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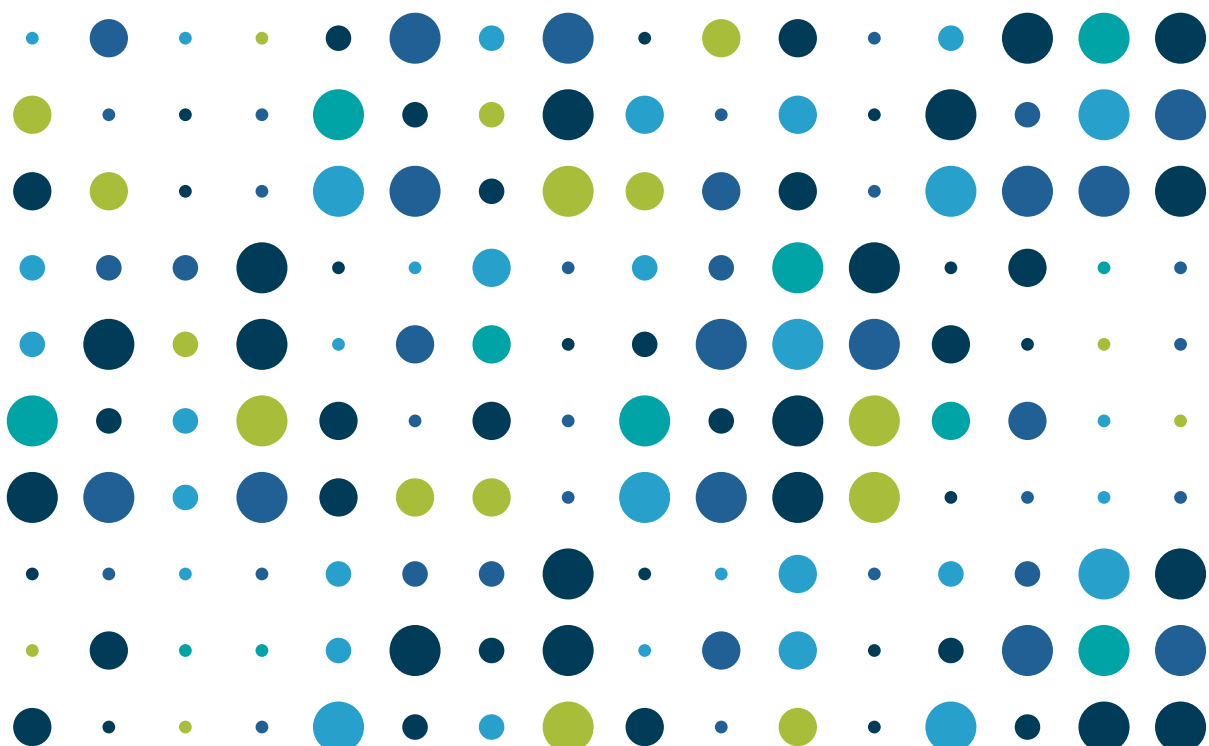
Standards for Official Statistics on Climate-Health Interactions (SOSCHI)

Non-Communicable Diseases: introduction

Alpha Phase document

Publication date: 12 November 2024

We welcome users' views and expertise on the alpha version of the statistical framework to further develop our work. Please email us at climate.health@ons.gov.uk.



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Introduction to the SOSCHI project

The impacts on the health of rising temperatures, wildfires, extreme weather events, and other direct and indirect effects of climate change are a major global concern. The most significant hazards and their impacts differ between countries and regions, as do the possibilities and priorities for climate change adaptation. National and local governments and other stakeholders need regular, reliable, and comparable data to monitor climate impacts and inform adaptation strategies, based on a transparent and globally generalizable statistical framework. The SOSCHI project, led by the UK Office for National Statistics and funded by Wellcome, is developing a framework of indicators based on state-of-the-art statistical methods to measure climate-related health risks. To support global reporting and monitoring, we are also developing a knowledge-sharing platform, open-source tools, and R code. Our findings will also help highlight data gaps and help set the agenda for future improvement of data sources and methods.

