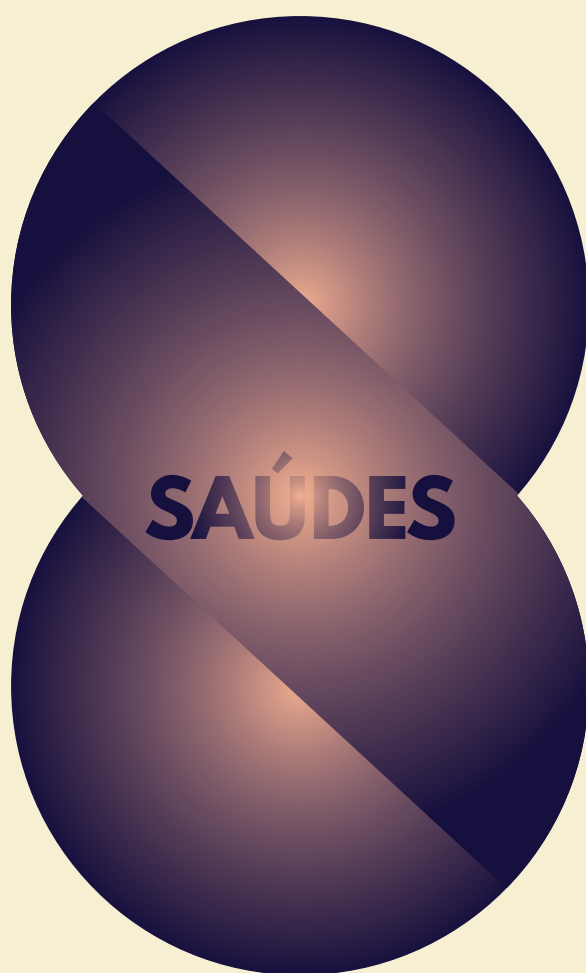


CLIMATE RISKS AND THE HEALTH OF THE PORTUGUESE:

Future(s) to imagine and build

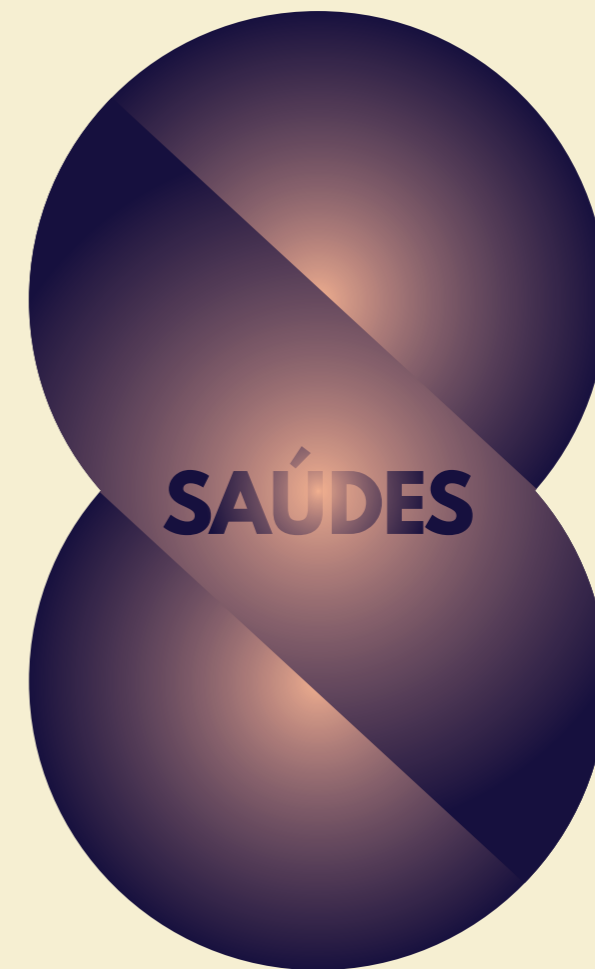


2023



CLIMATE RISKS AND THE HEALTH OF THE PORTUGUESE:

Future(s) to imagine and build



2023

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Previous Note

Climate change has long been on “the agenda”, but do we know exactly how does it relate to and impact our health? This was the starting point for the third edition of *Saúdes*, a knowledge-based project launched by Médis in 2021, which aims to provoke more and deeper discussions on various topics related to Individual and Collective Health.

