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Integrating Brain Health into Global Environmental Governance: A Policy Analysis of Major United Nations Conventions

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Abstract

Objectives

Global environmental conventions significantly influence population brain health by shaping governance conditions that affect environmental exposures and psychosocial stressors. However, brain health is often neglected in the formulation and evaluation of these treaties. Existing evidence links the exposures these treaties govern to measurable neurological consequences. Long-term air pollution, for example, is associated with increased epilepsy risk, while residential greenery is protective. This gap matters because neurological and mental health conditions together form one of the largest and fastest-growing contributors to the global burden of disease. Both are strongly environmentally determined, making these exposures modifiable, upstream drivers that current governance fails to capture.

Methods

We conducted a structured policy synthesis of major United Nations-ratified environmental conventions across six domains: chemicals and waste; biodiversity; climate and land; atmospheric protection; disaster risk reduction; and human rights. For each, we analysed the 20 most-affected countries using World Bank data and evaluated their brain health outcomes against global averages.

Results

Our findings revealed that conventions addressing chemicals and hazardous substances contained no acknowledgement of brain health, and the 20 countries most affected show epilepsy, anxiety, and suicide rates exceeding global averages. Biodiversity, climate, and land conventions similarly overlook brain and mental health, and their most-affected countries show the same elevated pattern coinciding with high exposure to climate shocks.

Atmospheric protection conventions omit brain health entirely, despite air pollution being an established environmental driver of epilepsy, consistently the most elevated outcome across all treaty groups analysed. The Sendai Framework addressed disaster victims without reference to mental health, and human rights conventions (CRC, CRPD) offered the strongest

basis for equitable monitoring yet overlooked the populations most affected by neurological conditions.

Conclusion

We conclude that existing global conventions are insufficient in comprehensively addressing brain health, and propose targeted amendments to treaty language and the monitoring of brain health indicators, particularly for vulnerable populations.

Keywords: Brain Health; Global Environmental Governance; Climate change and health

Introduction

Global environmental conventions have a significant impact on population brain health by shaping governance conditions that influence environmental exposures and psychosocial stressors. However, brain health is often overlooked in the development and assessment of these treaties. This paper is a policy synthesis that sits deliberately at an under-examined intersection: the point where the outputs of the major United Nations environmental and rights conventions meet the evolving epidemiology of brain health. To keep that intersection tractable, it focuses on six conventions that, between them, govern the principal environmental and psychosocial exposures relevant to the brain — the Paris Agreement, the United Nations Framework Convention on Climate Change (UNFCCC), the United Nations Convention to Combat Desertification (UNCCD), the Convention on Biological Diversity (CBD), the Sendai Framework for Disaster Risk Reduction, and the Convention on the Rights of the Child (CRC), and on four lifelong neurological and mental-health indicators that are both environmentally sensitive and trackable across populations: epilepsy, stroke, anxiety, and suicide. Rather than treating neurological and psychiatric disease as a downstream clinical problem, we approach it as a governance problem, one shaped by the same treaties that regulate the air, land, chemicals, and climate to which populations are exposed.

The scientific basis for that reframing is now well established. A growing body of recent evidence shows that much of the brain-health burden is driven by modifiable environmental and psychosocial exposures rather than by biology alone. Long-term exposure to air pollution, and to fine particulate matter (PM_{2.5}) in particular, is associated with elevated risk of epilepsy, anxiety, and dementia, while access to residential greenspace is associated with protective effects.¹ Climate-related heat, extreme weather, displacement, and food insecurity act as powerful upstream drivers of neurological and psychiatric harm — raising seizure and stroke burden, exacerbating anxiety, and elevating suicide risk — operating through concrete biological pathways including oxidative stress, neuroinflammation, and dysregulation of thermoregulatory and mood circuits.² The emerging "exposome" framework formalises this insight, positioning cumulative environmental exposure across the lifespan as a central determinant of brain health and disease.³ These exposures fall precisely within the remit of the conventions that govern climate, land, biodiversity, disaster risk, and children's rights, which is what makes their treatment of brain and mental health worth interrogating.