Project partners

African Institute for Mathematical Sciences, Kigali, Rwanda
Cochrane Planetary Health Thematic Group, University of Alberta, Edmonton, Canada
Office for National Statistics, Newport, United Kingdom
Regional Institute for Population Studies, University of Ghana, Accra, Ghana
UK Health Security Agency, London, United Kingdom
United Nations Global Platform, New York, United States of America

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concerning the availability of data can be made to the project team at climate.health@ons.gov.uk.

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Important notes

This document has been published as part of the alpha version of the SOSCHI statistical framework. Therefore, this should be read as a draft document, which does not necessarily represent the final state of the framework. We welcome users' views and expertise to further develop our work.

Please email us at climate.health@ons.gov.uk

Abbreviations

A	AIMSRIC	African Institute for Mathematical Sciences Research and Innovation Centre
C	COPD	Chronic Obstructive Pulmonary Disease
F	FDES	Framework for the Development of Environment Statistics
I	ICD-10-CM	International Classification of Diseases, Tenth Revision, Clinical Modification
	IPCC	Intergovernmental Panel on Climate Change
M	METEO Rwanda	Rwanda Meteorological Agency
	MINEMA	Ministry in Charge of Emergency Management
	MoH	Ministry of Health
N	NISR	National Institute of Statistics Rwanda
	NCDs	Non-Communicable Diseases
O	ONS	Office for National Statistics (UK)
R	RSA	Rwanda Space Agency
	RBC	Rwanda Biomedical Centre
	REMA	Rwanda Environment Management Authority
S	SDG	Sustainable Development Goals
	SOSCHI	Standards for Official Statistics on Climate-Health Interactions
U	UK	United Kingdom of Great Britain and Northern Ireland
	UNDP	United Nations Development Programme
W	WHO	World Health Organization

1. Acknowledgments

The improvement of indicators has been supported by key institutions, including the Rwanda Biomedical Centre (RBC), the Rwanda Environment Management Authority (REMA), the National Institute of Statistics Rwanda (NISR), METEO Rwanda, and the Ministry in Charge of Emergency Management (MINEMA). We extend our thanks to these institutions for their valuable contributions, particularly in providing datasets and participating in discussions that have facilitated the development of these indicators.

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Additionally, we are grateful to the African Institute for Mathematical Sciences Research and Innovation Centre (AIMS RIC) team for their valuable contributions to various aspects of the project.

As we progress into the beta phase, we welcome feedback from experts to further refine and develop these indicators. If you would like to contribute, please contact us at climate.health@ons.gov.uk.

2. Non-communicable diseases and climate change

2.1 Definition and Scope

Climate change is a global challenge that has significant implications for human health. Rising temperatures, shifting weather patterns, and the increasing frequency of extreme weather events are directly impacting health outcomes across the globe¹. These changes affect not only the physical environment but also critical social determinants of health, such as livelihoods, nutrition, and mental health, disproportionately impacting vulnerable populations^{2,3}. The interaction between climate change and health is especially evident in the growing burden of Non-

Communicable Diseases (NCDs), which are further exacerbated by environmental shifts⁴.

Among the most direct consequences of rising global temperatures is the increased risk of heatstroke, and fatalities, particularly during prolonged periods of extreme heat. Heatwaves have been linked to sharp increases in mortality, especially among those with preexisting conditions, including cardiovascular diseases and respiratory disorders⁵. For example, the European heatwave of 2003 caused an estimated 70,000 deaths across the continent, many of which were attributed to the worsening of chronic conditions in vulnerable populations⁶. These events signal a growing trend, as more frequent and intense heatwaves are projected in the coming decades, disproportionately affecting urban populations with limited access to cooling and healthcare.

Non-communicable diseases are diseases that are not contagious or transmitted through direct contact with others but are often associated with unhealthy behaviors⁷. Prominent examples include cardiovascular diseases, diabetes, chronic respiratory diseases, and cancer, which collectively represent a significant burden on global healthcare systems.

According to the World Health Organization (WHO), NCDs are responsible for an estimated 41 million deaths annually, accounting for over 70% of all global deaths. Of these, 17 million deaths are classified as premature, occurring among individuals aged 30 to 69⁸. Low- and middle-income countries (LMICs) bear the brunt of this burden, with 86% of premature NCD deaths occurring in these regions due to limited access to healthcare, unhealthy environments, and socio-economic disparities⁹.

