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SOCIEDAD ESPAÑOLA DE SALUD PÚBLICA
Y ADMINISTRACIÓN SANITARIA

SIBSA
Sociedad Iberoamericana
Salud Ambiental

Technical report:
Climate change and health: an Ibero-American vision

SESPAS - Sociedad Española de Salud Pública y Administración Sanitaria
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Executive summary

In the face of climate change, action should not only focus on mitigation. Adaptation efforts are needed to minimise people's vulnerability to health problems caused by climate change. Epidemiological early warning systems focused on environmental health and, in particular, on managing the risks associated with climate change are needed. Mitigation, adaptation and risk management are the public health tools we have to address the greatest challenge we face today.

Stronger links between meteorological services and health authorities are essential for early warning systems, as are increased efforts to promote and protect health and improve the responsiveness of health systems, without losing sight of the fact that social vulnerability plays an important role in shaping risk, particularly in Latin America and the Caribbean.

In general, there is great heterogeneity in the outcomes of drought on health. The main conclusion that can be drawn is that in the current context of increasing frequency and intensity of drought episodes, there is an urgent need for more studies that integrate all aspects, not only geographical but also economic and social, that influence the analysis of the impact of drought on specific aspects of health.

Decision-makers are urged to control emissions of climate-changing pollutants, which would bring short-term benefits to public health and long-term benefits to climate change mitigation. By reducing GHG air pollutants, Ibero-American countries could reduce the burden of disease associated with poor air quality and climate change.

Health systems should be prepared to cope with the foreseeable increase in the incidence and spread of vector-borne diseases and zoonoses, and the possible emergence of pandemics, especially in the most vulnerable areas and societies.

Achieving adequate sanitation and access to clean water for all and for all uses are fundamental objectives and challenges in the context of adaptation to climate change. It is important to remember that proper management of these resources can help mitigate the effects of climate change, demonstrating that adaptation and mitigation are two sides of the same coin, working synergistically in the new environmental context in which we find ourselves.

Climate change is linked to declining crop yields and quality, threats to fisheries and livestock resources, price instability and food access, and food safety risks. However,

there is scope for adaptation, provided it is accompanied by effective mitigation measures.

Climate change and displaced populations (environmental migrants, climate refugees) share common complexities, including strictly environmental aspects such as floods, droughts, sea-level rise, land degradation, epidemics, but also socio-economic conditions such as armed conflict, resource depletion, lack of work, political or religious persecution, etc., which are also linked to environmental specificities.

Although environmental risks are a major challenge for cities today and in the future, there are sufficient means and technologies to promote adaptation to climate change. This requires specific strategies for identifying, informing and protecting vulnerable groups, early warning systems and urban planning designed to reduce the risks associated with climate change and thus reduce the number of premature deaths associated with these phenomena.

An intelligent transition to zero-emission technologies will not only allow organized human society to survive, but will also reduce expected mortality and morbidity, generate massive new investment needs, economic growth with significant energy bill savings, create millions of local jobs and boost national economies.

Health workforce training at global, regional and national levels plays a key role in addressing the climate crisis. There is a need to enhance the knowledge and skills of health science students to ensure they continue to serve as trusted voices within their professions and institutions.

There is evidence of links between climate change and mental disorders in the population. These disorders mainly affect the most vulnerable populations. Consequently, it is recommended that environmental policies, plans and programs be sensitive to the impact on mental health by incorporating economic and social health interventions, both in Spain and globally.

Climate change proposals must reverse the unequal distribution of power, wealth and cultural resources. Intervention strategies must be located and articulated transversally through the axes of social class, age, gender, ethnicity and territory.

Because of the pluralistic nature of the impacts of climate change and its association with multiple health effects, the development of comprehensive plans, supported by a robust surveillance strategy, would reduce the burden of disease associated with environmental health determinants.

Understanding the climate crisis as a health crisis is not only an imperative for the sector's healing mission, but also an opportunity to move towards the One Health model (human, animal and ecosystem), with health systems and all those working in them leading by example.

The structure and processes of climate change governance provide multiple points of interaction for health. At the local or sub-national level, urban and provincial policies can provide transport systems that support increased physical activity through walking, cycling and accessible public transport, and reduce urban air pollution; access to clean and renewable energy and more energy-efficient housing and buildings; healthier and more nutritious diets from sustainable local agriculture; and urban and regional planning and design that support all of these.

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01. Climate change and health: from evidence to action.

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From Paleoclimatology we know that concentrations of CO2, greenhouse gas, have been around 280 ppm[1] for millennia, although these concentrations have also undergone changes related to natural factors[2]. It has not been until the second half of the 19th century, coinciding with the massive burning of fossil fuels in the Industrial Revolution, when this growth has experienced an increase at an unprecedented rate reaching CO2 concentrations close to 420 ppm[3].

Greenhouse gases (GHGs) allow the entry of energy from the sun at short wavelengths, but make it difficult to get out of the long wave energy emitted by the Earth corresponding to an average temperature of 15 °C. This accumulation of energy, which increases as the layer of greenhouse gases becomes denser, has as a direct consequence a rise in temperature (global warming) that determines a series of phenomena such as the melting of the ice caps and glaciers, the rise in sea level and the increase in frequency and intensity of extreme weather events that constitute the so-called Climate Change[3].

The United Nations Framework Convention on Climate Change (UNFCCC) by Cambo Climate "means climate change attributed directly or indirectly to human activity that alters the composition of the global atmosphere and adds to the natural variability of climate observed over comparable periods of time"[3]. Perhaps most importantly, it is recognised that most of the increase in global average temperatures since the mid-20th century is due to increased greenhouse gas (GHG) emissions from human activities[2.4].

One aspect that draws attention is the slow decision-making that had the "early warning" that scientists launched in 1979, in the framework of the first World Climate Conference, when "the first evidence of human interference in the climate was known"[5]. One of the consequences of this "alert" was the creation between the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) of the Intergovernmental Panel on Climate Change (IPCC) in 1988, as a scientific body supporting the United Nations. Since that date, the IPCC has published several reports, the most recent the sixth (Sixth Assessment Report — AR6)[6].

Although progress has been made at the scientific level, the same is not the case in decision-making. The Party Conferences (COPs), of which 26 editions have already been held1, end up leaving a certain uneasiness due to the limited involvement of the most developed countries with the commitments reached through the Paris Agreement, not to exceed the average temperature increase by 1.5 °C and to mobilise financial resources so that all countries can have the capacity to respond. As some authors say, "the widespread pessimism and the lack of real commitments on the part of the political representatives present at the second meeting (referring to COP 22 in Marrakesh) and the postponement of the expected decisions, can be related without fear of error, with uncertainty in international politics in general and in environmental policy in particular"[7].

What is certain is that this Climate Change is evidenced, and if you want to sharpen, some risks of environmental origin that impact on the health of the population. On the one hand, it acts as determining your structural health that affects other determinants (including the availability of drinking water and how to produce and consume food)[8]. On the other hand, it should be noted, Climate Change does not create new diseases, but magnifies and redistributes existing ones, causing public health problems to arise in places where they did not exist before.

Therefore, public health itself should take advantage of these already visible effects to make an "aggiornamento" of Environmental Health and develop strategic health and environmental plans, having as horizon the challenges that climate change demands for public health. In that regard, it is worth bringing to the debate a number of documents that have been prepared on both sides of the Atlantic Ocean. The Spanish Society of Environmental Health (SESA), in 2012, contributed to the book Global Change in Spain 2020/50: Climate change and health that was funded by the Caja Madrid Foundation (current Bankia)[9]. The Ministry of Health, Social Services and Equality and the Ministry of Agriculture, Food and Environment created the Observatory of Health and Climate

[1] The 27th took place from 6 to 18 November 2022 in Sharm El Sheikh, Egypt.

Change (OSCC) and published the book "Impacts of Climate Change on Health", in 2013[10]. From the Ibero-American Network of Climate Change Offices (RIOCC), it was published in 2020, "Adaptation to the risks of Climate Change in Ibero-American countries. RIOCCADAPT Report (2020)"[11] and, more recently, and within the framework of the Strategic Plan for Health and Environment (Pesma), a chapter called "Climate Risks" is included in which adaptation actions are proposed[12].

There is consensus on the health impacts of climate change, among other things, because they are already occurring,[13,14] are already being observed. Chapter 7 of IPCC Working Group II[14] sets out the set of impacts observed, with greater or lesser confidence: food insecurity that can lead to malnutrition especially in middle- and low-income countries; increases in the frequency of extreme temperatures (heat waves) with effects on morbidity and mortality; increased incidence of mosquito-borne arbovirosis (Aedes aegypti, Aedes Albopictus, Culex spp...) such as dengue, chikungunya, Zika or Nile Virus, or tick-related diseases such as Lyme disease and Crimea-Congo haemorrhagic virus; effects arising from exposure to ozone and smoke from fires and pollen; extreme events such as droughts and floods, mental health effects, ultraviolet radiation effects, etc.

In the same vein, The Lancet Countdown was stated in its 2021 report[14]: due to rising average temperatures and altered rainfall patterns, climate change is beginning to reverse years of progress in the fight against food and water insecurity that still affects the world's most underserved populations, denying them an essential aspect of good health. And he concludes: "The 2021 report finds a world overwhelmed by an ongoing global health crisis, which has made little progress to protect its population from the health impacts simultaneously exacerbated by climate change. The inequalities of these impacts and the response, including gender, are clearly highlighted within each of the indicators presented. This exposes the urgent need to collect standardised data to capture inequities and vulnerabilities"[14].

For its part, the IPCC's Sixth Report launches a resounding warning: "The scientific evidence is unequivocal: climate change poses a threat to the well-being of humanity and the health of the planet. If the implementation of concerted action at the global level continues to be delayed, the short and rapidly decreasing period of time that we have to ensure a dignified future will be exhausted"[6].

Actions should not be aimed solely at mitigating emissions. An adaptation effort is needed to minimise people's vulnerability to health problems arising from climate change. Epidemiological early warning systems focused on environmental health and especially those to manage the risks associated with climate change are needed.

Mitigation, adaptation and risk management are the public health tools we have to face the greatest challenge we face today.

Bibliography

1. Rivera-Olmos S, Gómez-Espinosa C, Vargas-Izquierdo C, Tapia-Zavala A, FJ Guadarrama-Cruz. Global Climate Change through geological time. Multidisciplinary University Research, 2011; 10(10): 114-122.
2. Depetris PJ. Earth sciences and global climate change. Science today, 2010; 20(117):7-15.
3. IPCC, 2014: Climate change 2014: Impacts, adaptation and vulnerability — Summary for policy makers. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B.G. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea and L.L. White (eds.)). World Meteorological Organisation, Geneva, Switzerland.
4. UNEP and Ministry of Environment and Rural and Marine Affairs. Climate in danger. An easy guide to the IPCC Fourth Report. Ministry of Environment and Rural and Marine Affairs. Madrid, 2009.
5. AEMET and OECC 2018. Climate Change: Global warming of 1.5 °C. State Meteorology Agency and Spanish Climate Change Office. Ministry for Ecological Transition, Madrid, 2018
6. Pörtner, HO, Roberts DC, Adams H, Adelekan I, Adler C, Adrian R, et al (eds.)]. 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. Joy, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)). Cambridge University Press, Cambridge,UK and New York, NY, USA, pp. 37–118, doi:10.1017/9781009325844.002.
7. Aldaz Berruezo J, Díaz Jiménez J. Situation of the United Nations Framework Convention on Climate Change. Summary of the Paris Summits, COP 21 and Marrakesh, COP 22. Rev. ambient health. 2017; 17(1):34-39.
8. Dahlgren G, Whitehead M. Policies and strategies to promote social equity in health. Background document to WHO — Strategy paper for Europe. Stockholm: Institute for Futures Studies; 1997
9. Martí Boscà JV, Ordóñez Iriarte JM, Aránguez Ruiz E, Barberá Riera M. Global Change Spain 2020/50. Climate change and health. General Foundation Complutense University of Madrid. Spanish Society of Environmental Health, Caja Madrid Foundation. Madrid,

2012. Available at: http://sanidadambiental.com/wp-content/uploads/varios/Informe%20Salud%20y%20Cambio%20Climatico.pdf

10. Observatory on Climate Change and Health. Impact of Climate Change on Health. Ministry of Health, Social Services and Equality. Madrid, 2013.
11. Moreno, J.M., C. Laguna-Defior, V. Barros, E. Calvo Buendía, J.A. Marengo and Ú. Oswald Spring (eds.), 2020: *Adaptation to the risks of climate change in Ibero-American countries — RIOCCADAPT Report*. McGraw-Hill, Madrid, Spain. (ISBN: 9788448621643).
12. Ministry of Health, Ministry for Ecological Transition and Demographic Challenge. Strategic Health and Environment Plan. Madrid, 2022,
13. Sanz, M.J. and Galán, E. (editors), 2020. Impacts and risks arising from climate change in Spain. Spanish Climate Change Office. Ministry for the Ecological Transition and the Demographic Challenge, Madrid.
14. Romanello M, McGushin A, Di Napoli C, Drummond P, Hughes N, Jamart L, et al The 2021 report of the Lancet Countdown on health and climate change: code red for a healthy future, The Lancet, 2021; 398 (10311):1619-1662, ISSN 0140-6736, https://doi.org/10.1016/S0140-6736(21)01787-6.

02. Extreme temperatures and their health impacts.

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Introduction

According to the latest report by the Intergovernmental Panel on Climate Change (IPCC), since the 1950s, extreme heat events, known as heat waves, have become more frequent and intense across the planet and have caused human mortality and morbidity[1,2]. It is estimated that heat waves have caused 13 % of total deaths from disasters worldwide between 2000 and 2019[3], however extreme cold events also have significant health consequences.

Health impacts

1. Health Impact of Heat Waves

There is no consensual definition of what a heat wave is from a health point of view. The meteorological definition of heat wave, usually based on daily (maximum, minimum or both) temperature exceeding a fixed percentile (e.g., 90th percentile, 95th of a historical series of temperatures, over several days), does not respond to the epidemiological perception of what is a heat wave[4]. There are demographic, economic, social, health and cultural factors that cause the impact of heat on people to vary from one place to another[5] and, therefore, the choice of a fixed percentile is not sufficient from the epidemiological point of view[6]. Daily mortality is currently used as a health indicator and the average or maximum daily temperature is used as a weather indicator for heat wave[7,8]; therefore, it will be said that there is a heat wave with an impact on health when the daily temperature exceeds a certain temperature called threshold temperature (T

threshold), from which daily mortality increases significantly[9]. This threshold temperature varies in space[5] and also varies over time as a result of the progressive adaptation of populations to heat[10]. This determination of the threshold T for each location is key to the activation of the Prevention Plans against high temperatures[11].

The effects of exposure may be directly related to heat (heat stress, dehydration or heat stroke) or indirectly, such as worsening cardiovascular, respiratory and kidney diseases, as well as neurological, endocrine or electrolytic disorders[11,12]. To a large extent the mortality associated with heat is not directly due to high temperatures, what would be called "heat hit", but is related to the aggravation of the diseases mentioned above. Particularly susceptible groups are people over 65 years of age[12,13], especially women over 75 years of age[14]. Normally the effects of heat occur in the very short term, from the same day that the heat wave occurs to 4 or 5 days after[13,15]. On the other hand, there has been an association between the increase in temperatures and the number of births that occur, as well as the number of births with low weight and preterm births[16]. The group of people working outside and people who exercise outdoors during the hottest hours of the day are also especially vulnerable groups[17,18].

2. Health Impact of Cold Waves

As explained in the case of heat, mortality attributable to cold is not the same as a cold wave. If the daily temperature-mortality diagram is made, the mortality that occurs with values lower than that of the minimum mortality temperature (MMT) is the mortality attributable to cold[19]. Cold mortality is higher than mortality attributable to heat, in some places up to an order of greater magnitude[20]. As in the case of heat, there is also a temperature below the MMT from which the increase in mortality would occurs abruptly (T threshold per cold wave).

As with heat waves, there is no universal definition of what a wave of cold in health is. From a weather point of view a cold wave occurs when for several days (at least three), the temperature (mean or minimum or both) daily is below a certain fixed threshold (e.g., percentile 3, 5 or 10) of the daily temperature series of a reference climate period[21]. Epidemiologically, the definition of cold wave should be made from the determination of the T threshold below which mortality increases significantly. This determination should be made for each place since the socio-economic, demographic, social and cultural characteristics make that the value that corresponds to that percentile varies from one place to another[22].

It is known that part of the etiology of excess mortality observed after exceptionally cold days is infectious[23]. Influenza virus is the main infectious agent associated with winter

mortality with interaction with low temperatures[24, 25]. Cold waves are associated with mortality after prolonged lags, between 7 and 14 days after the start of the cold period, making it more difficult to establish the cause-effect relationship[19-20,26]. Low temperatures have been associated with increases in the occurrence of respiratory tract infections[27], respiratory diseases[28], excess morbidity and mortality from cardiovascular disease[29] and deaths from cardiac arrest[30]. Exposure to cold is a trigger for certain diseases and can contribute to the worsening of pre-existing chronic diseases[31]. Therefore, the most vulnerable groups will be those with previous diseases. The group of over 65 years of age is especially vulnerable, including children and people with low economic resources who live on the street or who cannot have a comfortable temperature in their homes[32,33].

Warning Systems and Action Plans for Extreme Temperatures

From the heat wave that hit Europe in 2003, many countries in that region (66 %) have developed extreme heat early warning systems and action plans on heat and health[4,34-35]. However, in the region of the Americas there are still not enough developments in this regard, with a few exceptions (Argentina, Canada and the United States)[36-39]. It is, therefore, essential to strengthen the links between meteorological services and health authorities in order to have early warning systems, as well as to step up efforts to promote and protect health and improve the responsiveness of health systems, without losing sight of the fact that social vulnerability plays an important role in shaping risk, particularly in Latin America and the Caribbean.

Bibliography

1. IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.
2. IPCC, 2022: Summary for Policymakers [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem (eds.)]. 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. A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press.

3. The Centre for Research on the Epidemiology of Disasters. (2020). The human cost of disasters: an overview of the last 20 years (2000-2019). An Office for Disaster Risk Reduction.
4. World Meteorological Organisation and World Health Organisation. 2015. Heatwaves and Health: Guidance on Warning-System Development. McGregor, G.R., P.Bessemoulin, K. Ebi and B. Menne (eds.). WMO-No. 1142. WMO, Geneva. 96 pp.
5. Díaz J, Carmona R, Mirón IJ, Ortiz C, León I, Linares C. Geographical variation in relative risks associated with heat: update of Spain's Heat Wave Prevention Plan. Environment International. 2015; 85:273-283. https://doi: 10.1016/j.envint.2015.09.022.
6. Montero JC, Mirón IJ, Criado-Álvarez JJ, Linares C, Díaz J. Relationship between mortality and heat waves in Castile-La Mancha (1975-2003): influence of local factors. Science of Total Environment. 2012; 414:73-80. https://doi: 10.1016/j.scitotenv.2011.10.009.
7. Guo, Y., Gasparrini, A., Armstrong, B.G., Tawatsupa, B., Tobias, A., Lavigne, E., et al., 2017 Aug 10. Heat wave and mortality: a multicountry, multicommunity study. I sent it. Health Perspect. 125 (8), 087006.
8. Alberdi, J.C., Diaz, J., Montero, J.C., Mirón, I.J., 1998. Daily mortality in Madrid community 1986–1992: relationship with meteorological variables. EUR. J. Epidemiol. 14, 571–578.
9. Montero JC, Mirón IJ, Criado-Álvarez JJ, Díaz J, LinaresC. Comparison between two methods of defining heat waves: retrospective study in Castile-La Mancha (Spain). Science of the Total Environment 2010; 408:1544-1550. https://doi: 10.1016/j.scitotenv.2010.01.013.
10. López-Bueno JA, Díaz J, Follos F, Vellón JM, Navas MA, Culqui D, Luna MY, Sánchez-Martínez G, Linares C. Evolution of the Threshold Temperature Definition of a Heat Wave vs. Evolution of the Minimum Mortality Temperature: A Case Study in Spain During the 1983-2018 Period. Environmental Science Europe (2021) 33:101. https://doi.org/10.1186/s12302-021-00542-7.
11. Andersen NB, Böckman M, Bowen K, Diaz J, Flouris A, Hajat S, Katsouyanni K, Kovats S, Linares C et al., "Heat and health in the WHO European Region: Update evidence for effective prevention." Who Regional Office for Europe. Copenhagen. 2021. Logic: CC BY-NC-SA3.0 IGO.
12. Chesini F, Herrera N, Skansi MM, González Morinigo C, Fontán S, Savoy F, Titto E. Mortality risk during heat waves in the summer 2013-2014 in 18 provinces of Argentina. Ecological study. Ciência & Saúde Coletiva, 27(5):2071-2086, 2022. https://doi.org/10.1590/1413-81232022275.07502021

13. Chesini F, Abrutzky R and Titto E. Mortality from heat waves in the City of Buenos Aires, Argentina (2005-2015). CAD. Saúde Pública 2019; 35(9): e00165218

14. Díaz J, Carmona R, Mirón IJ, Ortiz C, Linares C.Comparison of the effects of extreme temperatures on daily mortality in Madrid (Spain), by age group: the need for a cold wave prevention plan. Environmental Research 2015; 143:186-191. https://doi: 10.1016/j.envres.2015.10.018.