“Climate Risks and the Health of the Portuguese: Future(s) to imagine and build”, the study that is now being launched, is an important step towards the ambition and vocation that has been idealised for the *Saúdes* project for several reasons:

- The relevance of the subject – we already know that, according to the WHO, climate change is “the greatest health threat facing humanity” worldwide. But when it comes to Portugal, we have now discovered that, far from seeing this issue as something geographically distant, the Portuguese report that they are aware and/or already experiencing the direct effects of climate change on their health. A large majority are asking for more and better information, which is essential to generate more action, dynamism, and prevention. This is exactly where we intend to act. Like with the two previous studies, we aim to provoke (re)action from society.

- The team and methodology: under the management of Return on Ideas (ROI), with scientific guidance from Prof. Dr. Luisa Schmidt, the collaboration of five experts (Dr Ana Horta, Dr Susana Viegas, Dr Carla Viegas, Dr Sofia Nuncio, Dr Osvaldo Santos), a clinical advisor (Prof. Dr Inês Leal), and a writer/author (Gonçalo M. Tavares), a “first-class” team worked together for over nine months to translate an interdisciplinary and complex reality into an easy and accessible language, close to the ordinary citizen. A big thank you to everyone.

- The partners who have joined Saúdes project for the first time since its creation. We welcome the Forum Saúde XXI (with whom we have signed a strategic partnership, as part of the overall project). We also welcome APSAI, CNADS, CPSA, the Portuguese Lung Foundation, Respira and Zero, all partners in this specific study and that will certainly help us to disseminate it.

Climate change has a very direct impact on our health. Changing the course of events is not something to be left to the world and/or to others. We cannot and must not be distant or quitters. Change is up to each one of us, in our own particular lives and in our inner circles.

For we are what we eat, drink and breathe, the impact we have on the climate comes back to us directly. Let’s face the truth that in this matter we are all simultaneously aggressors, victims and defenders of our own health. We believe that knowledge is an accelerator of (increasingly urgent) action.

Eduardo Consiglieri Pedroso
Chief Healthcare Ecosystem Officer
Ageas Portugal Group



Luísa Schmidt
Institute of Social Sciences of the University of Lisbon

Although health issues have been pointed out since the first scientific reports that carried out an integrated assessment of the impacts of climate change in Portugal, namely the Project SIAMI (2002) and SIAM2 (2006) – *Climate Change in Portugal: Scenarios, impacts and adaptation measures* – initially, health dimensions were not as properly recognised as they have been in recent years.

This underlines the importance of addressing this issue at a national level and with a multidisciplinary team of experts, being an issue that the conducted survey showed that is of the utmost importance and already significantly perceived as a matter of public concern.

The initiative of this study has thus confirmed the results of an already long history of research that has been carried out within the framework of OBSERVA/ICS-ULisboa on the subject of climate change.

The subject is extremely challenging due to the complexity of all the dimensions involved. From biophysics to conceptual, to the relationship between health and the natural and social environment, including cultural, psychological, communication and political factors, there are many dimensions to be considered.

Developing this study forced us to set limits and to make choices that remain open to review, starting with the conclusions of the study itself. In this case, since we were dealing with the country's population, some of the choices were easier to deal with and gave us a picture of problems that are familiar to us: the diversity and dynamics of change in Portuguese society.

In fact, various aspects of the unequal situation that the country faces regarding the impacts of climate change (CC), specifically on health, are revealed in these results: both from the objective point of view of identifying risks, and from the population's subjective perception that nowadays this a major problem.

1. The first aspect that we find relevant to comment on concerns the public's awareness of the impacts of CC on health, which the Portuguese already perceive, although they aren't unable to specify them. This perception might have resulted from the media and from the sharp growth and increased access to education especially among younger age groups.

Traditionally, divination, rather than predicting 'what's the weather going to be like', is a great classic in the life of traditional societies, but the climate issue brings this to a whole new level, of a totally different complexity. It involves the global scale and the comparison with disasters and extreme events in distant parts of the world, resulting in phenomena that only a few years ago seemed to remote, but that are now announced and beginning to occur in the EU and even in Portugal – extreme temperatures, air pollution, water scarcity, unusual disease vectors, mental impact... as identified by the Portuguese in the survey, and developed by the experts in the second part of this study.

The climate culture that today overlaps with the traditional ‘what’s the weather like’ requires scientific knowledge and perceptions of scale that progressively meet educational resources, especially among younger populations. It also poses other challenges, such as the mismatch between the country’s positive self-images of its landscape, natural quality and tourist popularity, and, on the other hand, the vulnerabilities and manifest damage to its landscape by fires, coastal erosion, extreme droughts and the diffuse environmental impact of metropolitan areas – urban, suburban and peri-urban – where the majority of the Portuguese population lives.

