

Brain Climate Equity Collaborative: Advancing Equitable Climate Resilient Brain Health

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Abstract: Climate change is increasingly recognized as a threat to neurological health through exposures such as extreme heat, wildfire smoke, and air pollution. Emerging evidence links these hazards to stroke, cognitive decline, neuroinflammation, and worsening neurological disability, with equity-denied populations bearing disproportionate burdens. Despite this growing evidence base, no national Canadian framework addresses the intersection of climate change, neurological health, and equity. This paper describes the development of the Brain Climate Equity Collaborative (Brain-CE Collab), a graduate-initiated, interdisciplinary non-profit established in 2025. Brain-CE operates through four integrated pillars: generating evidence, raising awareness, driving systemic change, and fostering innovation. Within its first year, Brain-CE assembled over 45 fellows, launched 14 projects spanning community-based participatory research and federal policy advocacy, and established partnerships with leading health and policy organizations. The Brain-CE model offers a replicable framework for trainee-led, equity-centred translation of climate-neurology evidence into actionable research, practice, and policy.

Introduction and rationale

Climate change poses escalating and well-documented risks to neurological health. Extreme heat events increase stroke risk, exacerbate dementia symptoms, and trigger migraines and seizures (Ranta et al., 2024; Delaney et al., 2025). A multi-country analysis demonstrated measurable stroke burden attributable to non-optimal temperatures across 204 countries between 1990 and 2019 (Qu et al., 2024). Fine particulate matter (PM_{2.5}) from wildfire smoke and industrial pollution crosses the blood-brain barrier, driving neuroinflammation and elevating long-term risks for Alzheimer's disease, Parkinson's disease, and cognitive decline (Christensen et al., 2024; Krzyzanowski et al., 2023; Abolhasani et al., 2023). Vector-borne diseases with neurological sequelae are expanding into previously unaffected regions of Canada as warming shifts tick and mosquito habitats northward (Mojahed et al., 2022). Climate anxiety, meanwhile, affects 59% of young people globally (Hickman et al., 2021), constituting a clinical concern demanding systemic rather than solely individual responses.

These risks are not evenly distributed across the life course. Prenatal and early-life exposure to PM_{2.5} has been associated with impairments in cognitive development, reductions in white and gray matter volumes, and dysregulated neuroinflammatory responses (Calderón-Garcidueñas et al., 2008; Suglia et al., 2008; Zhu et al., 2020; Cacciottolo et al., 2017; Perera et al., 2024). In older adulthood, exposure to PM_{2.5} can exacerbate age-related neuroinflammation and accelerate cortical thinning (Thompson et al., 2025; Perera et al., 2006; Younan et al., 2021). These vulnerabilities are further compounded by impaired thermoregulation, multimorbidity, and reliance on caregiving systems that are often disrupted during climate events. Furthermore, climate-driven exposures not only exert

direct deleterious effects on neurological health but also interfere with neuroprotective behaviours, such as regular outdoor physical activity. Physical activity supports brain health through multiple mechanisms, including enhanced neuroplasticity, increased cerebral blood flow, improved metabolic and vascular function, reduced neuroinflammation and oxidative stress, and the promotion of cognitive reserve (Barha et al., 2017; Cabral et al., 2019; Hötting & Röder, 2013). Collectively, these mechanisms protect against cognitive decline and support brain health trajectories. However, climate-related exposures like extreme heat and air pollution are increasingly constraining safe opportunities for outdoor physical activity and attenuating its neuroprotective benefits. Extreme temperatures and poor air quality may reduce participation in physical activity, increase physiological strain, and diminish physical activity-induced cognitive gains.

These burdens are not equally distributed. Air pollution exposure disparities in North America closely mirror racial and income geography (Jbaily et al., 2022), and the intersection of climate risk and racial health inequity has been described as “the climate gap and the color line” (Morello-Frosch & Obasogie, 2023). Indigenous communities face compounded climate and health system barriers (National Collaborating Centre for Indigenous Health, 2022; Schnitter et al., 2022), while newcomer and racialized populations in climate-vulnerable urban areas experience repeated shocks alongside systemic exclusion from culturally safe support. Despite this converging evidence, Canada has no national framework, clinical guidance, or surveillance system connecting climate events to neurological health outcomes. The Lancet Neurology Commission on climate change and disorders of the nervous system established that climate hazards affect virtually every

category of neurological disease (Sisodiya et al., 2024), yet Canada's policy response remains absent.

The Brain-CE model

Origins and organizational design

The Brain Climate Equity Collaborative (Brain-CE) was founded in 2025 after a neuroscience graduate student at the University of Calgary published an evidence-based op-ed in *The Conversation Canada*, arguing that wildfire smoke poses direct neurological threats beyond its well-known respiratory effects. The article was republished by more than 17 media outlets, and the national response revealed significant latent demand for an organization that addresses this intersection. Brain-CE was subsequently incorporated as a Canadian non-profit, assembling a multidisciplinary board including stroke neurologists, psychiatrists, (eco-)neuroscientists, trauma therapists, social innovators, and knowledge translation specialists.

