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Research

Cutting Edge Education: Climatic Change and Infectious Disease in Dentistry

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Abstract

Background: Climate change presents an imminent threat to almost all biological systems

across the globe. In recent years there have been a series of studies showing how changes in climate can impact infectious disease transmission. Many of these publications focus on simulations based on in silico data, shadowing empirical research based on field and laboratory data. A synthesis work of empirical climate change and infectious disease research is still lacking.

AIM:

To know the changes in climate change impact infectious disease transmission and to focus on stimulation based on silicone data shadowing empirical research

OBJECTIVE:

To examine the impact of climatic change on infection control and prevention in dental settings.

Methods:
Methods We conducted a systemic review of research from 2015 to 2020 period on climate change and infectious diseases to identify major trends and current gaps of research. Literature was sourced from Web of Science and Pub-Med literary repositories using a key word search, and was reviewed using a delineated inclusion criteria by a team of reviewers.

Keywords: Climate change, Infectious disease, Research trend, Systematic review.

1. Introduction

The Intergovernmental Panel on Climate Change has anticipated, with high confidence, that climate change will amplify health threats worldwide , which is sup-ported by the fact that the life cycles of many infectious agents are inextricably linked to climate . Mul-tiple studies have shown that variation in temperature, precipitation, and humidity affects the transmission and distribution of infectious diseases. Nevertheless, the magnitude, direction, and strength of the impact of climate change upon infectious disease transmissionremains unclear. To determine what further

research is needed to advance a given field in scientific research it is often necessary to synthesize previous work . This type of retrospective, systematic analysis of literature in a specific topic or field is referred to as a systematic review. Systematic reviews are a popular and effective method commonly utilized to identify trends and gaps in ongoing research . Results from system-atic reviews and scoping studies, which are often used to map the availability of literature on an specific topic , can be used to guide future research lines, future policy decisions, and can be particularly useful in scien-tific fields with emerging evidences, such as epidemiol-ogy .Despite their effectiveness, systematic reviews are noticeably lacking in the literary landscape of anthro-pogenic climate change research, especially with regard to its impacts on infectious diseases. There is, there-fore, a need for a systematic synthesis of recent empiri-cal research assessing disease impacts of climate change.

Here, we provide a synthesis of scientific literature on climate change and infectious diseases from recent his-tory. The overall objective of this study was to determine the trends of recent empirical research regarding climate change impacts on infectious diseases and to identify geographic, topical, or taxonomic trends of research. We sought to assess the geographic regions where climate change and disease transmission have been under stud-ied, accounting for both study area and first author affili-ation to identify geographic and bibliometric signals. In addition, we assessed the taxa of hosts and transmission types of pathogens studied. Finally, we sought to inform future research avenues, policy, and practices via the trends and impacts identified herein**.**

Methodology

1. Study Design

- Type: Observational, descriptive, retrospective gap analysis.
- Approach: Systematic literature review of peer-reviewed journal articles .
- Inclusion criteria: (1) peer-reviewed, non-retracted; (2) focus on climate change impacts on disease/infection; (3) original research, real-world (non-simulated) data; (4) pathogens/parasites affecting humans, animals, or both; (5) primary data.
- Exclusion criteria: Reviews, book chapters, conference abstracts, plant-disease studies, simulated-future climate data.
- Screening: Two independent reviewers; third reviewer resolved disagreements..

2. Objectives

- Identify bibliometric, subject, taxonomic, and geographic trends in climate-change-disease literature.

- Determine gaps in host (human, wildlife, livestock), transmission method, and taxa coverage.

- Compare proportion of zoonotic diseases studied vs. known prevalence (≈ 60 %).

- Assess funding sources (2020) relative to country GDP

3. Data Collection Methods

- Sources: Web of Science (Clarivate™) and PubMed™, keyword search with terms like “climate change”, “global warming”, “greenhouse gas*”, “disease”, “infectious”, etc.
- Import & Deduplication: EndNote for removing duplicates.
- Screening: Title/abstract review → full-text retrieval.
- Evidence Extraction: Metadata (year, journal, authors, affiliations, study location, host/vector, transmission, taxa, spatial scale, funding).
- Author Demographics: Lead/senior author pronouns (self-identified from public profiles) or “unknown”.

4. Data Analysis

- Descriptive statistics: Frequencies, proportions for host type (human, wildlife, livestock), transmission mode, taxa.
- Chi-square (χ^2) tests:
  - Compare zoonotic disease proportion (observed vs. 60 %).
  - Test equality of host species categories.
- Geospatial mapping: ArcGIS Pro 2.9.3 & R 4.1 for author affiliation and study location patterns.