In this context, it is urgent to create a new public climate culture as a crucial process for the resilience of Portuguese society in the specific field of health.

2. The second aspect that emerged from this study is directly related to social inequalities that permeate the entire panorama of vulnerability and exposure to the impact of CC on health. The fact that in Portugal there is a strong dynamic of ageing along with other dynamics concerning old and new poverty, and that this is distributed territorially in a very contrasting way, makes the problem even more difficult and its solutions even more demanding.

Let’s consider, for example, the imprecise status of the various poverties throughout the country and that are directly reflected in public health through housing. From the poor quality of buildings, the current fragility of access to housing, to energy poverty and poor and inefficient conditions of collective mobility, we have a vast and complex set of social inequalities that will directly cause health vulnerabilities when facing the impacts of CC.

The successive crises in Portuguese society, especially since the end of the first decade of the current millennium, have triggered a dynamic of diversification and aggravated vulnerabilities that are strongly reflected in health risks due to climate effects.

3. A third aspect highlighted by this study is how health as a concern began to be perceived differently by the population. It is understandable that an older population complains more about their health and is sensitive to all kind of failures, from NHS to social support, but CC brings a new context to this old problem. The concerns expressed by parents reveal the growing integration of a CC narrative as a lasting global change that deeply impacts the expectations about the future.

This becomes even more evident when public preventive health policies are weak. These policies focus mainly on schools and food education, and they exposed a paradox that other surveys on Sustainability conducted by Observa (2018, 2022) showed as well: the population strongly supports preventive public health policies in schools, especially concerning food habits, whereas in a society more sensitive to aspects of individual freedom a strong reaction would be expected.

Thus, we can conclude that the CC impact on public health requires strong and preventive policies to reduce future vulnerability especially among younger populations. This was clearly revealed by the concerns reported by the parents.

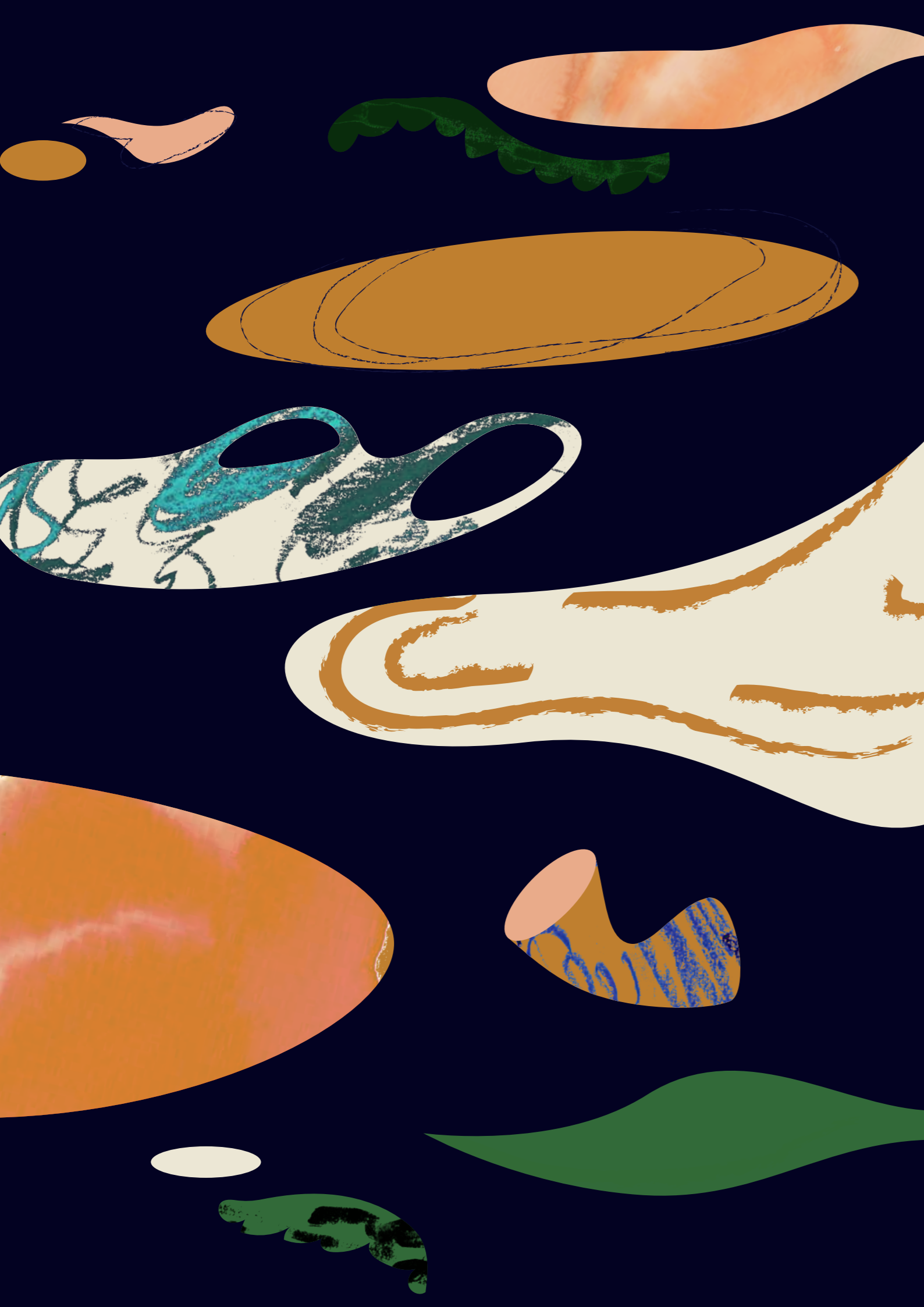
These policies will therefore become increasingly important and will need to be extended to new social, age-related, and other sectors. In addition to the quality of food, preventive public measures are already being developed on sun exposure and on the dissemination of warnings on air quality, heatwaves, and the arrival of new transmission vectors, as we can see in the texts by the experts included in this study.

