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The Annual Carbon Footprint of In-Person Attendance at Major Neurological Conferences

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ABSTRACT

Background: Anthropogenic climate change is the greatest threat to health of our century, including increased risk and severity of neurological diseases. Policies to contain the progression of climate change to within the adaptability of the human system demand urgent reduction in carbon emissions across all sectors. Neurologists should not be exempt. Global travel to conferences is the main source of academia's carbon emissions. Lack of awareness of the extent of the problem and of the urgency of effective intervention may explain the lack of mitigating actions from the neurological community.
We aimed to provide a conservative estimate of neurologists' annual CO_2 emissions from in-person attendance at some of their main global conferences.
Methods: The number of in-person attendees at some major international neurological conferences in 2022/2023 was assessed by a Google search. The CO_2 emissions per capita (tCO_2/person) was calculated by obtaining the average of the values published in four studies of non-neurological conferences. The total tCO2 emissions from all attendees at the neurological conferences was then compared to the annual tCO2/person in various countries world-wide.
Results: Thirteen conferences were identified with a total of 47,956 attendees. The total tCO_2 emissions was then calculated at 93,994 (1.96 tonnes x 47,956 attendees).
This equated to annual tCO_2/person ranging from >2.0 million people in several African countries to 6.700 in Canada.
Conclusion: This simple analysis based on literature values to calculate carbon emissions by attendees, shows staggering figures that only represent a partial annual contribution from the neurological discipline. In the context of a climate crisis that requires urgent actions, neurologists should carefully consider their choices and implement actions to effectively reduce the carbon cost of their conferences.
Keywords: Neurologists, conferences, in-person attendance, carbon footprint, virtual

Introduction

We are living in a climate change crisis, which is having disastrous effects on people lives, especially in the most economically disadvantaged communities.[1,2]

Awareness of the extent of the problem and of the urgency of effective intervention to block its progression, is paramount to motivate action. "Public health is the principal argument for climate action". Climate change is "fundamentally a health crisis" and is affecting the most vulnerable communities "here and now"." [3,4] Without urgent effective action, this crisis will rapidly evolve to catastrophic effects that are beyond the adaptive capacity of the human system.[1]

All aspects of human health are affected; neurological diseases are no exception.[5] Health practitioners thus have a special responsibility to act to mitigate emissions. The academic community in particular should lead by example and implement effective measures to reduce their own contribution to global greenhouse gas emissions.

Several studies over the past decades have shown that global travel to conferences and other scientific/learning gathering events is the main source of the academic community's carbon emissions.[6,7] Compared to other professions, academics produce much more emissions, due to their frequent air travel.[8-11] "A scientist's air travel for one intercontinental conference can result in two to five tCO_{2eq}. This is well above the annual limit of 1.5–2.3 tCO_2 per capita required to mitigate climate change and comply with the Paris Agreement to limit warming to the 1.5°C target by 2030."[10]

Long-distance travel has become normalised within academic work-culture, where face-to-face interaction is considered necessary for professional development, education and knowledge sharing. For this reason, effective mitigating actions from our neurological community to reduce, significantly, our annual contribution to CO_2 emissions have been scarce. The lack of effective action may also be at least partly due to an underestimation of the seriousness of the climate crisis or, underestimation of the weight of our own contribution. In fact, no studies have looked specifically at the neurological community's contribution to CO_2 emissions from conference attendance. Therefore, we aimed to provide the neurologists with a conservative estimate of their annual CO_2 emissions from in-person attendance at some of their main conferences worldwide.

Methods

A Google search was conducted to assess the number of attendees at some major international neurological conferences that occurred worldwide over a 12 month period in 2022/2023. The one year time frame was chosen because the Paris agreement recommendations are for annual emissions.[10]

The search words were 'American Academy of Neurology or American Neurological Association, European Academy of Neurology, World Federation of Neurology, Stroke, World Stroke conference, European Stroke Organization, Multiple Sclerosis, ECTRIMS, ACTRIMS, Consortium of Multiple Sclerosis Centre, Neuromuscular diseases, International Congress on Neuromuscular Diseases, World Muscle Society, AANEM, Alzheimer's Association International Conference, Alzheimer Europe.'

Inclusion was restricted to conferences for which the number of in-person attendees was available.