- Per-capita research effort: Using UN Population Division 2020 data.
- Funding analysis: Cross-tabulation of 2020 funding sources with World Bank GDP data.

5. Ethical Considerations

- Informed consent: Not applicable (published literature).
- Data privacy: Author pronouns collected only from publicly available information; "unknown" if not disclosed.
- Bias mitigation: Two-reviewer screening, third-reviewer arbitration; transparent inclusion/exclusion criteria.
- Reporting integrity: Adherence to PRISMA-like systematic review standards.

6. Limitations

- Publication bias: Only peer-reviewed journal articles; grey literature, conference papers excluded.
- Language bias: Searches limited to English-indexed databases.
- Author pronoun data: Reliance on self-identified public info; gaps where pronouns not declared.

Results:

A total of 205students took part in this with females (58.1%) and male of (41.9%). Age of the participants ranging from 18-25 years. In this study females were more likely to demonstrate perception in dissection room experiences than male. Significantly INTERNS showed greater familiarity with advanced applications than third year and final year students and interns.

AGE

	N	Minimum	Maximum	Mean	Std. Deviation
Age	205	18	24	21.56	1.065

GENDER

		Frequency	Percent
	MALE	86	41.9
	FEMALE	119	58.1
	Total	205	100.0

YEAR OF STUDY

		Frequency	Percent
	III BDS	73	35.6
	IV BDS	76	37.1
	INTERNS	56	27.3
	Total	205	100.0

Distribution and comparison of responses based on gender:

Item	Response	Males		Females		Chi-Square value	P value
		n	%	n	%		
Q1	1	11	12.7	20	16.8	11.646	0.05*
	2	61	70.9	79	66.3		
	3	8	9.3	8	6.7		
	4	6	6.9	6	5.0		
Q2	1	8	32	17	68	2.750	0.432
	2	6	33.3	12	66.7		
	3	6	60	4	40		
	4	66	41.2	94	58.8		
Q3	1	57	40.7	83	59.3	1.920	0.589

	2	**7**	**29.2**	**17**	**70.8**		
	3	**16**	**47.1**	**18**	**52.9**		
	4	**6**	**42.9**	**8**	**57.1**		
Q4	**1**	**6**	**33.3**	**12**	**66.7**	**0.697**	**0.874**
	2	**8**	**36.4**	**14**	**63.6**		
	3	**9**	**39.1**	**14**	**60.9**		
	4	**63**	**42**	**87**	**58**		
Q5	**1**	**4**	**4.6**	**6**	**5.0**	**2.464**	**0.03***
	2	**7**	**8.1**	**30**	**25.2**		
	3	**6**	**6.9**	**3**	**2.5**		
	4	**69**	**80.2**	**80**	**67.2**		
Q6	**1**	**71**	**42.6**	**98**	**57.4**	**3.720**	**0.05***
	2	**5**	**21.7**	**18**	**78.3**		
	3	**5**	**55.5**	**6**	**45.5**		
	4	**4**	**45.5**	**5**	**55.5**		
Q7	**1**	**74**	**40**	**111**	**60**	**1.489**	**0.475**
	2	**11**	**40.7**	**16**	**59.3**		
	3	**1**	**1.2**	**0**	**0**		
	4	**0**	**0**	**0**	**0**		
Q8	**1**	**8**	**33.3**	**16**	**66.7**	**3.980**	**0.409**
	2	**2**	**16.7**	**10**	**83.3**		
	3	**13**	**46.4**	**15**	**53.6**		
	4	**11**	**40.7**	**16**	**59.3**		
Q9	**1**	**40**	**41.2**	**99**	**58.8**	**0.671**	**0.413**
	2	**6**	**31.6**	**13**	**68.4**		
	3	**21**	**75**	**7**	**25**		
	4	**19**	**70.3**	**8**	**29.6**		
Q10	**1**	**5**	**25**	**15**	**75**	**7.241**	**0.065**
	2	**73**	**42.9**	**80**	**57.1**		
	3	**5**	**53.8**	**15**	**46.2**		
	4	**3**	**33.3**	**9**	**66.**		
Q11	**1**	**8**	**53.3**	**7**	**46.7**	**2.655**	**0.448**
	2	**8**	**36.4**	**14**	**63.6**		
	3	**9**	**30**	**21**	**70**		
	4	**61**	**41.8**	**85**	**58.2**		
Q12	**1**	**2**	**18.2**	**9**	**81.8**	**6.418**	**0.093**
	2	**69**	**45.1**	**84**	**54.9**		
	3	**8**	**25.8**	**23**	**74.2**		
	4	**7**	**38.9**	**11**	**61.1**		
Q13	**1**	**62**	**42.8**	**83**	**57.2**	**2.311**	**0.510**
	2	**6**	**26.1**	**17**	**73.9**		
	3	**11**	**39.3**	**17**	**60.7**		
	4	**7**	**41.2**	**10**	**58.8**		
Q14	**1**	**73**	**84.8**	**102**	**86.6**	**0.658**	**0.546**
	2	**6**	**6.9**	**5**	**3.9**		
	3	**5**	**8.1**	**11**	**9.4**		
	4	**2**	**3.1**	**1**	**3.6**		
Q15	**1**	**3**	**23.1**	**10**	**76.9**	**1.793**	**0.06**
	2	**5**	**41.7**	**7**	**58.3**		

