: 10.1289/ehp.7724
- Bell EJ, Turner P, Meinke H, Holbrook NJ. Developing rural community health risk assessments for climate change: a Tasmanian pilot study. *Rural and Remote Health* 2015;15:3174.
- Berry HL, Hogan A, Owen J, et al. Climate change and farmers' mental health: risk and responses. *Asia Pac J Public Health* 2011; 23(2 Supple):119S-32.
- Berry HL, Hogan A, Ng SP, et al. Farmer health and adaptive capacity in the face of climate change and variability. Part 1: Health as a contributor to adaptive capacity and as an outcome from pressures coping with climate related adversity. *Int J Environ Res Public Health* 2011;8(10):4039-54.
- Biswas A, Rahman A, Mashreky S, et al. Unintentional injuries and parental violence against children during flood: A study in rural Bangladesh. *Rural Remote Health* 2010;10:1199
- Bowles D. Climate change and health adaptation: consequences for Indigenous physical and mental health. *Ann Glob Health*, 2015;81(3):427-31.

Bowles DC, Butler CD, and Morisetti N. Climate change, conflict, and health. *J R Soc Med*, 2015;108(10):390-5.

British Medical Journal. Global warming: experts demand urgent action to prevent public health crisis, 09 October 2018. <https://www.bmj.com/content/363/bmj.k4241.full>

Britton PN, Dale RC, Booy R, et al. Acute encephalitis in children: progress and priorities from an Australasian perspective. *J Paediatr Child Health* 2015; 51(2): 147-58.

Bunyavanich S, Landrigan CP, McMichael AJ et al. The impact of climate change on child health. *Ambulatory Pediatrics* 2003, 3(1): 44-52.

Carlton EJ, Woster AP, DeWitt P, Goldstein RS, Levy K. A systematic review and meta-analysis of ambient temperature and diarrhoeal diseases. *Int J Epidemiology*. 2016;45(1):117-130. doi:10.1093/ije/dyv296.

Climate Change Authority 2014. Reducing Australia's greenhouse gas emissions - targets and progress review. Accessed from: <http://climatechangeauthority.gov.au/reviews/targets-and-progress-review-3>.

Climate Change Authority 2015. Authority observations on Australia's Post-2020 Emissions Reduction Target – Statement by the Chair. Accessed from: <http://climatechangeauthority.gov.au/publications/authority-observations-australias-2030-target>.

Climate And Health Alliance. Framework for a national strategy on climate, health and well-being for Australia. Climate And Health Alliance, 2017. https://d3n8a8pro7vhmx.cloudfront.net/caha/pages/40/attachments/original/1498008324/CAHA_Framework_for_a_National_Strategy_on_Climate_Health_and_Well-being_v05_SCREEN_%28Full_Report%29.pdf?1498008324

Hughes L and McMichael A (Climate Commission). *The Critical Decade: Climate Change and Health*. Climate Commission, 2011.

Climate Council. *Feeding a hungry nation: climate change, food and farming in Australia*. Climate Council, 2015.

Cobham VE, McDermott B, Haslam D, et al. The role of parents, parenting and the family environment in children's post-disaster mental health. *Curr Psychiatry Rep*, 2016;18:53

Costello A, Abbas M, Allen A, et al. Managing the health effects of climate change: Lancet and University College London Institute for Global Health Commission. *Lancet* 2009; 373: 1693-733.

Council of Presidents of Medical Colleges. *Managing and Responding to Climate Risks in Healthcare*, 30 May 2018. <https://cpmc.edu.au/communique/managing-and-responding-to-climate-risks-in-healthcare/>

CSIRO. (2008). 'Projections of days over 35°C to 2100 for all capital cities under a no mitigation case', data prepared for the Garnaut Climate Change Review Aspendale, Victoria.