15. Díaz J, López C, Jordán A, Alberdi JC, García R, Hernández E, OteroA. Heat waves in Madrid, 1986-1997: effects on the health of the elderly. International Archives Occupational and Environmental Health. 2002; 75:163-170.

16. Arroyo V, Díaz J, Ortíz C, Carmona R, Sáez M, Linares C. Short term effect of air pollution, noise and heat waves on preterm births in Madrid (Spain). Environmental Research 2016; 145:162-168. https://doi: 10.1016/j.envres.2015.11.034.

17. Fatima SH, Rothmore P, Giles LC, Varghese BM, Bi P. Extreme heat and occupational injuries in different climate zones: A systematic review and meta-analysis of epidemiological evidence. Environ Int. 2021; 148:106384. https://doi.org/10.1016/j.envint.2021.106384

18. Schneider S, von Winning A, Grüger F, Anderer S, Hoffner R, Anderson L. Physical Activity, Climate Change and Health-A Conceptual Model for Planning Public Health Action at the Organizational Level. INT J Environ Res Public Health. 2022;19(8):4664. https://doi.org/10.3390/ijerph19084664

19. Alberdi JC, Díaz J, Montero JC, Mirón IJ. Daily mortality in Madrid Community (Spain) 1986-1991: Relationship with atmospheric variables. European Journal of Epidemiology. 1998; 14:571-578. https://www.ncbi.nlm.nih.gov/pubmed/9794124

20. Vardoulakis, S., Dear, K., Hajat, S., Heaviside, C., Eggen, B., McMichael, A.J., 2014 Dec. Comparative assessment of the effects of climate change on heat- and cold-related mortality in the United Kingdom and Australia. I sent it. Health Perspect. 122 (12), 1285–1292.

21. Ryti NRI, Guo Y, Jaakkola JJ. 2016. Global Association of Cold Spells and Adverse Health Effects: A Systematic Review and Meta-Analysis. Environ Health Persp. 2016;124(1):12-22. https://doi.org/10.1289/ehp.1408104

22. Carmona R, Díaz J, Mirón IJ, Ortíz C, León I, LinaresC. Geographical variation in relative risks associated with cold waves in Spain: The need for a cold wave prevention plan. Environment International. 2016; 88:103-111. https://doi: 10.1016/j.envint.2015.12.027.

23. Kysely, J., Pokorna, L., Kyncl, J., Kriz, B., 2009. Exess cardiovascular mortality associated with cold spells in the Czech Republic. BMC Public Health 9, 19.

24. Glezen, W.P., 1982. Serious morbidity and mortality associated with influenza epidemics. Epidemiol. Rev. 4, 25–44.

25. Jaakkola, K., Saukkoriipi, A., Jokelainen, J., et al., 2014. Decline in temperature and humidity increases the occurrence of influenza in cold climate. I sent it. Oh, heal. 13, 22.

26. Chesini F, Abrutzky R, Herrera N, Skansi M, Fontan S, Morinigo E et et al. Mortality associated with extreme cold events in Argentina, 2005-2015. Rev Argent Public Health, 2019; 10(41): 28-36.

27. Makinen, T.M., Juvonen, R., Jokelainen, J., Harju, T.H., Peitso, A., Bloigu, A., et al., 2009. Cold temperature and low humidity are associated with increased occurrence of respiratory tract infections. Breathe in. It's Med. 103 (3), 456–462 (Mar).

28. Monteiro, A., Carvalho, V., Gois, J., Sousa, C., 2013. Use of "Cold Spell" indices to quantify excess chronic obstructive pulmonary disease (COPD) morbidity during winter (November to March 2000–2007): case study in Porto. INT. J. Biometeorol. 57 (6), 857–870 (Nov).

29. Urban, A., Davidkovova, H., Kysely, J., 2014 Aug. Heat- and cold-stress effects on cardiovascular mortality and morbidity among urban and rural populations in the Czech Republic. INT. J. Biometeorol. 58 (6), 1057–1068.

30. Medina-Ramon, M., Zanobetti, A., Cavanagh, D.P., Schwartz, J., 2006. Extreme temperatures and mortality: assessing effect modification by personal characteristics and specific cause of death in a multi-city case-only analysis. I sent it. Health Perspect. 114 (9), 1331–1336 (Sep).

31. Rytkonen, M., Raatikka, V.P., Nayha, S., Hassi, J., 2005. Exposure to cold and the symptoms thereof. Duodecim 121 (4), 419–423.

32. Díaz J, Carmona R, Mirón IJ, Ortiz C, Linares C.Comparison of the effects of extreme temperatures on daily mortality in Madrid (Spain), by age group: the need for a cold wave prevention plan. Environmental Research 2015; 143:186-191. https://doi: 10.1016/j.envres.2015.10.018.

33. López-Bueno JA, Navas-Martín MA, Díaz J, Mirón IJ, Luna MY, Sánchez-Martínez G, Culqui D, Linares C. The Effect of Cold Waves on Mortality in Urban and Rural Areas of Madrid. Environmental Science Europe. (2021) 33:72 https://doi.org/10.1186/s12302-021-00512-z.

34. WHO Regional Office for Europe (2018). Public health and climate change adaptation policies in the European Union. Copenhagen: Who Regional Office for Europe (https://www.euro.who.int/en/healthtopics/environment-and-health/Climate-change/publications/2018/public-health-and-climate-changeadaptation-policies-in-the-European-union-2018).

35. Martinez GS, Linares C, Ayuso A, Kendrovski V, Boeckmann M, Diaz J (2019). Heat-health action plans in Europe: challenges ahead and how to tackle them. Environ Res. 176:108548. doi:10.1016/j. envres.2019.108548.

36. Pan American Health Organisation, 2021. Heat waves: A guide to health-based actions. Washington, D.C.: Pan American Health Organisation. License: CC BY-NC-SA 3.0 IGO. https://doi.org/10.37774/9789275324080

37. Herrera N, Chesini F, Saucedo MA, Menalled ME, Fernández C, Chasco J, Cejas AG, (2021) Early Warning System for Extreme Temperature Heat (SAT-TE Heat): the evolution of SAT-OCS. Technical Note SMN 2021-111. Available at: http://repositorio.smn.gob.ar/handle/20.500.12160/1726

38. Issa, M.A., CHEBANA, F., Masselot, P. et al. A heat-health watch and warning system with extended season and evolving thresholds. BMC Public Health 21, 1479 (2021). https://doi.org/10.1186/s12889-021-10982-8

39. Kate R. Weinberger, Xiao Wu, Shengzhi Sun, Keith R. Spangler, Amruta Nori-Sarma, Joel Schwartz, Weeberb Requia, Benjamin M. Sabath, Danielle Braun, Antonella Zanobetti, Francesca Dominici, Gregory A. Wellenius, Heat warnings, mortality, and hospital admissions among older adults in the United States, Environment International 157, 2021, 106834. https://doi.org/10.1016/j.envint.2021.106834

03. Extreme weather events. Droughts and health.

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The health impacts of drought have not been analysed in depth compared to other health-affecting phenomena such as air quality, heat waves or desert dust intrusions so frequent in Spain. There is a growing concern about droughts, the frequency and intensity of which have increased in recent years in several regions of the world, causing significant impacts not only on the availability of water for ecosystems, agriculture, economic activities of all kinds and human consumption, but also on human health[1,2].

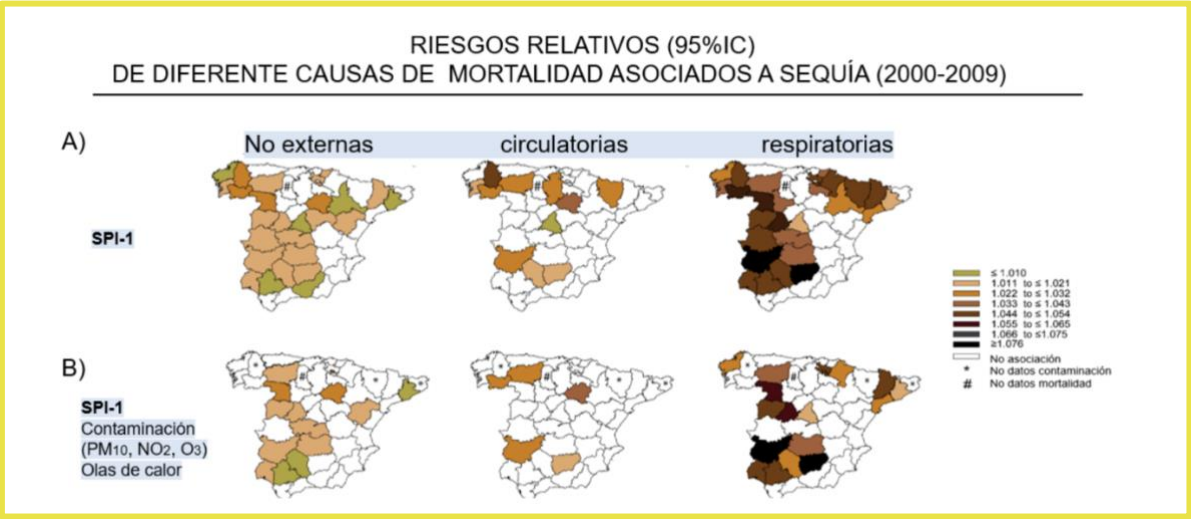
There are different types of droughts depending on the period of duration and the affected system, meteorological, agricultural, hydrological, socio-economic and ecological droughts, and each of them can affect human health through different pathways. For its analysis there are many indices to quantify them, constituting an essential tool for the monitoring of this phenomenon, as well as for the quantification of the impacts attributable to its occurrence[3]. The most used in recent studies are the Standardised Precipitation Index (SPI) and the Precipitation-Standard Evapotranspiration Index (SPEI)[4,5]. The need for drought information has led many institutions around the world to make information services available to researchers and the general public, such as the Drought Monitor of the State Meteorology Agency in Spain (http://www.aemet.es/es/serviciosclimaticos/monitor_sequia_met) or the South American Drought Information System of the Regional Climate Center for South America (https://sissa.crc-sas.org/monitoreo/indices-de-sequia/).

The impacts of drought on health, on the morbidity and mortality of the population, mainly depend on the interrelationship between the characteristics of the event, the degree of exposure, as well as the vulnerability of the population, their susceptibility and their ability to adapt. The population groups most affected by drought are children, elderly people, pregnant women, people with pre-existing chronic conditions, population with low socioeconomic status, marginal groups, and outside workers, in addition to the rural population whose subsistence depends on agriculture.

The impact of drought on public health is manifested in different ways, highlighting the following[6,7]:

- Increased risk of waterborne diseases, or related to poor water quality, including gastrointestinal conditions and diarrhoea. Not only does the amount of water available decrease, but its quality is reduced by increasing the concentration of chemical contaminants and heavy metals, proliferating microorganisms, increasing the concentration of toxin-producing cyanobacteria and even causing a reduction in energy production.
- Increased risk of food insecurity and malnutrition due to reduced food production and stability.
- Changes in distribution patterns and incidence of certain vector-borne diseases. The risk of these diseases can be spread with climate change because these vectors extend geographically by import from subtropical areas to extra tropical regions with increasingly similar climates.
- Reduction in air quality with increases in dust intrusions, suspended particles and tropospheric ozone, either directly or through increased risk of forest fires, increasing the risk of morbidity and mortality, affecting respiratory and circulatory health. Drought is associated with persistent anticyclonic blocking conditions and atmospheric stagnation, which promote pollution and contribute to the intensification of cold and heat events, with notable health implications.
- Psychosocial stress and mental health disturbances, particularly in the rural population.

As an example of analysis of the effects of drought on health, the authors of study[8] on peninsular Spain found significant impacts but subject to a lot of heterogeneity between the different provinces in terms of impact.



(A) Risk of daily mortality from non-external, circulatory and respiratory causes associated with droughts measured in the short term (1 month of accumulation) with the standardised precipitation index (SPI-1), incorporating only this variable of exposure in the model. **(B)** Daily mortality risk associated with drought by additionally controlling the effect of heat waves and pollution on the model. Source: Salvador *et al*., 2020b.

In general, there is a lot of heterogeneity in the results of drought impacts on health. The main conclusion that can be drawn is that in the current context of increasing frequency and intensity of drought episodes is the urgent need for more studies that integrate all aspects, not only geographical but also economic and social, that affect the analysis of the impact of drought on specific aspects on health.

Bibliography:

1. Vicente-Serrano SM, Quiring SM, Peña-Gallardo M, Yuan S, Domínguez-Castro F. A review of environmental droughts: Increased risk under global warming? Earth-Sci. Rev. 2019; 201, 102953.
2. Salvador C, Nieto R, Linares C, Díaz J, Gimeno L. Effects of droughts on health: Diagnosis, repercussion, and adaptation in vulnerable regions under climate change. Challenges for future research. SCI. Total Environ. 2020; 703, 134912.
3. Who (World Health Organisation) & WADA (World Water Association). Handbook of drought Indicators and Indices [Svodoba M, Fuchs BA (eds)]. Integrated Drought Management Programme (IDMP), Integrated Drought Management Tools and Guidelines Series 2. 2016. Geneva. ISBN 978-92-63-11173-9
4. McKee TB, Doesken NJ, Kleist J. The relationship of drought frequency and duration to time scales. In: Proceedings of the 8th Conference on Applied Climatology, Anaheim, CA, USA, 17–22 January, 1993. American Meteorological Society: Boston, MA, USA, 1993; pp. 179–184.
5. Vicente-Serrano SM, Beguería S, López-Moreno JI. A multiscalar drought index sensitive to global warming: The Standardised Precipitation Evapotranspiration Index. J. Clim. 2010; 23, 1696–1718.
6. Who (World Health Organisation) & WMO (World Meteorological Organisation). Atlas of Health and Climate. 2012. https://apps.who.int/iris/handle/10665/112303
7. Van Lanen HAJ. Vogt JV, Andreu J, Carrão H. De Stefano L, Dutra E, Feyen L, Forzieri G, Hayes M, Iglesias A, Naumann G. Pulwarty R. Spinoni J. Stahl K, Stefanski R, Stilianakis N, Svoboda M, Tallaksen L. Climatological risk: droughts, En; Science for Disaster Risk Management, 2017, pp. 271–293.

8. Salvador C, Nieto R, Linares C. Díaz J, Gimeno L. Short-term effects of drought on daily mortality in Spain from 2000 to 2009. Environmental Research, 2010; 183, 109200.

04. Air pollution and climate change: impact of urban growth, dust surges and forest fires.

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Introduction

The world population currently stands at nearly 8 billion inhabitants and more than half of it lives in urban settings. By 2050 it is estimated that between 7 and 8 out of 10 people live in cities. In Latin America and the Caribbean the countries with the most metropolises are Brazil (61), Mexico (54), Colombia (18), Argentina (17), Venezuela (17) and Peru (11), while Spain has 14 metropolises and Portugal, 3[1].

Although the rate of global urbanisation slowed due to the COVID-19 pandemic[2], a common problem in urban conglomerations is air quality, resulting from a complex interaction between natural environmental conditions and anthropogenic activities such as burning fossil fuels, the use of motor vehicles, industry and other sources that emit air pollutants that in some cases, when they come into contact with the atmosphere, undergo photochemical reactions to form other pollutants. Emissions of air pollutants, such as particulate matter (PM), ozone precursors (VOCs) and oxides of nitrogen (NOX)), nitrogen dioxide (NO2), sulphur dioxide (SO2) and carbon monoxide (CO), have deteriorated air quality, especially in urban areas[3].

Documented health effects range from eye, nose and throat irritation, wheezing, coughing, chest tightness, or shortness of breath, to chronic effects such as asthma, pneumonia, bronchitis, and lung and heart problems. In recent years, adverse effects of childbirth have been included (e.g.: low birth weight), neurological development, cognitive impairment, development of autoimmune diseases, as well as other conditions such as diabetes, hypertension and even obesity[4]. These events depend on factors such as socio-environmental conditions, composition, toxicological characteristics, inhaled fraction of contaminants or susceptibility of the individual, and have been associated with acute and chronic exposures. In addition, based on evidence from epidemiological and laboratory animal species studies, the International Agency for Research on Cancer (IARC) classified ambient air pollution as a Group 1 human carcinogen for lung cancer[5]. Nowadays environmental pollution has been identified as the main environmental risk factor contributing to the burden of disease[6].
In urban areas, some weather parameters linked to climate change affect atmospheric chemistry, such as extreme temperatures (cold and heat waves) that have been associated with respiratory diseases, allergies, fetal health (e.g.: low birth weight and premature birth), mental health (e.g.: stress and depression), as well as mortality from all causes, or from respiratory or cardiovascular disease. Pathways may be direct or indirect, such as forest fires or temperature or humidity that influence the formation or dispersion of pollutants in the atmosphere[7].

With regard to fires, in Latin American countries the use of fire in forest and agricultural land is a common practice to clean agricultural land or to harvest, as is the case with sugarcane. In the Amazon and Central America it is common to use the burning of natural reserve areas and indigenous territories to illegally occupy the land and extract timber. In the Mediterranean area there is also a more intense and frequent occurrence of fires every year. The emissions generated by these burnings can travel by the action of the wind from agricultural areas or nature reserves to the cities. The fires coincide with the stretch season due to temperatures and drought[8].

Also in recent years, some Ibero-American cities have been affected by the dust storms of the Sahara, whose size and weight of their particles makes it possible to disperse by wind and air currents, traveling great distances and reaching several cities of the planet[9].

Regarding the air pollutants that are influenced by meteorological variables that influence their spatial and temporal distribution, it is worth mentioning tropospheric ozone, which is mainly responsible for photochemical smog and is formed by reactions in the atmosphere of primary pollutants (COVs and NOx) in the presence of sunlight. Therefore, high temperatures favor its formation. Ozone in the stratosphere is also a greenhouse gas. Conversely, in low-temperature or winter seasons there are high concentrations of particulate matter that is related to a phenomenon known as thermal

inversion, which occurs when the layer of hot air that is flush from the ground, rises and leaves the contaminants trapped without the possibility of dispersing in the atmosphere. Both conditions are favored by climate change.

Greenhouse gases (GHGs) such as carbon dioxide (CO_2), methane (CH_4), nitrogen oxides (NOx) and ozone (O_3), are the main air pollutants associated with climate change. While they are naturally present in the environment, they are increased by the action of man and trap (absorb and re-emite) infrared radiation, increasing the temperature of the atmosphere.

By way of proposals

Despite considerable air pollution prevention and control measures that have been implemented in recent years, ambient air pollution remains one of the most important health risk factors.