The toll of cardiovascular diseases alone is estimated at 17.9 million deaths annually, making it the leading cause of death worldwide. Similarly, cancer claims 9.3 million lives each year, while chronic respiratory diseases and diabetes are responsible for 4.1 million and 2.0 million deaths, respectively, including those related to diabetes-associated kidney failure^{7,10,11}. Together, these four diseases account for more than 80% of all premature NCD deaths, underscoring the need for comprehensive prevention and treatment strategies.

The relationship between climate change and NCDs is multifaceted. As global temperatures rise, so do certain health conditions' prevalence. Extreme weather events such as floods, droughts, and hurricanes disrupt healthcare services, limit access to essential medications, and destroy infrastructure critical for managing chronic diseases^{12,13}. These events can also lead to psychological stress, which has been linked to both the onset and exacerbation of NCDs, particularly mental health disorders and cardiovascular conditions¹⁴.

Food and water insecurity, exacerbated by climate change, further intensifies the burden of NCDs. Droughts, floods, and other extreme weather events disrupt food systems, leading to poor nutrition and unhealthy diets, both key risk factors for diseases like diabetes and cardiovascular conditions. Populations facing food insecurity often rely on calorie-dense but nutrient-poor foods, increasing the risk of obesity, hypertension, and metabolic disorders. Additionally, water scarcity increases the risk of dehydration, particularly for individuals with diabetes, who may experience severe complications such as diabetic ketoacidosis when proper hydration and care are unavailable¹³.

Climate change also influences vector-borne diseases, altering the distribution of vectors such as mosquitoes that transmit diseases like dengue, malaria, and Zika. Although these are infectious diseases, their interaction with NCDs is significant. Individuals with chronic diseases often have weakened immune systems, making them more vulnerable to severe outcomes when co-infected with vector-borne illnesses¹⁴. Moreover, the dual burden of infectious diseases and NCDs in LMICs places immense pressure on already overburdened healthcare systems.

2.2 Impact pathway

The pathway illustrated in Figure 1 demonstrates the influence of climate change on non-communicable diseases (NCDs), primarily through increased exposure to extreme temperatures and related environmental changes. As global temperatures rise, heatwaves and prolonged periods of extreme heat become more frequent and severe, representing one of the most direct consequences of climate change^{5,15}. Furthermore, disasters such as floods and droughts are increasingly common, disrupting ecosystems and negatively impacting human health¹.

Exposure to high temperatures increases physiological stress, leading to dehydration, increased heart rates, and elevated blood pressure factors that exacerbate cardiovascular conditions¹⁶. Additionally, rising temperatures increase the concentration of ground-level ozone, a harmful air pollutant that aggravates respiratory and cardiovascular diseases^{12,17}.

