

Climate change and disability: a physical medicine and rehabilitation (PM&R) perspective

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Abstract

Climate change phenomena, such as droughts, floods, heat waves, hurricanes, and wildfires, have a deleterious effect on nature and the health of the people, especially on vulnerable population cohorts, such as persons with disabilities (PwD). PwD are disproportionately affected by the health effects of climate change and experience a greater burden due to various physiological, socio-economic and health-related factors. Rehabilitation professionals as trusted care providers/educators have an integral role in global efforts to educate, advocate and protect vulnerable people from the adverse impact of climate change. They are in a distinctive position as they are experts in understanding the complex medical, physiological and psychosocial needs of PwD. Although the impact of climate change on health is widely documented, the literature on the effect of climatic factors on PwD is sparse. Further, specific rehabilitation and disability-inclusive climate action plans are yet to be developed and/or implemented globally. As the climate-change-related health burdens continue to grow the critical importance of rehabilitation services is apparent. The challenge ahead is to build a structured people-centered approach to building rehabilitation-inclusive climate-resilient health systems to improve the adaptive capacity and resilience of the most susceptible people with distinct healthcare needs.

Keywords: Climate change, health, rehabilitation, disability, outcome

Introduction

The United Nations (UN) Intergovernmental Panel on Climate Change (IPCC), defines climate change as “any change in climate over time, whether due to natural variability or as a result of human activity”^[1]. There are major public health concerns resulting from persistent shifts in environmental conditions and global warming, such as the sea-level rise and coastal erosion, forest fires, air pollution, etc. It is estimated that ~3–3.6 billion people live in contexts that are highly vulnerable to the effects of climate change^[2]. The climate change phenomenon is a systemic crisis, with the changing human-induced climatic conditions and the speed at which this is occurring—has already had a deleterious effect on nature and the health of the people^[3]. The World Health Organization (WHO) predicts that between 2030 and 2050, climate change will cause ~250,000 additional deaths per

year, with direct damage to health costs attributed to climate change at US\$2–4 billion per year by 2030^[2,4]. This excludes costs in health-determining sectors such as agriculture, water, and sanitation. In 2019, the global magnitude of climate-sensitive diseases was estimated to be over 39.5 million deaths (69.9% of total annual deaths) and 1.5 billion disability-adjusted life years (DALYs), with cardiovascular diseases comprising the largest proportion (32.8% of deaths and 15.5% DALYs), followed by chronic respiratory disease (7% of deaths and 4.1% of DALYs) and respiratory infections (6.5% of deaths and 6% of DALYs)^[2,5]. Further, the recent IPCC report estimates that climate change will drive 32–132 million more people into extreme poverty in the next decade alone^[2].

The potential health effects of global climate change are prominent and can be “direct”—due to changes in temperature and precipitation, and occurrence of extreme heat or cold, natural disasters (floods, droughts, wildfires, etc.); or “indirect”—due to ecological disruptions brought on by climate change (crop failures, shifting patterns of disease vectors, reduced air and water quality, decreased food security, etc.), or social responses to climate change (such as displacement of the population following a prolonged drought, deforestation, etc.)^[6]. These can have a damaging health impact leading to and/or exacerbating various respiratory, allergic, cancer, and other chronic conditions. For example, adverse health risk attributed to air pollution is widely reported, with an estimated 99% of the world population in 2019 still living in places where the WHO air quality guidelines levels are not met^[7]. The WHO estimates in 2016 alone, air pollution caused 4.2 million premature deaths worldwide, of which 58% were associated with ischemic heart disease and strokes, 18% with chronic obstructive pulmonary disease and acute lower respiratory infections, and 6% with lung cancer^[7]. An increase in global temperature and extreme weather not only contributes to the loss of daily livelihood necessities (food, water, sanitation,

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Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

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Journal of the International Society of Physical and Rehabilitation Medicine (2023) 00:000–000

Received 26 July 2022; Accepted 1 December 2022

<http://dx.doi.org/10.1097/ph9.000000000000003>

etc.) but also increases natural disasters and disease outbreaks. It is estimated that a 2°C increase in average global temperature may result in 1–2 billion people lacking an adequate supply of water, placing 100–400 million more people at risk of hunger, and could result in 3 million additional deaths from malnutrition each year^[8]. Further, weather-related extreme events (specifically storms and floods) contribute to an annual average of over 20 million people being internally displaced^[2].

