Ciencia y Humanismo en la Salud 2023, Vol. 10, No 3, pp 57-62
http://revista.medicina.uady.mx

Editorial

Cambio climático y enfermedades comunicables: doble reto para la salud pública

Climate change and communicable diseases: double challenge for public health

Norma Elena Pérez-Herrera[1], Gaspar Fernando Peniche Lara[1], Héctor Armando Rubio-Zapata[1], Bertha Jiménez-Delgadillo[1]
[1]Facultad de Medicina, Universidad Autónoma de Yucatán, Mérida, Yucatán, México.

The World Health Organization (WHO) considers climate change to be the biggest environmental threat that humanity faces. The main factors contributing to climate change and air pollution are greenhouse gases derived from the extraction and burning of fossil fuels. It is estimated that carbon emissions and air pollution cause 7 million premature deaths per year (1). There is no doubt that climate change is already impacting both the livelihoods and the physical and mental health of people, with extreme weather events (heatwaves, storms, and floods), waterborne and foodborne diseases, disruption in food production, increased zoonotic diseases, and vector-borne diseases causing both deaths and illnesses (2). Neglected infectious diseases and vector-borne diseases are communicable diseases related to poverty and health disparities (3).

Climate change is evidenced by the increase in temperature, it produces heavy rainfall in some areas and droughts in others, extreme weather phenomena and rising sea levels. These environmental changes have a direct impact on food production, access to clean water, and worker productivity, posing a risk to public health. In addition, temperature variations, heatwaves, changes in rainfall patterns and droughts favor the increase of disease-transmitting vectors and infectious agents present in water and food, as well as allergic and respiratory conditions (4). In a bulletin issued in 2020, the World Health Organization (WHO) reported that vector-borne diseases account for more than 17% of all infectious diseases and annually cause over 700,000 deaths. For example, it is estimated that there are 219 million cases of malaria worldwide each year, resulting in approximately 400,000 deaths, mainly in children under the age of 5; dengue, the most common viral infection transmitted by mosquitoes, puts approximately 3.9 billion people in over 129 countries at risk of infection, with approximately 96 million symptomatic cases and 40,000 deaths reported annually (5). In the last 50 years, the incidence of dengue has increased globally by 0.19%, rising from 0.083% in 1990 to 0.27% of new cases in 2017; deaths from this disease have increased by 138%, a significant change in less than 30 years, from 16,957.28 deaths in 1990 to 40,467.63 in 2017. In Mexico, the incidence of dengue increased from 0.024% to 0.21% from 1990 to 2019 (6).

Other mosquito-borne diseases include chikungunya, Zika, yellow fever, West Nile fever, and Japanese encephalitis. In addition, diseases transmitted by other vectors such as ticks, lice, and arthropods, among others, not only increase overall morbidity and mortality rates but also burden healthcare systems, especially in low-income countries or among poor populations. In tropical and subtropical countries, diseases such as leishmaniasis and filariasis cause chronic suffering, lifelong morbidity, disability, and stigmatization, highlighting the impact these diseases have on public health (5).

The report of Working Group II of the Intergovernmental Panel on Climate Change (IPCC) in the Sixth Assessment Report presents information showing that extreme and variable unusual temperatures attributed to climate change increase mortality and morbidity rates in

Autor de Correspondencia: Bertha Jiménez-Delgadillo.
Correo electrónico: jdelgad@correo.uady.mx

North America. Adaptation plays a crucial role in reducing heat-related deaths, and the magnitude of this impact may vary by age, gender, location, and socioeconomic factors. The report by IPCC integrates studies showing that climate change creates environmental conditions such as high temperatures that favor the geographical expansion of vectors (previously concentrated in tropical areas), increasing the risk of exposure to diseases they transmit, such as ticks, triatomine bugs, and mosquitoes. As a result, diseases such as Lyme disease, West Nile virus, chikungunya, and dengue have spread to some regions of North American countries (USA, Canada, and Mexico), and it is projected that they will continue to expand, appearing in areas where they were not previously present and increasing the magnitude of the vulnerable population at risk of contracting climate-related diseases. The report also presents evidence of the relationship between heavy rainfall, water contamination, and the diseases transmitted by contaminated water; infections such as Salmonella, Giardia, and E. coli, among other gastrointestinal diseases, are among the infectious diseases associated with rain and high temperatures. Changes in rainfall, warm temperatures, and extreme weather events can increase the microbial load of pathogens in food (7). The IPCC concludes that the temperature increase should be limited to 1.5°C to prevent catastrophic impacts of climate change on public health and to prevent millions of deaths (7).