Based on this concern, WHO developed global air quality guidelines with guidance levels on major air pollutants[10], from which national and local governments develop their regulations. However, according to WHO estimates, more than 150 million people live in cities that exceed the 2005[11] air quality guidelines. Even in cities whose levels of pollutants do not exceed those established by international regulations (e.g.: the European Directive in Spain) and nationals, have been estimated effects on health. For this reason, it has been established that there is no safe threshold value below which no adverse effects are observed. While the WHO guidelines provide countries with benchmarks to protect human health, the support of international agencies and countries are required to generate cross-sectoral policies that promote cleaner transport, energy-efficient housing and cleaner energy generation.

In this sense, air quality management tools are public policy tools that contribute to the improvement of air quality through different mechanisms. Some of these instruments simultaneously pay attention to the pollutant criteria, i.e., those that have been identified as harmful to health and to air pollutants associated with climate change. All are ultimately intended to protect the health of the population.

The Air Quality Improvement Programs are one of the main instruments developed to reverse the deterioration trends of air quality, through the cross-sectoral proposal of measures and actions to reduce emissions. Also, in Ibero-American cities with air pollution problems, there are instruments for regulating limit values for pollutants (e.g.: national air quality standards) and timely reporting on air quality (e.g.: air quality indices).

Another fundamental instrument and input for air quality management is atmospheric monitoring. Many of the Ibero-American cities, even those most polluted, do not have an air quality monitoring network, with exceptions such as Santiago de Chile, Sao Paulo in Brazil or Mexico City, so it is recommended that governments increase atmospheric environmental monitoring. In rural areas such networks are almost non-existent. For monitoring long areas at risk of forest fires, dust clouds, and high-altitude smoke circulation, satellite sensors have been used to estimate the concentration of air pollutants[12].

In some cities, mechanisms have been put in place to use alternative non-oil fuels, such as ethanol, biodiesel, natural gas, or even electricity. While these fuels generate fewer emissions that contribute to poor air quality and global warming, governments and private industry should take a more active role in incentivising the use of alternative fuels and assessing their economic and environmental impact.

In the most polluted cities, plans or programs have been implemented to decree contingencies in episodes of high pollution. In general, it is observed that there is heterogeneity between contingency plans with respect to the mechanisms to determine the activation of the established phases. However, countries in the region are making progress in updating their plans, mainly for ozone and particulate matter, and it is therefore recommended to include other pollutants.

It is important to note that the activations of environmental contingencies due to high concentrations of ozone are usually due to weather conditions such as the low wind speed, which does not allow the dispersion of pollutants and high temperatures, which have been in historical records and favor the formation of ozone. Therefore, decision-makers are urged to control emissions of climate change-related pollutants, which would give short-term benefit to the health of the population and in the long term the benefit of climate change mitigation. By reducing greenhouse air pollutants, Ibero-American countries could reduce the disease burden of those conditions related to poor air quality and climate change.

Bibliography

1. United Nations Human Settlements Programme (UN-Habitat). (2020).: Global State of the Metropolis 2020. Population Data Brochure. Nairobi, Kenya, UN-Habitat.
2. United Nations Human Settlements Programme (UN-Habitat). (2022). World Cities Report 2022 Nairobi, Kenya, UN-Habitat.

3. Querol, X. (2008). Air quality, suspended particles and metals. Spanish Journal of Public Health, 82, 447-454.
4. Sun, Z., & Zhu, D. (2019). Exposure to outdoor air pollution and its human health outcomes: A scoping review. PLOS one, 14(5), e0216550.
5. International Agency for Research on Cancer. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans: Vol. 109, Outdoor Air Pollution. Lyon, France: IARC; 2014.
6. Babatola, S.S. (2018). Global burden of diseases attributable to air pollution. Journal of public health in Africa, 9(3).
7. Goshua, A., Gomez, J., Erny, B., Burke, M., Luby, S., Sokolow, S.,... & Nadeau, K. (2021). Addressing climate change and its effects on human health: A call to action for medical schools. Academic Medicine, 96(3), 324-328.
8. Sardiñas, S. B., Leandro, M. F., & González, E. Y. V. (2019). Hotspots and wildfires in Cienfuegos province, Cuba. Cuban Meteorology Magazine, 25.
9. López, E. M., Parrado, R. P., Bultó, P. O., Gózales, A. O., & Valencia, A. R. (2006). Sahara dust storms. Its impact on the Atlantic, Caribbean Sea and the Gulf of Mexico. Space Technologies, Disasters and Agriculture in Ibero-America (I), 88.
10. World Health Organisation (2021). Who global air quality guidelines. Particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. Geneva
11. World Health Organisation (2016). Who global air quality guidelines. Particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. Geneva
12. Della Ceca, L. S. (2018). Space-time analysis of the distribution of atmospheric aerosols in the city of Córdoba (Argentina) and development of a predictive model of particulate material levels (Master's thesis)

05. Proposal for positioning on climate change and diseases transmitted by vectors and rodents.

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Diseases transmitted by arthropods represent, according to WHO, about 17 % of infectious diseases[1]. They especially affect tropical and subtropical regions, as is the case with much of Ibero-America for malaria, dengue, chikungunya, Zika or Chagas. On the other hand, it is estimated that rodents and other animal reservoirs are responsible for the transmission (zoonosis) of more than 60 % of these diseases[2]. These are diseases that sometimes have great potential to provoke international alerts and pandemics[3].

Animal vectors and reservoirs have a great dependence on theelements of the clima, in particular on temperature, precipitation and smoke, which condition their activity, biological cycles and spatial distribution[4-7].

Climate change, according to several studies[8-11], can cause alterations in the incidence and epidemiological pattern of vector diseases, extending or reducing transmission periods, both in terms of their seasonal condition and their geographical distribution. Climate change can also facilitate the establishment in new territories of invasive alien species[12], which carry new risks.

In any case, the effect of climate change on vector diseases is the subject of ongoing debate among the scientific community[13-15]. While the changes in the distribution of vectors and the increase in the incidence of some diseases are a fact of fact, it is difficult to differentiate the contribution of climate change from that of other factors that also impact, in a multiscale and multidimensional way, the emergence of these diseases. In this sense, it is also necessary to take into account factors linked to the ecology of vector-pathogen-reservoir systems and others such as population growth, migration and urbanisation, changes in productive activities and land uses, the globalisation of travel, trade and tourism, alterations in the density of hosts and reservoirs and the modification

of human behaviour patterns. Therefore, some authors propose to speak of "global change"[16,17].

Likewise, it should be noted that the impact of these changes on the incidence and distribution of vector diseases and zoonoses will depend on the vulnerability of the affected communities and their territories, which is determined by their social and economic conditions, the strength and accessibility of their health system, as well as their system of values and beliefs.

Health systems should be prepared to cope with the foreseeable increase in the incidence and spread of these diseases, as well as the possible occurrence of pandemics, in particular in the most vulnerable territories and societies. To this end, health policies should take into account the following considerations:

- Establish systems of prevention, alertness and rapid action in which the "One Health" or Eco-Health (EcoHealth) approach is adopted and involving all actors involved in animal, human and environmental health[18].
- Generate and record systematic and standardised information on each of the components of the epidemiology of these diseases. Develop maps of risk areas and identify vulnerable areas and groups that enable the formulation of preventive strategies.
- Promote national, regional and international collaboration mechanisms, with the participation of the different international organisations[18-20], with the aim of designing and adopting global health policies.
- To promote research projects that deepen the knowledge of the problems of vector diseases and climate change, and that allow the foundationof public health policies in this field.
- Promote healthy and resilient territories, within the framework of Sustainable Development Goals[21], by launching initiatives that address the social determinants associated with vector diseases.
- Implement in our societies measures to adapt to the new challenges posed by climate change, improving the diagnostic and treatment capacity of the health system, strengthening the capacity of surveillance and vector control at local and regional level and training the population, especially the most vulnerable groups, in the protection and prevention measures against these diseases.

Bibliography

1. World Health Organisation (WHO). Vector-borne diseases. Key facts. [updated in 2020; cited on 7 July 2022] Available at: https://www.who.int/news-room/fact-sheets/detail/vector-borne-diseases
2. Taylor LH, Latham SM, Woolhouse EJ. Risk factor human disease emergence. Oh, Phil. It's trans. R. Soc. Oh, Lond. B. 2001; 356, 983-989.
3. Piret J, Boivin G. Pandemics Throughout History. Front. Microbiol. 2021; 11: 631736.
4. Gubler DJ, Reiter P, Ebi KL, Wendy Y, Nasci R, Patz JA. Climate variability and change in the United States; potential impacts on vector-and rodent-borne diseases. Environ Health Perspect. 2001; 109 (suppl 2). 223-233.
5. Githeko AK, Lindsay SW, Confalonieri EU, Patz JA. Climate change and vector-borne diseases: a regional analysis. Bull World Health Organ. 2000; 78(9): 1136-1147.
6. Molina R, Lucientes J, Good R, From the Heras E, Iriso A. Climate change and diseases transmitted by vectors and rodents. Guide for professionals. Health and Environment Observatory of Andalusia (OSMAN). 2021.
7. Ogden NH, Ben Beard C, Ginsberg HS, Tsao JI. Possible effects of climate change on ixodid ticks and the pathogens they transmit: predictions and observations. Journal of Medical Entomology. 2021; 58(4): 1536-1545.
8. Carlson, C.J., Albery, G.F., Merow, C. *et al.* Climate change increases cross-species viral transmission risk. Nature (2022).
9. Sipari S, Hussein K, Magnusson M, Evander M, Hörnfeldt B, Ecke F. Climate change accelerates winter transmission of a zoonotic pathogen. AMBIO, I'm sorry. 2022; 51(3): 508-517.
10. Maroli M, Rossi L, Baldelli R, Capelli G, Ferroglio E, Genchi C, Gramiccia M, Mortarino M, Pietrobelli M, Gradoni L. The northward spread of leishmaniasis in Italy: evidence from retrospective and ongoing studies on the canine reservoir and Phlebotomine vectors. Trop. Med. and Int. Health. 2008; 13(2). 256-264.
11. Jaenson TGT, Jaenson DGE, Eisen L, Petersson E, Lindgren E. Changes in the geographical distribution and abundance of the tick *Ixodes ricinus* during the past 30 years in Sweden. Parasit Vectors. 2012; 10:5-8.
12. Ryan SJ, Carlson CJ, Mordecai EA, Johnson LR. Global expansion and redistribution of Aedes-borne virus transmission risk with climate change. PLOS negl Trop Dis. 2019; 13(3).
13. Lafferty KD. The ecology of climate change and infectious diseases. Ecology. 2009; 90(4): 888-900.
14. Reiter P. Global warming and malaria: knowing the horse before Hitching the cart. Malar J. 2008; 7(Suppl 1): S3.

15. Randolph SE. Dynamics of tick-borne disease systems: minor role of recent climate change. Rev Sci Tech. 2008; 27(2): 367-81.

16. Sutherst RW. Global change and human vulnerability to vector-borne diseases. Clin Microbiol Rev. 2004; 17(1):136-73.

17. Baker RE, Mahmud AS, Miller IF, Rajeev M, Rasambainarivo F, Rice BL, Takahashi S, Tatem, AJ, Wagner CE, Wang LF, Wesolowsky Am Metcalf JE. Infectious disease in an era of global change. Nature Review Microbiology. 2021; 13:1-13.

18. World Health Organisation (WHO), Food and Agriculture Organisation of the United Nations (FAO), World Organisation for Animal Health (OIE). Adaptation of a multisectoral "One Health" approach. Tripartite guide to tackling zoonotic diseases in countries. 2019

19. WHO. Global vector control response 2017-2030. 2017.

20. Food and Agriculture Organisation of the United Nations (FAO), World Organisation for Animal Health (OIE), United Nations Environment Program (UNEP), World Health Organisation (WHO), One Health High Level Expert Panel. Annual Report 2021.

21. United Nations. Transforming our world: the 2030 Agenda for Sustainable Development. Resolution of the United Nations General Assembly. 2015; A/RES/70/1.

06. Water risk and climate change.

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Water was an essential substance in the emergence of life on earth and has always been a key constraint in maintaining ecosystems. Its presence is indispensable for agriculture, livestock and industry and, therefore, for economic development. The availability of water in sufficient quantity and quality delimits and conditions the state of health of a population. No one questions that the technological purification of water was a fundamental tool in the epidemiological transition of the 20th century. Today all this is compromised by climate change. Human health depends on water and is therefore vulnerable to climate change.

From an environmental point of view, water depletion and pollution are the main causes of water resource decline, ecosystem degradation and biodiversity loss. These two factors ultimately reduce ecosystem resilience, making societies that depend on them more vulnerable to climate and non-climate risks.

It is therefore an unquestionable fact that water bodies are changing due to climate change, increasing their temperature and chemical composition[1]. The seas, the main sink of atmospheric carbon dioxide transforming it into carbonic acid, is gradually acidifying, which is a growing threat to marine life cycles[2], and rising aquatic temperatures have effects on the salinity and oxygen levels of these ecosystems by altering ecological and meteorological balances. The changes that climate change is inducing in the water cycle[3]

[2] Since the beginning of the industrial era, the incorporation of CO2 into the oceans has led to its acidification; the pH of surface ocean water has decreased by 0.1, corresponding to a 26 % increase in acidity[1].
[3] Changes in rainfall or melting of snow and ice are altering hydrological systems, affecting the quantity and quality of water resources. Glaciers continue to retreat virtually across the planet due to climate change, affecting runoff and downstream water resources. Rainfall is becoming more irregular and more intense[1].

are increasingly noticeable, as floods, droughts and other extreme events are becoming more frequent.

According to the IPCC Fifth Assessment Report (AR5, 2014), climate change projections for the 21st century indicate that renewable surface water and groundwater resources will be reduced in most subtropical dry regions[1]. It is also evident that as the climate changes, fresh and saltwater resources underpin our societies and economies are deteriorating. The IPCC also reports that the global oceans will continue to warm during the 21st century and that by the end of the century, sea level will have risen by more than 95 % of the areas occupied by oceans[1], no doubt due to the melting of Greenland, Antarctica, and thousands of glaciers around the world, as well as the thermal expansion of the ocean[4]. For the year 2100, the average sea increase is projected to be between 0.4 m and 0.8 m above the 1986-2005 average[2].

Groundwater accounts for approximately 99 % of the liquid freshwater on earth, and is being impacted by climate change in various ways, both in quality and quantity. Undoubtedly, the sea level rise already described, generates pressure on the coasts, causing the intrusion of seawater into coastal aquifers around the world. The natural recharge of groundwater is also affected by the variation experienced by precipitation and pressure on surface waters. In short, all existing water resources are affected in one way or another by climate change[3,4].

The United Nations also informs us that flooding and increased concentration of pollutants during droughts will increase the risk of water pollution and contamination by pathogens. The increased loads of sediments, nutrients and pollutants in water implies greater exposure to infectious diseases, whether transmitted by water, vectors or lack of personal or environmental hygiene, and also implies a reduction in agricultural productivity, impacting nutrition and foodborne diseases, among other consequences[7-12]. In addition, extreme water-related phenomena also pose a threat to water infrastructure and, therefore, to sanitation and hygiene[5,6]. And synergistically, the capacity for self-purification of freshwater bodies is reduced by lowering the amount of oxygen dissolved by an increase in temperature, and the impact may be greater on the water resources of mountainous regions and adjacent plains by an acceleration of the melting of the glaciers of the mountain ranges[7].

[4] During the period 1993-2010, the rise in the global average sea level coincides, with the sum of the contributions observed from the thermal expansion of the ocean due to warming and changes in glaciers, in the Greenland ice mantle, in the Antarctic ice mantle and in land water storage[1].

Globally, it is expected that the temperature increase of only 1°C will mean a 20% reduction in renewable water resources and will affect an additional 7% of the population, so it is essential to limit the temperature increase as soon as possible.[4]

United Nations data indicate that 3.6 billion people worldwide live in areas with water scarcity at least one month per year, and this could reach 4.8 billion to 5.7 billion by 2050[8,9]. Water use is expected to increase at an approximate rate of 1% per year globally over the next 30 years, driven by population growth, economic development and change in consumption[11], which could mean the world faces a 40% global water deficit by 2030[12].

In the European Union it is estimated that 35% of the area will be subject to high water stress in the 2070s[13]. For its part, Latin America and the Caribbean is home to almost a third of the world's water resources, although it presents high levels of water stress in many cities and productive areas[14], since the distribution is very asymmetric and in many cases the infrastructure to provide it safely is poor. Overexploitation is common and monitoring against contaminants[15] is scarce.

On the contrary, the World Health Organisation points out that universal access to safe water and sanitation would return at a profit of $170.000 billion per year, in terms of reducing health spending and increasing productivity due to disease reduction[16]. Estimates leave us the need for a global investment in water security of some $6.7 trillion by 2030 and 22.6 billion by 2050[17].

The above described leaves a clear conclusion: identifying the main changes in water resources caused by climate change, mitigating them and adapting to new circumstances, are essential public health objectives to ensure a healthy life and promote the well-being of the entire population. Developing the structure of a model for water resilience is fundamental to facing future climate change scenarios[18].

Likewise, the changes outlined above and those estimated for the relatively near future, coupled with an increasing demand for water resources, draw us a scenario in which efficiency in water management must be a primary objective of an advanced and sustainable society. It is necessary to reduce unnecessary consumption and losses of supplies, value 'unconventional' water resources, including the concept of circularity and establish nature-based solutions, as part of the strategy. Water resources management must be resilient to the effects of climate change[12]. It also identifies the need to further improve hydrological data and the effects of rising temperatures and also the capacity of institutions in the governance of these changes, with a major focus on education and capacity-building for the entire population, as well as risk assessment and knowledge sharing between countries, areas and institutions[7].

In short, achieving adequate sanitation and access to clean water, for all and for all uses, are basic objectives and challenges within the framework of adaptation to climate change. It must be borne in mind that an adequate management of these resources can help mitigate the effects of climate change, demonstrating that adaptation and mitigation are two sides of the same coin, acting synergistically within the new environmental framework in which we find ourselves.