Bunker et al^[9] in a meta-analysis on the effects of ambient hot and cold temperatures on mortality and morbidity in the elderly (65+ years) population reported that a 1°C temperature rise increased mortality related to cardiovascular conditions by 3.4%, respiratory diseases by 3.6%, and cerebrovascular conditions by 1.4%. The authors suggest that a 1°C temperature reduction increased mortality related to respiratory conditions and cardiovascular diseases by 2.9% and 1.66%, respectively^[9]. Bongioanni et al^[10] in another review reported that prolonged heat exposure is linked to various health impacts (including heat stress, heat exhaustion, heatstroke, hyperthermia, and multi-organ-dysfunction syndrome). The authors hypothesize that molecular mechanisms activated by heat, play a role in the worsening functionality of people suffering from neurodegenerative diseases or elderly people, who have compromised thermoregulation^[10]. However, the exact mechanism of the human body’s response to exposure to more frequent, longer, and more intense global warming is not yet completely understood^[10]. Further, climate-related illnesses and consequences (such as premature deaths, malnutrition, poverty, etc.) exacerbate mental health issues (such as anxiety, depression, suicide thoughts, posttraumatic stress, etc.) and are the growing driver of involuntary migration and displacement, and violent conflicts^[2]. Table 1 summarizes the potential impact of climate change on health outcomes, many of which interact and overlap depending on climatic variability.

Impact of climate change on persons with disability (PwD)

Rapidly changing climate patterns are threatening environmental security and making it increasingly difficult for people globally to adapt to existing lifestyles. Climate change has the largest impact on the world’s most vulnerable people, specifically on those with preexisting conditions/impairments with distinct health care needs, such as PwD. Further, climate change–related health burdens will continue to grow due to an increase in population growth, the aging population, people with noncommunicable diseases, emerging communicable disease epidemics/pandemics, an increase in the number of PwD, etc.^[9,14–16]. There are an estimated 1 billion disabled people worldwide (15% of the world’s population), of these 110–190 million have significant difficulties, such as the inability to walk, perform self-care, or communicate^[17]. Climate change impacts health in these vulnerable cohorts, attributed to various physiological and socioeconomic factors, including multiple comorbidities, impairments, high medication usage, limited access to medical services, living environments (heating or cooling), poverty, etc. (Box 1)^[9,14,18]. Further, these vulnerable cohorts (specifically PwD) tend to have the least physiological capacity and behavioral response to adapt and cope with climate vicissitudes, face higher risks, and experience a greater burden of impact. This amplifies preexisting health disparity and socioeconomic circumstances^[15,16].

Table 1

Potential climate change–related health impacts^[2,4,7,9,11–13]

Climate exposure	Health impacts	Other vulnerabilities
Extreme heat	Metabolic diseases	Reduced adaptive capacity
	Cardiovascular and cerebrovascular diseases	Increased risk of mortality/morbidity
	Clinical heatstroke	Physical challenges
	Dehydration	Loss of habitation
	Malnutrition	Loss of livelihood and financial hardship
	Cancer	Food/water insecurity
	Mental health issues	Decreased productivity
Air pollution/poor air quality	Infectious and vector-borne diseases	Exacerbate poverty/inequalities
	Respiratory diseases	Increasing displacement/migration
	Cardiovascular diseases	Lack of safety
	Allergic conditions	Emerging new vulnerabilities
	Dermatological disease	Increased risk of mortality/morbidity
	Cancer	Damage infrastructure
	Climate-related disasters (droughts, hurricanes, flooding, wildfires, etc.)	Increase mortality/morbidity
Acute injuries		Lack or limited skilled health care professionals
Disability		Living environments (eg, lack of heating/cooling)
Mental health issues		Travel constraints
Floods and drought	Physical injuries	Isolation
	Infectious diseases outbreaks (water-borne, rodent-borne diseases)	Decreasing access to clean water, sanitation, and hygiene
	Mental health issues	Increase violent conflicts
	Nutritional issues (malnutrition)	

Gaskin et al^[19] in a systematic review report that PwD are the most vulnerable population cohort to climate change impact, largely due to inequality and exclusion from adaptation and mitigation efforts. The authors describe the various factors contributing to climate change vulnerability in PwD based on the International Classification of Functioning, Disability, and Health (ICF) framework, which include: bodily impairments (cognitive impairments, hearing impairments, progression of impairments, relapse/exacerbation of symptoms, and thermoregulation

Box 1: Potential issues impacting persons with disabilities resulting from climate change^[14,18]