It is projected that heat-related deaths will increase in North America because of the combination of climate change, aging population, poverty, chronic diseases, and inadequate public health systems in a region where temperature and precipitation changes are causing changes in the ecosystem that favor the expansion of insects and the risk of exposure to Vector-Borne Diseases (VBD) (7). Regarding the prediction of the dynamics of zoonotic and vector-borne diseases associated with wildlife, this poses many challenges due to the absence or insufficient characterization of host species, pathogens, and vectors in various regions worldwide, as well as changes in their presence in geographical areas and the constant expansion of urbanization (7). In addition to this need, the environmental factor plays a very important role as it modifies the natural dynamics of infection. An example of this is rickettsiosis, which is transmitted by the bite of various species of ticks and fleas. In 2008, an unusual epidemic of Rocky Mountain spotted fever caused by *Rickettsia rickettsii* occurred in Mexicali, Baja California, Mexico, where the identified transmitting vector was the tick *Rhipicephalus sanguineus*, a tick species whose parasitic host is not humans, demonstrating a modification in its presence, distribution, and feeding habits (8). A recently proposed theory is that migration and human development routes around the world have favored the presence of ectoparasites. In addition, modifications in temperature and humidity in the areas have generated adaptations of vectors to new ecological niches. This growth has generated two scenarios of expansion of the risk of transmission of rickettsiosis in Mexico, one in the southeast and another in the northeast of Mexico where, due to climate change caused by humans, a high degree of exposure to rickettsiosis vector may occur (9).

It is projected that by 2030-2050, climate change will cause around 250,000 extra annual deaths from malnutrition, heat stress, diarrhea, and malaria (2). This situation has prompted a global response from countries, as reflected in the Paris Agreement of the United Nations (UN) to strengthen the global response to the threat of climate change in the context of sustainable development and poverty eradication (10).

In this regard, to address this issue, the WHO/PAHO has proposed a "Global Vector Control Response 2017-2030", as a result of an extensive consultation process that began in June 2016 with the aim of achieving its adoption by the Seventieth World Health Assembly in May 2017, to provide countries with guidance to strengthen vector control as a key point in preventing and responding to outbreaks (11).

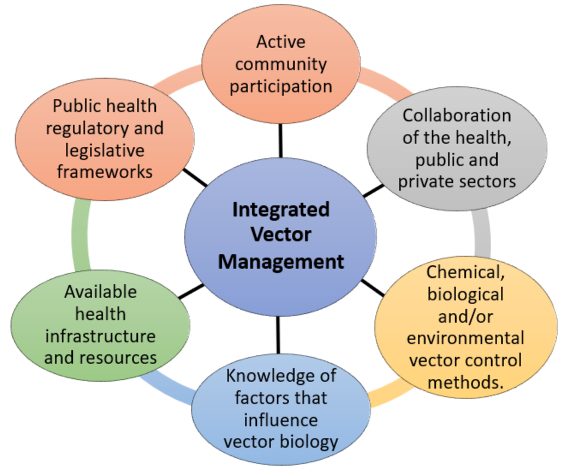
Since climate change directly impacts the fauna related to disease transmission, controlling disease vectors is an urgent priority. This vector

Autor de Correspondencia: Bertha Jiménez-Delgadillo.
Correo electrónico: jdelgad@correo.uady.mx

control is particularly important in developing countries as it can have a huge impact on mortality rates, especially in children. In Mexico, the Official Mexican Standard NOM-032-SSA2-2010 for epidemiological surveillance prevention, and control of vector-borne diseases, establishes in point 6.3, an integrated vector management using two or more methods or tactics for control of vector-transmitted diseases (physical, chemical, biological, biorational and regulatory control), starting with actions of lesser environmental impact, and always considering the use of synthetic chemical agents as a last resort. This NOM also states that "to protect population health and, as far as possible, avoid the risk of transmission of one or more vector-borne diseases, the Ministry of Health, through the National Center for Preventive Programs and Disease Control (CENAPRECE), will recommend the use of effective insecticides for the public health objective they pursue" (12). In addition to the use of pesticides to combat disease-transmitting vectors, there is a demand for private services of urban pest controllers; urban fumigators have little knowledge about the toxicity of pesticides and the policies that apply to their proper handling (13). García-Hernández et al. (2018) reported the effects of pesticides on the environment and exposed populations and recommend the implementation of pesticide registration programs used in the control of agricultural pests and disease-transmitting vectors as a starting point to assess the environmental and human health problems caused by the historical and current use of pesticides in Mexico (14).

