

FEATURES ARTICLE

Climate medicine: our changing climate and health inequity in New Zealand

Cameron Toogood

Abstract

Climate change is a present and ongoing threat to the wellbeing of New Zealanders. The impacts of climate change will both exacerbate current inequities of health and generate new ones. As climate change impacts are regionally specific, there is pressing need to investigate the population groups in New Zealand at greatest risk of these inequitable outcomes. The present article discusses by what environmental mechanisms, and through what medical sequelae, climate change is expected to inequitably affect the health of these key populations. The groups discussed here include socioeconomically deprived individuals, Māori, Pacific peoples, children and the elderly, and agricultural workers. Greater clarity surrounding specific local population vulnerabilities to the impacts of climate change will allow for the development of targeted initiatives that prevent, mitigate, and foster adaptation to these threats.

Background

Climate change will reshape health care as we know it. Globally, the World Health Organisation conservatively estimates an additional 250,000 deaths yearly due to climate change between 2030 and 2050.¹ Though poised to affect all livelihoods across the coming decades, not everyone will be equally impacted.² Through to mid-century, the United Nations International Panel for Climate Change (IPCC) reports that impacts are expected to primarily affect those already suffering health inequities, who will suffer rising inequity as a result.² Accurately detailing these impacts requires locally-driven, contextual approaches.³ The present article aggregates some key future threats to health equity in New Zealand as a foundation for targeted action.

From blue fluorescing pillars in front of me leaped shining Tokelau, covered in glimmering solar panels and lush foliage. This was Te Taiao, the latest offering from the Wellington national museum Te Papa. Yet, these photos evoked unease. Palm trees poked their heads above the tops of water-stained concrete walls. The sign before me: "Facing climate change... float and hope?"⁴ I walked away, passing two children fighting over a lever that drowns a house in a tsunami.

We are presently transforming our climate through human greenhouse gas (GHG) emissions, which include carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and fluorinated gases.³ The greatest contributor to warming from emissions to date is CO₂, and as of 2017 we had produced 2,200 ± 320 gigatonnes (Gt) of it since pre-industrial times.⁵ The United Nations' Paris Agreement (Accord de Paris) is currently ratified by 185 countries including New Zealand.⁶ It recognises "the need for an effective and progressive response to the urgent threat of climate change," and thus commits parties to "holding the increase in global average temperature to well below 2 °C above pre-industrial levels, and pursuing... 1.5 °C".⁶ The absolute total

carbon budget remaining, should we be likely to meet these goals, was estimated in 2018 as merely another 570 GtCO₂ for 2 °C, or 420 GtCO₂ for 1.5 °C.⁵ Yearly emissions are currently 42 ± 3 GtCO₂, leaving under ten years to change course and avoid 1.5 °C of warming.⁵ Current international commitments by world governments lead to approximately 3.3 °C of warming by 2100, and without these a rise of 4.1 °C to 4.8 °C.⁷ In 2018, we reached 1.0 °C.⁵

Climate change evokes many global outcomes, but amongst the most salient is sea level rise (SLR). Although SLR occurs across hundreds of years and with a significant lag-time following emissions of GHG, it will continue rising beyond 2100, even within the 1.5 °C target.⁵ This will reshape future coastlines and force mass human displacement internationally.⁵ New Zealand's SLR is at 0.22 m since 1916.⁸ Should warming reach 2 °C by 2100, local areas modelled to ultimately fall below sea level include South Dunedin, Napier, and Blenheim.⁹ At 4.0 °C by 2100, this expands to include the Auckland airport, Lower Hutt, Gisborne, and large parts of Tauranga, Invercargill, Christchurch, Tokelau, and Rarotonga.⁹ Overseas, this would be expected to submerge Florida, Shanghai, and roughly half of London, amongst others.⁹ Without the maintained integrity of Antarctic and Greenland ice sheets, SLR is expected to climb many further metres.⁵ These ice sheets are thought to destabilise between 1.5 °C and 2 °C of warming.⁵

Other global impacts of climate change are numerous and heavily region dependent. These impacts include ocean acidification, reduced food security, more frequent droughts and floods, loss of air quality, and spread of disease.³ Impacts are discussed below as relevant to specific populations inequitably at risk.³

Before I could leave Te Taiao, my eye caught a map stylised as a weather forecast. "Climate change at your place." I leaned in, searching for my home in Kāpiti. "More rain and floods,"¹⁴ it said. Float and hope?