4. Finally, as a fourth aspect, this study clearly shows to the crucial role that knowledge and structured information already play, and will increasingly play, in the future. By knowing the vulnerabilities of the population and the main impacts of CC and its extreme effect on health, the whole dynamic of personal protection relies on society empowerment, in order to understand not only the nature of the phenomena that we’re facing, but also the adaptive and/or reactive responses that are required. In this context, and beyond the important role of the media, schools, regardless the year grade, play an essential role.

Let’s not forget that, according to recent surveys, the population confidence in scientists and health professionals was the highest. This is a “capital of trust” that cannot be neglected, and this study also shows that clearly.

Knowledge is the basis and the beginning of everything, and this study - by combining a national survey, focus groups and a series of technical papers written by experts of recognised merit - allowed us to gain a better understanding of an undeniable and urgent problem. Moreover, it clarified the main ways in which we can act now to protect ourselves from the most serious consequences of CC and overcome some of its most destructive effects.

The aim was not to cover exhaustively, and in all their vastness and complexities, the vulnerabilities and impacts of the relationship between the health of the population and the impact of climate change. Rather we aimed to highlight the most important and recognised ways in which these impacts will occur, and the main vulnerabilities the population will face and be exposed to: heatwaves and extreme temperatures, air and water pollution, vector-borne diseases and mental health. All these factors are addressed successively in light of what is now known about the recent conditions the people of Portugal are facing, and their potential future prospects.



1. Introduction

Introduction

This study, sponsored by Médis, aims to put on the public agenda an issue that has been little researched from the citizens' point of view, and that is rarely discussed in the public sphere: the perception and impact of the risks resulting from climate change on the health of the Portuguese, today and in the future.

The alarm level is high, and health was considered one of the priority scientific areas of the COP26, the Climate Summit held in Glasgow in November 2021 (very different from the attention given at the 2009 Copenhagen Summit, where there was not a single reference to health in 200 pages of conclusions).

A report prepared by the World Health Organization for the Glasgow Summit finally assessed the gaps and trends concerning the relation between climate change and human health. It concluded that, although there is a genuine and growing academic interest in this topic, there is a need to diversify the geographical areas and the issues studied.

The methodology of this research was designed with this in mind. In addition to the qualitative and quantitative evaluation carried out by Return on Ideas with ordinary citizens, a scientific team coordinated by Professor Luísa Schmidt was brought together to support the understanding of the level of risk to which the Portuguese are and may be exposed in five priority areas: heatwaves, air pollution, water pollution, vector-borne diseases and mental health.