DARA (2012) Climate Vulnerable Forum. *Climate Vulnerability Monitor. A Guide to the Cold Calculus of a Hot Planet*, 2nd edn. Estudios Graficos Europeos, S.A., Spain.

Dasgupta S. Burden of climate change on malaria mortality. *Int J Hyg Environ Health*, 2018;221(5):782-91.

Doctors for the Environment Australia Inc. *No Time For Games*, 2015. <https://www.dea.org.au/dea-report-no-time-for-games-childrens-health-and-climate-change-healthy-planet-healthy-people-dea/>

Doctors for the Environment Australia Inc. *Climate change and health in Australia, fact sheet*, 2016. <https://www.dea.org.au/climate-change-and-health-in-australia-fact-sheets/>

Doctors for the Environment Australia Inc. *Heatwaves and health in Australia, fact sheet*, 2016. <https://www.dea.org.au/heatwave-fact-sheet/>

Doctors for the Environment Australia Inc. Severe storms and your health, fact sheet, 2017. <https://www.dea.org.au/severe-storms-floods-and-your-health-fact-sheet/>

Doctors for the Environment Australia Inc. Bushfires and health in a changing environment, fact sheet, 2017. <https://www.dea.org.au/bushfires-and-health-in-a-changing-environment-fact-sheet/>

Environmental Justice Foundation. Beyond Borders: our changing climate – its role in conflict and displacement. London 2017.

FAO, IFAD, UNICEF, WFP and WHO. The State of Food Security and Nutrition in the World 2017. Building resilience for peace and food security. Rome:FAO, 2017.

Foreign Affairs, Defense and Trade Committee, Department of the Senate. Implications of climate change for Australia’s national security. Commonwealth of Australia, 2018.

Garcia DM and Sheehan MC. Extreme weather-driven disasters and children’s health. *Int J Health* 2016; 46(1):79-105.

Garnaut R. The Garnaut Climate Change Review: Final Report. Melbourne: Commonwealth of Australia, 2008

Ghazani M, Fitzgerald G, Hu WB, et al. Temperature variability and gastrointestinal infections: a review of impacts and future perspectives. *Int J Environ Res Public Health*, 2018; 15:e766

Goodman J, Hurwitz M, Park J, Smith J. Heat and Learning - working paper 24639. Cambridge Massachusetts: National Bureau of Economic Research, 2018. Accessed at: <http://www.nber.org/papers/w24639>

Green D and Minchin, L. Living on climate-changed country: indigenous health, well-being and climate change in remote Australian communities. *EcoHealth*, 2014;11: 263. <https://doi-org.ezp.lib.unimelb.edu.au/10.1007/s10393-013-0892-9>

Green D, Bambrik H, Tait P, et al. Differential effects of temperature extremes on hospital admission rates for respiratory disease between Indigenous and Non-Indigenous Australians in the Northern Territory. *Int J Environ Res Public Health* 2015;12:15352-365

Grineski SE, Clark-Reyna SE, Collins TW. School-based exposure to hazardous air pollutants and grade point average: a multi-level study. *Environ Res.* 2016;147:164-171. doi:10.1016/j.envres.2016.02.004.

Hales S, Kovats S, Lloyd S, Campbell-Lendrum D. Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Geneva: World Health Organization, 2014.

Intergovernmental Panel on Climate Change (IPCC). Global Warming of 1.5°C. Incheon, South Korea:IPCC 2018.

Internal Displacement Monitoring Centre (2017). On the grid: internal displacement in 2016. Access at <http://www.internal-displacement.org/global-report/grid2017/#on-the-grid>.

International Energy Agency. IEA Energy Atlas, Accessed at <http://energyatlas.iea.org/>

Keenan HT, Marshall SW, Nocera MA, & Runyan DK. Increased incidence of inflicted traumatic brain injury in children after a natural disaster. *Am J Prev Med* 2004, 26(3), 189-93. doi: 10.1016/j.amepre.2003.10.023

King S and Laplante DP. The effects of prenatal maternal stress on children’s cognitive development: Project Ice Storm. *Stress* 2005; 81(1): 35-45.