- Exacerbation preexisting impairments or development of new impairment/s
- Increase risk of medical conditions (both communicable and/or noncommunicable diseases)
- Increase mental health issues (such as stress, anxiety, depression, posttraumatic stress disorder, etc.)
- Increase premature deaths, injuries
- Decreasing food security (malnutrition)
- Decreasing access to basic necessities (eg, shelter, clean water, sanitation, hygiene)
- Increasing emergencies due to extreme weather events
- Reduction in access to basic health and support services
- Increasing displacement/migration
- Increasing poverty due to loss of livelihood, work, etc.
- Disruption of social protection and support systems
- Increasing human security and protection issues (conflicts, violence, abuse, exploitation, etc.)

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difficulties), activity limitations and participation restrictions (limited preparedness, difficulties with evacuation, and difficulties reassembling individual accommodations and repairing or replacing adaptive equipment), environmental factors (limited practical support from government agencies and disability organizations), and personal factors (eg, female sex, living alone, non-White ethnicity, and low income)^[19]. Lindsey et al^[20] in a recent scoping review explored the impact of extreme weather events on people with preexisting disabilities and chronic conditions. The findings suggest that extreme weather events significantly impacted the physical and mental health of PwD and placed them at greater risk of acquiring a new injury or health problem, and/or worsening their current condition. The key barriers to accessing health services during extreme weather included a lack of rehabilitation services, lack of knowledge about PwD, communication challenges, and lack of adequate housing^[20].

Rehabilitation professionals and the impact of climate on health

Many impairments and health conditions resulting from or exaggerated by the climate change activities are amenable to rehabilitation, specifically noncommunicable diseases [such as stroke, multiple sclerosis (MS), cancer, chronic obstructive pulmonary disease, etc.], physical injuries (eg, spinal cord injuries). Further, thermal sensitivity is reported in patients with various health conditions such as MS^[21]; rheumatic diseases (eg, rheumatoid arthritis, ankylosing spondylitis, juvenile idiopathic arthritis)^[22]; neuromuscular diseases (eg, neuropathies, muscular atrophy)^[23], etc. In some conditions such as MS, elevated environmental heat, humidity, and exercise exacerbate heat sensitivity which is associated with fatigue that reduces patient performance levels^[24,25]. Experts suggest that, though warm temperatures may positively affect certain protective mechanisms at the central nervous system level, the harmful effects of long exposure to high temperature tend to damage the nervous system in several ways and outweighs these beneficial effects^[10]. Climate change is linked with other issues which impact the delivery and outcomes of rehabilitation programs (temperature imbalance, fatigue, and psychological issues such as depression, anxiety, and mood alterations)^[15,26]. These suggest the importance of consideration of climatic conditions for the development of structured rehabilitation programs in the future, on disease trajectory and rehabilitation outcomes.

Physical medicine and rehabilitation (PM&R) professionals are experts in providing care for various population cohorts, specifically PwD. Their role as trusted care providers/educators is integral in global efforts to educate, advocate, and protect vulnerable people from the adverse impact of climate change^[27,28]. They are content experts and advocates in this area^[29] and understand the relevance of climate change to direct patient care^[15,27,28]. They are in a distinctive position as they are experts in understanding the complex medical, physiological and psychosocial needs of PwD. Alexander et al^[15] surveyed rehabilitation professionals from different parts of the world in the field of science (n=125, 74% physicians, 13% physical therapy) to determine their experiences, concerns, and educational needs regarding natural disasters, climate change, and sustainability, and the effects on their clientele. The authors reported that most respondents acknowledged a need for more information related to disasters, climate change, and disability. In total, 57.6%

believed climate change had negatively impacted their client's health, over two third (82.5%) were concerned with sustainability and 85.5% suggested the need for further education. Remarkably, respondents from North America were significantly less likely to report climate change had an impact on their patient's health than those from Asia or Europe ($P < 0.01$)^[15]. Similarly, another multinational survey of health professionals (n = 4564) viewed climate change as a human health issue, and a growing cause of health harm^[27]. They highlighted the need for education, policy statements, action alerts, and guidance on how to make health care workplaces sustainable, and to address barriers, including adaptation and mitigation action^[27]. Despite, these concerns, specific rehabilitation-inclusive and/or disability-inclusive climate action plans are yet to be developed and implemented globally.