New Zealand is already experiencing changes to its climate, giving rise to evolving threats to local equity of health.¹⁰ The ClimateEx model identifies areas of greatest predicted climactic change, estimated by expected temperature and precipitation shifts.¹¹ Regions modelled to experience the most change include those within Northland, Bay of Plenty, Tairāwhiti, and Waikato District Health Boards (DHBs).^{11–15} This model does not, however, incorporate some other important regional impacts such as deglaciation.¹⁰

Groups at risk of inequity

Populations at risk of inequitable impacts from climate change overlap with populations already facing health inequities.^{11–15} Immediate steps taken now to support these groups with prevention, mitigation, and adaptation strategies has the power to reduce these inequities in

the future.¹⁶ Synergistically, steps to reduce pre-existing inequity in New Zealand also decrease the future impacts of climate change.³ Some of the groups facing inequity of health as a result of their specific pressures are discussed here.

1. SOCIOECONOMICALLY-DEPRIVED INDIVIDUALS

Socioeconomic deprivation is correlated with increased all-cause mortality in New Zealand across all age groups.¹⁷ These existing health inequities are expected to worsen due to increasing financial pressures from climate change, embedding people further into poverty. The World Bank cites climate change as a major driver of international poverty, expected to impoverish 100 million people over the next ten years.¹⁸

Climate change exerts disproportionate financial pressures on those who are socioeconomically deprived, due to both a reduced capacity to prepare against economic loss, and greater damage from these losses when they occur.¹⁹ Extreme weather and natural disaster-triggered economic 'shocks' are expected to become more frequent.¹⁹ For those who have less access to insurance, greater reliance on consistent employment wages and financial aid, and fewer financial assets for recovery or relocation out of devastated areas following disasters, these shocks become life-changing.¹⁹ The subsequent mental health toll may be more severe; victims of the February 2011 Christchurch earthquake in low socioeconomic suburbs were found to suffer higher rates of depression and anxiety when compared to those in medium and high socioeconomic suburbs.²⁰

Food security is expected to fall due to shifting precipitation patterns and ocean life migration driving up food prices.⁵ Because of the greater proportion of their income that is spent on food, those who are socioeconomically deprived will be disproportionately affected.¹⁹ This financial burden is recurrent, making escaping poverty more difficult for deprived individuals.¹⁹ This may subsequently increase the risk of undernutrition amongst the most impoverished and their susceptibility to illness.¹⁹

Furthermore, areas predicted to be exposed to the largest climatic changes are currently already disproportionately impoverished.^{11–15} In the Bay of Plenty and Waikato DHBs, the most deprived citizens are 'over-represented', whereas in Northland and Tairāwhiti the proportions in the quintile of most deprivation are 'very high'.^{12–15} These residents therefore face the double threat of vulnerability to extreme weather events from existing inequality, and a forecast of greater weather variability relative to other areas.¹¹ This may intensify damage from these events, such as increased disaster-related trauma and greater psychosocial harm.¹⁶

2. MĀORI

Coastal erosion, sea level rise, and flooding threaten cultural connections to whenua (land), rohe (territory), and sites of intergenerational cultural importance to Māori, such as marae and urupā (burial grounds).²¹ Increasingly researched as a uniquely impactful psychiatric stressor, the dysphoria experienced from witnessing environmental change to a place that one connects to has been termed 'solastalgia'.²² Solastalgia may affect Māori who experience loss of land that is tied strongly to their beliefs of origin and identity.²² Consumption of kai-moana (seafood) may also be undermined as a result of emerging and increasing rates of foodborne illness associated with warming and acidifying oceans, such as ciguatera fish poisoning and *Vibrio* gastroenteritis.^{8,21} These cultural impacts threaten both hinengaro (mental health) and wairua (spirituality) aspects of hauora Māori (Māori wellbeing).²³