A precise estimate of the carbon emissions for each attendee would have required details of the country of origin and travel arrangements of each attendee at each conference, which were not available. Because of that, we calculated the CO_2 emissions per capita for each attendee, by obtaining the mean of the values published in four studies of non-neurological conferences (Table 1):

1. The study by Leddin et al.[12] calculated the travel-related emissions of the Canadian attendees at two main annual meetings of the Canadian association of gastroenterologists, one in Toronto and one in Banff, with 534 and 502 Canadian attendees, respectively. Transport included long-haul and short-haul flights, train, car and coach.
2. In the study by Klower et al,[13] calculations were based on the emissions of 28,000 attendees at the Fall meeting of the American Geophysical Union, held in San Francisco, the world's largest Earth- and space-science conference. "Seventy-five per cent of the emissions were generated by intercontinental flights for one-way distances greater than 8,000 km…"
3. Burtsher et al.[14] calculated the emissions of 1,240 attendees at the annual European Astronomical Society in Lyon who travelled by European or intercontinental flights, and train.
4. Gattrell et al.[15] calculated the carbon emissions of 1,723 anticipated in-person attendees to four conferences: American Society of Clinical Oncology [ASCO], European Neuroendocrine Tumor Society [ENETS], European Society for Medical Oncology [ESMO], World Congress for NeuroRehabilitation [WCNR]). Calculations included travel, accommodation and congress attendance. "Travel accounted for 91–96% of total emissions, mainly through long distance and business-class air travel."

The total CO_2 emissions from all attendees at the neurological conferences was then compared to the annual tCO_2/person in various countries world-wide on the Global Carbon Atlas.[16]

Results

Thirteen neurological international conferences were identified. These occurred in eight countries (five in the United States, six in Europe and two in Canada) across two continents (North America and Europe) (Table 2). The total number of in-person attendees was 47,956 (mean 3688.9; range 1000 to 8639 per conference).

The average tCO_2/person emissions for conference attendance across the four reference studies was calculated at 1.96 (Table 1).

Table 1: Estimated tCO_2 emissions per person (tCO_2/person) for conference attendees

ARTICLE	CONFERENCE	tCO_2/person
Burtscher et al. 2020	European Astronomical Society	1.85
Klöwer et al. 2020	Fall Meeting of the American Geophysical Union	3.0
Leddin et al. 2022	Canadian association of gastroenterologists CDDW Toronto	0.54
	CDDW Banff	0.76
Gattrell et al. 2022*	ASCO, ENETS, ESMO and WCNR	1.89
Average		**1.96**

*Ipsen company attendees to 4 conferences: American Society of Clinical Oncology (ASCO), European Neuroendocrine Tumor Society (ENETS), European Society for Medical Oncology (ESMO), and World Congress for Neurorehabilitation (WCNR).
t = metric tonne

Table 2: Number of Attendees At 13 Major Neurological Conferences

CONFERENCE	SITE	YEAR	ATTENDEES	ESTIMATED total at 1.96 tCO2/person
American Academy of Neurology	Seattle	2022	8344	
European Academy of Neurology	Budapest	2023	5748	
World Federation of Neurology	Montreal	2023	2300	
World Stroke conference	Toronto	2023	3600	
European Stroke Organization	Munich	2023	4000	
ECTRIMS/ACTRIMS	Milan	2023	8639	
Consortium of Multiple Sclerosis Centre	Nashville	2023	1890	
ACTRIMS	San Diego	2023	1270	
International Congress on Neuromuscular Diseases	Brussels	2023	1465	
World Muscle Society	Charleston	2023	1000	
AANEM	Phoenix	2023	1700	
Alzheimer's Association International Conference	Amsterdam	2023	7000+	
Alzheimer Europe conference	Helsinki	2023	1000+	
Total			**47956**	**93994**

AANEM = American Association of Neuromuscular and Electrodiagnostic Medicine
ACTRIMS = American Committee for Treatment and Research in Multiple Sclerosis
ECTRIMS = European Committee for Treatment and Research in Multiple Sclerosis
t = metric tonne

The total tCO2 emissions was then calculated at 93,994 (1.96 tonnes x 47,956 attendees).