The conclusions are as follows: although the fieldwork shows that the Portuguese are very aware of the climate problem and can easily relate climate change and the consequences for their health, they are far from understanding the scale and severity of these risks. Even among those who claim to understand it (1 out of 4), risk-to-risk analysis reveals the inaction that results from this knowledge or concern.

If it is clear that the superficiality of knowledge on the topic is justified not only by the lack of information, but also by its complexity, it is also confirmed that the information disclosed should not focus solely on the risks.

Presenting apocalyptic problems without any action guidance does little for changing behaviours or, as is also proven here, for the mental health of individuals. Mobilisation around an environmental agenda, be it at individual or community level, will not be encouraged if pathways of hope are not provided.

Moreover, although 79% reported that they are willing to take more preventive action for their health in the near future (knowing that climate change may increase the risk), when we consider most health risks, the possible individual actions are limited or require financial resources that are often also limited [for example, 28% claim that they do not have the means to prepare for living in a country with higher temperatures].

As a project team, knowing that the environmental agenda must also be based on signs of hope, we felt the need to identify lines of action for each of the risk areas. We believe that these examples of what is already being done (or planned) are essential for spreading the message: it is as important to be aware of the threat as it is to be aware of the solutions that governments, organisations, companies and even citizens have at their disposal.

Once again, we believe we have had the privilege, together with Médis, to unveil a hidden reality that is insufficiently discussed and act upon. We see it as a window to new questions:

Is health really the ultimate and strongest driver to accelerate the fight against climate change?

How much information should citizens have today (given their capacity to act)?

Given the undeniable impact that climate change is already having on the quality of life of the Portuguese people, which public and private institutions should be mobilised to act?

What tools and information should be guaranteed to health professionals to better support the authorities?

How can research in the field of Environmental Health be highlighted and promoted?

At the end of the research, we felt that bridges for alternative futures are being built in the 'examples that show the way' – a new flag on the beach to warn people of the risks of sun exposure, a wind garden that cools a city, a playground that purifies the air, and sponge cities that absorb excess flooding.

This reading suggests that, in addition to the concerns about our health and fate, we could go further in raising awareness, using this platform to highlight the opportunity we have today to imagine and build another future(s). This seemed to us such an obvious conclusion that we used it as the sub-title of this research.

We know that art, by the way it touches our emotional life, is a primordial vehicle to influence what people think and feel, even their ambitions. And that, therefore, science (or its thinking) can be more consequential if it inspires artistic experiences and constructions that people can relate to.

This is the purpose the objet d'art presented here in the form of a short essay by Gonçalo M. Tavares.

We do so with the aim of directing energies towards an alternative future, not out of fear, but because of the well-being (and beauty) it may hold for us. This future will require of us "extreme modesty combined with extreme ambition".

How does climate change affect human health?

Health is nested in a set of external factors, and the environment is one of the most evident. There are numerous environmental conditions that can directly or indirectly impact the health status of a person or population, and today this cause-effect relation is evident to most Portuguese, such as the consumption or contact with contaminated water, the exposure to chemicals, exposure to certain types of radiation, exposure to high noise levels, consumption of food produced under unhealthy conditions or soils containing industrial waste.

Among the different environmental changes that may have an influence on health, there is a topic that calls for attention: Climate change. The impact it may have on health are closely related to other environmental changes and problems, but have different origins and mechanisms.

Climate change refers to changes in Earth's climate patterns that persist for a long period of time. These changes include increasing global average temperatures, changes in rain patterns, sea level rise and more frequent and intense extreme weather events, such as heatwaves, storms, and prolonged droughts.

Although climate change over time is a natural phenomenon, its rapid evolution and magnitude has been associated with human activities, such as burning fossil fuels or indus-

trialisation, among many others that contribute to increased greenhouse effect on the atmosphere, retaining the heat and increasing the average temperature of the planet

Changes in climate patterns, whose accountability will not to be discussed here, are amplifying some environmental phenomena and problems and, consequently, their health effects. They are a risk amplifier.