The Journal of Science and Humanism in Health has published 17 original research articles on emerging and re-emerging vector-borne diseases, 5 editorial articles, and 4 review articles, which have addressed aspects of the natural history of the disease, the historical evolution of the disease, seroprevalence, transmission vectors, clinical symptoms, socio-economic and cultural determinants, humanism, advances and knowledge gaps. None of them has considered the importance of climate change in the progression of these diseases, the objective of this editorial article. Derived from the proposal "Global Vector Control Response 2017-2030", made by PAHO/WHO, they propose an Integrated Vector Management program (IVM) aimed at contributing to the reduction of the spread of vector-borne diseases and strengthening regional and national capacity for vector prevention and control (15). The IVM proposed by WHO/PAHO is a decision-making process for vector population management, which seeks to optimize and rationalize the use of resources and tools for vector control, with the aim of reducing or interrupting vector-borne disease transmission. The strategy proposed in the IVM is based on the premise that effective control is not the exclusive domain of the health sector but of various public and private organizations and affected communities. The most prominent pillars and attributes of IVM include: the selection of methods based on knowledge of factors influencing the biology of the local vector, disease transmission, and morbidity, and improving surveillance, monitoring, and evaluation of vector control including management of insecticide resistance; the use of a variety of tools and interventions, often in combination and synergistically, as well as evaluating, documenting, and integrating proven or innovative tools and approaches and expanding them on a larger scale when possible and necessary; collaboration between the health

Figure 1. Key points of the Integrated Vector Management (IVM) program proposed by the WHO/PAHO (15).



Autor de Correspondencia: Bertha Jiménez-Delgadillo.
Correo electrónico: jdelgad@correo.uady.mx

sector and other public and private sectors that integrate various levels of action to strengthen interprogrammatic, intrasectoral, and intersectoral performance in vector prevention and control; the committed involvement of government and local and regional communities, including local health services, to ensure sustainable commitment to entomology and vector prevention and control; an adequate regulatory and legislative framework for public health. (figure 1). This comprehensive approach considers the available infrastructure and health resources and integrates all available effective measures, whether chemical, biological or environmental.

Climate change is considered a threat to the advances that have been made in global public health, and it could generate even more health inequities and less climate justice. Regarding vector-borne diseases, it is expected that the increase in temperature will create conditions that favor their expansion to new regions of the planet. Therefore, among the general recommendations for reducing, preventing, and controlling this impact, the authors propose:

- Monitor the commitments of the Paris Agreement and make the necessary adjustments to address the current and future climate situation.
- Evaluate the progress of the Sustainable Development Goals in eradicating vector-borne diseases and zoonoses.
- Reduce and prevent the use of pesticides in vector control to avoid environmental contamination and the risk of associated chronic diseases.
- Train healthcare professionals on the impact of climate change on public health, with an emphasis on zoonotic and vector-borne diseases.
- Follow up on the commitments of the Paris agreement and make the necessary adjustments to address the current and future climate situation.
- Assess the progress of the Sustainable Development Goals in the eradication of vector-borne diseases and zoonoses.

Climate change and communicable diseases represent a double challenge for global public health. The time to act on climate change and global health from all levels and by all stakeholders is now, especially in countries like Mexico where non-communicable and communicable diseases coexist in a geographical region that fosters ecosystem vulnerability and population exposure to the impacts of climate change.

References

1. World Health Organization. Cambio climático y salud [Climate change] [Internet]. [update 2021 Oct 30; cited 2023 Oct 13]. Available from: https://www.who.int/es/news-room/fact-sheets/detail/climate-change-and-health
2. World Health Organization. Climate change. Impact [Internet]. [cited 2023 Oct 13]. Available from: https://www.who.int/health-topics/climate-change#tab=tab_1
3. Molyneux D, Hallaj Z, Keusch GT, et al. Zoonoses and marginalised infectious diseases of poverty: Where do we stand?. Parasites Vectors 4, 106 (2011). https://doi.org/10.1186/1756-3305-4-106
4. Levy, B. S., & Patz, J. A. (2015). Climate Change, Human Rights, and Social Justice. Annals of global health, 81(3), 310–322. https://doi.org/10.1016/j.aogh.2015.08.008)
5. World Health Organization. Enfermedades transmitidas por vectores. Datos y cifras [Vector-borne diseases. Key facts]. [Internet]. [update 2020 Mar 2; cited 2023 Mar 9]. Available from: https://www.who.int/es/news-room/fact-sheets/detail/vector-borne-diseases
6. Stephanie Masetto. Cambio climático y un enemigo más: el dengue . Foreign Affairs Latinoamérica, junio 2020. https://revistafalrevistafal.com/cambio-climatico-y-un-enemigo-mas-el -dengue/
7. Hicke, J.A., S. Lucatello, L.D., Mortsch, J. Dawson, M. Domínguez Aguilar, C.A.F. Enquist, E.A. Gilmore, D.S. Gutzler, S.