Bibliography

1. IPCC. *Climate change 2014: Synthesis report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. It's Geneva. IPCC, 2014. [revised 1 August 2022]. Available at: https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full_es.pdf
2. IPCC. *Impacts, adaptation and vulnerability — Summary for policy makers. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* IT'S WMO. It's Geneva. IPCC, 2014 [revised 1 August 2022]. Available at: https://www.ipcc.ch/site/assets/uploads/2018/03/WGIIIAR5_SPM_TS_Volume_es-1.pdf
3. Pörtner HO, Roberts DC, Masson-Delmotte V et al. *Summary for Policymakers. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*. Cambridge. Cambridge University Press. 2019 pp. 3–35. [revised 1 August 2022]. Available at: https://www.ipcc.ch/site/assets/uploads/sites/3/2022/03/01_SROCC_SPM_FINAL.pdf.
4. United Nations. Economic and Social Council. The Sustainable Development Goals Report 2022. New York. United Nations, 2022. [revised 1 August 2022]. Available at: https://unstats.un.org/sdgs/report/2022/The-Sustainable-Development-Goals-Report-2022.pdf
5. UN-WATER. *Policy Report on Climate Change and Water*. It's Geneva. UN, 2019 [revised 1 August 2022]. Available at: https://www.unwater.org/app/uploads/2019/12/UNWater_PolicyBrief_Water_Climate-Change_ES.pdf
6. United Nations. *The United Nations World Water Development Report 2022: Groundwater: Making the invisible visible*. It's Paris. UNESCO, 2022 [revised 1 August 2022]. Available at: https://www.unesco.org/reports/wwdr/2022/en/download
7. United Nations. Economic and Social Council. High-level political forum on sustainable development (2022). E/2022/55, Progress made towards achieving the Sustainable Development Goals. It's Geneva. United Nations, 2022 [revised 1 August 2022]. Available at: https://unstats.un.org/sdgs/files/report/2022/secretary-general-sdg-report-2022--ES.pdf

8. UNESCO, UN-Water (2020). United Nations World Water Development*Report 2020: Data and Figures*. It's Paris. UNESCO,2020 [revised 1 August 2022]. Available at: https://unesdoc.unesco.org/in/rest/annotationSVC/DownloadWatermarkedAttachment/attach_import_905ea763-5484-497c-a409-f0f23a6bc2a6?_=372876spa.pdf&to=16&from=1#pdfjs.action=download

9. UNESCO, UN-Water. *United Nations World Water Development Report 2020: Executive Summary*. It's Paris. UNESCO, 2020. [revised 1 August 2022]. Available in: https://unesdoc.unesco.org/ark:/48223/pf0000372882_spa

10. UNESCO, UN-Water. United Nations World Water Development Report 2020: Water and Climate Change. It's Paris. UNESCO, 2020. [revised 1 August 2022]. Available at: https://unesdoc.unesco.org/ark:/48223/pf0000373611.locale=es

11. United Nations. UN Global*Report on Water Development 2021: The value of water*. It's Paris. UNESCO, 2021 [revised 1 August 2022]. Available at: https://www.unesco.org/reports/wwdr/2021/es

12. 2030 WRG. *Charting our Water Future: Economic Frameworks to Inform Decision-making.* 2030 WRG,2009 [revised 1 August 2022]. Available at: https://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/sustainability/pdfs/charting%20our%20water%20future/charting_our_water_future_full_report_.ashx

13. United Nations. Climate change will jeopardise access to drinking water in the pan-European region. UN News. United Nations, 20 May 2022 [accessed 1 August 2022] Available at: https://news.un.org/es/story/2022/05/1509072

14. Nations Unity. Water Resources. ECLAC. [accessed August 1, 2022] Available at: https://www.cepal.org/es/subtemas/recursos-hidricos#

15. World Bank. Water Matters Resilient, Inclusive and Green Growth through Water Security in Latin America (Spanish). World Bank Group. Washington, D.C., (2022). [revised 1 August 2022]. Available at: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099450103222231166/p1668950059b6e0af0bc670ffe759af1487

16. WHO. Global Costs and Benefits of Drinking-Water Supply and Sanitation Interventions to Reach the MDG Target and Universal Coverage. It's Geneva. WHO, 2012. [revised 1 August 2022]. Available at: https://apps.who.int/iris/handle/10665/75140

17. WWC/OECD. Water: Fit to Finance? Catalysing National Growth through Investment in Water Security. Report of the High Level Group on Financing Infrastructure for a Safe World of Water. Marseilles. WWC/OECD 2015. [revised 1 August 2022]. Available at: www.worldwatercouncil.org/en/publications/water-fit-finance

18. Cruz-Cervantes RI, Adame-Martínez S. Referenceal theoretical foundation for the generation of a model of strategies for water resilience Quivera. Journal of Territorial Studies. 2021; 23 (2): 5-26.

07. Food risks and climate change.

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When talking about food risks and climate change it usually refers, on the one hand, to security in the provision or supply of food, and on the other to the health or hygiene of food (food safety). The risks inherent in the diet are not usually considered, although eating habits can influence the causes of climate change if we speak in terms of environmental sustainability.

Climate change and food production

According to most published studies, climate change is producing, and projections indicate that it will continue to produce, a decline in crop yields[1], especially in temperate and tropical regions with particularly significant effects in developing countries, where the capacity to adapt to change is more limited[2,3]. Not only is the yield being affected but also the quality of the crops, with lower protein concentration[4]. However, areas located at high latitudes would have a favorable outlook due to the rise in temperature[5,6], extending the period of vegetative growth although with a higher risk of spreading pests from temperate areas[7,8]. Likewise, the extent of pesticide use, along with climatic alterations, plays a key role in decreasing pollinating insect populations, negatively affecting crop yields[9].

Being the similar effects on praticulture, livestock farming would be affected via animal feed by an increase in production costs and also by direct effects on animal welfare and its lower yields at the level of production of food of animal origin[10-12].

Particularly sensitive are proving to be fishery resources regarding climate change, altering marine ecosystems significantly due to temperature rise, changes in salinity and acidification resulting from increased CO_2[13-16] concentration.

The increased uncertainty in food production coupled with market speculation derived from food production and certain political decisions (biodiesel production, export

restrictions, armed conflicts) are already producing significant fluctuations in prices, especially of cereals, with growing market access problems for large population groups in a context of increased demand due to world population growth.

Climate change and food safety

Taking into account the seasonal behaviour (with peaks in summer cases) of diseases such as campylobacteriosis or salmonellosis, which are the two most frequent food-eating diseases in Europe[18], the rise in the overall average temperature would lead to a higher potential risk of foodborne diseases, although in countries with hygiene control measures, the trend is not clearly unfavourable in recent years in terms of reported cases[19], although there is no doubt that the risk exists especially in countries where they lack sufficiently developed control measures and health information systems.

The increase in average temperature has also been linked with a higher incidence of ochratoxin A and aflatoxins in food[20,21], with increases in the frequency and amplitude of toxic dinoflagellate outcrops[22] and the appearance of marine pathogens such as *Vibrio spp*[23] because, together with a higher frequency of extreme events such as large storms, they affect the marine system in terms of decreased salinity and contaminant trawling.

Adaptation

There is scientific consensus[1] on the adaptive potential of crops and animal and fisheries production with measures such as crop change or crop varieties, good agricultural practices, management and rationalisation of extractive fisheries, protection of extensive livestock farming, responsible consumption, reduction of food waste, etc., integrating them into policies, plans and programmes (some already included in the agricultural and fisheries policies of our European environment), although it is warned that these would not be sufficient in a scenario of non-mitigating gas emissions that contribute to global warming.

Conclusions

Climate change is linked to declining crop yields and quality, threatens fishery and livestock resources, creates price instability and access to food and produces risks related to food safety. However, there is scope for adaptation provided that it is accompanied by effective emission mitigation measures.

Bibliography

1. Bezner Kerr RT. Hasegawa T, Lasco I, Bhatt D, Deryng A, Farrell H, Gurney-Smith H, Ju S, Lluch-Cota F, Meza G, Nelson H, Neufeldt H, Thornton P. Food, Fibre, and Other Ecosystem Products. 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 DC, Roberts M, Tignor ES, Poloczanska K, Mintenbeck A, Alegría M, Craig S, Langsdorf S, Löschke V, Möller A, Okem B. Rama (eds.)]. Cambridge University Press, 2022. In Press.
2. Lobell DB, Schlenker W, Costa-Roberts J. Climate trends and global crop production since 1980. Science. 2011; 333(6042):616-20. doi: 10.1126/science.1204531
3. Sultan B, Defrance D, Iizumi T. Evidence of crop production losses in West Africa due to historical global warming in two crop models. SCI Rep. 2019; 9(1):12834, https://doi.org/10.1038/s41598-019-49167-0.
4. Myers SS, Zanobetti A, Kloog I, Huybers P, Leakey ADB, Bloom AJ, et al. Increasing CO2 threatens human nutrition. Nature. 2014; 7503 (510):139-42. doi:10.1038/nature13179
5. Chen C, Wang E, Yu Q, Zhang Y. Quantifying the effects of climate trends in the past 43 years (1961-2003) on crop growth and water demand in the North China Plain. Climatic Change. 2010; 100:559-78. https://doi.org/10.1007/s10584-009-9690-3
6. Gregory PJ, Marshall BE. Attribution of climate change: a methodology to estimate the potential contribution to increases in potato yield in Scotland since 1960. Global Change Biology. 2012; 18:1372-88. https://doi.org/10.1111/j.1365-2486.2011.02601.x
7. Ziska LH, McConnell LL. Climate Change, Carbon Dioxide, and Pest Biology: Monitor, Mitigate, Manage. J. Agric. Food Chem. 2016; 64(1): 6–12. https://doi.org/10.1021/jf506101h
8. Bajwa AA, Farooq M, Al-Sadi AM, Nawaz A, Jabran K, Siddique KHM. Impact of climate change on biology and management of wheat pests. Crop Prot. 2020;137: 105304. https://doi.org/10.1016/j.cropro.2020.105304
9. Rodger JG, Bennett JM, Razanajatovo M, Knight TM, van Kleunen M, Ashman TL, Steets JA, Hui C, Arceo-Gómez G, Burd M, Burkle LA, Burns JH, Durka W, Freitas L, Kemp JE, Li J, Pauw A, Vamosi JC, Wolowski M, Xia J, Ellis AG. Widespread vulnerability of flowering plant seed production to pollinator declines. SCI Adv. 2021; 7(42):eabd3524. doi: 10.1126/sciadv.abd3524.
10. Nyoni NMB, Grab S, Archer ERM. Heat stress and chickens: climate risk effects on rural poultry farming in low-income countries, Climate and Development. 2019; 11(1): 83-90, DOI: 10.1080/17565529.2018.1442792

11. Thornton P, Nelson G, Mayberry D, Herrero M. Increases in extreme heat stress in domesticated livestock species during the twenty-first century. *Global Change Biology*. 2021; 27: 5762-72. https://doi.org/10.1111/gcb.15825

12. Godde C, Mason-D'Croz D, Mayberry D, Thornton PK, Herrero M. Risk of climate-related impacts on the livestock sector: A review of the evidence. *Global Food Security*. 2021; 28:100488. https://doi.org/10.1016/j.gfs.2020.100488

13. Pinsky ML, Eikeset AM, McCauley DJ, Payne JL, Sunday JM. Greater vulnerability to warming of marine versus terrestrial ectotherms. *Nature* 2019; 569: 08–111. https://doi.org/10.1038/s41586-019-1132-4

14. Bryndum-Buchholz A, Boyce DG, Tittensor DP, Christensen V, Bianchi D, Lotze HK. Climate-change impacts and fisheries management challenges in the North Atlantic Ocean. It's a sea. ECOL. Oh, Prog. To be. 2020; 648:1-17. https://doi.org/10.3354/meps13438

15. Cheung WL, Watson R, Pauly D. Signature of ocean warming in global fisheries catch. Nature. 2013; 497:365-8. https://doi.org/10.1038/nature12156

16. Báez JC, Gimeno L, Real R. North Atlantic Oscillation and fisheries management during global climate change. Reviews in Fish Biology and Fisheries. 2021; 31:319–36. https://doi.org/10.1007/s11160-021-09645-z

17. Food and Agriculture Organisation of the United Nations (FAO). The State of Food Insecurity in the World: How does International Price Volatility Affect Domestic Economies and Food Security? Food and Agriculture Organisation of the United Nations, International Fund for Agricultural Development, World Food Programme: Rome, Italy, 2011.

18. European Centre for Disease Prevention and Control. Assessing the potential impacts of climate change on food- and waterborne diseases in Europe. Stockholm: ECDC. 2012. https://www.ecdc.europa.eu/en/publications-data/assessing-potential-impacts-climate-change-food-and-waterborne-diseases-europe

19. EFSA and ECDC (European Food Safety Authority and European Centre for Disease Prevention and Control). The European Union One Health 2020 Zoonoses Report. EFSA Journal 2021;19(12):6971, 324 pp. https://doi.org/10.2903/j.efsa.2021.6971

20. Cervini C, Verheecke-Vaessen C, Ferrara M, García-Cela E, Magistà D, Medina A, Gallo A, Magan N, Perrone G. Interacting climate change factors (CO_2 and temperature cycles) effects on growth, secondary metabolite gene expression and phenotypic ochratoxin A production by Aspergillus carbonarius strains on a grape-based matrix. Fungal Biol. 202;125(2):115-122. doi: 10.1016/j.funbio.2019.11.001.

21. Battilani P, Toscano P, Van Der Fels-Klerx HJ, Moretti A, Camardo Leggieri M, Brera C, et al. Aflatoxin B 1 contamination in maize in Europe increases due to climate change. SCI Rep. 2016; 6: 24328. doi: 10.1038/srep24328.

22. Estevez P, Castro D, Small-Valtierra A, Giraldez J, Gago-Martinez A. Emerging Marine biotoxins in Seafood from European Coasts: Influence and Analytical Challenges. Food's. 2019 May 1;8(5):149. doi: 10.3390/foods8050149.

23. Froelich BA, Daines DA. In hot water: effects of climate change on Vibrio-human interactions. Environ Microbiol. 2020 Oct;22(10):4101-4111. doi: 10.1111/1462-2920.14967

08. Displacement of populations. Climate refugees.

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Climate change (CC) has with displaced populations (environmental migrants, climate refugees) common edges of great complexity, including from strict environmental aspects such as: floods, droughts, sea level rise, soil deterioration, epidemics; even socio-economic conditions such as armed conflicts, exhaustion of resources, lack of work, political or religious persecution among others; these are also interrelated with environmental particularities.

The UN Human Rights Council's 'Climate Change and Poverty' report[1] notes that by the end of this century, with an increase of 2°C in the average temperature of the planet, between 100 and 400 million additional people will be added to those already hungry in 2019; and between 1 and 2 billion individuals will be added to people who did not have access to safe water.

The same report argues that since the beginning of this century the death rate from disasters is seven times higher in poor countries than in high-income countries. Climate change deepens poverty and inequality, with more intense impacts on countries and regions whose inhabitants are poor. Half of the world's population (3.5 billion people) of lower income generates only 10% of carbon emissions, while 10% of the richest inhabitants are responsible for half of CO_{2equiv} emissions. A person who belongs to the 99th percentile of per capita income uses 175 times more carbon than a person in the 10th percentile of the income scale.

The link between poverty and socio-economic inequality and the magnitude of the impacts that climate change already produces and will produce, also on the health of communities among other consequences, is evident. In addition, processing global data of gross domestic product per capita (GDP) and gross mortality rate (GMR) for all causes, corresponding to the period 2000-2020 obtained from the World Bank (BM) data repository (https://datos.bancomundial.org/), the author has estimated that for every $1,000 that does NOT grow in a year the GDPpc of a country grows at least 11.6 deaths per 100 inhabitants per year. That is to say, promoting in a decisive way from public policies Sustainable Development Goals #1 (End of Poverty) and #8 (Decent

Work and Economic Growth) will contribute significantly to mitigating and adapting to the health impacts of climate change, including the effects on refugees or climate displaced persons, and in particular in the countries of Latin America and the Caribbean (AL&C), all countries of less than 10 thousand dollars/year of GDPpc on average.

The above BM base indicates that the specific emissions of AL&C (year 2019) are 2.6 tons CO_{2equiv}/inhabitant.year, while the emissions of the European Union (EU) are 6.1 tons CO_{2equiv}/inhabitant.year, and the respective GDPpc (year 2021) is $8,340/year and 38,234 dollars/year.

Then, in AL&C, the measures of adaptation to climate change, which in turn allow to mitigate the health impacts of the phenomenon, surely happen to strengthen urgently the increase GDPpc of each country in the region, even though the economic development of AL&C implies an increase in the specific emissions of CO_{2equiv}.

It is desirable that financial and technological cooperation between AL&C countries and the EU, as well as other economic regions, make possible the growth of AL&C's GDPpc by applying less carbon-intensive technologies. However, it is necessary to understand that increasing GDPpc, within the framework of sustainable development, will be essential and a priority for adaptation to climate change in AL&C.

Bibliography

1. United Nations Human Rights Council. General Assembly, 41 session from 24 June to 12 July 2019; Report of the Special Rapporteur on extreme poverty and human rights: Climate change and poverty; 2019.

09. Urban adaptation. Urban settlements and vulnerability to climate change.

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The development of modern society at the global level has two very relevant demographic characteristics that condition the exposure to environmental risks and their adaptation strategies.

The first of these is the increased growth of the urban population. According to the United Nations (UN), by 2030 three fifths of the global population will live in urban areas; twice as much as in the 50s of the last century. In the case of the European population, by then 77.5% could live in urban areas; and 83.6% for Latin America and the Caribbean. Also in Asia this process occurs at great speed, and it is expected that most of the major metropolises will be located in the poorest countries[1]. In Europe, this phenomenon also occurs simultaneously with the inversion of the population pyramid and the progressive aging of the population. By the horizon 2100, the percentage of over 65% is forecast to exceed 31% in the European Union of 27[2]. With age, the incidence of chronic and long-term diseases inevitably increases. In these patients, whose health is already compromised, it is in whom many of the environmental risks associated with climate change can be more severe.

Together, these urban areas will face great environmental risks. On the one hand, the activity in cities involves large energy consumption, coupled in turn with the emission of greenhouse gases and chemical air pollution[1,3].

Along with this, another major environmental risk in urban areas is physical air pollution, mainly noise. This is an important risk in cities that overstresses the organism and inhibits immune defense. Thus, this has been associated with attributable increases in mortality from ischemic heart disease, myocardial infarction, pneumonia or COPD[4]. In addition to being associated with hospital admissions for depression and anxiety[5].

Extreme temperatures are also significant environmental risks in urban areas. In the most severe cases, patients may suffer from hypothermia or heat stroke. However, such extreme situations occur very rarely.

Much more relevant, though silent, is the role of heat and cold waves as aggravating long-lasting chronic diseases. Thus, extreme temperatures mainly over stress the organism. When these are of great intensity or lasting, they can precipitate the decompensation of the organism. Therefore, associated with these episodes are detected morbidity-mortality peaks for all kinds of natural causes. And among them, stand out those of respiratory type, those that affect the cardiovascular system or the kidneys. In addition, heat waves have been linked to premature birth and low birth weight[6].

In urban areas, particular attention deserves the risk of heat wave. In this case, the scientific consensus seems to suggest that the urban population tends to be more vulnerable to this environmental risk than the rural population, at least if controlled by socio-economic factors[7]. Various factors could explain this, such as the effect of urban thermal island, which can enhance local exposure by generating microenvironments at high temperature inside cities and buildings[1]. On the other hand, it is expected to find greater vulnerability where the status of the population is worse, which could be distributed in a very asymmetric way between rural and urban areas depending on the country analysed. Finally, formal and informal networks that protect certain vulnerable groups, such as dependent or low-income people, may also work more effectively in rural areas[7].
In addition, global warming allows the spread of diseases communicable by food, vectors or water. This particular risk grows in relevance when high temperatures occur simultaneously with floods[3].

Obviously, given the record temperatures that are reached in various parts of the world because of global warming, there is enormous concern about the public health risks associated with heat waves. However, it is not clear that the cold waves will be mitigated spontaneously.

As temperatures rise, they increase the tolerance of populations to heat. This has been revealed by means of different indicators such as the evolution of relative mortality risks associated with heat waves, the evolution of minimum mortality temperatures or the evolution of threshold temperatures from which extreme heat is associated with population mortality peaks[8-12].

In parallel, as populations adapt to heat, their tolerance to low temperatures is also readjusted. Thus, although in some countries a process of mitigating the health impacts

of low temperatures has been reported, in others it appears that these risks could remain stable or be reduced at a lower rate than initially expected[13]. In any case, the scientific literature seems to agree that the possible risks associated with heat waves far outweigh the hypothetical positive effects that climate change could cause on winter mortality[3].

Another major environmental risk is droughts, associated with food safety and malnutrition issues. Today, a quarter of the population living in large cities depends on stressed water resources[1]. And looking ahead, as the twenty-first century progresses, renewable sources of water and groundwater will be reduced, which will further aggravate this situation in the most arid areas of globe[1], intensifying and aggravating migratory movements caused by other causes[3].
Although the environmental risks discussed are a major challenge for today's and future's cities, there are sufficient means and technology to promote adaptation to climate change. This requires specific strategies for the identification, information and protection of vulnerable groups; early warning systems, as well as urban planning designed to reduce the risks associated with climate change; thus reducing the number of premature deaths associated with these phenomena.

In connection with this last point, the technical guide Climate technologies in an urban context has recently been published, with the collaboration of the UNEP DTU Partnership and UN[1]. Following it, a wide range of options can be needed to achieve environments better adapted to climate change.

At the level of intervention on buildings, vertical surfaces and roofs are in general completely untapped; when they could serve as support of urban gardens and photovoltaic panels. However, such interventions should also consider the increased risk of respiratory disease due to increased allergen levels. This requires careful selection of plant species from them.

A phenomenon that arouses growing concern in cities is the phenomenon of Urban Thermal Island, whose main consequence is to increase the demand for electricity in the warm seasons[14]. To mitigate this phenomenon there are novel solutions in addition to the aforementioned urban gardens and the classic awnings and blinds[1]. For example, work on envelopes that allow passive cooling of buildings through phase changes or others that improve the insulating properties of buildings. In this same sense, it should also promote the installation of double-glazed windows and implement and study new building materials with more suitable thermal properties[1].