Brain-CE operates as a youth-led, expert-supported network. Over 45 fellows from universities across Canada and internationally lead 14 active projects, with scientific mentorship from senior clinical and research experts. The organizational structure provides three pathways for contribution: a core operational team responsible for strategy and infrastructure, project fellows who lead time-bound research and advocacy initiatives, and autonomous open initiatives that enable self-directed contributions. This structure ensures that graduate students and early-career researchers drive the work while maintaining scientific rigour through senior oversight.

Four pillars of action

Brain-CE's work is organized through four interdependent pillars, designed to address the systemic nature of the climate-brain-equity crisis.

Generate evidence. Brain-CE is building Canada's first evidence base at the climate-brain-equity intersection through systematic reviews, community-based participatory research (CBPR), and data partnerships. Active projects include a scholarly analysis article investigating PM2.5 and neurological health equity, a partnership with an eastern Canadian hospital examining heat vulnerability in dementia populations (building on evidence from Delaney et al., 2025 and Abolhasani et al., 2023), and a 14-month CBPR study with racialized communities in northeast Calgary's "hailstorm alley," where repeated climate shocks intersect with insurance exclusion, financial strain, and neurological and mental health harm.

Raise awareness. Evidence that does not reach practitioners and the public does not change outcomes. Through a partnership with Earth to Action, Brain-CE is developing clinical toolkits for family physicians on climate-neurological risk, informed by emerging guidance in clinical communication (Kotcher et al., 2024). Knowledge mobilization efforts include conference presentations, youth-facing resources on climate anxiety, and

an internal lecture series building interdisciplinary capacity across the fellow network.

Drive systemic change. In February 2026, Brain-CE submitted formal recommendations to Environment and Climate Change Canada on the Draft 2026-2029 Federal Sustainable Development Strategy, proposing four neurological health Key Risk Indicators as sentinel intelligence for Canada's national resilience framework, a first-of-its-kind intervention at the federal level. The collaborative is also developing a strategy for involvement at COP31, aiming to bring neurological health equity to the international climate policy table for the first time as a dedicated Canadian voice.

Foster innovation. Brain-CE's innovation pillar applies design-thinking and trauma-informed methodologies to co-create prevention-focused solutions with affected communities. Current initiatives include a children's climate-health storybook, clinical screening tools for climate-related psychological distress, and community co-design events with multilingual, culturally safe facilitation targeting equity-deserving populations.

Equity as infrastructure

Equity is treated as infrastructure rather than an additive lens within Brain-CE's organizational model. Research prioritizes the populations bearing the greatest climate-neurological burden: Indigenous and rural communities, racialized newcomers, older adults with dementia, and persons with disabilities. CBPR methods ensure that affected communities co-design research instruments, participate in data interpretation, and own the resulting outputs. This approach is informed by evidence that climate-health inequities are the direct product of systemic factors, including inequitable land use, urban planning, and racialized environmental exposures (Jbaily et al., 2022; Morello-Frosch & Obasogie, 2023; Public Health Agency of Canada, 2024).

Early outcomes and implications

In under one year, Brain-CE has achieved federal incorporation as a non-profit; assembled over 45 fellows across 14 projects; submitted its first federal policy intervention connecting neurological health to Canada's sustainability governance framework; established formal partnerships with Universities across Canada, the Planetary Health Alliance, and the International NeuroClimate Working Group; and secured presentations at the six national conferences and hosted Canada Climate Week within University of Calgary. A peer-reviewed analysis article targeting a major medical journal is in advanced development, and community-based data collection is underway.

The Brain-CE model demonstrates that graduate-initiated, interdisciplinary collaboratives can rapidly mobilize to address emerging intersectional health challenges. By integrating evidence generation, knowledge translation, policy advocacy, and community innovation within a single organizational framework, Brain-CE offers a replicable model for trainee-led

responses to complex health equity problems. The four-pillar structure ensures that research outputs do not remain siloed in academic journals but are systematically translated into clinical tools, policy recommendations, and community resources.

Conclusion

Climate change is a neurological emergency that Canada's health systems are not yet equipped to address. While the United Kingdom and Australia have begun integrating brain health into their climate adaptation frameworks (Sisodiya et al., 2024), Canada has no equivalent strategy. Brain-CE represents a proof of concept for how trainee-led, equity-centred organizations can fill critical national gaps in research, practice, and policy. As climate hazards intensify, the need for dedicated responses that protect brain health, particularly among equity-deserving populations, will only grow. The collaborative invites researchers, clinicians, and policymakers to engage with this emerging field and help build climate-resilient neurological health systems in Canada.

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