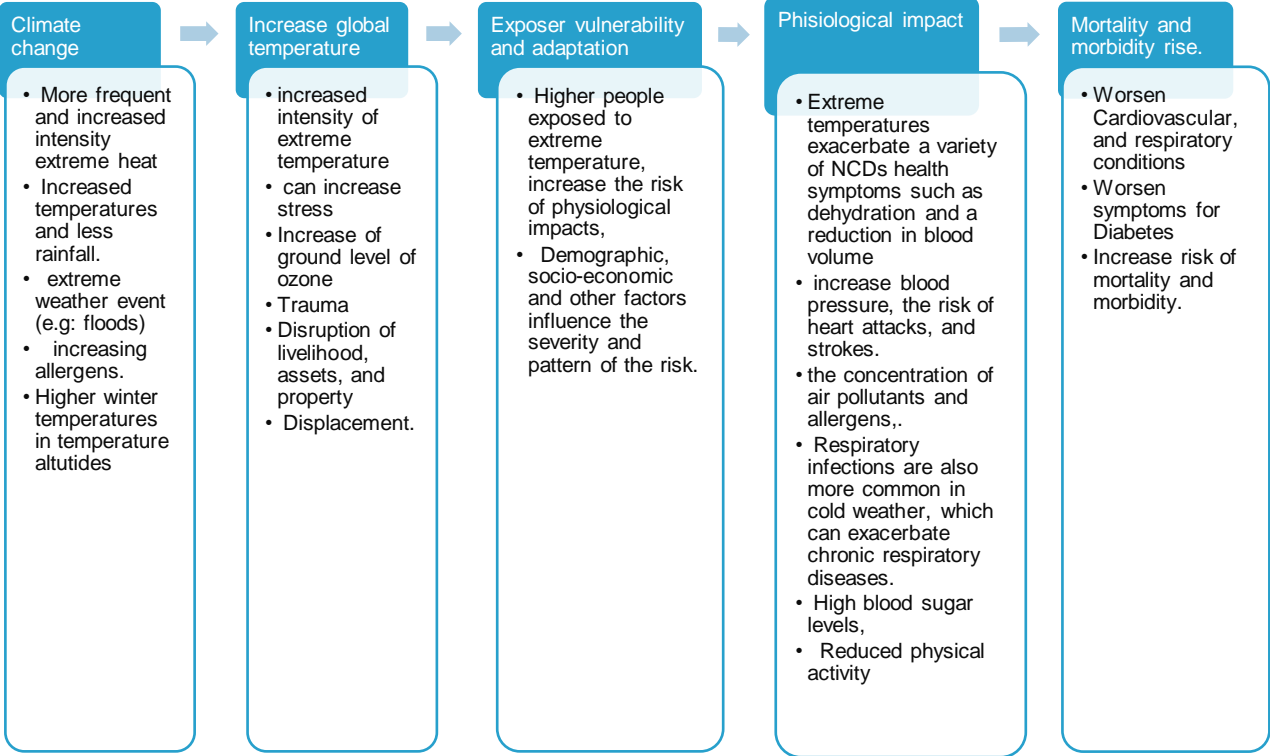
Extreme weather events can also result in displacement, loss of homes, and livelihoods, leading to heightened stress and diminished access to healthcare. These traumatic experiences disrupt treatment and increase psychological strain, worsening NCD outcomes¹. Vulnerable populations, including the elderly, individuals with pre-existing NCDs, and low-income communities, are particularly susceptible to these adverse health effects^{5,15}. Socioeconomic status, healthcare access, and demographic factors such as age and gender significantly influence how individuals are affected by the health risks associated with climate change. Lower-income populations, in

particular, are often more exposed and vulnerable due to limited healthcare access and resources¹.

Heat stress, exacerbated by extreme temperatures, poses serious risks, including heatstroke, dehydration, and cardiovascular events. Dehydration caused by extreme heat reduces blood volume, placing additional strain on the cardiovascular system and increasing the risk of heart attacks and strokes¹⁶. Heatwaves can elevate blood pressure, exacerbating conditions like hypertension and increasing the risk of cardiovascular events, such as heart attacks¹². Furthermore, heat stress can disrupt blood sugar regulation, complicating diabetes management. Reduced physical activity, often a consequence of high temperatures, further impairs diabetes management and other NCDs¹⁵.

The combination of extreme heat, air pollution, and heightened stress contributes to a worsening of cardiovascular and respiratory diseases, resulting in increased morbidity and mortality¹⁷. Disruptions in blood sugar regulation, along with reduced physical activity and increased stress, exacerbate complications in managing diabetes¹⁵. Vulnerable populations, including those with pre-existing NCDs, face an increased risk of death due to the combined effects of climate change and its impact on healthcare access, environmental conditions, and physiological stress^{1,18}.

Figure 1 - Impact pathways ⁴



3. Health impacts

Temperature fluctuations significantly impact human health from various perspectives, making cardiovascular diseases and diabetes critical health outcomes of interest. These conditions are among the most prevalent and distinguishable non-communicable diseases (NCDs) worldwide, and their links to climate change are increasingly recognized as a critical public health concern¹⁹.

Climate change exacerbates risk factors for many NCDs, particularly through rising temperatures, increased air pollution, and more frequent extreme weather events. For instance, extreme heat can worsen cardiovascular and respiratory conditions, leading to higher mortality rates and hospital admissions^{20–22}. Air pollution, driven by urbanization and industrialization, is a key contributor to chronic respiratory diseases like asthma and chronic obstructive pulmonary disease (COPD)²³. Moreover, climate change disrupts food systems, heightening the risk of malnutrition and contributing to the rise of NCDs such as diabetes and cardiovascular diseases. Extreme weather events, including floods and droughts, further complicate healthcare access, making it more difficult for individuals with chronic conditions to receive necessary care²⁴.