Likewise, the internal structure of the buildings must be thought of guaranteeing passive ventilation systems that optimise the evacuation of heat without energy expenditure during summer[1]. In turn, the promotion of more efficient air conditioning systems, such as central heating systems, cannot be renounced.

From a broader perspective, it is known that the temperature that a city acquires depends deeply on how the blocks of buildings are distributed, the urban canyons they form and how the air currents flow through them or, on the contrary, interfere with their flow[14]. It is difficult to change the urban physiognomy of areas already built; however, new urban expansions can be planned according to these details.

Also at this level of intervention, the so-called *District cooling*[1] systems have been tested in several countries, with very encouraging results. These are piping systems in neighborhoods or districts that channel substances with a high heat absorption capacity, usually cold water. The main advantages of this system are that they allow to collectively cool urban environments with greater energy efficiency than individual air conditioning systems and in a more equitable way. In addition, by reducing the temperature of the areas they cover, the electricity demand of the residences and establishments that benefit from them is also reduced. This system has the added advantage of being able to serve certain specific high heat industrial waste, e.g., liquefied natural gas processing waste[1].

As for the countries where this technology has been tested[1], the Middle East in 2014 installed 7 million square meters of these refrigerant pipeline networks. Dubai in particular is the country with the world's largest network, and plans to cover two-fifths of its refrigerant demand with this system by 2030. It can also be found in Japan, where the system is well developed in Tokyo, Osaka, Sapporo, Nagoya, Fukuoka and Yokohama. In South Korea this system is also growing rapidly and, already in Europe, can be found in Denmark.

Where there is a risk of drought, we can promote the installation of rainwater accumulator structures in cities[1]. Subsequently, this water can be directed to different uses that allow the preservation of water for human consumption; or even direct this same water to human consumption if it is possible to guarantee adequate quality standards for it to be considered drinkable.

At the opposite end there are places where the risk is flooding. In these cases, the most obvious solution is to respect natural water flows and redirect problematic water flows to them. With the same philosophy of integrating the built environment and the natural ones, there is the possibility of restoring natural flood plains[1].

The so-called classic grey infrastructure of cities is a big problem given the waterproof properties that these materials normally have. In opposition, again urban parks and gardens can be very useful since they require a substrate with some water retention power. Also, as far as possible, waterproof surfaces can be replaced by permeable surfaces. These materials can even be integrated into drainage and infiltration systems, re-channeling and sustainable retention of large water flows when these occur.

Obviously, urban centres can face increasing and sometimes contradictory environmental risks. For example, places that alternate dry seasons with flood risk or cold winter seasons along with warm summers. However, certain solutions to some of these risks may intensify the opposites. Therefore, the implementation of these measures requires strong political will and multidisciplinary teams that harmonise the different initiatives that take place in cities and are able to reach the most optimal compromise solutions to reduce the health impacts of climate change.

Bibliography

1. Puig, D. (Ed.) (2021). Climate technologies in an urban context. UNEP DTU Partnership.
2. Eurostat 2020. Demographic structure and population ageing. Consulted in: Archive:Demographic structure and population ageing — Statistics Explained (europa.eu)
3. IPCC (2022). Climate change 2022: impacts, adaptation and vulnerability.
4. Recio, A., Linares, C., Banegas, J. R., & Díaz, J. (2016). The short-term association of road traffic noise with cardiovascular, respiratory, and diabetes-related mortality. *Environmental Research*, *150*, 383-390.
5. Díaz, J., López-Bueno, J. A., López-Ossorio, J. J., Gónzález, J. L., Sánchez, F., & Linares, C. (2020). Short-term effects of traffic noise on suicides and emergency hospital admissions due to anxiety and depression in Madrid (Spain). *Science of the total environment*, *710*, 136315.
6. WHO (2021). Heat and helath in the WHO European Region: updated evidence for effective prevention.
7. López-Bueno, J. A., Navas-Martín, M. A., Díaz, J., Mirón, I. J., Luna, M. Y., Sánchez-Martínez, G., & Linares, C. (2022). Analysis of vulnerability to heat in rural and urban areas in Spain: What Factors Explain Heat's Geographic Behavior? *Environmental Research*, *207*, 112213.
8. Romanello, M., McGushin, A., Di Napoli, C., Drummond, P., Hughes, N., Jamart, L., & Hamilton, I. (2021). The 2021 report of the Lancet Countdown on health and climate change: code red for a healthy future. *The Lancet*, *398*(10311), 1619-1662.

9. Sheridan, S. C., & Allen, M. J. (2018). Temporary trends in human vulnerability to excessive heat. *Environmental research letters*, *13*(4), 043001.

10. Follos, F., Linares, C., López-Bueno, J. A., Navas, M. A., Culqui, D., Vellón, J. M., & Díaz, J. (2021). Evolution of the minimum mortality temperature (1983–2018): is Spain adapting to heat? *Science of the Total Environment*, *784*, 147233.

11. Díaz, J., Carmona, R., Mirón, I. J., Luna, M. Y., & Linares, C. J. E. I. (2018). Time trend in the impact of heat waves on daily mortality in Spain for a period of over thirty years (1983–2013). *Environment international*, *116*, 10-17.

12. Lopez-Bueno, J. A., Diaz, J., Follos, F., Vellón, J. M., Navas, M. A., Culqui, D. & Linares, C. (2021). Evolution of the threshold temperature definition of a heat wave vs. evolution of the minimum mortality temperature: a case study in Spain during the 1983–2018 period. *Environmental Sciences Europe*, *33*(1), 1-10.

13. López-Bueno, J. A., Diaz, J., Navas, M. A., Mirón, I. J., Follos, F., Vellón, J. M., & Linares, C. (2022b). Temporary evolution of threshold temperatures for extremely cold days in Spain. *Science of the Total Environment*, 157183.

14. Bahi, H., Radoine, H., & Mastouri, H. (2019). Urban Heat Island: State of the Art. 2019 7th International Renewable and Sustainable Energy Conference (IRSEC), 1-7. https://doi.org/10.1109/IRSEC48032.2019.9078329
https://doi.org/10.1109/IRSEC48032.2019.9078329

10. The economy of climate change.

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Introduction

Human activity is changing the climate at risk of irreversibility. The impact on all human activities is already visible and will grow exponentially, as long as we continue to emit gases that trap some of the heat that the planet tries to dissipate to maintain an energy balance compensating for the heat it receives from the sun.

Science provides overwhelming evidence that the cause is the additional greenhouse effect from the accumulation of gases such as carbon dioxide (CO_2), methane (CH_4) and others, produced mainly by burning fossil fuels and agricultural/livestock activity. The atmospheric concentration of these gases continues to grow[1,2], as human activity causes increasing emissions that natural sinks cannot absorb.

The main consequences already observed are[3,4]: (a) The average temperature of the planet has risen 1.11 °C (± 0.13 °C) (b) The precipitation regime has changed, raining more in areas that were already rainy and raining less in those that were prone to drought (c) The ice at the poles and glaciers is disappearing. (D) The acidity of the oceans is increasing by a higher concentration of CO_2, (e) Sea level has risen and (f) The intensity and frequency of extreme weather events has increased, with an increasing degree of attribution to observed global warming.
A trending future would lead us to a situation of societal collapse: The world's population continues to grow, reaching 10,000-11,000 million over the 21st century[5]. Energy consumption per capita continues to grow[6]. The improvement of energy and carbon intensities is not being necessary to offset that growth so, if we continue with current policies, emissions would continue to grow over the coming decades. With serious consequences: (a) the average warming could exceed 4° C, (b) The change in the rainfall regime would be aggravated, with desertification in some areas and torrential rains in others where today a large part of the crops of wheat, barley, corn and rice are concentrated and (c) It would increase the acidity of the oceans[4]. With that warming, desertification, and marine acidity there will not be enough agriculture and fishing for a

human population of 10 billion living in the civilised way we know. That cost would be unaffordable. Long before the collapse, the economic and military powers would eventually react, with that cost being exponentially higher depending on the late response decided and coordinated[7].

We can avoid the worst consequences

If governments, businesses and citizens tackle a radical transformation, consisting of reducing consumption and decarbonising the economy, there will be hope. This can only be achieved with a combination of energy efficiency, decarbonisation, renewable electrification and other accompanying measures.

The main gases are CO_2, CH_4 and N_2O caused by electricity generation, agriculture/livestock, industry, transport and heating[8]. Well, known the causes, we will be able to know the remedies, which are no other than to reduce emissions to zero (or almost) sometime before 2050 (or shortly thereafter).

We have renewable resources and cheaper technologies than conventional[1]

The planet receives from the sun more than 6,000 times the primary energy that humanity needs. In a sustainable and inexhaustible way[9]. Technologies to capture that energy are already more competitive than conventional energies[10]. The solution to the problem would therefore be a massive and comprehensive combination of the following measures:

1. **Energy efficiency:** It is about consuming less energy without sacrificing quality of life. This would affect buildings, industry, transportation, heating and agriculture.
2. **100 % renewable electricity:** solar, wind and hydroelectric mainly.
3. **Electrification** (renewable) of demand:
    (a) Transport: Terrestrial by batteries, catenary or fuel cell. Maritime and air, through combustion and fuel cell with zero-emission fuels such as e-

[1] The Earth receives from the sun 3,850,000 EJ/600 EJ = 6,416 times the primary energy it consumes. The comparison in terms of final energy is, at the very least, double: The planet receives more than 13,000 times the final energy it consumes. And he only needs one.

H_2, e-ammonia, e-methanol and biofuels from waste. Renewable electrification achieves two objectives: reduced consumption by higher efficiency of electric motors and is emission-free.

(b) Heat pump heating. Its efficiency triples that of fossil gas or gasoil boilers. District heating, of biomass or geothermal origin where feasible.

4. **Replacement of fossil natural gas** by electrolytic hydrogen or biomethane for those activities that are difficult to electrify, such as industry, some high temperature processes and backup electricity generation.

5. **Measures for the management of the intermittence** of renewable energies:

(a) Storage using electrolyte hydrogen, pumping, batteries and others.

(b) Use of surplus renewable electricity to clean water.

(c) National and international interconnections.

(d) Digital solutions for intermittency management: Smart cities, Smart grids, demand management, mass storage in vehicle batteries (V2G).

(e) Massive deployment of solar thermal installations, which accumulate day energy and release it at night.

6. **Solutions to the hard-to-decarbonise sectors** (heavy industry and transport) using hydrogen, advanced biofuels and carbon capture and storage (CCS).

7. **Solutions for agriculture, livestock, forests:** electrification, more plant diet, reforestation, research on protein synthesis.

8. **Legislative and fiscal measures:**

(a) Establishment of timetables for the eradication of fossil fuels (coal power stations, thermal vehicles, combustion boilers), for the registration and circulation of polluting vehicles, for the installation of heat pumps and the removal of gas or diesel boilers and for the sectoral reduction of emissions.

(b) Establishment of Low Emission Zones (ZBE) in cities.Unfortunately, the transition will also create losers: States and companies exporting coal and oil, developing countries whose access to local fossil energy is cheaper and, in general, vulnerable families whose resources do not allow them access to technologies with better total cost of ownership (electric car,

heat pump heating, rehabilitation of buildings) but that require investment. Therefore, it will also be necessary to deploy fiscal and redistributive measures, not only for justice, but to avoid rejections such as those observed by certain exporting nations, energy companies and developing countries at successive Climate Summits (COPs) and the popular classes in developed countries, such as the "yellow vests".

(c) Global CO2 Price Establishment. Generalised environmental taxation policies, governed by the "polluter pays" principle. It is known that this can end in that "the one who pays, pollutes", but today, unfortunately, the polluter, does not even pay for the damage it causes.

(d) Establishment of redistributive policies of environmental taxation, such as the well-known Carbon Charge with Return.

9. **Coordinated action by the International Community,** for this task must be undertaken by all. The leadership of those who can, such as the European Union, the United States and China, will be instrumental in demonstrating to the rest the advantages of decarbonisation.

How we are coping with the transition

According to Bloomberg NEF, global investments in zero-emission technologies are growing year after year, having reached 0.76 billion dollars in 2021 (10^12, B$)[11]. However, they believe that, in order to reach Net Zero's 2050 targets, the world should triple the level of investments to reach an average of $2.1 B in the 2022-2025 triennium and then double it to levels of 4.2 B$ per year in the triennium 2026-2028. This is not happening at this rate, which is a cause for concern, as Antonio Guterres said on 18 May when presenting the WMO's annual report (WMO)[3].

Adaptation

The consequences of warming are already occurring: extreme weather events, more frequent, powerful and harmful hurricanes, floods in rainy places and droughts in dry places, increasingly frequent and harmful fires, loss of ice and snow cover, with impact on agricultural production systems, coastal infrastructure and a long etc. Enormous resources will have to be allocated to adapt to the changes that have already begun and that will go to more. They highlight the protection of coastal infrastructures, the development of new crops resistant to heat, drought or torrential rains, the protection of tourist infrastructures on the coast and in the mountains. To the extent that we are

unable to mitigate the causes of warming in time, the economic impact on adaptation will grow, like the damage itself, exponentially.

Other co-benefits of decarbonisation

The energy transition as a whole and the eradication of fossil fuels will also reduce air pollution by gases and particulates from combustion, responsible for millions of premature deaths and rising health costs[12,13]. In addition, the manufacture, installation, maintenance, dismantling and recycling/reuse of all the infrastructures described would necessarily be relocated in each of the countries, with an increasing reduction of the energy bill for all citizens, generating jobs and distributed wealth. Many analysts estimate these co-benefits at several times the cost of investments needed to make the[14-16] transition.

Conclusions

The problem is undeniable. The planet warms and its worst consequences will worsen if we do not avoid it. Population growth and energy consumption can only be offset by total decarbonisation in a few decades. The risk of not preventing an irreversible crisis is existential. And in this eventuality, the cost of late action will be extraordinarily higher than the cost of coordinated and early action.

Fortunately, a smart transition to zero-emission technologies will not only allow the survival of organised human society, but also reduce anticipated mortality and morbidity, generate massive needs for new investments, economic growth with significant savings in the energy bill, create millions of local jobs and boost national economies.

Bibliography

1. Global Monitoring Laboratory. Trends in Atmospheric Carbon Dioxide. Available at: https://gml.noaa.gov/ccgg/trends/history.html
2. United States Environmental Protection Agency. Climate Change Indicators: Atmospheric Concentrations of Greenhouse Gases. Available at: https://climatechange.chicago.gov/climate-indicators/climate-change-indicators-atmospheric-concentrations-greenhouse-gases
3. World Meteorological Organisation. State of Global Climate 2021. WMO-Nor. 1290. Available at: https://library.wmo.int/index.php?lvl=notice_display&id=22080#.Yos0ZyFS9Bx

4. IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 3− 32, doi:10.1017/9781009157896.001.
5. United Nations. Peace, dignity and equality in a healthy plan. Population, Available in: https://www.un.org/es/global-issues/population
6. Our World in Data. The World's Energy Problem. Available in: https://ourworldindata.org/energy-production-consumption https://ourworldindata.org/future-population-growth
7. Burke, M., Davis, W.M. & Diffenbaugh, N.S. Large potential reduction in economic damages under UN mitigation targets. Nature 557, 549–553 (2018). https://doi.org/10.1038/s41586-018-0071-9
8. Drawdown. Project Drawdown Climate Solutions 101. Available at: https://drawdown.org/climate-solutions-101/unit-2-how-to-stop-climate-change
9. International Energy Agency. Statistics report. Key World Energy Statistics 2020. IEA. Available at: https://iea.blob.core.windows.net/assets/1b7781df-5c93-492a-acd6-01fc90388b0f/Key_World_Energy_Statistics_2020.pdf
10. Lazard. Levelised Cost Of Energy, Levelised Cost Of Storage, and Levelised Cost Of Hydrogen. Available at: https://www.lazard.com/perspective/levelized-cost-of-energy-levelized-cost-of-storage-and-levelized-cost-of-hydrogen/
11. BloombergNEF.Energy Transition Investment Trends. Available at: https://about.bnef.com/energy-transition-investment/
12. World Health Organisation. Climate change and health. Available at: https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health
13. World Health Organisation. Climate change and health. Health co-benefits of climate action. Available at: https://www.who.int/teams/environment-climate-change-and-health/climate-change-and-health/capacity-building/toolkit-on-climate-change-and-health/cobenefits
14. Union of Concerned Scientist. Top 10 Benefits of Climate Action. Available at: https://www.ucsusa.org/resources/top-10-benefits-climate-action
15. Berkeley Economic Review. The Cost-Benefit Analysis of Climate Change. Available at: https://econreview.berkeley.edu/the-cost-benefit-analysis-of-climate-change/
16. Massachusetts Institute of Technology. Study provides scenarios for assessing long-term benefits of climate action. Available at: https://news.mit.edu/2015/study-provides-scenarios-assessing-long-term-benefits-climate-action-0901

11. Social perception, education, communication, training, training and participation in climate change and health.

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1. Climate crisis is a public health crisis

The climate crisis is above all a public health crisis[1] that threatens the health and well-being of all people. It already has a huge impact on the health of people and communities through its direct and indirect effects[2,3] It will still be greater in the future if we are not able to mitigate climate change and adapt to its impacts[4]. This is the message and the fundamental narrative that we must communicate as a starting point when we do education, awareness raising, training, training... for climate action with different types of audiences: climate change is bad for your health.

Some studies of social perception[5] show that large sectors of the population already relate climate change and health: for example, 70.9 % of the Spanish population believe that climate change (CC) can greatly or significantly affect their health. While there is no absolute certainty as to whether that fact can mobilise climate action alone, there is evidence that it can be used as an important and motivating lever for action.

2. There are different health approaches in which to integrate climate action

There is a lack of standardisation in what is meant by health and climate change in the regional, national, departmental or municipal management of climate risk management. This generates ambiguity in the role and responsibilities of the actors involved in the

definition, implementation and evaluation of policies, adaptation plans or design of sectoral and intersectoral monitoring tools in territorial management.

It is essential to consider the health approach to be used in climate risk management. There are several that can serve as a framework for climate action: a health, global health, planetary health, public health, health in all policies, health promotion and assets for health, health as an indicator of the three dimensions of sustainable development (economic, social and environmental) and health from the approach of social determinants[6]. The latter integrates strengths and opportunities from other approaches, such as a set of biological, cultural, social, physical and environmental factors, including individual, genetic, biological, environmental and lifestyle-related factors, society's way of life and living conditions that are generally framed within the context of the territories. Climate risk is based on climate and meteorological threats, vulnerability and exposure of human groups and ecosystems, which are intrinsically related to the different factors of the social determinants model, which allows to propose a holistic approach to climate risk.

3. Socio-educational tools are key to climate mitigation and adaptation with a health approach

Socio-educational tools (education, communication, training, training, participation) are essential in building capacity for mitigation and adaptation to the climate crisis, as already reflected in Article 6 of the United Nations Framework Convention on Climate Change[7] and the preamble and Article 12 of the Paris Agreement[8], now included in Climate Empowerment Action[9]. Under a health approach even more, as they can provide us, adapting to[10]:

- awareness and awareness of the need for climate action (mitigation and adaptation) to protect our health and that of our communities,
- building capacities, competences and concrete know-how (individual, social, community, professional) for different health mitigation and adaptation strategies and instruments,
- and a sense of responsibility and mobilisation for action to implement them, framed in adequate governance.

4. Health-Based Communication from Climate Action May Be More Effective Than Other Strategies

When climate change news sets out its impact on health, it promotes greater interest in audiences, because they see it as something more relevant and closer. Effectively communicating the health impacts of climate change (and solutions to address them) can help generate the public demand for climate action needed to increase political will among government leaders.

Evidence-based messages that include health impacts of climate change, co-benefits of solutions and a call to action are more effective for engagement. A key approach is to transform the individual from "object", who only receives information, to "subject", which allows empowerment and participation in decision-making that support climate governance and promote health[11].