Māori are over-represented across all measures of socioeconomic deprivation in New Zealand, and will therefore be inequitably affected by the aforementioned impacts on the socioeconomically deprived.²⁴ Northern areas of New Zealand predicted to experience greater climatic variance are also disproportionately inhabited by Māori.^{11–15} Due to the changes in precipitation and temperatures, these areas are at greater risk of the establishment of new disease vectors such as *Aedes aegypti*.^{8,21} Diseases with raised concern of possible outbreak

in New Zealand include Zika, dengue fever, malaria, Japanese encephalitis, Ross River fever, various tick-borne illnesses, and human myiasis (parasitic flies), amongst others.⁸ Combined with the increased vulnerability of these areas due to socioeconomic deprivation, northern Māori communities may risk inequitable harm, should such a disease produce an epidemic.^{12–15,21}

Existing health inequities are expected to worsen through climate change.³ Māori currently have inequitably high mortality rates due to respiratory and cardiovascular disease, including asthma, chronic obstructive pulmonary disease, and ischaemic heart disease.²⁵ Climate change is expected to increase the severity and prevalence of these diseases by increasing allergen counts and reducing air quality.⁸ Pollen production is predicted to increase many times over and airborne particulate matter may be generated through fire outbreaks and dust formed in droughts.⁸

3. PACIFIC PEOPLES

Pacific peoples in New Zealand originate from a diverse background of Pacific nations, as well as from the greater New Zealand realm including Tokelau, Niue, and the Cook Islands.²⁶ These are a heterogeneous peoples, and will both respond to and be affected by climate change in varying ways.

International climate change forums have been criticised for effectively condemning small island territories such as Tokelau to the fate of eventual, unavoidable evacuation to escape flooding and overwhelming SLR.²⁷ The striking injustice of this fate is that these islands contribute almost nothing to overall global carbon emissions, and yet the people face the ultimate loss of their homelands, which will precipitate both tangible harms and damage to intangible cultural identity, beliefs, and practices.²⁷ Evacuation is not welcomed by many Pacific peoples, as it sacrifices their cultural heritage, normalises their irreparable losses, and strips them of agency and dignity.^{27,28} However, migration from low-lying islands will become necessary for survival for some Pacific peoples should countries fail to uphold the Paris Agreement; some may be migrating for this reason already.²⁹ Forced migration will have large impacts on psychosocial wellbeing, and may separate families between islands.²⁹ Like for Māori, Pacific peoples whose homes are lost around them are also likely to be heavily affected by solastalgia.²²

For those living on small island nations, rising ocean acidity and temperatures trigger new migration patterns of fish and threaten traditional food security.²⁹ This in turn increases dependence on imported, energy-dense, obesogenic foods.²⁹ Pacific peoples are further at increased risk of seafood toxicity from previously mentioned diseases such as *Vibrio* gastroenteritis and ciguatera, which may further encourage the reliance on imported foodstuffs.²⁹

Pacific peoples in New Zealand receive lower average incomes compared to New Zealand Europeans, and will be at increased risk of the inequitable outcomes linked to socioeconomic deprivation discussed prior.³⁰ They also face increased risk of present non-communicable disease inequities being further exacerbated, as faced by Māori.²⁹

4. CHILDREN AND THE ELDERLY

Children are dependent upon caretakers for normal childhood growth and development, and require stability to maintain school attendance and develop cognitively.³¹ This creates vulnerability to sudden lifestyle upheavals, or health and socioeconomic shocks to families in the wake of disasters.³¹ Forced migration and coastal retreat disrupts children's academic progress, and may create long-term psychological trauma.³¹ Due to their reliance on caregivers for safety and wellbeing, children are particularly vulnerable if separated from families through extreme weather disasters, or if harm befalls family and guardians.³¹ Children are also at risk of undernutrition and resulting developmental delay due to socioeconomic shock.³¹ Infants may face suboptimal breastfeeding if their mothers are stressed or harmed.³²

Children in New Zealand have amongst the highest rates of asthma in the world, which is expected to be exacerbated, as described

prior, through air quality and pollen count changes.^{8,33} The World Health Organisation additionally estimates a small increase in yearly diarrhoeal disease mortality amongst children in Australasia.¹ Should tick-borne or mosquito-borne illnesses such as Lyme disease and malaria reach New Zealand, children are likely to be most affected.³¹