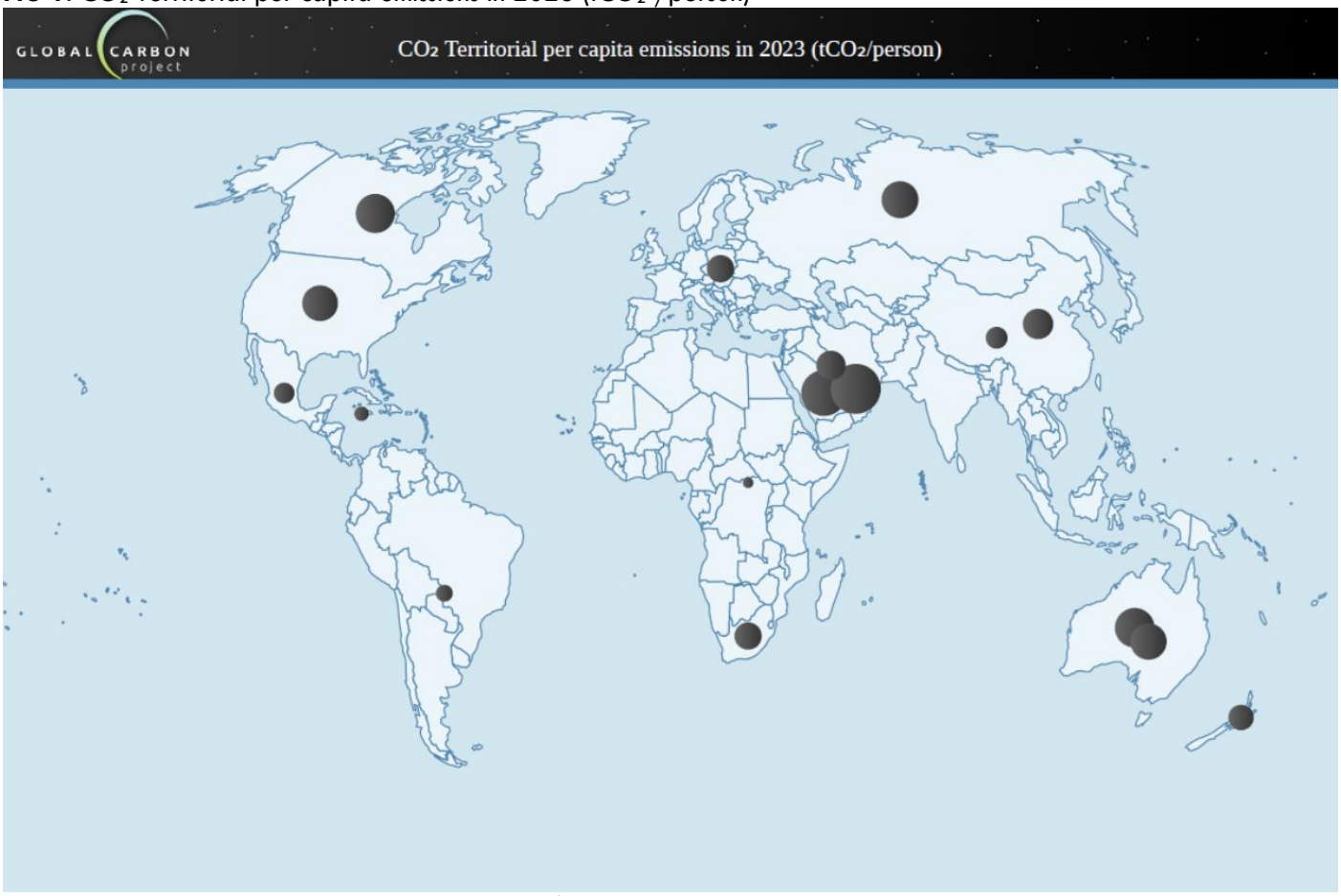
On the Global Carbon Atlas (2023), this equated to the annual CO_2 emissions per capita of >2.0 million people in several African countries (or, using a different analogy, more than a third of the annual tCO_2 emissions of the entire population of some African countries, such as, the Central African Republic), 313.313 people in Afghanistan, 134.277 in Bangladesh and, on average within territorial regions, 93.994 persons in Africa, 49.470 in Central America, 44.759 in India, 14.000 in Europe, 11.324 in China, 7800 in North America or Oceania, 7.200 in the Russian Federation, or 6.700 in Canada (Fig 1).

Many duplications in scientific contents and learning activities were noted across the conferences, which were annually staged by different Societies, as well as many repetitions of content from one year to another (although these observations were not systematically analysed).

Discussion

This estimate of the annual CO_2 emissions produced by in-person attendance at 13 major neurological conferences is quite staggering, particularly if compared to the annual per capita emissions of some of the world's lowest-income countries. It should be noted that the latter include some of the communities that are most affected by the climate crisis.

FIG 1: CO_2 Territorial per capita emissions in 2023 (tCO_2 /person)



The larger the black bubble the higher the tCO_2 /person for that country. In descending order, the annual CO_2 emissions per capita in the regions and/or countries which contain the bubble were:
Arab Emirates = 24; Saudi Arabia = 20; Australia = 15; Canada = 14; Russian Federation = 13; North America and Oceania = 12; China = 8.3; Middle East = 7.8; Europe and South Africa = 6.7; New Zealand = 5.8; Asia = 4.2 ; Mexico = 3.8; South America = 2.5 ; India = 2.1 ; Central America = 1.9 ; Africa = 1 ; Bangladesh = 0.7 ; Afghanistan = 0.3; Dem Rep Congo = <0.02

Modified from the Global Carbon Atlas 2023[16]

The CO_2 emissions calculated in this study represent only the partial contribution of a single medical discipline, and as such, only a small part of the total carbon footprint of thousands of in-person academic events each year. Our neurological community and the medical community in general should acknowledge and consider this sober realisation.

