

OPINION

Heat waves, climate crisis and adaptation challenges in the global south metropolises

Christovam Barcellos ^{1,2*}

1 Brazilian Climate & Health Observatory, Institute of Health Information and Communication, Oswaldo Cruz Foundation (ICICT/Fiocruz), Rio de Janeiro, Brazil, **2** National Institute of Health (INS), Marracuene, Mozambique

* christovam.barcellos@fiocruz.br

Introduction

You only know what water is when you carry it over your head.

(African proverb, collected by Mia Couto)

Over the course of 2023—the hottest year ever recorded in human history—there were a series of heatwaves in Europe and Asia, whose impact on health is still being assessed [1]. As summer begins in the southern hemisphere, equally intense heatwaves are predicted across Latin America and Africa. Over the next months, there is the risk of dangerous interaction between global warming, the effect of El Niño and heat islands in large cities, which together could lead to temperatures above 40° C in many cities [2].

Numerous studies have shown an increase in the number of overall deaths during heat waves, particularly in landlocked, industrialised, and temperate countries [3]. This information is important for establishing thresholds for the definition of heat waves themselves, and for triggering warnings to the public and health services [4]. However, it is important to note that the health effects of heatwaves are not limited to thermal stress. The risks are particularly severe in underdeveloped, tropical and Global South cities, which are characterized by rapid and recent growth and inadequate coverage of protective systems such as sanitation, energy, and healthcare. The “precarious universalization” of urban services is a key challenge in adapting cities in the Global South to extreme climate events.

The complexities of services in cities of the Global South

The history of humanity could be summarized as a permanent struggle against variability. Shelters were constructed against the vagaries of the weather; agriculture was developed against food insecurity; walls were built against invaders; vaccines and sanitation were conceived against epidemics. More recently, technologies such as air conditioning units have been incorporated in buildings in order to ensure comfort and safety for city dwellers. These amenities are increasingly present in residential buildings, but they do not work in isolation. They depend on technical networks, in-home facilities, public or private supply agencies, and therefore on state, community, and citizen investments.

All such services are characterized by their complexity and entropy. For example, water supply systems are composed of the capture of water from surface or underground sources, treatment and distribution networks, and domestic piping. Disruption in one of these



OPEN ACCESS

Citation: Barcellos C (2024) Heat waves, climate crisis and adaptation challenges in the global south metropolises. PLOS Clim 3(3): e0000367. <https://doi.org/10.1371/journal.pclm.0000367>

Editor: Jamie Males, PLOS Climate, UNITED KINGDOM

Published: March 7, 2024

Copyright: © 2024 Christovam Barcellos. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Funding: This article is a result of project Harmonize, financed by Wellcome Trust (project 224694/A/21/Z), and Brazilian Climate and Health Observatory, financed by the Brazilian National Council for Scientific and Technological Development (CNPq, 444665/2023-4). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing interests: The authors have declared that no competing interests exist.

components can compromise the integrity of the whole system, sometimes leading to its collapse. These systems depend on an interconnected series of technical, mutually dependent, and hierarchical objects that complement each other and interact.

Consideration of the hierarchical and complex nature of these utility systems can facilitate the evaluation of possible health risks due to the systemic failures. Contamination or reduction of water supply in springs can affect whole cities. Severe outbreaks of waterborne diseases have been reported among populations supplied by water supply systems with flaws in water treatment devices [5]. Vulnerabilities can also be due to problems that occur at the most basic levels of the utility system. The lack of resources to ensure isolation of water and sewage circuits and the safe storage of drinking water in households compromise water quality and population health [6]. In Brazil, it is still common to find households without a bathroom but connected to the general water supply network. In many cities of Africa, the proximity between water supplies and sewage disposal sites may amplify risks, even within communities served by water mains [7]. End-user activity can also generate systemic pressures; for example, the abrupt increase of energy and water consumption during heatwaves [8], which may cause the interruption of these services due to demand overload. It is no coincidence that many households have resorted to water reservoirs to ensure continuity of supply in periods when services are interrupted due to the general failure of supply systems. Local solidarity networks can also provide support for obtaining minimum quantities of water from neighbouring wells or rivers, as can be seen in Fig 1. This work often places a heavy burden on children and women to transport water.



Fig 1. Sharing a community water well during period of drought in the city of Nampula, Mozambique (photo from the author, Christovam Barcellos, 2023).

<https://doi.org/10.1371/journal.pclm.0000367.g001>

Precarious technical systems and climate crises- Some impacts on population health

In Latin America, most of the urban population has access to water through the expansion of supply networks, but there is often no equivalent adequate system for the collection and treatment of sewage and garbage. Thus, the expansion of water supply services cannot be seen to represent an effective health protection measure, because it is undermined by insufficient investment in complementary services. It is worth remembering that a large proportion of the population served by water supply systems are highly susceptible to severe infectious diseases such as hepatitis A virus or rotavirus, which can cause outbreaks of greater magnitude among these socio-spatial groups.