Yet a gap runs through both the literature and the policy instruments themselves. The exposures are documented, and the treaties that govern them exist, but the connection between the two is largely unmade: brain health is rarely named in the design or assessment of these conventions, people with neurological disease are seldom counted among the "vulnerable" populations the treaties prioritise, under 0.5% of international climate finance is allocated to health, and the WHO Intersectoral Global Action Plan on neurological disorders does not mention climate change at all.^{4, 5} For example, Campbell-Lendrum et al. in 2023 establish the core governance gap in the Paris Agreement and UNFCCC that the "right to health" is at the core of the treaty but largely absent from operational mechanisms, with under 0.5% of climate finance going to health and only 30% of NDCs accounting for health gains. The result is that convention language, monitoring metrics, and reporting obligations do not align with what the scientific evidence now shows. Where policy does not explicitly name a relationship, it cannot measure it, resource it, or be held accountable for it. Hence, brain health becomes invisible in exactly the governance structures best positioned to protect it.

We therefore hypothesise that the current framework of major UN-ratified environmental and rights conventions is insufficient to account for neurological and mental health conditions, and that closing this gap requires targeted amendment of treaty language and the mandated monitoring of brain-health indicators. This is not a call for new institutions but for the existing conventions to make explicit what their own scientific premises already imply.

This matters now because the two curves are moving together. The epidemiology of neurological and psychiatric disease is shifting in step with a changing climate and intensifying environmental exposure, and the populations bearing the heaviest burden are the low- and middle-income countries that have contributed least to the underlying harms and are least equipped to adapt to them.⁵ If environmental governance does not evolve to name and measure brain health, the instruments meant to protect the most vulnerable will continue to overlook one of the fastest-growing dimensions of the harm they govern. This paper asks whether these conventions adequately account for neurological and mental health conditions in the countries most vulnerable to those harms, and argues that, as currently written, they do not.

Methods

This study used a two-part design: a structured policy synthesis of major United Nations-ratified environmental conventions across six domains and a descriptive country-level analysis comparing brain-health outcomes in the most affected countries against global averages.

Convention selection and domains

Major UN-ratified environmental conventions in their four governance tiers were identified and categorised into six domains according to their connection to brain health: chemicals and waste; biodiversity; climate and land; atmospheric protection; disaster risk reduction; and human rights.

For each convention, its core governance functions are identified and established from the official treaty text and accompanying UN documentation.

Identification of most-affected countries

For each convention, the top 20 most-affected countries were operationally defined using the indicator best aligned with the specific harm or effect the convention governs and addresses. If strong comparable data on a convention-specific indicator did not exist, the closest available proxy was used and flagged below.

For the Paris Agreement, the ND-GAIN Vulnerability Index Score was used to measure the effects of climate change on countries. It involves a country's exposure, sensitivity, and ability to adapt to the negative impact of climate change by considering vulnerability in six life-supporting sectors, including food, water, health, ecosystem services, human habitat and infrastructure.

For the UNFCCC Agreement, the World Bank's 'Droughts, floods, and extreme temperatures' indicator ([EN.CLC.MDAT.ZS](#)) was used as a general climate hazard exposure proxy rather than a climate change attribution-specific measure. This is also a limitation, as this indicator does not distinguish climate change effects from natural climate variability, and its reference period (1990-2009) predates the most recent decade of accelerating climate impacts.

For UNCCD, the proportion of degraded land per country (2019) drawn from the UNCCD Data Dashboard under SDG Indicator 15.3.1 was extracted. This directly measures the treaty's core governance. However, coverage is limited to 121 self-reported countries so non-reporting countries may be under-represented regardless of true degradation levels.

For CBD, the World Bank's data sourced from the IUCN Red List Data on the number of nationally threatened bird species ([EN.BIR.THRD.NO](#)) was used to reflect underlying biodiversity and assessment intensity. This limitation is acknowledged as it does not solely reflect conservation performance, but no alternative metric fully separates these factors at country level and this indicator is used by many published literature as a measure of conservation efforts.⁶

For the Sendai Framework, the World Bank's Disaster Risk Reduction progress score ([EN.CLC.DRSK.XQ](#)) was recruited using a 1-5 self-assessment scale under the Hyogo

Framework, with 5 being the best score. The 20 lowest-scoring countries were selected as the most-affected countries with the least disaster risk reduction progress.