King S, Dancause K, Turcotte-Tremblay AM, et al. Using natural disasters to study the effects of prenatal maternal stress on child health and development. *Birth Defects Res C Embryo Today* 2012; 96(4):273-88

- Lam, L. T. (2007). The association between climatic factors and childhood illnesses presented to hospital emergency among young children. *Int J Environ Health Res*, 17(1), 1-8. doi: 10.1080/09603120601124264
- Li X, Huang S, Jiao A, Yang X, Yun J, Wang Y, et al. Association between ambient fine particulate matter and preterm birth or term low birth weight: An updated systematic review and meta-analysis. *Environmental Pollution*. 2017;227:596-605.
- Lloyd SJ, Kovats RS, Chalabi Z. Climate change, crop yields, and undernutrition: development of a model to quantify the impact of climate scenarios on child undernutrition. *Environ Health Perspect* 2011, 119: 1817-23.
- Maclean JC, Popvich I, French M. Are natural disasters in early childhood associated with mental health and substance use disorders as an adult? *Soc Sci Med*, 2016; 151:78-91
- Mathew S, Mathur D, Chang A, et al. Examining the effects of ambient temperature on pre-term birth in Central Australia. *Int J Environ Res Public Health* 2017, 14(2):e147. doi:10.3390/ijerph14020147.
- McDermott B, Cobham V, Berry H, et al. Correlates of persisting posttraumatic symptoms in children and adolescents 18 months after a cyclone disaster. *Aust N Z J Psychiatry*, 2014;48(1):80-6.
- McMichael, A. Human health and climate change in Oceania: a risk assessment, Commonwealth of Australia, Canberra. 2003
- McMichael A and Campbell-Ledrum D, et. al. (2004). Climate Change. In: Ezzati M, et al. (editors) *Comparative Quantification of Health Risks: Global and Regional Burden of Disease Due to Selected Major Risk Factors*.
- McMichael A and Lindgren E. Climate change: present and future risks to health, and necessary responses. *J Int Med* 2011;270(5):401-13.
- McMichael C, Barnett J, McMichael AJ. An ill wind? Climate change, migration, and health. *Environmental health perspectives*. 2012;120(5):646-54. Epub 2012/01/2
- Mirsaeidi M, Motahari H, Taghizadeh Khamesi M, et al. Climate change and respiratory infections. *Ann Am Thorac Soc*, 2016;13(8):1223-30.
- Morgan G, Broome R, Jalaludin B. Summary for policy makers of the health risk assessment on air pollution in Australia. Commonwealth of Australia: National Environment Protection Council, 2013.
- Moss KM, Simcock G, Cobham V, et al. A potential psychological mechanism linking disaster-related prenatal maternal stress with cognitive and motor development at 16 months: the QF2011 Queensland Flood Study. *Dev Psychol* 2017; 53(4): 629-41.
- Naish S, Mengersen K, Hu W, Tong S. Forecasting the Future Risk of Barmah Forest Virus Disease under Climate Change Scenarios in Queensland, Australia. *Vespignani A*, ed. *PLoS ONE* 2013;8(5):e62843. doi:10.1371/journal.pone.0062843.
- Naish S, Dale P, Mackenzie JS, McBride J, Mengersen K, Tong S. Climate change and dengue: a critical and systematic review of quantitative modelling approaches. *BMC Infect Dis*. 2014;14:167. doi:10.1186/1471-2334-14-167.
- Nelson GC, Rosegrant MW, Koo J, et al. for Climate Change: Impact on Agriculture and Costs of Adaptation, Food Policy Report. Washington D.C.: International Food Policy Research Institute, 2009.
- Pacific Institute. Accessed at <http://worldwater.org/water-conflict/>
- Paun A, Acton L, and Chan WS. *Fragile Planet: scoring climate risks around the world*. United Kingdom: HSBC pic, 2018.
- Pfefferbaum B, Noffsinger MA, Jacobs AK, et al. Children's cognitive functioning in disasters and terrorism. *Curr Psychiatry Rep* 2016; 18(5): 48
- Plan International. *Weathering the Storm: Adolescent Girls and Climate Change*, 2011.