One of the significant challenges in this regard has been the interruption of these services in cases of insufficient sources and resources for their supply, and the occurrence of extreme climatic events. In these situations, alternative and improvised measures must be found to meet the population's basic needs for water, energy, and food. Different socio-spatial groups seek alternatives to meet their needs outside formal supply systems and services, and their health risks are significantly increased in dense and unequal metropolises.

Events such as water rationing in the metropolitan region of São Paulo in 2014 and 2015, during an El Niño phase, trigger disturbances to urban services and lead to sudden changes in the conditions of communities and households. The adoption of alternatives such as the opening of wells and the supply of water through tank trucks was an option for socioeconomic groups with higher purchasing power. Other people improvised water storage containers inside their homes, but in many cases, this led to contamination of household water by pathogens and the proliferation of mosquitoes. This exceptional situation caused an outbreak of diarrhoea, with an increase of thousands of cases in São Paulo state in 2014, probably due to the consumption of contaminated water. In 2015, the number of dengue cases tripled in the city of São Paulo, and reports from health agencies pointed to a significant increase in the use of improvised containers for water storage as a key factor.

These examples reinforce the need to consider fluctuations in sanitation systems and their sensitivity to disruptions caused by extrinsic (generated by natural disasters) or intrinsic (triggered by increased demand) factors as important vulnerability indicators.

Final comments

Large cities, even in underdeveloped countries, have been reaching satisfactory levels of coverage of basic sanitation systems. However, this progress has been more due to individual investments than to public investment in the quality of these supply systems. Insufficient water supply to households, contaminated and compromised water sources, and poor sewage and wastewater treatment, which are generally state responsibilities, threaten the safety of sanitation systems. The vulnerability of these systems is being aggravated by the intensifying climate crisis. Extreme climatic events such as droughts, floods, landslides, and storms may cause disruption of these complex systems. Even population groups accustomed to being satisfactorily supplied may suddenly be deprived of these services, forcing a temporary change in their living standards. The impacts of these events on health can be severe and extend over large areas.

Two main concerns stand out for the metropolises of the Global South. On the one hand, water, energy, and healthcare policies must better support marginalized groups, who are often dispersed, with little investment capacity, and who experience problems with income, education, and access to health services. On the other hand, it is necessary to ensure the quality and safety of sanitation systems for those already included in these systems, recognizing that their complexity and vulnerability makes them prone to failure, especially during extreme climatic

events. This can only be fully achieved with the participation of the population directly affected by immediate or potential risk conditions within a democratic environment that allows for intersectoral and interdisciplinary dialogue.

References

1. Zachariah M., Philip S, Pinto I, Vahlberg M, Singh R, Otto Fet al. Extreme heat in North America, Europe and China in July 2023 made much more likely by climate change. *Scientific Report*. 2023; <https://doi.org/10.25561/105549>
2. Kew S, Pinto I, Alves L, Santos D, Libonati R, Liberato MLR et al. Strong influence of climate change in uncharacteristic early spring heat in South America. *Scientific report*. 2023; <https://doi.org/10.25561/106753>
3. Martiello MA, Giacchi MV. High temperatures and health outcomes: a review of the literature. *Scand J Public Health*. 2010; 38(8):826–37. <https://doi.org/10.1177/1403494810377685> PMID: 20688791
4. Royé D, Codesido R, Tobías A, Taracido M. Heat wave intensity and daily mortality in four of the largest cities of Spain. *Environ Res*. 2020; 182:109027. <https://doi.org/10.1016/j.envres.2019.109027> PMID: 31884190
5. Semenza JC, Ko AI. Waterborne Diseases That Are Sensitive to Climate Variability and Climate Change. *New England Journal of Medicine*. 2023; 389(23): 2175–2187. <https://doi.org/10.1056/NEJMra2300794> PMID: 38055254
6. Fewtrell L, Kaufmann R, Kay D, Enanoria W, Haller L, Colford JM, et. al. Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis. *The Lancet Infectious Diseases*. 2005; 5 (1): 42–52. [https://doi.org/10.1016/S1473-3099\(04\)01253-8](https://doi.org/10.1016/S1473-3099(04)01253-8) PMID: 15620560
7. Holcomb DA, Knee J, Sumner T, Adriano Z, de Bruijn E, Nalá R et al. Human fecal contamination of water, soil, and surfaces in households sharing poor-quality sanitation facilities in Maputo, Mozambique. *International Journal of Hygiene and Environmental Health*. 2020; 226, 113496. <https://doi.org/10.1016/j.ijheh.2020.113496> PMID: 32135507
8. Olsson G. Water, energy and food interactions—Challenges and opportunities. *Front. Environ. Sci. Eng*. 2013; 7: 787–793. <https://doi.org/10.1007/s11783-013-0526-z>