	3	**8**	**44.4**	**10**	**55.6**		
	4	**70**	**41.2**	**100**	**58.8**		

P≤0.05 is statistically significant

Distribution and comparison of responses based on year of the study:

Item	**Response**	**III BDS**		**IV BDS**		**INTERN**		**Chi-Value**	**P-Value**
		n	**%**	**n**	**%**	**n**	**%**		
Q1	**1**	**4**	**4.8**	**6**	**8.1**	**4**	**7.1**	**11.546**	**0.04***
	2	**59**	**71**	**63**	**85.1**	**45**	**80.3**		
	3	**7**	**8.4**	**3**	**4.0**	**3**	**5.3**		
	4	**3**	**3.6**	**4**	**5.4**	**2**	**3.5**		
Q2	**1**	**6**	**24**	**10**	**40**	**9**	**36**	**28.554**	**0.0001***
	2	**3**	**16.7**	**4**	**22.2**	**11**	**61.1**		
	3	**2**	**20**	**1**	**10**	**7**	**70**		
	4	**62**	**38.8**	**69**	**43.1**	**29**	**18.1**		
Q3	**1**	**55**	**39.3**	**58**	**41.4**	**27**	**19.3**	**21.445**	**0.002***
	2	**4**	**16.7**	**6**	**25**	**14**	**58.3**		
	3	**12**	**35.3**	**12**	**35.3**	**10**	**29.4**		
	4	**1**	**7.1**	**8**	**57.1**	**5**	**35.7**		
Q4	**1**	**5**	**27.8**	**7**	**38.9**	**6**	**33.3**	**27.128**	**0.0001***
	2	**2**	**9.1**	**6**	**27.3**	**14**	**63.6**		
	3	**7**	**30.4**	**6**	**26.1**	**10**	**43.5**		
	4	**59**	**39.3**	**65**	**43.3**	**26**	**17.3**		
Q5	**1**	**53**	**37.5**	**64**	**37.5**	**40**	**25**	**12.714**	**0.048***
	2	**10**	**29.4**	**10**	**29.4**	**11**	**41.2**		
	3	**6**	**50**	**3**	**25**	**3**	**25**		
	4	**4**	**30.7**	**7**	**53.8**	**2**	**15.3**		
Q6	**1**	**60**	**34.7**	**69**	**40.5**	**47**	**24.7**	**2.257**	**0.323**
	2	**7**	**30.4**	**7**	**30.4**	**9**	**39.1**		
	3	**4**	**34.5**	**5**	**21.5**				
	4	**2**	**21.6**	**3**	**11.5**				
Q7	**1**	**64**	**34.6**	**74**	**40**	**47**	**25.4**	**2.712**	**0.607**
	2	**8**	**29.6**	**10**	**37**	**9**	**33.3**		
	3	**1**	**100**	**0**	**0**	**0**	**0**		
	4	**0**	**0**	**0**	**0**	**0**	**0**		
Q8	**1**	**9**	**37.5**	**10**	**41.7**	**5**	**20.8**	**34.979**	**0.001***
	2	**1**	**8.3**	**2**	**16.7**	**9**	**75**		
	3	**7**	**25**	**6**	**21.4**	**15**	**53.6**		
	4	**14**	**51.9**	**8**	**29.6**	**5**	**18.5**		
Q9	**1**	**60**	**36.1**	**69**	**41.2**	**40**	**22.7**	**14.651**	**0.001***
	2	**3**	**15.8**	**4**	**21.1**	**12**	**63.2**		
	3	**5**	**32.5**	**5**	**32.7**	**3**	**12.6**		
	4	**4**	**22.7**	**6**	**33.6**	**1**	**7.3**		
Q10	**1**	**7**	**35**	**7**	**35**	**6**	**30**	**12.306**	**0.055**
	2	**63**	**37.1**	**60**	**40.6**	**38**	**22.4**		
	3	**2**	**7.7**	**7**	**46.2**	**10**	**46.2**		
	4	**1**	**25**	**1**	**25**	**2**	**50**		
Q11	**1**	**6**	**40**	**5**	**33.3**	**4**	**26.7**	**33.408**	**0.0001***