For CRC, the World Bank's under-5 mortality rate (SH.DYN.MORT) is used, sourced from the UN Inter-agency Group for Child Mortality Estimation (2024). This is among the most complete and internationally comparable child-wellbeing indicators available.

For Stockholm, Minamata, Rotterdam, Basel, and CRPD. There is no single internationally ranked country-level dataset for persistent organic pollutant exposure, mercury exposure, hazardous pesticide poisoning, hazardous waste dumping, or disability prevalence. For these conventions, affected-country identification relies on qualitative and case-study evidence, rather than a quantitative ranking, and is presented narratively rather than mapped.

Prevalence and mortality rates of neurological and mental health conditions

Among these top 20 countries, we searched for the prevalence and mortality rates from the age-standardised 'Our World In Data' database, whichever is more suitable/available, of different neurological and mental health indicators, including neurological indicators of prevalence of epilepsy, death rate of stroke, and mental health indicators of prevalence of anxiety disorders and suicide death rates. These conditions were chosen for their lifelong effect on the lifespan. For each indicator, the country-level value was recorded, and the most recent year available in each source was used. Where a country was missing data for a given indicator, it was excluded from the average for that indicator only. Prevalence of epilepsy is not available on the 'Our World In Data' database. Hence, data were taken from a systematic analysis published in The Lancet Public Health on its global epilepsy burden data.⁷

Comparison to global averages

The average values of each of these indicators from the top 20 most-affected countries were compared to the global averages of these indicators, respectively. The global averages are obtained from peer-reviewed studies, all analysing 2021 Global Burden of Disease (GBD) data. The values away from the global averages are calculated, inferring how these policies do not protect against certain aspects of neurological and brain health, giving rise to

recommendations for the improvement of treaty language in their official documentation and implementation.

Scope and limitation

This is a perspective synthesis conducted at country-level, and it is intended to characterise patterns of association between governed exposures and the reality of population brain-health burden. It does not support individual-level or causal inference. These findings are constrained by the availability, year, and comparability of country-level indicator data across sources.

Results

The global reference values used were: dementia prevalence 0.694%, epilepsy prevalence 0.6578%, the stroke death rate 0.0875%, Parkinson's disease prevalence 0.2929%, depression prevalence 4%, anxiety-disorder prevalence 4.4%, and the suicide death rate 0.009%.

Six conventions have available strong, comparable international data on their most-affected countries, which are the Paris Agreement, UNFCCC Agreement, UNCCD, CBD, Sendai Framework for Disaster Risk Reduction, and CRC.

6 choropleth maps below will showcase the distribution of the top 20 most-affected countries for individual conventions.