The way forward

Currently, many government and environmental-related organizations recognize climate change-related health impact as a global public health priority and advocate for climate-smart sustainable societies. With the growing evidence of serious adverse health outcomes related to climate change, the UN, WHO, and IPCC have published comprehensively^[1,2,4,13]. A range of approaches is recommended to mitigate the problem of climate change to achieve the 1.5°C targets in the Paris Agreement to the UN Framework Convention on Climate Change (such as reducing greenhouse gases, adopting sustainable energy technologies, reducing fossil fuel combustion, building climate-resilient cities, reducing disasters risks, etc.). Further, various health and medical coalitions have been established, such as Global Climate and Health Alliance (<http://www.climateandhealthalliance.org/>), Medical Society Consortium on Climate and Health (<https://medsocietiesforclimatehealth.org/>), Global Green and Healthy Hospitals (<https://noharm-global.org/issues/global/global-green-and-healthy-hospitals>), and others.

With increasing climate change impact on the health and well-being of the global human population, the critical importance of rehabilitation services is apparent. PM&R professionals are increasingly concerned about the exacerbation of many environmental health risks and the vulnerability of PwD, the elderly, and people with chronic conditions^[15,29]. They can play an important role in contributing to strategies for reducing climate-related health risks, as they have the knowledge and skills. The International Society of Physical and Rehabilitation Medicine (ISPRM), recently endorsed its position statement on "Climate change and disability" through its Disaster Rehabilitation Committee^[29]. It recommends actions at many levels to assist in mitigation and adaptation to the effects of climate change globally, using a people-centered approach, timely management, and meaningful collaboration and active participation of all relevant stakeholders, including PwD for a rehabilitation-inclusive climate action strategy^[29]. There is still much progress to be made in tackling underlying drivers of complex climate change impact, specifically in vulnerable cohorts, such as poverty, marginalization, education, etc. The challenge ahead is to build a structured approach to build climate-resilient health systems and ensure PM&R and PwD are well represented within the climate change agenda. This requires multisectoral, multisystem, and collaborative efforts at all governance scales from relevant bodies

(UN, WHO, IPCC, ISPRM, governments, disability organizations, etc.) for:

- Advocacy and awareness regarding the health impact of climate change.
- Assist in capacity building (infrastructures, skilled workforce) to reduce health vulnerability to climate change.
- Develop comprehensive integrated risk management strategies for resilience against climate change.
- Prioritization of climate adaptation and mitigation measures to reduce the burden of ill health and community resilience.
- Ensuring that climate policies incorporate a clear prohibition of the needs of vulnerable cohorts, including PwD.
- Inclusion, education, and empowerment of vulnerable populations (such as PwD) in decision-making and developing action plans.
- Development of educational resources on climate change and health for core medical school curricula.
- More research to build scientific evidence on the impact of climatic factors from a rehabilitation perspective—develop global research agenda.
- Improve communication (information gathering, sharing, and disseminating), using cost-effectiveness and proactive technologies.

Conclusions

Climate change is occurring at an unprecedented rate from extreme weather events and air pollution. The negative impact on health for the most disadvantaged in the community has led to an increase in mortality and morbidity with a significant impact on social determinants for good health. The climate change phenomenon has a deleterious effect on health, especially for PwD. Their needs and legal rights are often not represented. PM&R professionals must advocate for guidance for disability-inclusive climate action policies and educate/empower PwD. However, there remains limited literature on the impact on health from a rehabilitation perspective. Universal standards are needed for preparedness and risk mitigation, with coordinated support systems among the key actors in the field. Comprehensive inter-sectoral coordination of all relevant stakeholders and actors (UN, WHO, Governments, ISPRM, civil society, private sector, and others) is required for rehabilitation-inclusive governance and policies tackling climate change risks focusing on improving resilience and adaptation, and timely management. There is no alternative, and all must step up to build climate-resilient health systems.

Ethical approval

Not applicable.

Sources of funding

This report was prepared by the Department of Rehabilitation Medicine, Royal Melbourne Hospital, Australia. No external funding was available.

Author contribution

Both Authors (BA and FK) conceptualized the manuscript and contributed to the final version.

Conflict of interest disclosures

The authors declare that they have no financial conflict of interest with regard to the content of this report.

Research registration unique identifying number (UIN)

Not applicable.

Guarantor

Not applicable.

Acknowledgments

The authors acknowledge the Disaster Rehabilitation Committee, International Society of Physical and Rehabilitation Medicine (ISPRM), and Rehabilitation Medicine Society of Australia and New Zealand (RMSANZ) for their support. The views expressed in this article are of the authors only.

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