Autor de Correspondencia: Bertha Jiménez-Delgadillo.
Correo electrónico: jdelgad@correo.uady.mx

Harper, K. Holsman, E.B. Jewett, T.A. Kohler, and KA. Miller, 2022: North America. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 1929–2042, doi:10.1017/9781009325844.016.IPCC.

8. Foley J, Tinoco-Gracia L, Rodriguez-Lomelí M, Estrada-Guzmán J, Fierro M, Mattar-Lopez E, Peterson A, Pascoe E, Gonzalez Y, Hori-Oshima S, Armstrong PA, Lopez G, Jacome-Ibarra M, Paddock CD, Zazueta OE. Unbiased Assessment of Abundance of Rhipicephalus sanguineus sensu lato Ticks, Canine Exposure to Spotted Fever Group Rickettsia, and Risk Factors in Mexicali, México. Am J Trop Med Hyg. 2019 Jul;101(1):22-32. doi: 10.4269/ajtmh.18-0878. PMID: 31094313; PMCID: PMC6609199.
9. Moo-Llanes DA, Sánchez-Montes S, López-Ordoñez T, Dzul-Rosado K, Segura-Trejo D, Salceda-Sánchez B, Danis-Lozano R. Comparison of Climate Change Scenarios of Rhipicephalus sanguineus sensu lato (Latreille 1806) from México and the Boarders with Central America and the United States. Trop Med Infect Dis. 2023 Jun 4;8(6):307. doi: 10.3390/tropicalmed8060307. PMID: 37368725; PMCID: PMC10301199.
10. United Nations. Framework convention on climate change [Internet]. Acuerdos de Paris.2015. [cited 2023 Mar 9]. Available from: https://unfccc.int/sites/default/files/spanish_paris_agreement.pdf
11. Organizción Panamericana de la Salud. Respuesta Mundial para el control de vectores 2017–2030 [Global vector control response 2017–2030]. [Internet]. [update 2017 Oct 22; cited 2023 Sep 20]. ISBN 978-92-4-151297-8. Available from: https://www.paho.org/es/documentos/respuesta-mundial-para-control-vectores-2017-2030-0
12. Gobierno de México. Secretaría de Salud: NORMA Oficial Mexicana NOM-032-SSA2-2010. Para la vigilancia epidemiológica, prevención y control de las enfermedades transmitidas por vector. [Internet]. 2003 jul 21. [update 2009 Nov 4; cited 2023 Sep 09]. Available from: https://www.gob.mx/salud/documentos/norma-oficial-mexicana-nom-032-ssa2-2010#:~:text=Para%20la%20vigilancia%20epidemiológica%2C%20prevención,las%20enfermedades%20transmitidas%20por%20vector.&text=Que%20el%2021%20de%20julio,de%20enfermedades%20transmitidas%20por%20vector.
13. Ruiz-Gamboa KD, Cámara-Vallejo RM, Medina-Moreno MR, Albertos-Alpuche NE, Esperón-Hernández RI, Zapata-Vázquez RE, Rojas-García AE, Medina-Díaz IM, Montero-Lara GA, Moo-Huchin JC, Silva-Pérez A, Pére-Herrera NE. (2018). Occupational exposure to pesticides and knowledge about related policies in urban pest control operators from Southeast Mexico. Rev Int Contam Ambie 34 (Especial sobre Contaminación y Toxicología por Plaguicidas (CTP) 45-55. DOI: https://doi.org/10.20937/RICA.2018.34.esp02.04
14. García Hernández J, Leyva Morales JB, Martínez Rodríguez IE, Hernández Ochoa MI, Aldana Madrid ML, Rojas García AE, Betancourt Lozano M, Pérez Herrera NE, Perera Rios JH. (2018). Estado actual de la investigación sobre plaguicidas en México. Rev Int Contam Ambie 34 (Especial sobre Contaminación y Toxicología por Plaguicidas (CTP) 29-60. DOI: https://doi.org/10.20937/RICA.2018.34.esp01.03
15. Handbook for Integrated Vector Management. World Health Organization. ISBN 978 92 4 150280. https://iris.who.int/bitstream/handle/1066

Autor de Correspondencia: Bertha Jiménez-Delgadillo.
Correo electrónico: jdelgad@correo.uady.mx

5/44768/9789241502801_
eng.pdf;sequence=1

Autor de Correspondencia: Bertha Jiménez-Delgadillo.
Correo electrónico: jdelgad@correo.uady.mx