5. Adequate communication of the health risks of climate change is essential

Faced with the impacts of climate change on health, such as the increase in extreme weather events, risk communication must be professional, interdisciplinary, rigorous, based on the knowledge of people's risk perception (subject to many biases that need to be known and overcome), with different roles (professionals, citizenship...), with different phases (consensus, care, crisis), and should look for profiles that give confidence to citizens. Weber[12] proposes to develop initiatives for collective participation and responsibility for climate change that strengthen the perception of risk.

Communication strategies that reflect the systemic nature of climate risks are based on continuous and ongoing dialogue. They can improve understanding of exposure, vulnerability and hazards, recognise and respect local, regional and global priorities, share knowledge, drive innovation, build trust and increase transparency. They can also strengthen people's motivation and ability to make informed decisions and be able to act, ultimately contributing to a change in the way societies relate to risk.

In addition, climate action plans with a health component and their processes of training, communication, dissemination and training to citizens must be adapted and framed in the territory and aimed at specific recipients. The action must be regional, local and

should scale down as much as possible. There are no specific recipes, but tools such as risk maps, early warning systems, or the use of mobile alert app can be interesting examples of tools to develop.

6. Education is, in itself, a strategy to adapt to the impacts of climate change on health as well

The phenomenon of climate change has made the environment on the public agenda and has increased the concern of citizens, academia and society about the consequences of harmful treatment to the environment around us[13]. This visualisation of the environment through the health impacts of climate change should not only be taken up as a challenge, but also an opportunity to bring about a change in the lifestyle of individuals and populations that will enable the development of a sustainable world. This is why education, training and awareness-raising in environmental health become essential adaptation strategies and tools.

Education systems need to be resised and include climate change and risk management as topics to be addressed, especially in the development of content and methodologies that generate capacity in society from formal, non-formal and informal scenarios. In these spaces we must teach about environmental awareness, ecological knowledge, attitudes and values towards the environment in order to take a commitment to actions and responsibilities that have at last the rational use of resources and thus be able to achieve an adequate and sustainable development[14].

7. Health and climate crisis aspects must be integrated into all educational curricula at all educational levels

The main knowledge, capacities and tools of mitigation and adaptation to climate change in specific relation to health should be integrated into school curricula at all educational levels, from compulsory education to specific undergraduate and postgraduate programmes in public health, Earth and environmental sciences and sustainable development, economics, engineering, social sciences, etc. and also in other seemingly more distant topics, such as the humanities and the arts.

Universities have to "transversalise" climate change and health education for all students to address the issue in their core curriculum. This is particularly important as many of the decisions taken in one sector can have impacts on human health (health in all policies). Climate and health education should be part of the broadest possible curriculum.

8. Training in climate change and health is key in the training of health science professionals

Health science professionals are among the most trusted voices in society; it is imperative that they are well informed and trained on climate change, environmental issues and their relationship to health. Surveys conducted at the global, regional and national levels show significant gaps in knowledge and few educational programs or curricula developed. Institutional knowledge of health protection measures is limited for several reasons, including the lack of structured content on climate change and environmental health in health science programmes, as well as lack of funding for research, especially in developing countries[15-17].

Interest in integrating climate change into health science education has increased significantly in recent years and change is often driven by[18-20] students. In 2017, the Global Education Consortium for Climate and Health (GCCHE) emerged from a need identified during COP21 to invest more in educating health professionals around the world to prevent, reduce and respond to the health impacts of climate change. Some examples of good practices in this regard (there are many more) are the project of the Pontificia Universidad Javeriana, headquarters Bogotá, to address the current knowledge gaps in education in education and resources related to climate change and health or the itinerary of continuous training for social health professionals in Global Health, with special attention to climate change, of the Aragonese Institute of Health Sciences IACS (Aragon, Spain).

Education of health workers at global, regional and national levels plays a key role in addressing the climate crisis. It is necessary to increase knowledge and skills among health science students to develop skills, so that they continue to serve as trusted voices within their professions and institutions[21].

9. Health professionals must be pioneers in responding to the health threat of climate

change

Health professionals (in a broad and inclusive sense of socio-health professionals from a wide range of fields) have fought major health threats, such as tobacco, HIV, polio (these threats were solved with a vaccine) or COVID-19, and have often faced powerful interests along the way. Similarly, they must pioneer the response and commitment to the health threat posed by climate change.

In this regard, initiatives and declarations such as Doctors for Climate, Climate and Health Alliance or Global Climate and Health Alliance, the Medical Alliance against CC (AMCC Spain), Call for emergency action to limit global temperature increases, restore biodiversity, and protect health (September 2021), the COP26 Global Health Community Charter, the Pediatric societies' declaration on responding to the impact of climate change on children should and can be promoted, replicated and disseminated. the letter Public health institutes and the fight against climate change, the Declaration of the American Medical Association (AMA) on climate change as a public health crisis, the Network of Climate Change Researchers of the Americas, the Planetary Health group of SEMFYC and other similar ones that may arise, such as this very positioning of SESPAS, SESA and SIBSA.

10. Climate action is good for health: communicate this message

Climate action through mitigation and adaptation has huge collateral benefits (health co-benefits)[22] on the health of people and communities and can prevent climate change-related diseases and deaths, saving the lives of millions of people, promoting better public and community health and saving the enormous economic costs of that health impact. That is a positive and relevant message for citizens that can move to action: climate action is good for your health and that of your community.

Bibliography

1. Velasco, M. María Neira: "Apart from the whole political debate, the climate crisis is a health issue. The Huffington Post. 12/11/2021. [Quoted 22/08/2022]. Available at: https://www.huffingtonpost.es/entry/entrevistamarianeiraoms_es_618baacbe4b0ad6f588b4667
2. De la Osa J. Climate change and health: acting in the face of climate change to improve

the health of people and the planet. Health and Environment Observatory 2016. DKV Institute of Healthy Life. Zaragoza: Oh, Ed. DKV Insurance; 2016. [Quoted 22/08/2022]. Available at: https://dkv.es/corporativo/observatorio-cambio-climatico-y-salud-2016

3. DKV Institute of Healthy Life. Climate change and health. The fight against climate change, the greatest global health challenge of the 21st century. Health and Environment Observatory 2021. Zaragoza: Oh, Ed. DKV Insurance; 2021. [Quoted 22/08/2022]. Available at: https://dkv.es/corporativo/observatorio-cambio-climatico-y-salud
4. Huertas S, Rodrigo-Cano D, De la Osa, J, Alcañiz, G. acclimatise us. Climate change, a public health problem. Didactic guide on adaptation to heat. Ministry for Energy Transition and the Demographic Challenge. Biodiversity Foundation. Ministry of Science and Information. Carlos III Health Institute. PIMA Adapta Program. Spanish Climate Change Office. 2021. [Quoted 22/08/2022]. Available at: https://www.adaptecca.es/sites/default/files/documentos/guiaaclimatarnosfinal.pdf
5. Ideara Research. Spanish society in the face of climate change. Perception and behaviors of the population. 2021. [Quoted 22/08/2022]. Available at: https://idearainvestigacion.es/la-sociedad-espanola-ante-el-cambio-climatico-percepcion-y-comportamientos-en-la-poblacion-2/
6. World Health Organisation. Commission on Social Determinants of Health. (2008). Closing the gap in a generation: health equity through action on the social determinants of health: final report: Executive summary. World Health Organisation. https://apps.who.int/iris/handle/10665/69832
7. United Nations. United Nations Framework Convention on Climate Change. 1992. [Quoted 22/08/2022]. Available at: https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/convsp.pdf
8. United Nations Framework Convention on Climate Change. 2015. Paris Agreement, UNFCC. [updated in 2015; cited 22/08/2022].Available at: http://unfccc.int/paris_agreement/items/9485.php
9. United Nations. Action on climate empowerment. [Quoted 22/08/2022]. Available at: https://unfccc.int/es/blog/accion-sobre-el-empoderamiento-climatico
10. Heras F. Addressing climate risks from a social and educational approach. SIPS International Congress 2021/XXXIII Interuniversity Seminar on Social Pedagogy, Environmental Education and Sustainability Culture: building the ecological transition. 2022 (in press).
11. Health without Damage (2020). Journalism and climate change. Recommendations for journalistic coverage from a health perspective. [Quoted 22/08/2022]. Available at: www.saludsindanio.org/cambio-climatico/guia-periodistas
12. Weber, USA. What shapes perceptions of climate change? Wiley interdiscip. Rev: Climate Change, 2010. **1**, 332–342, [updated 2010; cited 22/08/2022). Available at:

https://doi.org/10.1002/wcc.41.

13. Ayuntamiento de Huelva. Green line. Environmental education: Environmental awareness and awareness]. 2017. [Quoted 22/08/2022]. Available at: http://www.lineaverdehuelva.com/lv/consejos-ambientales/educacion-ambiental/sensibilizacion-y-concienciacion-ambiental.asp)
14. Martínez Chaparro César. Strategy of Education, Training and Public Awareness on Climate Change, for the Capital Region (Bogotá's-Cundinamarca) Comprehensive Regional Plan for Climate Change Capital Region Bogotá — Cundinamarca (PRICC). 2012. [Quoted 22/08/2022]. Available at: https://oab.ambientebogota.gov.co/?post_type=dlm_download&p=21634
15. Leal Filho, W., Sima, M., Sharifi, A. et al. Handling climate change education at universities: an overview. Environ Sci Eur 33, 109 (2021). [Quoted 22/08/2022]. Available: https://doi.org/10.1186/s12302-021-00552-5
16. Palmeiro-Silva YK, Ferrada MT, Ramírez Flores J, Silva Santa Cruz I. Climate change and environmental health in graduate health careers in Latin America. Rev Saude Publica. 2021; 55:17. [Quoted 22/08/2022]. Available in: https://doi.org/10.11606/s1518-8787.2021055002891
17. Mantilla, G, Li C. Teaching of climate change and health in medical schools in Colombia. 2019. [Quoted 22/08/2022]. Available at: https://www.ojs.diffundit.com/index.php/rsa/article/view/946/948
18. Howard, B. Climate change in the curriculum. AAMC. 2019. [Quoted 22/08/2022]. Available in: https://www.aamc.org/news-insights/climate-change-curriculum
19. Marill, M. C. Pressured by Students, Medical Schools Grapple with Climate Change. Health Affairs, 39 (12), 2050–2055. (2020). [Quoted 22/08/2022]. Available at: https://www.healthaffairs.org/doi/10.1377/hlthaff.2020.01948
20. Rabin, B. M., Laney, E. B., & Philipsborn, R. P. The Unique Role of Medical Students in Catalysing Climate Change Education. Journal of Medical Education and Curricular Development, 7, 2382120520957653. 2020. [Quoted 22/08/2022]. Available at: https://doi.org/10.1177/2382120520957653
21. Henderson, E. How can healthcare professionals help address climate change? 2021. [Quoted 22/08/2022]. Available at: https://www.news-medical.net/news/20211012/How-can-healthcare-professionals-help-address-climate-change.aspx
22. Osa J. Climate change and health: acting in the face of climate change to improve the health of people and the planet. Health and Environment Observatory 2016. DKV Institute of Healthy Life. Zaragoza: Oh, Ed. DKV Insurance; 2016. [Quoted 22/08/2022]. Available at: https://dkv.es/corporativo/observatorio-cambio-climatico-y-salud-2016

12. Climate change and mental health.

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Mental and behavioral disorders are a major public health problem and are a priority for the World Health Organisation (WHO)[1]. In Spain, in 2017, 19 % of the population had psychological distress, 15 % received some diagnosis of mental disorder[2], the adjusted suicide mortality rates (2011-2015) were 8.2 per 100,000 inhabitants[3] and for several European countries, including Spain, approximately 25 % of the population has suffered some mental disorder in their life[4].

Among other factors, with greater weight in the incidence of mental illness, climate change (both due to its extreme acute climatic events, subacute and long-term events) negatively affects the well-being and mental health of the population[5-9]. Therefore, the WHO suggests raising it to the priority category, among measures that address climate change, thus urging countries[10]. In particular, the impact of climate change on mental health includes, among others: worsening of population psychological malaise[5-10], sleep disturbances[9], increased cases of mental illness (depression, anxiety, post-traumatic stress syndrome, substance abuse, schizophrenia and bipolar disorder among others), [5-10] , exacerbation of symptoms[5,9], increased susceptibility to diseases and higher mortality in those with a previous mental illness[8,9], lethargy and cognitive decline[6], anxiety about the future[5], solastalgia[5,9], and the increase in the incidence of suicides[5-10]. Additionally, more events related to climate change can have long-term consequences, such as ecosystem degradation and environmental loss[5], increased conflicts[5], social, economic, and migration (to another country or internal displacement), it is estimated that by 2050 there will be approximately 200 million climate refugees[12], resulting in a breakdown of their social support and direct consequences on their mental and emotional well-being[13,14]. Therefore, the negative impact of climate change on mental health can persist for years[6,9].

On the other hand, there are populations especially vulnerable to the impact of climate change on mental health: people with previous mental illness, young people and

adolescents, those with lower socioeconomic status, women, individuals with low social support and the elderly, among others[5,6,8,9,10]. In particular, in 2021 at international level, almost half of young people saw their lives and well-being negatively affected by the impact of climate change[15]. In addition, specialised mental health support available to affected people is insufficient worldwide[10,16] and in Spain, which is below the European average, in particular[17]. Finally, climate change also affects the response capacity of mental health services worldwide.

Who proposes five recommendations to address the detrimental impact of climate change on mental health: "(1) Integrating climate considerations into mental health policies and programmes; (2) Integrating mental health into policies and programmes addressing climate change; (3) Based on global commitments; (4) Develop community/multisectoral approaches to reduce vulnerability; and (5) Reduce the funding gap that exists in support of mental health"[5,10]. Without action, the direct and indirect impact that climate change has on mental health will continue to worsen and increase social inequalities[9]. However, given that currently in policy development the impact of climate change on mental health and its health and economic burden is underestimated[9], the benefits that can produce the greatest climate change benefits will have the greatest impact of climate change.

In conclusion, there is evidence to highlight the associations between climate change and mental disorders in the population. These disorders mainly affect the most vulnerable populations. Consequently, it is recommended that environmental policies, plans and programs be sensitive to the impact on mental health by incorporating economic and socio-health interventions[5-10], both in Spain and globally.

Bibliography

1. World Health Organisation. *Comprehensive Mental Health Action Plan 2013-2030*. World Health Organisation; 2021. https://www.who.int/initiatives/mental-health-action-plan-2013-2030 Accessed July 8, 2022.
2. Henares Montiel J, Ruiz-Pérez I, Sordo L. Mental health in Spain and differences by sex and by autonomous communities. *Health Gazette*. 2020;34(2):114-119. doi:10.1016/j.gaceta.2019.03.002
3. Padron-Monedero A, Fernandez Cuenca R. Mental health and public health in Spain: Epidemiological surveillance and prevention. Suicide mortality. Published online 2017. http://gesdoc.isciii.es/gesdoccontroller?action=download&id=09/01/2018-44802ce4e8. Accessed July 8, 2022.

4. Alonso J, Angermeyer MC, Bernert S, et al. Prevalence of mental disorders in Europe: results from the European Study of the Epidemiology of Mental Disorders (ESEMeD) project. *Minutes Psychiatr Scand Suppl*. 2004;(420):21-27. doi:10.1111/j.1600-0047.2004.00327.x

5. WHO. Mental Health and Climate Change: Policy Brief. Published online 2022. https://www.who.int/publications/i/item/9789240045125 Accessed July 8, 2022.

6. Palinkas LA, Wong M. Global climate change and mental health. *Curr Opin Psychol*. 2020; 32:12-16. doi:10.1016/j.copsyc.2019.06.023

7. Obradovich N, Migliorini R, Paulus MP, Rahwan I. Empirical evidence of mental health risks posed by climate change. *Proc Natl Acad Sci U S A*. 2018;115(43):10953-10958. doi:10.1073/pnas.1801528115

8. Charlson F, Ali S, Benmarhnia T, et al. Climate Change and Mental Health: A Scoping Review. *INT J Environ Res Public Health*. 2021;18(9):4486. doi:10.3390/ijerph18094486

9. Lawrance E, Thompson R, Fontana G, Jennings N. *The Impact of Climate Change on Mental Health and Emotional Wellbeing: Current Evidence and Implications for Policy and Practice*. Imperial College London; 2021. doi:10.25561/88568

10. World Health Organisation. Climate action must include mental health to protect people's physical and mental health from climate threats. Published online June 3, 2022. https://www.who.int/news/item/03-06-2022-why-mental-health-is-a-priority-for-action-on-climate-change Accessed July 8, 2022.

11. United Nations High Commissioner for Human Rights. Analytical study on the relationship between climate change and the human right of everyone to the enjoyment of the highest attainable standard of physical and mental health. It's a report. Published online 2016. https://digitallibrary.un.org/record/841798/?ln=es Accessed July 8, 2022.

12. Myers N. Environmental refugees: a growing phenomenon of the 21st century. *Philos Trans R Soc Lond B Biol Sci*. 2002;357(1420):609-613. doi:10.1098/rstb.2001.0953

13. Trombley J, Chalupka S, Anderko L. Climate Change and Mental Health. *Am J Nurs*. 2017;117(4):44-52. doi:10.1097/01.NAJ.0000515232.51795.fa

14. Adger WN, BJ Marshall K, O'Brien K. Cultural dimensions of climate change impacts and adaptation. *NAT Clim Chang*. 2013;3(2):112-117.

15. Hickman C, Marks E, Pihkala P, et al. Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey. *Lancet Planet Health*. 2021;5(12):e863-e873. doi:10.1016/S2542-5196(21)00278-3

16. Intergovernmental Panel on Climate Change. Climate Change 2022: Impacts, Adaptation and Vulnerability. Published online 2022. https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_FinalDraft_FullReport.pdf Accessed July 8, 2022.

17. EUROSTAT. Number of psychiatrists: how do countries compare? Published online 2016. https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20181205-1 Accessed July 8, 2022.

13. Social inequalities in health in the face of climate change.

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People can have a healthier life based on "the conditions in which they are born, grow, work, live and age"[1]. The set of these social determinations generates unequal health outcomes that we consider unfair and preventable due to their social origin[2]. Social inequalities in health (DSS) are systematically manifested through social characteristics such as gender, social class, age, ethnicity and territory[3]. Vulnerability to Climate Change (CC) is only a one-dimensional expression, regarding the inequality that derives from the control over the distribution of resources (cultural, economic and political) by each group in relation to other social sectors.

In addition, these inequalities in the health-disease process express the complexity, interaction and simultaneity of multiple exposures in their ways of living. Thus, for example, the interrelationship of gender and age causes young women to have worse health than even other groups of women[4]. Vulnerability to CC, therefore, should be understood as a multidimensional way of inequality.

The DSS between countries and within the same country, is becoming larger. The difference in life expectancy can reach up to 40 years in rich countries compared to the poorest[5]. Latin American and Caribbean (LAC) societies are characterised by their high inequality compared to other regions of the world. Between 2002-2018, in 15 countries of the Region inequality was reduced annually by 0.9 %[6]. However, between 2019 and 2020 the rate of inequality increased by 0.7 % in the regional average: 8 out of 10 people in ALyC belong to vulnerable groups according to their income level[7].

SSDs become more acute with the effects of CC. Children, the elderly, women (especially pregnant women) and people working abroad are particularly vulnerable groups.

Age

Age is the axis of inequality that affects the entire population. SSDs are expressed throughout the life cycle, generating different conditions of vulnerability to the CC.

Health in Older People

In the world, since 2018, people aged 65 and over have already outnumbered children under five years of age[8]. In Spain, for example, the projection of life expectancy at birth by 2050 is 87.2 years[9] for both sexes[10]. It is projected that in three decades the world's population over 60 will exceed 20 %, and people aged 80 and over will triple. In AL&C, people aged 60 and above total about 85 million (13 % of their population), and by 2050 this group would reach 190 million people (25 %) (8). The group of people aged 80 and over, in the next 30 years, would increase from 2 % to 6 %[11].

Older adults are more vulnerable to heat waves. From the age of 55 the vulnerability is greater due to the characteristics of the aging process in its biological, social and cultural dimension. Physiological changes, typical of aging, can aggravate the impact of high temperatures as they hinder functional reserve and response to thermal stress. Functional dependency requires family and community capacities to respond to a range of health needs during an extreme temperature[12] event.