Conferences are important to share and acquire knowledge, and to establish connections between people with common research and professional interests. Conferences have been traditionally held with in-person attendance. However, in-person attendance has been questioned over the past few decades on the grounds of environmental cost and inclusivity.[17,18] On this note, it may also be of interest that none of the conference venues included in this study were in the countries most impacted by the climate crisis and, although a systematic analysis of conference attendance by country was not possible due to insufficient data on the demographics of the attendees, the representation from low economy communities was generally very poor. This raises fundamental issues of equity in education and exchange of scientific knowledge.

The disastrous effects of climate change on health are undisputed.[1,2] This should create an ethical dilemma for medical professionals attending conferences.

Global policies to contain the progression of climate change within the adaptability of the human system demand a reduction in carbon emissions in all sectors. There is no reason why the medical academia community should be exempt.[6] In fact, medical professionals have a special responsibility to lead by example. The experience during the COVID-19 pandemic restrictions provided ample demonstration that virtual meetings can effectively meet all the demands of our scientific community.[19-22] With regard to neurology in particular, the biannual World Congress of Neurology, held in Rome in 2021 as a fully virtual event, was considered a great success with over 4,400 participants from 120 countries, "more than 270 speakers and experts", participating in a scientific program consisting of "more than 150 scientific sessions presented in different formats – plenary lectures, scientific sessions, teaching courses, free communication sessions and regional symposia" (WCN 2021 Postscript). So, we also have successful models of virtual conferences to refer to, to help the transition away from on-site meetings.

Under the current circumstances, until a viable solution is found for sustainable long-distance travelling,

neurologists should consider transitioning to more sustainable practices to reduce their carbon footprint. The most effective measure would be to make virtual events the norm and in-person events significantly reduced.[23] However, there are other more amenable options that could be considered in the meantime, that would still achieve a significant reduction of carbon emission in comparison to the traditional modus operandi.[11] For example:

- Reducing the number of large international annual conferences by holding them every second or third year and alternating the in-person or hybrid conference with on-line events, lectures or courses;
- Increasing the use of the hybrid model for the main conferences, which offers both in-person and digital attendance, thus reducing the number of attendees who travel, while also improving conference accessibility;
- finding conference venues that minimise the travel distance for most participants, or offering multi-hub conferences so attendees travel to the closest hub; and/or
- mainstreaming the practice of medical institutions allocating travel budgets or carbon budgets as part of institutional sustainability policies , in order to cap the number and distance of flights taken by academics in each department. The process of allocating the available budget amongst staff could also help to prioritise sending early career academics to conferences to present their research. In addition to the environmental advantages, these measures would reduce significantly the economic cost of scientific interaction, thus addressing the compelling issue of current inequalities in education and the sharing of medical knowledge

A systematic discussion of advantages and limitations of on-site vs. virtual or hybrid conferences (including measures to avoid a potential rebound effect where greater uptake of online and hybrid meetings leads to greater energy use/new environmental loads in unanticipated areas) is beyond the scope of this article, as are other considerations, such as duplication of scientific and learning materials across conferences and over subsequent years. We recommend these all as topics of future studies that could provide valuable insights in the restructuring of future events.

Despite its limitations (including the calculation of the CO_2 per capita emissions, which was based on literature values, and the criteria of inclusions that restricted the analysis to a limited number of annual neurological events), this analysis shows alarming figures that should generate concern in the neurological and general medical community. While it is true that effective changes require collective global actions agreed between states, it is also clear that actions will not occur without cultural changes that motivate a transition to more sustainable behaviours. Evidence-based action from professional communities may play a significant role in this respect.

Conclusions

The annual contribution to carbon emissions by in-person attendance at neurological conferences was calculated conservatively at 93,994 tonnes. These staggering figures only represent a partial contribution from our discipline. This simple analysis based on literature values to calculate carbon emissions by attendee shows alarming figures that should generate concern in the neurological and general medical community. In the context of a climate crisis "that is fundamentally a health crisis" requiring urgent mitigating actions, neurologists should carefully review their methods for education and knowledge exchange.

Declaration

We confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

The authors have no potential conflicts of interest to be disclosed

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