Top 20 Countries Most Vulnerable to Climate Change

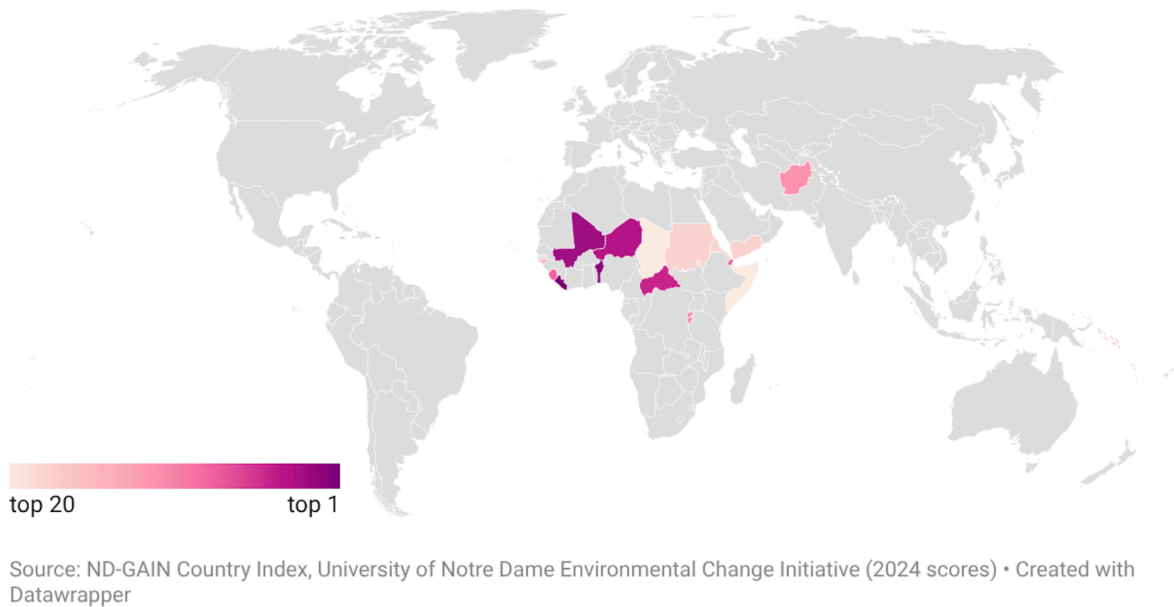


Figure 1: Top 20 Countries Most Vulnerable to Climate Change (Paris Agreement)

Top 20 Countries Most Affected by Droughts, Floods, and Extreme Temperatures

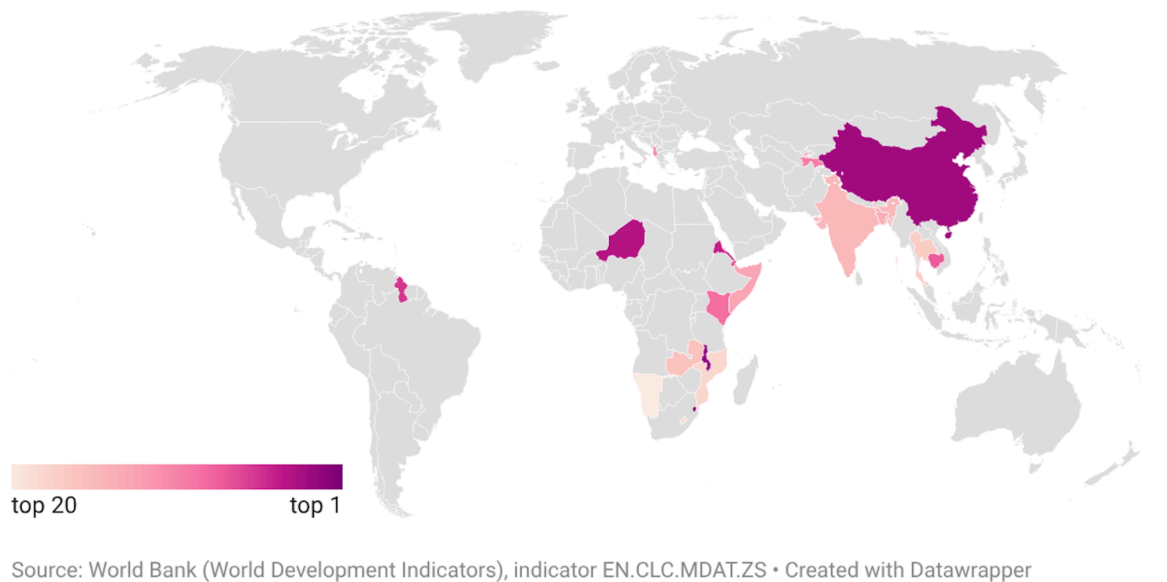
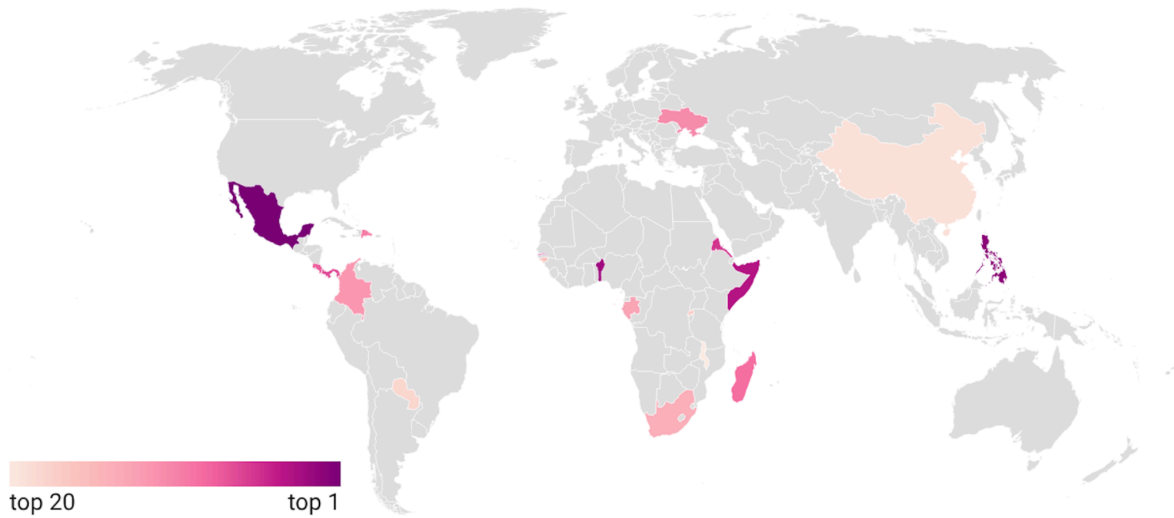