Pynoos, R. S., Steinberg, A. M., Ornitz, E. M., & Goenjian, A. K. (2006). Issues in the Developmental Neurobiology of Traumatic Stress. *Annals of the New York Academy of Sciences*, 821(1), 176-93. doi: 10.1111/j.1749-6632.1997.tb48278.x

Queensland Health. (2011a). Annual Report 2010-2011. <https://publications.qld.gov.au/storage/f/2014-06-10T04%3A57%3A48.920Z/part-1.pdf>

Rabobank. Australian 2018/19 Winter Crop Production Outlook: Running on Empty, 2018. Accessed at: <https://www.rabobank.com.au/media-releases/2018/181023-australia-facing-smallest-winter-crop-in-10-years-rabobank-outlook/>

Rezaeian M. The association between natural disasters and violence: a systematic review of the literature and a call for more epidemiological studies. *J Res Med Sci* 2013; 18:1103-7

Rich D.Q., Liu K., Zhang J., Thurston S.W., Stevens T.P., Pan Y., et al. Differences in birth weight associated with the 2008 Beijing Olympic air pollution reduction: results from a natural experiment. *Environ Health Perspect*. 2015;123(9):880-7.

Royal Australasian College of Physicians. Climate change and health position statement, November 2016. <https://www.racp.edu.au/docs/default-source/advocacy-library/climate-change-and-health-position-statement.pdf?sfvrsn=3>

Royal Australasian College of Physicians. The health benefits of mitigating climate change position statement, November 2016. https://www.racp.edu.au/docs/default-source/advocacy-library/health-benefits-of-mitigating-climate-change-position-statement.pdf?sfvrsn=3d34361a_5

Royal Australasian College of Surgeons. Surgeons join Call for Action against climate change, 13 April 2018. <https://www.surgeons.org/media/media-releases/surgeons-join-call-for-action-against-climate-change/>

Save The Children. Legacy of Disasters 2007. Save The Children Web site. <http://www.savethechildren.org.uk/en/docs/legacy-of-disasters.pdf>

Sharma A & Kumar P. A review of factors surrounding the air pollution exposure to in-pram babies and mitigation strategies. *Environ Int* 2018, 120:262-78.

Sprung M. Unwanted intrusive thoughts and cognitive functioning in kindergarten and young elementary school-age children following Hurricane Katrina. *J Clin Child Adoles*

Stain HJ, Dean J, Blinkhorn S, et al. Climate adversity: yet another stressor for rural adolescents. *Int Public Health J* 2011: 2(4):513-9.

State of Victoria, Department of Health and Human Services. The November 2016 Victorian epidemic thunderstorm asthma event: an assessment of the health impacts. The Chief Health Officer's Report, 27 April 2017.

Stephen DM & Barnet AG. Using microsimulation to estimate the future health and economic costs of salmonellosis under climate change in Central Queensland, Australia. *Environ Health Perspect* 2017;125(12):e127001. doi: 10.1289/EHP1370

Strand, L. B., Barnett, A. G., & Tong, S. (2012). Maternal exposure to ambient temperature and the risks of preterm birth and stillbirth in Brisbane, Australia. *Am J Epidemiol*, 175(2), 99-107. doi: 10.1093/aje/kwr404

Sunyer J, Esnaola M, Alvarez-Pedrerol M, et al. Association between traffic-related air pollution in schools and cognitive development in primary school children: a prospective cohort study. *PLoS Med*. 2015;12(3):e1001792. doi:10.1371/journal.pmed.1001792.