Health in Children

Development during childhood determines health conditions and therefore conditions their learning and opportunities in life. At least 200 million children do not fully develop in world[1]. Nearly twice as many poor children are more likely to die before they reach 5 years of age than children from rich families[13].
In climate change scenarios, younger generations will face the most climate adversities throughout their lives compared to previous generations. Thus, children born between 2015-2020 in Europe and Central Asia will suffer almost 4 times the effects of extreme events than current ones. Extreme weather events will also cause serious mental health consequences for young people, such as post-traumatic stress disorder, depression or anxiety, among[14] others.

Territory

Regions are more exposed than others to the direct effects of the CC. Socio-economic, geographical and climatic differences condition the adaptability of a given population.

Among the different types of classification of the territory, is the delimitation of rural or urban areas.

In cities, climate peculiarities impact differently by configuring groups with unequal exposure to risk in extreme weather events[15]. Environmental conditions are given, on the one hand, by the traditional risks typical of inadequate environmental management, insufficient infrastructure coverage, which are associated with infectious and communicable diseases[1] and, on the other hand, modern risks, which are associated with chronic and degenerative diseases.

The populations of Latin American cities, for example, have a heterogeneous epidemiological profile, in which health problems related to poverty are recorded along with those that are the consequence of urban development, industrial activity and the massive use of vehicles and new technologies, such as CC[16]. Moreover, in Spain, it was observed that urban areas were more vulnerable to heat compared to rural areas; although the former adapted more to the heat than the non-urban populations. This was conditioned by being in more economically privileged areas and being in areas more accustomed to registering higher temperatures. In non-urban provinces, however, the best adaptation was linked to a higher number of housing rehabilitation licences and a greater number of health professionals[17].

Gender

CC affects the interrelationship between gender, health and environment. Gender as an analytical perspective and political positioning allows us to highlight the relationships of structural and lived inequality, and to complicate the ways of understanding social life in a context of adaptation to CC[18].

However, as far as CC is concerned, the gender perspective has been gradually and progressively incorporated, and has been gaining strength from the beginning of the twenty-first century to the present. Until then, the visualisation of mitigation and adaptation policies with a gender perspective was virtually nil[19].

In fragile and conflict-affected countries, it is noted that the CC increases gender inequalities as it increases social, political and economic tensions. For example, ALyC has been the developing region most affected by the COVID-19[19] pandemic, having a greater impact on women and girls by deepening the structural knots of gender inequality: socio-economic inequality and the persistence of poverty; the sexual division of labour and the unjust social organisation of care; the predominance of privilege culture

and patriarchal, discriminatory and violent cultural patterns; and the unequal concentration of power[19].

There are multiple problematic nuclei around addressing adaptation and mitigation strategies for the fight against CC with a gender perspective. Worse neonatal and maternal outcomes are due to the spread of vector-borne diseases favored in CC contexts (such as Zika, dengue, chikungunya). This also involves more time in caring for patients by women[21]. In many low- and middle-income regions, agriculture is the most important labour sector for women. During times of irregular drought and rainfall, women must work harder to earn income and resources for their families. Girls must drop out of school, increasing the inequality of education and training, which will then lead to fewer job opportunities and economic improvement. Faced with these structural knots of inequality, a key challenge is to ensure that response actions generate the necessary conditions for gender equality, and that women and dissidents are not excluded from the search for solutions[19].

People who work outdoors

Unlike the general population, exposure to meteorological and climatic conditions of workers is not voluntary. The risk is higher among those who work outdoors such as agriculture, forestry, mining, construction, natural resource management, urban waste recyclers, delivery workers, public maintenance servers, or security personnel, and also have increased exposure to ultraviolet radiation that can increase the risk of eye damage, sunburn or skin cancer. Manual workers who perform physical efforts, often of a heavy nature, and who are exposed to extreme heat, increase their risk of suffering heat stress, even with the appearance of unknown pathologies.

In Central American countries, for example, reports have been published showing an unusual occurrence of cases of nephropathy rapidly evolving to terminal stages in men engaged in agriculture[22-25]. The Pan American Health Organisation (PAHO) calls it Chronic Renal Disease of Non-Traditional Origin (ERCnT). Descriptive epidemiological studies showed an increased occurrence of kidney dysfunction in hotter areas on the Pacific coast and in physically hard-working people such as sugarcane, cotton, mining and agriculture in general[24.25]. The CC has been identified as an important factor in the increase of ERCnT[26].

Proposals to reduce inequalities due to climate change

Proposals before the CC must reverse the unequal distribution of power, wealth and cultural resources. Intervention strategies must be located and articulated transversally by the axes of social class, age, gender, ethnicities and territory.

- Political, regulatory and economic actions must protect vulnerable groups before the CC from the exercise of their citizen rights and their active participation demanding from the State its responsibility in the implementation of adaptation plans with social and environmental justice.
- Gender parity should be promoted and women's participation and dissent in decision-making promoted at subnational, national, and international levels related to adaptation and mitigation strategies [19,21].
- It is necessary to adapt the world of work, altering **traditional** forms of working time organisation, preserving and incorporating new labour rights to promote fair and dignified jobs.
- Changes in health diagnosis and analysis are needed to identify needs and problems of vulnerable groups. Information systems and the construction of indicators should monitor the results of adaptation with a view to reducing SSDs.
- Studies are required to identify which local factors influence the process of adaptation to the population, taking into account age, territory, and gender.
- Access to the health care system should be guaranteed including traditional forms of health, particularly in rural areas.
- Finally, health care systems and health teams should be prepared to address the impact of CC and collaborate in adapting the population from a DSS perspective.

Bibliography

1. Commission on Social Determinants of Health. Remedying inequalities in a generation: achieving health equity by acting on the social determinants of health: analytical summary of the final report [Internet]. 2008 [cited 2022 Jul 18]. Available from: https://apps.who.int/iris/handle/10665/69830
2. Whitehead M, Dahlgren G. Concepts and principles of combating social inequalities in health: Developing maximum health potential for the entire population-Part 1 [Internet]. 2010 [cited 2022 Jul 18]. Available from: https://www.sanidad.gob.es/profesionales/saludPublica/prevPromocion/promocion/desigualdadSalud/docs/concepDesigual.pdf

3. Borrell C, Malmusi D, Artazcoz L, Diez E, Rodríguez-Sanz IP y. M, Campos P, et al. Proposal of policies and interventions to reduce social inequalities in health in Spain. Health Gazette [Internet]. 2012 Mar 1 [cited 2022 Jul 18];26(2):182–9. Available from: http://www.gacetasanitaria.org/es-propuesta-politicas-e-intervenciones-reducir-articulo-S0213911111003025

4. Ballesteros MS, Krause M. Intersectionality in the self-perceived state of health of the Argentine population (2005-2018). Latin American Population Magazine [Internet]. 2022 [cited 2022 Jul 18];16. Available from: https://dialnet.unirioja.es/descarga/articulo/8130088.pdf

5. World Health Organisation. Commission on Social Determinants of Health: report of the Secretariat (No. A62/9) [Internet]. 2009 [cited 2022 Jul 18]. Available from: https://apps.who.int/gb/ebwha/pdf_files/WHA62-REC1/WHA62_REC1-sp-P2.pdf

6. ECLAC. Building a new future A recovery with equality and sustainability. ECLAC [Internet]. 2020 [cited 2022 Jul 18];1(1):1–243. Available from: www.cepal.org/apps

7. ECLAC. A decade of action for a change of epoch. Fifth Report on the Regional Progress and Challenges of the 2030 Agenda for Sustainable Development in Latin America and the Caribbean | Publication | Economic Commission for Latin America and the Caribbean [Internet]. Santiago; 2022 [cited 2022 Jul 18]. Available from: https://www.cepal.org/es/publicaciones/47745-decada-accion-un-cambio-epoca-quinto-informe-progreso-desafios-regionales-la

8. ECLAC. The sociodemographic impacts of the COVID-19 pandemic in Latin America and the Caribbean | Publication | Economic Commission for Latin America and the Caribbean [Internet]. Santiago; 2022 [cited 2022 Jul 28]. Available from: https://www.cepal.org/es/publicaciones/47922-impactos-sociodemograficos-la-pandemia-covid-19-america-latina-caribe

9. Government of Spain. Diagnosis of national strategy against the demographic challenge. Ageing axis [Internet]. 2013 [cited 2022 Jul 18]. Available from: https://www.mptfp.gob.es/dam/es/portal/reto_demografico/Indicadores_cartografia/Diagnostico_Eje_Envejecimineto.pdf

10. National Institute of Statistics. Population projections 2020-2070 [Internet]. 2020 Sep [cited 2022 Jul 6]. Available from: https://www.ine.es/prensa/pp_2020_2070.pdf

11. ECLAC. World Population Outlook 2019: United Nations methodology for population estimates and projections | Publication | Economic Commission for Latin America and the Caribbean [Internet]. 2019 [cited 2022 Jul 28]. Available from: https://www.cepal.org/es/publicaciones/45989-perspectivas-la-poblacion-mundial-2019-metodologia-naciones-unidas-estimaciones

12. Huenchuan S. Ageing, elderly people and 2030 Agenda for Sustainable Development: regional and human rights perspective [Internet]. Santiago; 2018 [cited 2022 Jul 28]. Available from: https://repositorio.cepal.org/bitstream/handle/11362/44369/1/S1800629_es.pdf

13. United Nations. Sustainable development goals and targets [Internet]. 2015 [cited 2022 Jul 18]. Available from: https://www.un.org/sustainabledevelopment/es/objetivos-de-desarrollo-sostenible/

14. Grauer SR. Climate change: The thief of childhood: https://doi.org/101177/0031721720917541 [Internet]. 2020 Mar 30 [cited 2022 Jul 18];101(7):42–6. Available from: https://journals.sagepub.com/doi/abs/10.1177/0031721720917541

15. Barboza G. Climate variability and likely impacts on health in Latin American cities: Buenos Aires, Santiago, Montevideo, Salto and Manaus [Internet]. 2013 [cited 2022 Jul 28]. Available from: https://www.iai.int/index.php/en/post/detail/climate-variability-and-likely-impacts-on-health-in-latin-american-cities-buenos-aires-santiago-montevideo-salto-and-manaus

16. Fontan S, Rusticucci M. Climate and Health in Buenos Aires: A Review on Climate Impact on Human Health Studies Between 1995 and 2015. Frontiers in Environmental Science. 2021 Feb 12;8:290.

17. Navas-Martín M, López-Bueno JA, Díaz J, Follos F, Vellón J, Mirón I, et al. Effects of local factors on adaptation to heat in Spain (1983–2018). Environmental Research. 2022 Jun 1;209:112784.

18. Fatyass R. Working table on genders and environmental health. 2022.

19. Aguilar Revelo L. Gender equality in the face of climate change: what can the mechanisms for the advancement of women in Latin America and the Caribbean do? | Publication | Economic Commission for Latin America and the Caribbean [Internet]. 2021 [cited 2022 Jul 18]. Available from: https://www.cepal.org/es/publicaciones/46996-la-igualdad-genero-cambio-climatico-que-pueden-hacer-mecanismos-adelanto-mujeres

20. UN Women. Explanatory article: How gender inequality and climate change are interlinked | UN Women [Internet]. 2022 [cited 2022 Jul 18]. Available from: https://www.unwomen.org/es/noticias/articulo-explicativo/2022/03/articulo-explicativo-como-la-desigualdad-de-genero-y-el-cambio-climatico-estan-relacionados-entre-si

21. UN Women, United Nations Environment Programme. Gender, Climate & Security. Sustaining inclusive peace on the frontlines of climate change. 2020 Jun [cited 2022 Jul 18]. Available from: https://wedocs.unep.org/bitstream/handle/20.500.11822/32638/GCS.pdf?sequence=1&isAllowed=y

22. Cuadra S, Jakobsson K, Wesseling C. Assessment of current knowledge and feasibility for regional research collaboration in Central America. In: Chronic kidney disease: Assessment of current knowledge and feasibility for regional research collaboration in Central America. IRET-UNA [Internet]. 2006 [cited 2022 Jul 18];2. Available from: http://www.iret.una.ac.cr/index.php/component/joomd/joomdtypepublicaciones/items/view/publicacion781

23. Oliver A, Gracia-Trabanino R, Dominguez J, Jansa J. Proteinuria and chronic renal failure on the coast of El Salvador: detection with low cost methods and associated factors | Nephrology. Nephrology [Internet]. 2005 [cited 2022 Jul 18];25(1):0–102. Available from: https://www.revistanefrologia.com/es-proteinuria-e-insuficiencia-renal-cronica-articulo-X0211699505017763

24. Peraza S, Wesseling C, Aragon A, Leiva R, García-Trabanino RA, Torres C, et al. Decreased Kidney Function Among Agricultural Workers in El Salvador. American Journal of Kidney Diseases. 2012 Apr 1;59(4):531–40.

25. Torres C, Aragon A, González M, López I, Jakobsson K, Elinder CG, et al. Decreased kidney function of unknown cause in Nicaragua: a community-based survey. Am J Kidney Dis [Internet]. 2010 Mar [cited 2022 Jul 18];55(3):485–96. Available from: https://pubmed.ncbi.nlm.nih.gov/20116154/

26. Glaser J, Lemery J, Rajagopalan B, Diaz HF, García-Trabanino R, Taduri G, et al. Climate Change and the Emergent Epidemic of CKD from Heat Stress in Rural Communities: The Case for Heat Stress Nephropathy. Clin J Am Soc Nephrol [Internet]. 2016 [cited 2022 Jul 18];11(8):1472–83. Available from: https://pubmed.ncbi.nlm.nih.gov/27151892/

14. Challenges for epidemiology. Monitoring of health and the environment. Emergency and disaster prevention plans. Integrated plans.

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When assessing the potential health risks and impacts linked to climate change, we face multiple challenges, mainly determined by the different approaches used in climate and health sciences[1]. This paper will define seven main challenges when developing these studies.

I. **The effect of scales on the design of epidemiological studies.** The population of "Not Exposed" is difficult to define. This is because the nature of the exposure needs to be assessed using large geographic and temporal scales[2-4]. In addition, many of the potential health effects need long periods of time to develop and express themselves, increasing the costs associated with the[5,6] study.

II. **Exposure assessment.** The climate varies geographically and temporally in a natural way[6-10]. It is necessary to distinguish the variability of climate related to anthropogenic climate change, avoiding the uncertainty of projections based on simulated models, which do not differ between it and natural variability. This facilitates the precise description of the[7-10] exposure.

III. **Ecological and atomistic fallacies.** Ecological approaches that use aggregated data cannot infer their results on individuals. However, these results are very

useful for designing recommendations, interventions and policies[11,12]. On the other hand, approximations using individual data cannot be used to make such recommendations, but they will be very useful for the identification of vulnerable groups[2,13,14].

IV. **Effect modifiers and confusing.** Identifying these factors is relevant to making a correct impact assessment. However, the nature of climate change is complex and requires a cross-cutting approach with an integrated systems approach[15,16]. This is because the changes promoted by climate change cause a multitude of direct and indirect effects that, in addition, are related to each other[2,6,17,18].

V. **Possible biases.** The information provided so far means that, a priori, we identify selection biases (e.g. definition of population "Exposed" vs. "Not exposed") and information biases (e.g. determination of climate variability due to climate change), the two biases that will predominate in this type of approximations. On the other hand, climate models are exposed to other types of bias, many of them undetermined, which could introduce errors in the[19,20] estimates.

VI. **Vulnerable groups. Populations and subpopulations** have been identified that may be most exposed to the effects of climate change (e.g. area affected by drought or flooding; children, pregnant women and older adults, population with comorbidities that are aggravated by climate change, or workers who carry out their activities outdoors among others). It is necessary to determine the degree of vulnerability of each group according to systematised aspects (e.g. nature and extent of damage; extent of damage; sensitivity and resilience of the population, etc.) in order to prioritise populations and propose more effective solutions[14]. Integrating these vulnerable populations into quantitative approaches remains a challenge for environmental epidemiology[2]. The determination of these populations is highly necessary for the proper implementation of surveillance systems[1,21,22].

VII. **Communication of results.** Many times the results obtained do not follow a linearity[2,16,23]. This makes it difficult to describe the relationship between climate change and health effects. That is why communicating the results to the general population and political decision-makers remains one of the major challenges to address[1,2,6,18,24-26].

1. Emergency and Disaster Prevention Plans

Environmental disaster events resulting from climate change make it necessary to gather in specialised documents the knowledge and capabilities to effectively anticipate, respond and recover the impacts that are likely, imminently or immediately, to impact health[27]. To respond efficiently to a disaster or emergency, different preparedness actions must be planned that include aspects of governance, training and resources needed to minimise impacts[21,22,27,28].

Emergency situations are not the only events that can have negative effects on the health of the population. Most of the population's disease burden originates in sectors other than those of the health sector. That is why it should be prioritised: Implementation of

integrated plans linked to environmental events, strongly linked to a robust surveillance strategy[21,29]; and II) the implementation of the Health Impact Assessment, which integrates the health factor in the elaboration of plans, projects and programs[14].

2. Integrated plans

Early warning systems are designed to minimise health effects[29-31]. Some environmental events often trigger different phenomena related to possible health impacts (e.g., increased Saharan dust in the sky, increases heat and lowers air quality, affecting health by heat exposure and particle inhalation)[30,31]. Traditionally, specific plans have been proposed to control or minimise the effects of such phenomena (e.g., temperature plans in response to high temperatures). These plans have been effective in reducing mortality[29]. However, they do not address other phenomena that develop synergistically due to the occurrence of the environmental event (e.g., frequently associated risks such as decline in simultaneous air quality or if such an increase is linked to the presence of Saharan dust in the environment)[2,32]. Different steps 21,27[-29] have been proposed for the proper development of integrated plans that address these synergies: 1) Early warning system detecting the event with potential health effect: (2) Quantification and impact assessment, considering the effects on vulnerable populations; 3) Activation of the different plans or protocols related to the health impacts, as well as the measures associated with them; 3) Iterative evaluation process that compares the results obtained with those expected and allows the continuous improvement of the integrated plan.

Due to the plurality of the effects of climate change and their link with multiple health effects[33] the development of these comprehensive plans supported by a robust surveillance strategy would reduce the disease burden linked to environmental determinants in health[29].

Bibliography

1. Brooke Anderson G, Barnes EA, Bell ML, Dominici F. The Future of Climate Epidemiology: Opportunities for Advancing Health Research in the Context of Climate Change. Am J Epidemiol. 2019;188(5):866–72.
2. Xun WW, Khan AE, Michael E, Vineis P. Climate change epidemiology: Methodological challenges. INT J Public Health. 2010;55(2):85–96.
3. Leavesley GH. Modeling the Effects of Climate Change on Water resources — A Review. Assess Impacts Clim Chang Nat Resour Syst. 1994;159–77.