Figure 2. Top 20 Countries Most Affected by Droughts, Floods, and Extreme Temperatures (UNFCCC Agreement)

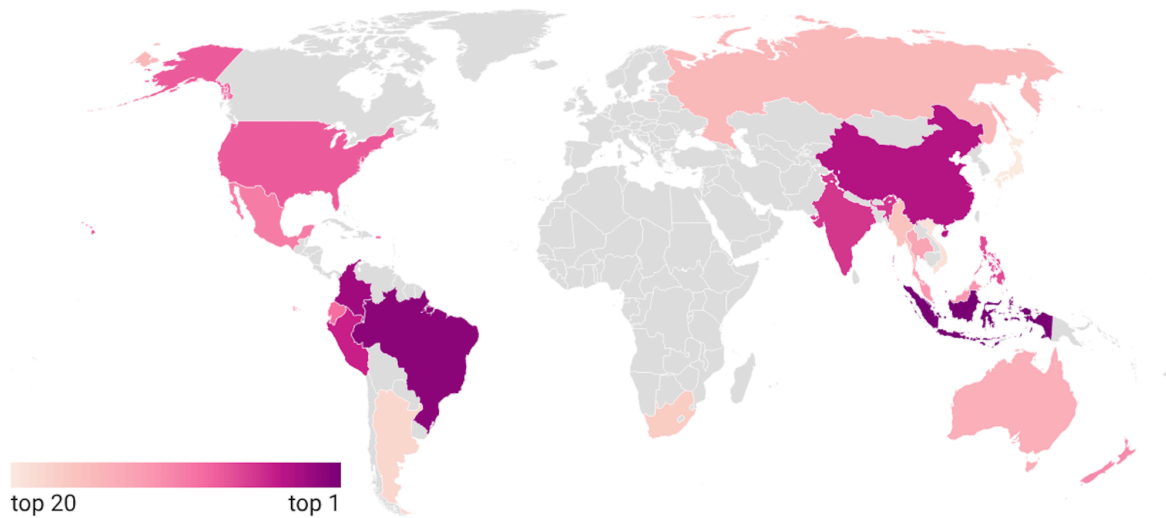
Top 20 Countries Most Affected by Land Degradation



Source: UNCCD Data Dashboard / UN SDG Global Database, Indicator 15.3.1 • Created with Datawrapper

Figure 3. Top 20 Countries Most Affected by Land Degradation (UNCCD)