Amongst the elderly, cognitive impairment and anxiety may be worsened during disasters.³⁴ This may impair communication for effective response and result in additional morbidity.³⁴ The elderly risk inequitable health outcomes through exacerbation of existing cardiovascular and respiratory illnesses in similar ways to those described above.⁸ Although New Zealand faces less heat wave risk than many other countries, the elderly are amongst the most vulnerable to heat stroke, and by 2 °C of warming the number of heat-related deaths amongst those over 65 is predicted to rise from 14 to 51 in Auckland and Christchurch.⁸ Similar rises can be expected in other northern areas.⁸

5. AGRICULTURAL WORKERS

Individuals relying on agriculture and farming for their livelihood are at risk of financial threat from the changing climate.¹⁰ Precipitation changes will alter the frequencies of heavy rainfall and severe droughts, which will demand advance management to maintain crop yields through dry periods.³⁴ Pestilence of crops may also increase.³⁵

New Zealand's GHG emissions come primarily from the agricultural industry.³⁵ Policies such as the restriction of land deforestation for agriculture, or scaling back dairy farming, may be necessary to reach New Zealand's Paris Agreement commitments and reduce overall climate change impacts.¹⁰ However, agricultural workers would be disproportionately impacted by such policies.¹⁰

These collective pressures may create socioeconomic shocks and result in the downstream health consequences previously discussed for the socioeconomically deprived if workers are heavily impacted. Despite these risks, with sufficient mitigation and adaptation planning, temperature, precipitation, and CO₂ concentration shifts have the potential to expedite plant growth for limited periods, increasing crop yields and resisting downturn.³⁵

Should crops fail, or if mitigation and adaptation are unsuccessful in buffering future impacts, agricultural workers are at increased risk of psychiatric illnesses such as suicidality, anxiety, and depression.^{36,37} Further specific health impacts on those who work outside include higher rates of asthma through means described above, and greater risk of heat stroke.⁸

6. OTHER GROUPS AT RISK

It is not possible here to exhaustively detail all those at risk from climate change; there is also evidence that women, the disabled, and recent migrants may face specific and inequitable impacts.^{16,38,39} More research is needed to apply this to local contexts.

The way forward

Widespread ecological shifts will continue to inequitably precipitate numerous medical sequelae, which must be well characterised and targeted through a range of interventions fostering prevention, mitigation, and adaptation.

Despite the scope of these challenges, a large range of mitigating and adaptive initiatives have been discussed and analysed by the IPCC for their effectiveness.² A review of these is beyond the present article's scope, but solutions include international collaboration, regional and national government coordination, and community mobilisation.² New Zealanders have further intangible assets to draw upon, including guidance through Māori concepts such as kaitiakitanga (reciprocal stewardship) and our culture of historical grassroots mobilisation in the face of adversity.^{40,41}

With such a range of potential impacts from climate change, there is no shortage of ways to respond. As current and future health professionals, we hold a responsibility to understand these challenges and how they will affect our patients. Every New Zealander is capable

of contributing to initiatives that resist the impacts of climate change. The key message is that these responses are urgent if we are to avoid an inequitable future for our country; there is under a decade before we breach the carbon budget expected to hold us to 1.5 °C of warming.⁵ There is no time left to debate the need for action.