Swaminathan A, Lucas RM, Harley D, McMichael A. Will global climate change alter fundamental human immune reactivity: implications for child health. *Children* 2014; 1:403-23.

The Lancet. Countdown on health and climate change: from 25 years of inaction to a global transformation for public health. October 30, 2017.

[https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(17\)32464-9/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(17)32464-9/fulltext)

Toloo G (Sam), Hu W, FitzGerald G, Aitken P, Tong S. Projecting excess emergency department visits and associated costs in Brisbane, Australia, under population growth and climate change scenarios. *Sci Rep.* 2015;5:12860. doi:10.1038/srep12860.

United Nations High Commissioner for Refugees (UNHCR). *Global Trends: Forced Displacement in 2017*. Geneva:UNHCR, 2017.

Wang, J., Williams, G., Guo, Y., Pan, X., & Tong, S. (2013). Maternal exposure to heatwave and preterm birth in Brisbane, Australia. *BJOG*, 120(13):1631-1641. doi: 10.1111/1471-0528.12397

Williams S, Peng B, Newbury J, et al. Extreme heat and health; perspectives from health service providers in rural and remote communities in South Australia. *Int J Environ Res Public Health* 2013; 10:5565-83.

World Health Organization. *Mental Health: New Understanding, New Hope*. Geneva: World Health Organization, 2001.

World Health Organization. *Climate change and health: World Health Organization Factsheet No 266*, 2014. <http://www.who.int/mediacentre/factsheets/fs266/en/>

World Health Organization. *Dengue and Severe Dengue: World Health Organization Fact Sheet*. Accessed at: <http://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue>

World Health Organization. *World Malaria Report 2017*. Geneva: World Health Organization, 2017.

World Health Organization. *Air Pollution and Child Health: Prescribing Clean Air*. Geneva: World Health Organization, 2018.

Xu, Z., Hu, W., Su, H., Turner, L. R., Ye, X., Wang, J., & Tong, S. Extreme temperatures and paediatric emergency department admissions. *J Epidemiol Community Health* 2014, 68(4), 304-311. doi: 10.1136/jech-2013-202725

Xu Z, Liu Y, Ma Z, (Sam) Toloo G, Hu W, Tong S. Assessment of the temperature effect on childhood diarrhea using satellite imagery. *Sci Rep.* 2014;4:5389. doi:10.1038/srep05389.

Zhang Y, Bi P, Hiller JE. Climate change and disability-adjusted life years. *J Environ Health.* 2007;70(3):32-36

Author

Doctors for the Environment Australia

Publication date

November 2018

Acknowledgements:

Doctors for the Environment Australia gratefully acknowledges the major contribution of Dr Karen Kiang and the assistance of many of its members in bringing this report to you.

Copyright

You must acknowledge DEA appropriately and you must not distribute content that you have modified. Except where otherwise noted, content in this report is licensed under a Creative Commons Attribution, No Derivatives 4.0 International License.

2018 Campaign Coordinator:

Dr Ingo Weber

E ntfgdea@gmail.com

No Time For Games website:

<http://notimeforgames.dea.org.au>

Contact:

67 Payneham Road College Park SA 5069

M 0422 974 857

E admin@dea.org.au

W www.dea.org.au

Follow us on Facebook and Twitter @DocsEnvAus

**About Doctors for the Environment Australia**

Doctors for the Environment Australia (DEA) is an independent, self-funded, non-government organisation of medical doctors in all Australian States and Territories.

Our members work across all specialties in community, hospital and private practices and public health.

We work to prevent and address the diseases local, national and global-caused by damage to our natural environment. We are a public health voice in the sphere of environmental health with a primary focus on the health harms from pollution and climate change.



Healthy planet,
healthy people

67 Payneham Road
College Park SA 5069
P 0422 974857
E admin@dea.org.au
W www.dea.org.au