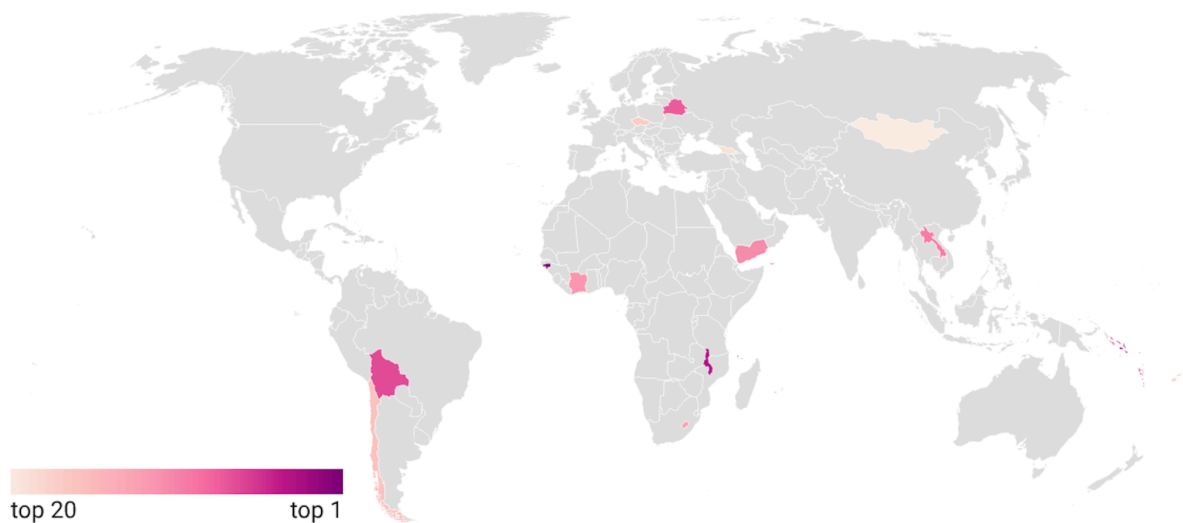
Top 20 Countries with the Most Threatened Bird Species



Source: World Bank (World Development Indicators), based on IUCN Red List data • Created with Datawrapper

Figure 4. Top 20 Countries with the Most Threatened Bird Species (CBD)

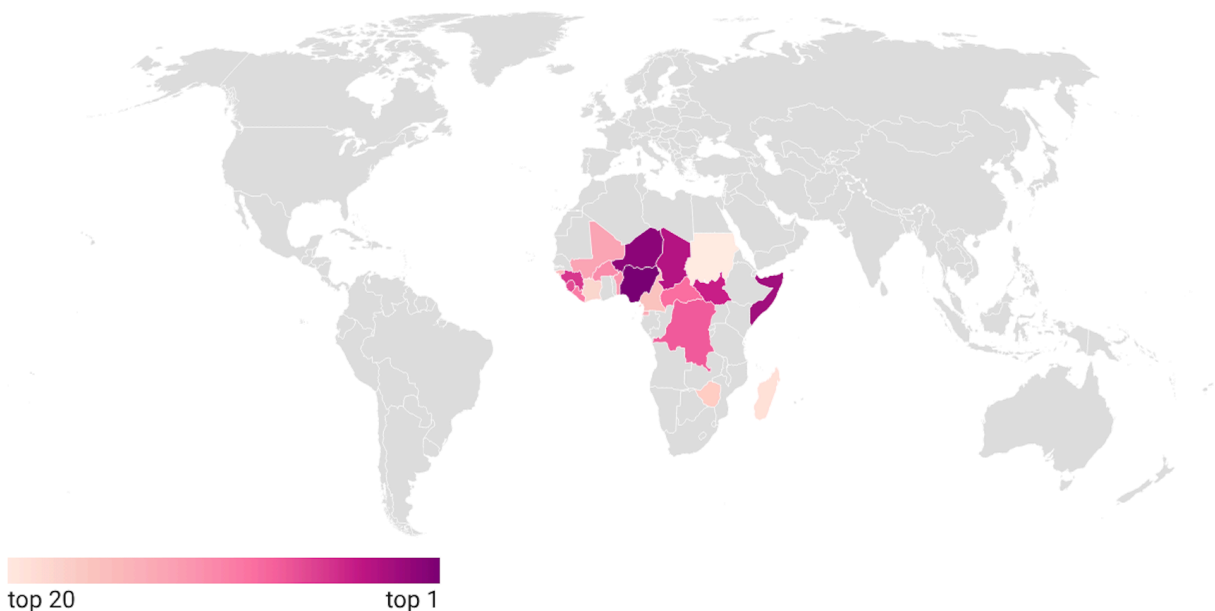
Top 20 Countries with the Lowest Disaster Risk Reduction Progress



Source: World Bank (World Development Indicators) • Created with Datawrapper

Figure 5. Top 20 Countries with the Lowest Disaster Risk Reduction Progress (Sendai Framework)

Top 20 Countries with the Highest Child Mortality



Source: World Bank (World Development Indicators), indicator SH.DYN.MORT — under-5 mortality rate per 1,000 live births • Created with Datawrapper

Figure 6. Top 20 Countries with the Highest Child Mortality (CRC)

Table 2 below compares the mean neurological and mental health outcomes across the top-20 countries most affected by each convention against global averages, to assess whether populations exposed to the harms these treaties address also carry elevated brain-health burdens. The data show increasing prevalence and mortality of neurological and mental health conditions against global averages.