References

- World Health Organisation. Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s [Internet]. World Health Organisation; 2014 [cited 2019 Aug 06]. Available from: <https://apps.who.int/iris/handle/10665/134014>
- International Panel on Climate Change. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Internet]. Geneva: International Panel on Climate Change; 2014 [cited 2019 Aug 06]. Available from: <https://www.ipcc.ch/assessment-report/ar5/>
- Rao ND, van Ruijven BJ, Riahi K, Bosetti V. Improving poverty and inequality modelling in climate research. *Nat Clim Chang* [Internet]. 2017 Nov 30 [cited 2019 Aug 06];7:857-62. DOI: <https://doi.org/10.1038/s41558-017-0004-x>
- Museum of New Zealand Te Papa Tongarewa. Te Taiao [Exhibition]. Museum of New Zealand Te Papa Tongarewa; 2019. [cited 2019 Jul 7].
- International Panel on Climate Change. Global Warming of 1.5 °C. An IPCC Special Report on the impacts of global warming of 1.5 °C above pre-industrial 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 [Internet]. Geneva: International Panel on Climate Change; 2018 [cited 2019 Aug 06]. Available from: <https://www.ipcc.ch/sr15/>
- United Nations Framework Convention on Climate Change. The Paris Agreement (Decision 1/CP.21) [Internet]. United Nations Framework Convention on Climate Change; 2015 [in force 2016 Nov 04; cited 2019 Aug 06]. Available from: <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>
- Climate Action Tracker. Temperatures [Internet]. Climate Action Tracker; 2018 Dec 11 [cited 2019 Aug 06]. Available from: <https://climateactiontracker.org/global/temperatures/>
- Royal Society. Human health impacts of climate change for New Zealand [Internet]. Royal Society; 2017 Oct [cited 2019 Aug 06]. Available from: <https://royalsociety.org.nz/assets/documents/Report-Human-Health-Impacts-of-Climate-Change-for-New-Zealand-Oct-2017.pdf>
- Climate Central. "Surging Seas: Seeing Choices" map [Internet]. Climate Central; 2019 [cited 2019 Aug 06]. Available from: <http://sealevel.climatecentral.org/maps/mapping-choices>
- Ministry for the Environment & Stats New Zealand. New Zealand's Environmental Reporting Series: Our atmosphere and climate 2017 [Internet]. Ministry for the Environment & Stats New Zealand; 2017 Oct [cited 2019 Aug 06]. Available from: <https://www.mfe.govt.nz/sites/default/files/media/media/our-atmosphere-and-climate-2017-final.pdf>
- Netzel P. ClimateEx [Internet]. Cincinnati: University of Cincinnati; 2018 Mar [cited 2019 Aug 06]. Available from: <http://sil.uc.edu/webapps/climateex/>
- Ministry of Health New Zealand. Population of Northland DHB [Internet]. Ministry of Health New Zealand; 2019 Mar 14 [cited 2019 Aug 06]. Available from: <https://www.health.govt.nz/new-zealand-health-system/my-dhb/northland-dhb/population-northland-dhb>
- Ministry of Health New Zealand. Population of Bay of Plenty DHB [Internet]. Ministry of Health New Zealand; 2019 Feb 25 [cited 2019 Aug 06]. Available from: <https://www.health.govt.nz/new-zealand-health-system/my-dhb/bay-plenty-dhb/population-bay-plenty-dhb>
- Ministry of Health New Zealand. Population of Tairāwhiti DHB [Internet]. Ministry of Health New Zealand; 2018 Mar 14 [cited 2019 Aug 06]. Available from: <https://www.health.govt.nz/new-zealand-health-system/my-dhb/tairawhiti-dhb/population-tairawhiti-dhb>
- Ministry of Health New Zealand. Population of Waikato DHB [Internet]. Ministry of Health New Zealand; 2019 Mar 14 [cited 2019 Aug 06]. Available from: <https://www.health.govt.nz/new-zealand-health-system/my-dhb/waikato-dhb/population-waikato-dhb>
- Bennett H, Jones R, Keating G, Woodward A, Hales S, Metcalfe S. Health and equity impacts of climate change in Aotearoa-New Zealand, and health gains from climate action. *N Z Med J* [Internet]. 2014 Nov 28 [cited 2019 Aug 06];127(1406):16-31. Available from: <http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2014/vol-127-no-1406/6366>
- Jatrana S, Blakely T. Socio-economic inequalities in mortality persist into old age in New Zealand: study of all 65 years plus, 2001–04. *Aging Soc* [Internet]. 2014 Jul [cited 2019 Aug 06];34(6):911-29. DOI: 10.1017/S0144686X12001195
- The World Bank Group. Climate change overview [Internet]. Washington: The World Bank Group; 2019 Apr 02 [cited 2019 Aug 06]. Available from: <https://www.worldbank.org/en/topic/climatechange/overview>