4. Framework indicators

According to the International Classification of Diseases, Tenth Revision, and Clinical Modification (ICD-10-CM), the following codes and specific indicators are relevant to non-communicable diseases.

- Diabetes (E08-E24, O24)
- Hypertension (I10-I97), Cardiovascular (I00-I99)
- Chronic respiratory disease: J30-J98

Climate change has resulted in an overall rise in temperature of about 1.9°C throughout the last century and will likely continue²⁴. To measure and mitigate against this, we need to develop globally consistent indicators that capture the influence of extreme temperature on human health across vulnerable groups. Based on our research, we recommend the following indicators, each related to a health outcome.

4.1 Headline Outcome Indicators

Within this topic, the priority indicators are:

- Number of cardiovascular hospital admissions attributed to extreme temperature
- Number/ rate of diabetic hospital admissions attributed to extreme temperature

When assessing the impact of extreme temperatures on NCDs, it is important to consider various factors that can affect the results. Pollutants like particulate matter (PM2.5), nitrogen dioxide (NO₂), and ozone can independently affect health outcomes, regardless of extreme temperatures. Socioeconomic factors, such as income, education, and employment, can influence both exposure to extreme temperatures and the ability to manage health conditions. Age, gender, and ethnicity can also influence vulnerability to extreme temperatures and their health effects. Personal behaviors, such as physical activity, diet, and smoking, can additionally shape health outcomes related to extreme temperatures.

Housing quality, including insulation, air conditioning, and heating, can impact exposure to extreme temperatures. Disparities in access to and utilization of healthcare services can affect the management of NCDs exacerbated by extreme temperatures. Regional variations in climate, urban infrastructure, and healthcare resources can influence both exposure and health outcomes. Seasonal changes and the timing of extreme temperature events can affect health outcomes and complicate analysis. Furthermore, factors like stress, mental health conditions, and social support can influence how extreme temperatures affect health. These factors are difficult to capture in statistical analysis because quantifying them in a globally applicable manner is challenging. However, their potential impact should be considered for all NCD indicators.

4.2 Supplementary Outcome Indicators

Due to current data limitations, we were unable to incorporate the following indicators into our analysis. However, once the necessary data becomes available, we will develop the appropriate methodologies and supporting materials. The supplementary indicators are as follows:

- Number of cardiovascular-related deaths attributed to extreme temperature
- Number/ rate of diabetic related deaths attributed to extreme temperature

5. Proposed beta phase developments

The heat- and cold- related mortality and morbidity topic (heat and cold) exists as a separate topic within the alpha phase. However, a decision has been made to combine

the NCD topic with the heat and cold topic as part of the beta phase developments, given the overlaps between these two areas. The proposed NCD indicators can be captured as sub-topics or disaggregations within the heat and cold topic, given that they are focused on hospitalisations and deaths attributed to extreme temperature, which are also included within the scope of the ongoing developments for the heat and cold topic. This will mutually aid the development of outstanding methodologies for each topic.

6. Comparison to existing frameworks

[Sustainable Development Goals \(SDGs\):](#)

- Target 3.4: Reduce premature mortality from NCDs by one-third through prevention, treatment, and promoting mental health and well-being.

[UN Global Set of Climate and Health Indicators:](#)

- Indicator 45: Hospital admissions due to climate-sensitive conditions.

[Paris agreement article](#)

- Article 7
- Article 13.8: Each Party should also provide information related to climate change impacts and adaptation under Article 7, as appropriate.

[Lancet Countdown:](#)

- Indicator 1.1.3: Heat-related mortality.
- Indicator 1.1.4: Heat-related morbidity.

[Framework for the Development of Environment Statistics \(FDES\) 2013:](#)

- Component 5: Human Settlements and Environmental Health

7. Further reading

- [Lancet Countdown on health and climate change](#)
- [Climate change and nutrition- associated diseases](#)
- [Indicators for Non-Communicable Diseases \(NCD\)](#)
- [NCD Global Monitoring Framework](#)
- [Sustainable Development Goal \(SDG\) indicators correspondence with the Basic Set of Environment Statistics of the FDES 2013](#)

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