Table 2: Deviation from global average prevalence/mortality rates for seven brain-health indicators, by convention (%)

Convention	Epilepsy Prevalence	Stroke death rate	Anxiety disorders Prevalence	Suicide death rates
Paris Agreement	+2.15	+68.3	+23.28	+25.6
UNFCCC Agreement	+15.4	+15.5	-0.26	+41.2
UNCCD	+29.1	0.0	+21.7	+15.7
CBD	+8.71	-17.4	+20.6	+1.11
Sendai Framework for Disaster Risk Reduction	+15.4	+49.0	+11.6	+6.02
CRC	+12.1	+52.2	+40.2	+36.7

Discussion

Across the six conventions examined, the twenty countries most affected by the harms each treaty governs carry a higher mean burden of epilepsy, stroke, anxiety, and suicide than the global average. These are the populations the Paris Agreement, UNFCCC, UNCCD, CBD, Sendai Framework, and CRC are meant to protect, yet on the neurological and mental-health indicators examined here, they are the populations doing worst. This section interprets that pattern against the published evidence, argues that it reveals a structural blind spot common to all six conventions, and sets out what would have to change for these treaties to be judged on whether they actually protect the brains of the people who live inside the environments they regulate.

The literature supplies the mechanism linking the governed exposures to the observed conditions

The exposures these treaties regulate are the same exposures the neuroscience literature links to the four indicators, which is what makes the association more than coincidental. For stroke, the World Stroke Organization's scientific statement concludes that extreme temperatures, temperature variability, wildfire smoke, and dust and sandstorms are consistently associated with increased stroke risk, with effects most pronounced among older adults and populations in LMICs.⁸ For anxiety and suicide, an umbrella review of global evidence found highly suggestive evidence that each 1 °C short-term rise in temperature increases suicide- and mental-disorder-related mortality, suicidal behaviour, and psychiatric hospital access, and that particulate air pollution is associated with depression, anxiety, and suicide.⁹⁻¹¹ For epilepsy, thermal stress, neuroinflammation from air pollution, and climate-driven shifts in neurotropic infection are all recognised contributors to seizure burden.² Each pathway, including climate hazard, air pollution, land and ecosystem degradation, and disaster-related trauma, falls squarely within the remit of one or more of the six conventions.

These populations are not receiving the neurological dividend the treaties imply

Putting the two observations together produces the core argument of this analysis. The exposures are governed by treaties and the biological mechanisms linking those exposures

to epilepsy, stroke, anxiety, and suicide are well-established by literature. Yet the populations most exposed show elevated, not reduced, burden. Whatever protection these conventions deliver environmentally, it is not translating into measurable brain-health benefit for the people living in the affected environments. This is compounded by the fact that these same countries have the weakest capacity to absorb the burden. Sub-Saharan Africa has roughly three adult neurologists per ten million people, against 475 per ten million in high-income countries.¹² The environmental harm concentrates where the clinical safety net is thinnest.

This exposes a shared structural gap across all six conventions

The most direct evidence that the gap is structural rather than incidental comes from the climate conventions, where the analysis is furthest developed. The "right to health" is at the core of the UNFCCC and the Paris Agreement but is largely absent from their operational mechanisms: under 0.5% of international climate finance is allocated to health, and only 30% of nationally determined contributions account for the health gains expected from mitigation.⁵ Within that already-thin health footprint, the brain is thinner still. People with neurological disease are rarely counted among the "vulnerable" populations these instruments prioritise, and the WHO Intersectoral Global Action Plan on epilepsy and other neurological disorders (2022–2031) does not mention climate change at all.⁴ The WHO has separately acknowledged that mental-health considerations remain largely absent from country commitments under the Paris Agreement.⁹ The pattern generalises across the other five conventions examined: health is nominally present in the treaty language, but the brain is operationally invisible, so nothing in the monitoring architecture would detect the elevated burden that Table 2 reveals.