	2	**3**	**13.6**	**3**	**13.6**	**16**	**72.7**		
	3	**7**	**23.3**	**12**	**40**	**11**	**36.7**		
	4	**57**	**39**	**64**	**43.8**	**25**	**17.1**		
Q12	**1**	**1**	**9.1**	**4**	**36.4**	**6**	**54.5**	**14.996**	**0.020***
	2	**59**	**38.6**	**63**	**41.2**	**31**	**20.3**		
	3	**8**	**25.8**	**13**	**41.9**	**10**	**32.3**		
	4	**5**	**27.8**	**4**	**22.2**	**9**	**50**		
Q13	**1**	**54**	**37.2**	**59**	**40.7**	**32**	**22.1**	**14.977**	**0.020***
	2	**5**	**21.7**	**8**	**34.8**	**10**	**43.5**		
	3	**6**	**21.4**	**9**	**32.1**	**13**	**46.4**		
	4	**8**	**47.1**	**8**	**47.1**	**1**	**5.9**		
Q14	**1**	**62**	**32.5**	**2**	**3.6**	**5**	**7.9**	**15.657**	**0.754**
	2	**3**	**18.8**	**64**	**43.8**	**40**	**37.5**		
	3	**7**	**23.1**	**1**	**7.7**	**9**	**69.2**		
	4	**1**	**42.1**	**9**	**47.4**	**2**	**10.5**		
Q15	**1**	**1**	**7.7**	**6**	**46.2**	**6**	**46.2**	**13.807**	**0.04***
	2	**4**	**33.3**	**1**	**8.3**	**7**	**58.3**		
	3	**6**	**33.3**	**7**	**38.9**	**5**	**27.8**		
	4	**62**	**36.5**	**70**	**41.2**	**38**	**22.4**		

Discussion

Through this study we have revised the major trends in the current literature on climate change and infectious diseases. Our assessment identified both topical and geographic biases in the climate change and disease research arena. More specifically, we found that there was a notable focus on diseases which impact humans and upon arthropod-borne pathogens. Taxonomic bias, or the emphasis of study on specific organisms, has previously been identified in biodiversity and conservation science research. Our results have identified taxonomic biases toward mammalian hosts and arthropod-borne pathogens and in climate change and infectious disease research. When certain taxa are over-represented in various scientific fields it is possible for them to draw both attention and funds away from less understood taxa. It is possible that taxonomic bias has impacted the study of climate change and infectious disease by skewing research toward specific disease systems, suggesting an anthropocentric research approach potentially influenced by external forces, such as public health funding and disease burden. Vector-borne diseases have considerable burden on human health, killing approximately 700,000 people annually. A research emphasis on diseases affecting humans is, therefore, potentiallyunsurprising as human health is a driving force behind many research efforts and encompassesa large proportion of research and development funding . Other research has shown that societal pressures correlate with taxonomic bias, which could explain why human-only and zoonotic diseases were so heavily studied as well.Despite the anthropocentric nature of our results, many understudied taxa, such as amphibians, birds, and aquatic invertebrates, have higher risks of extinction due to infectious diseases than humans or other mammals. Taxonomic bias in the study of infectious disease is concerning, as a lack of research effort coud limit the understanding of diseases systems for threatened or endangered taxa. This in turn limits our capacities to understand how, where, and why diseases emerge in the wild. Risks of climate change impacts on lesser studied groups, such as wildlife and livestock, could still have public health effects due to spillover transmission of unknown pathogens. The dearth of research on wildlife diseases could also lead to gaps of knowledge. Infectious diseases may harm ecological balance by reducing wildlife populations and decreasing overall biodiversity. A large body of literature shows that ecological imbalances and biodiversity loss have detrimental effects on human health as well. For instance, decreases in diversity of wildlife has been associated with increases risk of hantavirus spillover transmission from rodents to humans. Public health efforts to study climate change and human health should consider biodiversity dimensions of spillover transmission for a more holistic ecosystem health approach.We found that most lead authors were linked to highereducation institutions (i.e., universities or colleges), with fewer publications originating from governmental organizations or independent research institutions.