19. Leichenko R, Silva JA. Climate change and poverty: vulnerability, impacts, and alleviation strategies. *Wiley Interdiscip Rev Clim Change* [Internet]. 2014 Jul [cited 2019 Aug 06];5(4):539-56. DOI: 10.1002/wcc.287
20. Dorahy MJ, Rowlands A, Renouf C, Hanna D, Britt E, Carter JD. Impact of average household income and damage exposure on post-earthquake distress and functioning: a community study following the February 2011 Christchurch earthquake. *Br J Soc Psychol* [Internet]. 2015 Aug [cited 2019 Aug 06];106(3):526-43. DOI: 10.1111/bjop.12097
21. Jones R, Bennett H, Keating G, Blaiklock A. Climate change and the right to health for Māori in Aotearoa/New Zealand. *Health Hum Rights* [Internet]. 2014 Jun 14 [cited 2019 Aug 06];16(1):54-68. Available from: <https://www.jstor.org/stable/10.2307/healhumarigh.16.1.54>
22. Albrecht G, Sartore GM, Connor L, Higginbotham N, Freeman S, Kelly B, et al. Solastalgia: the distress caused by environmental change. *Australas Psychiatry* [Internet]. 2007 Jan 1 [cited 2019 Aug 06];15:595-8. DOI: 10.1080/10398560701701288
23. Rochford T. Whare tapa wha: a Māori model of a unified theory of health. *J Prim Prev* [Internet]. 2004 Sep 1 [cited 2019 Aug 06];25(1):41-57. DOI: 10.1023/B:JOPP.0000039938.39574.9
24. Ministry of Health New Zealand. Socioeconomic indicators [Internet]. Ministry of Health New Zealand; 2018 Aug 02 [cited 2019 Aug 06]. Available from: <https://www.health.govt.nz/our-work/populations/maori-health/tatau-kahukura-maori-health-statistics/nga-awe-o-te-hauora-socioeconomic-determinants-health/socioeconomic-indicators>
25. Te Rōpū Rangahau Hauora a Eru Pōmare. Hauora IV: Māori standards of health: A study of the years 2000-2005 [Internet]. Te Rōpū Rangahau Hauora a Eru Pōmare; 2007 [cited 2019 Aug 06]. Available from: [http://www.moh.govt.nz/NoteBook/nbbooks.nsf/0/C3C40E20B25D301ECC2573B500014445/\\$file/hauora-iv.pdf](http://www.moh.govt.nz/NoteBook/nbbooks.nsf/0/C3C40E20B25D301ECC2573B500014445/$file/hauora-iv.pdf)
26. Cook LW, Didham RA, Khawaja MA. On the demography of Pacific people in New Zealand [Internet]. Wellington: Statistics New Zealand; 1999 Jul [cited 2019 Aug 06]. Available from: https://www.researchgate.net/profile/Robert_Didham/publication/237511392_On_the_Demography_of_Pacific_People_in_New_Zealand/links/54e634a30cf277664ff471fb/On-the-Demography-of-Pacific-People-in-New-Zealand.pdf
27. Barnett J. The dilemmas of normalising losses from climate change: towards hope for Pacific atoll countries. *Asia Pac Viewp* [Internet]. 2017 Apr [cited 2019 Aug 06];58(1):3-13. DOI: 10.1111/apv.12153
28. McNamara KE, Farbotko C. Resisting a 'doomed' fate: an analysis of the Pacific Climate Warriors. *Aust Geogr* [Internet]. 2017 Jan 2 [cited 2019 Aug 06];48(1):17-26. DOI: 10.1080/00049182.2016.1266631
29. McIver L, Kim R, Woodward A, Hales S, Spickett J, Katscherian D, et al. Health impacts of climate change in Pacific Island countries: a regional assessment of vulnerabilities and adaptation priorities. *Environ Health Perspect* [Internet]. 2015 Dec 8 [cited 2019 Aug 06];124(11):1707-14. DOI: <http://dx.doi.org/10.1289/ehp.1509756>
30. Fahy KM, Lee A, Milne BJ. New Zealand socio-economic index 2013 [Internet]. Wellington: Statistics New Zealand; 2017 [cited 2019 Aug 06]. Available from: <archive.stats.govt.nz/methods/research-papers/nz-socio-economic-index-2013.aspx>
31. Ahdoot S, Pacheco SE. Global climate change and children's health. *Pediatrics* [Internet]. 2015 Nov 1 [cited 2019 Aug 06];136(5):e1468-84. DOI: <http://dx.doi.org/10.1289/ehp.1509756>
32. Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R, et al. Managing the health effects of climate change. *Lancet* [Internet]. 2009 May 16 [cited 2019 Aug 06];373(9676):1693-733. DOI: [https://doi.org/10.1016/S0140-6736\(09\)60935-1](https://doi.org/10.1016/S0140-6736(09)60935-1)
33. Lai CK, Beasley R, Crane J, Foliaki S, Shah J, Weiland S, et al. Global variation in the prevalence and severity of asthma symptoms: phase three of the International Study of Asthma and Allergies in Childhood (ISAAC). *Thorax* [Internet]. 2009 Jun 1 [cited 2019 Aug 06];64(6):476-83. DOI: 10.1136/thx.2008.10660
34. Heppenstall CP, Wilkinson TJ, Hanger HC, Dhanak MR, Keeling S. Impacts of the emergency mass evacuation of the elderly from residential care facilities after the 2011 Christchurch earthquake. *Disaster Med Public Health Prep* [Internet]. 2013 Aug [cited 2019 Aug 06];7(4):419-23. DOI: 10.1017/dmp.2013.47
35. Office of the Prime Minister's Science Advisory Committee. New Zealand's changing climate and oceans: the impact of human activity and implications for the future [Internet]. Auckland: Office of the Prime Minister's Science Advisory Committee; 2013 Jul [cited 2019 Aug 06]. Available from: <https://www.pmcsc.org.nz/wp-content/uploads/New-Zealands-Changing-Climate-and-Oceans-report.pdf>
36. Berry HL, Bowen K, Kjellstrom T. Climate change and mental health: a causal pathways framework. *Int J Public Health* [Internet]. 2010 Apr 1 [cited 2019 Aug 06];55(2):123-32. DOI: 10.1007/s00038-009-0112-0
37. Polain JD, Berry HL, Hoskin JO. Rapid change, climate adversity and the next 'big dry': older farmers' mental health. *Aust J Rural Health* [Internet]. 2011 Oct [cited 2019 Aug 06];19(5):239-43. DOI: 10.1111/j.1440-1584.2011.01219.x
38. Masika R. Gender, development, and climate change [Internet]. Oxford: Oxfam; 2002 [cited 2019 Aug 06]. Available from: <https://oxfamilibrary.openrepository.com/handle/10546/121149>
39. Wolbring G. A culture of neglect: climate discourse and disabled people. *M/C Journal* [Internet]. 2009 Aug 28 [cited 2019 Aug 06];12(4). Available from: <http://www.journal.media-culture.org.au/index.php/mcjournal/article/view/173.html>
40. Kawharu M. Kaitiakitanga: a Maori anthropological perspective of the Maori socio-environmental ethic of resource management. *J Polynesian Soc* [Internet]. 2000 Dec 1 [cited 2019 Aug 06];109(4):349-70. Available at: https://www.researchgate.net/profile/Merata_Kawharu/publication/284045145_Kaitiakitanga_A_Maori_anthropological_perspective_of_the_Maori_socio-environmental_ethic_of_resource_management/links/572ff07008ae3736095c20b3.pdf
41. Hayward BM. Rethinking resilience: reflections on the earthquakes in Christchurch, New Zealand, 2010 and 2011. *Ecol Soc* [Internet]. 2013 Nov 14 [cited 2019 Aug 06];18(4):37. Available from: <https://www.jstor.org/stable/26269450>

About the author

> Cameron Toogood, BSc, is a senior medical student at Wellington School of Medicine, Otago Medical School, University of Otago, currently lost in Dannevirke as part of the Otago Rural Medical Immersion Programme. He is interested in limited resource and disaster relief environments and is passionate about projects that tackle global and local healthcare inequalities.

Acknowledgements

Thank you to Roshit Bothara, for the encouragement to stop talking and pick up a pen!

Conflicts of Interest

The author is a member of OraTaiao: The New Zealand Climate and Health Council.

Correspondence

Cameron Toogood: tooca660@student.otago.ac.nz