4. Landauer M, Juhola S, Klein J. The role of scale in integrating climate change adaptation and mitigation in cities. J Environ Plan Manag. 2019;62(5):741–65.
5. Butler CD. Climate change, health and existential risks to civilisation: A comprehensive review (1989–2013). INT J Environ Res Public Health. 2018;15(10).
6. Woodward A, Smith KR, Campbell-Lendrum D, Chadee DD, Honda Y, Liu Q, et al. Climate change and health: on the latest IPCC report. Lancet. 2014;383(9924):1185–9.
7. Pienkosz BD, Saari RK, Monier E, Garcia-Menendez F. Natural Variability in Projections of Climate Change Impacts on Fine Particulate Matter Pollution. Earth's Futur. 2019;7(7):762–70.
8. Osaka S, Bellamy R. Natural variability or climate change? Stakeholder and citizen perceptions of extreme event attribution. Glob Environ Chang. 2020; 62:102070.
9. Garcia-Menendez F, East J, Pienkosz BD, Monier E. Climate Model Response Uncertainty in Projections of Climate Change Impacts on Air Quality. Springer Proc Complex. 2020;433–7.
10. Garcia-Menendez F, Monier E, Selin NE. The role of natural variability in projections of climate change impacts on U.S. ozone pollution. Geophys Res Lett. 2017;44(6):2911–21.
11. Krieger N. The real ecological fallacy: epidemiology and global climate change. J Epidemiol Community Health. 2015;69(8):803–4.
12. Valley D, Laporta GZ. A Cautionary Tale Regarding the Use of Causal Inference to Study How Environmental Change Influences Tropical Diseases. Am J Trop Med Hyg. 2021;104(6):1960–2.
13. Ferguson K. The Health Reframing of Climate Change and the Poverty of Narrow Bioethics. J Law, Med Ethics. 2020;48(4):705–17.
14. Tong S, Ebi K. Preventing and mitigating health risks of climate change. Environ Res [Internet]. 2019;174(February):9–13. Available from: https://doi.org/10.1016/j.envres.2019.04.012
15. Kadkhodazadeh M, Anaraki MV, Morshed-Bozorgdel A, Farzin S. A New Methodology for Reference Evapotranspiration Prediction and Uncertainty Analysis under Climate Change Conditions Based on Machine Learning, Multi Criteria Decision Making and Monte Carlo Methods. Sustain 2022, Vol 14, Page 2601. 2022;14(5):2601.
16. Mpandeli S, Naidoo D, Mabhaudhi T, Nhemachena C, Nhamo L, Liphadzi S, et al. Climate Change Adaptation through the Water-Energy-Food Nexus in Southern Africa. Int J Environ Res Public Heal 2018, Vol 15, Page 2306. 2018;15(10):2306.
17. Santamouris M. Recent progress on urban overheating and heat island research. Integrated assessment of the energy, environmental, vulnerability and health impact. Synergies with the global climate change. Energy Build. 2020;207:109482.

18. Arbuthnott K, Hajat S, Heaviside C, Vardoulakis S. What is cold-related mortality? A multi-disciplinary perspective to inform climate change impact assessments. Environ Int. 2018;121:119–29.

19. Fagan ME. A lesson unlearned? Underestimating tree cover in drylands biases global restoration maps. Glob Chang Biol. 2020;26(9):4679–90.

20. Adams C, Ide T, Barnett J, Detges A. Sampling bias in climate-conflict research. NAT Clim Chang 2018 83. 2018;8(3):200–3.

21. World Health Organisation. A Strategic Framework for Emergency Preparedness. 2017.

22. Woodruff SC, Meerow S, Stults M, Wilkins C. Adaptation to Resilience Planning: Alternative Pathways to Prepare for Climate Change. J Plan Educ Res. 2022;42(1):64–75.

23. Rocklöv J, Dubrow R. Author Correction: Climate change: an enduring challenge for vector-borne disease prevention and control (Nature Immunology, (2020), 21, 5, (479-483), 10.1038/s41590-020-0648-y). NAT Immunol. 2020;21(6):695.

24. Toppenberg-Pejcic D, Noyes J, Allen T, Alexander N, Vanderford M, Gamhewage G. Emergency Risk Communication: Lessons Learned from a Rapid Review of Recent Gray Literature on Ebola, Zika, and Yellow Fever. Health Commun. 2019;34(4):437–55.

25. Mabon L. Making climate information services accessible to communities: What can we learn from environmental risk communication research? Urban Clim. 2020;31:100537.

26. Nkoana EM, Verbruggen A, Hugé J. Climate Change Adaptation Tools at the Community Level: An Integrated Literature Review. Sustain 2018, Vol 10, Page 796. 2018;10(3):796.

27. Pan American Health Organisation. Strategic Plan of the Pan American Health Organisation Equity at the Heart of Health 2020-2025. 2020.

28. Pan American Health Organisation. Strategic plan 2020-2025. Health emergencies. 2020.

29. Linares C, Martinez GS, Kendrovski V, Diaz J. A new integrative perspective on early warning systems for health in the context of climate change. Environ Res. 2020;187(April):109623.

30. Ministry for the Ecological Transition and the Demographic Challenge. Air quality assessment in Spain. 2020.

31. Ministry of Health. National Plan of Preventive Accidents of the Effects of Excess Temperatures on Health. 2021.

32. Anenberg SC, Haines S, Wang E, Nassikas N, Kinney PL. Synergistic health effects of air pollution, temperature, and pollen exposure: a systematic review of epidemiological evidence. Sent Heal A Glob Access Sci Source. 2020;19(1).

33. World Health Organisation. Climate change and health. 2021.

15. The health system in the face of climate change. Resilient and low-emission hospitals.

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In media, political and academic conversations on climate change and health, the focus is often — justifiably — on the multiple impacts of this phenomenon on human health. However, growing attention to the issue has begun to focus on health as a sector, recognising that it is significantly vulnerable to extreme and long-term weather events, and at the same time is part of the problem as it contributes at least 4.4 % of global net greenhouse gas emissions (if it were a country, it would be the fifth largest emitter in the world[)]. This duality implies the urgency of adopting adaptation and mitigation measures specifically for the health sector, both internally in health facilities and systems, and at the level of public health policy.

This is in the context of a public health crisis, taken to the extreme in the context of the COVID-19 pandemic, which accounted for the huge shortcomings of health systems in addressing global risks. The pressing need to ensure universal health coverage, so that all people have access to affordable and quality health services, means that the health sector must continue to expand, especially in developing countries. However, carrying out such growth with the same model carries an unacceptable risk: in the absence of climate action within and outside the health sector, emissions from the health sector could more than triple by 2050[2]. Hence the urgency of transforming the global health care model, with a view to a sector that is simultaneously climate resilient, environmentally sustainable and capable of responding to the pandemics of the future.
The transition to climate-smart health care does not occur in a vacuum. There are huge disparities in the levels of vulnerability and in the volumes of emissions presented by health systems in different countries. Therefore, the transformation of the sector must take place within a climate justice framework, which translates into differentiated decarbonisation trajectories (significantly more pronounced for the health systems of developed countries) and in the call for international solidarity to strengthen the

resilience of health systems in the countries of the Global South and ensure equity in health care.

2021 was a key year to steer these efforts as for the first time in the history of the Conferences of the Parties (COPs) to the United Nations Framework Convention on Climate Change (UNFCCC), the incumbent Presidency, held by the United Kingdom, recognised health as a thematic priority. As a result, the British government, the World Health Organisation (WHO) and the international NGO Health Care Without Harm launched the COP26 Health Programme[3] through which, so far as this text was drafted, 59 countries have committed to developing climate-resilient and low-emission health systems (including several Ibero-Americans). To accompany the implementation of the commitments derived from this initiative, the Alliance for Transformative Action in Climate and Health[4] was created in June 2022.

In terms of resilience, it should be noted that adaptation is a very specific process to the local context, which determines the vulnerability of a specific health establishment or system: the type of impacts to which it is exposed, the degree of sensitivity to such impacts and its adaptive capacity. Therefore, the first step is to carry out an assessment of this vulnerability. Who has developed multiple resources to guide countries in conducting these assessments[5] and in developing National Health Adaptation Plans[6] (HNAPs), as well as checklists[7] and other resources[8] for individual health facilities.
In the same way, to inform the adoption of mitigation measures, it is necessary to understand the emission profile -dimension and composition- of the establishment or health system concerned. Organisations such as Health Care Without Harm have developed methodologies for establishing baseline emissions in national and subnational health systems, including supply chains (estimated to account for more than 80 % of the health sector's climate footprint[9]). Specific tools have also been developed to calculate the climate footprint of health facilities[10] and guidance to translate the results into *ad hoc* mitigation plans. Consistent with the promise of the hypocratic oath to "do no harm first," the health sector must align with the Paris Agreement by committing to a net zero emissions trajectory by 2050. A growing number of health facilities and systems around the world are joining this global goal by, among other things, joining the United Nations "Race to Zero" campaign[11].

The road is mapped out. In light of the devastation caused by the COVID-19 pandemic, there is no doubt about the urgency to act now to limit origin and respond to the already inevitable impacts of climate change, which constitutes the greatest threat to global public health of the 21st century. For Ibero-America, this sense of urgency translates into a political call to prioritise the transition to climate-smart health care, which strengthens pandemic preparedness and guarantees health equity. Understanding the

climate crisis as a health crisis is not only an imperative for the healing mission of the sector, but also represents an opportunity to move towards the one health model (human, animal and ecosystem), with the health systems and all the people who work in them leading by example.

Bibliography

1. Health without Damage and Arup. Climate footprint of the health sector. How the health sector contributes to the global climate crisis: opportunities for action. [2019, cited on 11 July 2022] Available at: https://saludsindanio.org/HuellaClimaticaSalud
2. Health without Damage and Arup. Global roadmap for the decarbonisation of the health sector. A navigation tool to achieve zero emissions with climate resilience and health equity. [2021, cited on 11 July 2022] Available at: https://accionclimaticaensalud.org/hojaderuta
3. World Health Organisation. COP26: Action on health in countries. [2021, cited on 11 July 2022] Available at: https://www.who.int/es/publications/i/item/cop26-health-programme
4. World Health Organisation. Health-climate alliance launched to help countries turn commitments into action. [27 June 2022, cited on 11 July 2022] Available at: https://www.who.int/news/item/27-06-2022-health-climate-alliance-launched-to-help-countries-turn-commitments-into-action
5. World Health Organisation. Vulnerability and adaptation assessments. [Updated 2021, cited on 11 July 2022] Available at: https://www.who.int/teams/environment-climate-change-and-health/climate-change-and-health/capacity-building/toolkit-on-climate-change-and-health/vulnerability
6. World Health Organisation. National adaptation strategies and plans. [Updated 2021, cited on 11 July 2022] Available at: https://www.who.int/teams/environment-climate-change-and-health/climate-change-and-health/capacity-building/toolkit-on-climate-change-and-health/adaptation
7. World Health Organisation. National adaptation strategies and plans. [2021, cited on 11 July 2022] Available at: https://www.who.int/publications/i/item/9789240022904
8. World Health Organisation. Climate Resilient and Environmentally Sustainable Health Facilities — WHO Guidelines. [2021, cited on 11 July 2022] Available at: https://www.who.int/es/publications/i/item/9789240012226
9. Health without Damage and Arup. Global roadmap for the decarbonisation of the health sector. A navigation tool to achieve zero emissions with climate resilience and health equity. [2021, cited on 11 July 2022] Available at: https://accionclimaticaensalud.org/hojaderuta

10. Health without Damage. Monitoring of climate impact. Tool for hospitals and health systems. [Updated 2021, cited on 11 July 2022] Available at: https://accionclimaticaensalud.org/monitoreo
11. Health without Damage. Race to zero. [Updated 2022, cited on 11 July 2022] Available at: https://accionclimaticaensalud.org/carrerahaciaelcero

16. The voice of health in climate action: governance and advocacy.

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Introduction

Over the years, climate scientists have warned that without transformative action our planet's temperature will exceed safe levels, and impacts on human health and the ecosystem will worsen, affecting the most vulnerable disproportionately. Health experts around the world continuously affirm that a stable climate is the most fundamental determinant of human health. As a multidimensional planetary threat, the health implications of climate change require multilateral and multisectoral solutions, implemented at the local, national, regional and international levels.

However, action on key health and climate change priorities continues to be postponed at global climate summits, with Ibero-American countries, along with most other countries in the world, sparing "insufficient" and "highly insufficient" efforts to mitigate greenhouse emissions and adapt to changing risks[4,5]. As a result, at the national and subnational levels, populations are exposed to the increasingly severe impacts of a changing climate and continue to lack access to high-quality, prevention-oriented health care, exacerbating existing social and health inequities. These same populations lose substantial health co-benefits resulting from well-designed climate policies, such as cleaner air, healthier diets, and daily physical activity in more walkable and habitable cities, while nations lose health cost savings from these benefits. If climate policies in the areas of energy, agriculture, transport and finance are crafted with health and equity in mind, they will be more ambitious to address climate change and generate greater health benefits.

Health professionals are among the most trusted professionals in most societies. They have the capacity to reformulate public and political debates on climate change around shared human value: people's health. Health and public health professionals are scientifically trained and able to raise evidence about climate change and its health impacts, conveying the message with examples of impacts on real people, in the

communities they serve. There is an urgent need and extraordinary opportunity for health professionals to use their expertise and trusted voice in support of local, national, regional and global efforts to improve climate action and protect people from the threat of climate change. They are well positioned and increasingly empowered to promote, inform and help design climate policies that improve health outcomes and human well-being, while reducing emissions and vulnerabilities, and adapting ecosystems and populations to a warming planet. In fact, many health professionals believe that they and their peers have an ethical responsibility to do so[7,8].

The voice of health in climate governance

The Paris Agreement, an international climate agreement backed by the 196 countries that are party to the United Nations Framework Convention on Climate Change, establishes the "right to health" as a fundamental reason to take action to address climate change and requires an economic and social transformation, based on the best science to deliver the necessary response.

Climate change governance structure and processes provide multiple points of interaction for health. At local or subnational level, urban and provincial policies can offer transport systems that support increased physical activity through walking, cycling and accessible public transport, and reducing urban air pollution; access to clean and renewable energy as well as more energy-efficient housing and buildings; healthier and richer diets in sustainable local farm plants; urban and regional planning and design that support all these areas. Cities and provinces can implement adaptation plans that prepare communities to respond to climate impacts, substantially reducing diseases and deaths from heat waves, storms, wildfires and air pollution. Policies at the national level also shape food systems, transport systems and energy systems to mitigate climate change and improve people's health.

At the international level, all countries that are parties to the Paris Agreement (almost all countries in the world) must submit a "Nationally Determined Contribution" (NDC): its own national commitment to climate action, committing to its share of climate action to achieve the goal of the Paris Agreement. Integrating health into the NDC and setting high greenhouse gas emission reduction targets help set the national direction for climate policymaking and drive international ambition for climate action[5]. Several Ibero-American countries, such as Colombia, Panama and Argentina, are leaders in integrating health into their NDCs. Some have even set emission reduction commitments almost aligned with protecting people's health, such as Costa Rica[10]. Still, it takes hard work for

[5] Please note that Spain and Portugal are part of the joint NDC presented by the European Union.

more countries in the region to commit to specific health actions in their NDCs and adaptation plans, and each country must make stronger emission reduction commitments, to stay in line with scientific recommendations to protect people's health. And, of course, countries have to take the necessary steps to implement those commitments.

Health in climate advocacy

What is the role of the medical, public health and environmental health community in the formulation of climate policies?
Generally speaking, the health community has two vital roles to play. First: despite the unfolding climate crisis and the need for significant transformations in all sectors[11], progress remains gradual. Most governments have not prioritised climate action and sometimes the policies that have been adopted have faced public opposition. To achieve the commitments and policies that are urgently needed, and to ensure their successful implementation, public demand for such changes must grow, as must the response of decision-makers. The trusted and influential voices of health professionals and health organisations representing them can play a key role in strengthening public support and encouraging governments to take ambitious climate action.

Secondly: while many climate solutions provide countless health benefits, not all of them do. For climate policies to provide maximum health protection and maximum health co-benefits, health leaders and experts must inform and influence them. Recognising the urgency of the need to address climate change to protect people's health, the global health community has increasingly united around calls to action.

In 2020, 300 health organisations called for a Healthy Recovery[12], calling on governments to invest funds to recover the covid economy in ways that promote the sustainability of industries, jobs, production and food supply rather than responding to the COVID-19 health crisis by supporting carbon-intensive industries, thus worsening the climate health crisis. Unfortunately, aligning the response to climate change with pandemic recovery to bring better public health to future generations is a missed opportunity today. In response, the health consensus on the need for climate action has only grown, and in 2021 the health community delivered the Healthy Climate Prescription[13], signed by more than 600 organisations around the world representing 46 million health professionals in all health professions. The Charter — Prescription calls for a rapid and fair elimination of fossil fuels as a public health imperative, along with climate finance to support low-income countries in their climate transition and investment in resilient, low-carbon health systems. Many Ibero-American organisations are among the signatories. The Call

to Climate Education for Health[14], a call to incorporate climate change into the curriculum of all health professions, further highlights the ethical and professional responsibility health professionals recognise to develop understanding and capabilities about climate change and current and future environmental health threats and thus fulfill their duty to the patients and communities they serve. These international positions of the health community are based on the work of pioneering health professionals who, for years, have worked to raise awareness of the threat of climate change. The letters, in turn, have inspired more health organisations to publicly address climate change as a health crisis.

This job is not always easy. Health professionals who individually advocate for the subject may feel that they are putting their profession or themselves at risk and, in fact, in some cases it is. Currently, it is not as safe for a health professional to talk about climate change in Latin America as it is in Europe or North America. By taking organizational positions on the subject, health professional societies and organisations not only bring their institutional influence to public discussions and decision-making, but also make it safer for health professionals to speak up individually. In turn, health professionals who talk about climate change, in decision-making processes and in the media, can be powerful voices reporting on the real impacts they are seeing in their communities from both climate change and climate change drivers. This positioning adds to the creation of *momentum* for a more prominent presence of the voice of health in the climate agenda worldwide, in the countries of Ibero-America and at the local level. The Ibero-American Society of Environmental Health joins the global health community in expressing its deep concern and commitment and is prepared to contribute to creating a greener, fairer and healthier world through climate education, advocacy and governance.

Bibliography:

1. AR6 Climate Change 2022: Mitigation of Climate Change — IPCC [Internet]. [Cited 2022 Jul 12]. Available from: https://www.ipcc.ch/report/sixth-assessment-report-working-group-3/
2. Maibach E, Miller J, Armstrong F, El Omrani O, Zhang Y, Philpott N, et al. Health professionals, the Paris agreement, and the fierce urgency of now. J Clim Change Health. 2021 Mar 1;1:100002.
3. Willetts E, Grant L, Bansard J, Kohler PM, Rosen T, Bettelli P, et al. Health in the global environmental agenda: A policy guide. Inst Sustain Dev. 2022;
4. Home [Internet]. [Cited 2022 Jul 12]. Available from: https://climateactiontracker.org/

5. Yglesias-González M, Palmeiro-Silva Y, Sergeeva M, Cortes S, Hurtado-Epstein A, Buss DF, et al. Code Red for Health response in Latin America and the Caribbean: Enhancing peoples' health through climate action. Lancet Reg Health — Am [Internet]. 2022 Jul 1 [cited 2022 Jul 13];11. Available from: https://www.thelancet.com/journals/lanam/article/PIIS2667-193X(22)00065-5/fulltext#.Yl_krTyiA6E.twitter

6. Hamilton I, Kennard H, McGushin A, Höglund-Isaksson L, Kiesewetter G, Lott M, et al. The public health implications of the Paris Agreement: a modelling study. Lancet Planet Health. 2021 Feb 1;5(2):e74–83.

7. Lee H ryeon, Pagano I, Borth A, Campbell E, Hubbert B, Kotcher J, et al. Health professional's willingness to advocate for strengthening global commitments to the Paris climate agreement: Findings from a multi-nation survey. J Clim Change Health. 2021 May 1;2:100016.

8. A pledge for planetary health to unite health professionals in the Anthropocene — PubMed [Internet]. [Cited 2022 Aug 5]. Available from: https://pubmed.ncbi.nlm.nih.gov/33010210/

9. The Paris Agreement | UNFCCC [Internet]. [Cited 2022 Jul 13]. Available from: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

10. NDC Scorecards [Internet]. The Global Climate and Health Alliance. [Cited 2022 Aug 5]. Available from: https://climateandhealthalliance.org/initiatives/healthy-ndcs/ndc-scorecards/

11. IPCC_Briefing-AR6-WG3.pdf [Internet]. [Cited 2022 Jul 12]. Available from: https://climateandhealthalliance.org/wp-content/uploads/2022/05/IPCC_Briefing-AR6-WG3.pdf

12. A #HealthyRecovery [Internet]. Healthy Recovery. [Cited 2022 Jul 12]. Available from: https://healthyrecovery.net/

13. #HealthyClimate [Internet]. #HealthyClimatePrescription. [Cited 2022 Jul 13]. Available from: https://healthyclimateletter.net/

14. Curriculum-letter.pdf [Internet]. [Cited 2022 Jul 13]. Available from: https://climateandhealthalliance.org/wp-content/uploads/2022/06/Curriculum-letter.pdf