What this means for how the conventions are written and judged

The language of these conventions should name neurological and mental-health outcomes as explicit, monitored endpoints, so that a treaty's success or failure is measured partly by what it does for the brains of the people inside its jurisdiction. Concretely, ten to twenty years from now the performance of these agreements should be judged not only on emissions, land restored, or hectares protected, but on whether epilepsy, stroke, anxiety, and suicide burden fell in the populations most exposed to the harms each treaty governs.

This reframes the conventions' purpose: the environmental narrative that carbon, biodiversity, degraded land, and disaster losses are a means, and human outcomes, including brain health, are the end by which the means should be evaluated.

Toward a more comprehensive governance mindset

These treaties are not comprehensive enough. An environmental convention that optimises an ecological variable while remaining blind to the neurological and psychiatric condition of the people living in that ecosystem is measuring only part of its own effect. A comprehensive framework has to hold the environment, the ecosystem, and the health, rights, and living conditions of exposed populations in the same view, brain health included, given that it underpins all 17 Sustainable Development Goals yet remains fragmented across health and environmental policy.¹²⁻¹³ This is consistent with, and extends, the direction the literature is already taking: exposome and One Health framings argue explicitly that environmental governance and brain outcomes cannot be separated¹³, and recent field-building efforts such as the International Alliance on Brain Health call for integrated brain-and-mental-health frameworks that bridge the global North and South.¹⁴

Agreements and points of departure from the existing literature

This synthesis aligns with the emerging consensus that environmental exposures are genuine, modifiable, upstream drivers of neurological and psychiatric disease, and that current policy under-weights this link.¹⁵ Where this paper goes further is in treating the treaties themselves, not only clinical systems or research agendas, as the unit that must be amended and measured. It also departs from that literature in one important respect of interpretation: much of the existing work frames the evidence as still too uncertain to act on, and the mental-health reviews in particular stress methodological limitations and residual confounding.¹⁰⁻¹¹ This paper reads the same uncertainty differently as a reason for precaution rather than delay. As the exposure-to-disease biology is coherent and the affected populations are precisely those with the least surveillance and the fewest clinicians, waiting for definitive proof systematically postpones protection where it is most needed.

Policy Recommendations

These findings support two linked recommendations.

First, a general call for amendment: the six conventions should be revised so that brain health is named explicitly within treaty language rather than left implicit under the "right to health," since the present analysis shows the populations most exposed to the harms these treaties govern also carry the heaviest neurological and psychiatric burden, yet none of the instruments tracks that burden.

Second, and more concretely, the conventions should adopt an explicit brain-health performance and monitoring narrative, in which epilepsy, stroke, anxiety, and suicide are each individually specified as environment-linked outcomes to be measured and reported. The results here justify naming them separately rather than collapsing them into a generic "mental health" category, specifying distinct indicators for distinct exposure pathways: stroke and epilepsy rise with heat, air pollution, and pesticide exposure, while anxiety and suicide track temperature, extreme weather, displacement, and food insecurity.

Framing these as named, disaggregated, age-standardised performance metrics would convert brain health from an unmeasured externality into an accountable obligation, so that treaty performance a decade from now can be judged partly by what it has done for the neurological and mental health of the people living within these environments.

A call for a multidisciplinary response

Closing this gap is beyond the reach of any single discipline. It requires neurologists and psychiatrists to define measurable brain-health endpoints, epidemiologists to build disaggregated surveillance validated for LMIC settings, environmental scientists to link exposure to outcome, economists to value brain capital and cost the burden of inaction, and legal and policy scholars to translate all of this into enforceable treaty language.^{9, 13, 14} The observed elevation in epilepsy, stroke, anxiety, and suicide among the most-affected countries is the signal; the invisibility of that signal in current treaty design is the failure; and a coordinated, multidisciplinary reform of how these conventions are written and evaluated is the response this paper calls for.

Conclusion

This analysis reveals a critical gap in major UN-ratified environmental and rights conventions, namely the Paris Agreement, UNFCCC, UNCCD, CBD, the Sendai Framework, and the CRC. Epilepsy and suicide mortality are elevated across all six mapped conventions relative to global averages, which is consistent with established climate- and pollution-driven mechanisms. Hence, this shows that existing global conventions are insufficient in comprehensively addressing brain health. We propose targeted amendments to treaty language and routine monitoring of neurological and mental health indicators, prioritising vulnerable populations.

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