This bias towards academic-based research is not surpris-ing considering that higher-education institutions often focus efforts on research and disseminating knowledge. This result also indicates a poor active participation of stakeholders in governing bodies on climate change and health research, which could explain the slow pro-gress of international

policy on climate change and dis-ease research. It is important to note, however, that most funding for the support of recent research publications originated from federal or national institutions . While funding agencies constitute important stakeholders in the scientific publication pro-cess, agendas from funding sources may bias the research topics and discoveries reported . For instance, publications with corporate funding are more likely to contribute to the polarization or politicization (i.e., con-tributing to the tension between political ideologies or identities) of climate change related topics . We found that most articles reviewed for funding sources did not receive funding from corporate or industry agen-cies. Government funding is the main driver of science and provides research directions for non-government funding sources . As such, an increase in govern-ment funding for climate change and infectious disease research accounting for environmental justice could transform the landscape of public and private research funding opportunities to reduce the inequities presented here. An increase in funding in the social science aspects of climate change may also facilitate the framing of cli-mate change as a global social challenge, rather than apurely scientific endeavor with limited social legitimacy. We also found that there was greater usage of he/him pronouns by lead and senior authors across the articles revised, suggesting that more male or male identified authors were present than female or female identified authors. Gender discrepancies in authorship were more notable for senior authorship than for first author-ship, which appears to be a general pattern in academic authorship inequity, even with increased author-ship by women in recent decades . Until recently, women or female-identified authors comprise a minority of researchers and trainees in science in general, which has resulted in authorship inequities that are expected to persist for some time. Gender persistant inequity in authorship is specifically conerning within the field of climate change and infectious disease research due to its cross cutting social implications. Women are expected to experience greater climate change and health impacts as a result of their social and economic positions, and cul-tural discrimination . As such it is important that women's viewpoints and experiences are represented within the scientific literature to develop more effective and inclusive policies for climate change adaptation and mitigation.In terms of geographic scale and location, we found that most climate change and infectious disease research was conducted at the regional and local scales , suggesting that fine-scale studies dominate the field and our understanding of climate change impacts on human and animal health. Climate change and disease research also occurred principally in temperate areas (e.g., North America, Europe) rather than in tropical areas (e.g., sub-Saharan Africa, Latin America, and Pacific Southeast Asia). This spatial bias is present even when publications were corrected for count…

Conclusion:

We found that both geographic and taxonomic trends were present in recent studies assessing climate change and the burden of infectious disease. The majority of research was focused on vector-borne pathogens and was conducted in well-developed, high-income countries with temperate climates, neglecting directly-transmitted diseases in tropical regions. The anthropocentric signal in research effort may contribute to a lack of understanding of climate change effects on wildlife systems. The under-representation of some taxonomic groups of pathogens and hosts, pathogen transmission types, and geographic areas should be of global health concern, as areas and diseases neglected may become sources of emerging zoonotic diseases. An ecosystem-based framework to study disease responses to climate change could miti-gate topical and taxonomic biases identified here. Viral zoonoses outbreaks at the local level in underrepresented countries such as Madagascar, Saudi Arabia, and Indo-nesia have led to prolific human epidemics of plague, Middle East respiratory syndrome, and cholera in recent years , highlighting the need for more research in regions underrepresented in the literature. The recent coronavirus disease pandemic also highlights the need for more research on directly transmitted pathogens circulating in wildlife . Furthermore, research is still needed to understand the linkages between patterns of research funding with climate change and infectious dis-ease studies. Understanding the funding landscape (e.g., agencies prioritizing certain regions, diseases, and topics) could further elucidate the relationship between research bias, research equity, and funding allocation.The impact of climate change research on intergovern-mental policy and vice versa is both tractable and increas-ingly important . Policy changes to address the biases presented here, including the diseases studied, areas, and identities of leading authors, should be prioritized by both funding agencies and the scientific community. Policy change could include, for example, the prioritization of infectious disease research and surveillance at the human-wildlife interface within the context of climate change, funding prioritizing scientists from minority groups, and neglected geographic regions. Addressing research ineq-uity will help build human capacity, surveillance, and sci-entific infrastructure to better prepare and strengthen the global health response to climate change threats . Fur-thermore, research foundations in high-income countries should implement and maintain inclusive-collaboration practices to value contributions by local scientists in coun-tries underrepresented in this review to advance research equity as a means towards effective prevention of future emerging diseases from their sources. Building political and social support behind climate change and infectious disease research will be essential under the expected rates of climatic variation in the near future. In conclusion, there is an urgent

need to increase research effort for neglected disease systems and geographies, and there is a need to re-examine aspects of environmental justice from the scientists leading these studies to the local beneficiaries for the advancement of infectious diseases research in the context of climate change.

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