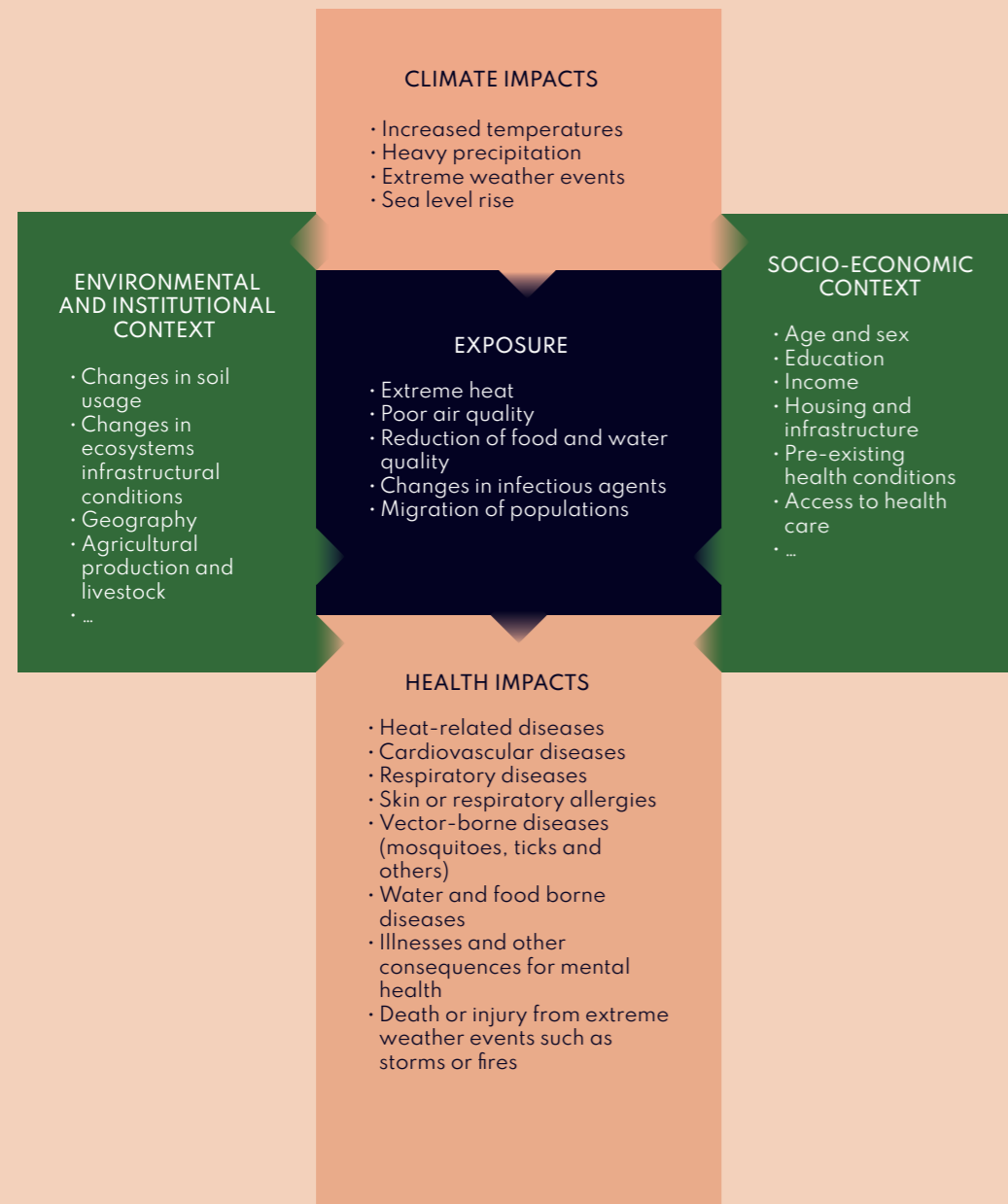
As a relatively new fact in science, it is possible that all the connections between climate shocks and health are not yet identified, and history suggests that surprises should be anticipated; if there is anything we learned in recent years, is that any change, however modest, in a system (in this case, the chemical composition of the atmosphere), can have long term effects on other natural systems (such as the water cycle), with unpredictable consequences.

Despite the unforeseen, the impacts that climate change may have on human health are identified and inventoried by science, and they have been widely disseminated through institutions such as the World Health Organization (WHO) or the Intergovernmental Panel on Climate Change (IPCC), as well as books and articles in newspapers that come to us in an increasingly accessible language.

«It has been predicted long ago that more energy retained on the planet would lead to increased temperatures, causing ice melting and thermal expansion of water. Yet, no one predicted that the sea level rise would cause saltwater intrusion into coastal aquifers and would increase the risk of pre-eclampsia and gestational hypertension among the women of Bangladesh. Likewise, it would have not been easy to predict that modest increases in atmospheric CO₂ would make our food less nutritious resulting in hundreds of millions of people facing a higher risk of micronutrient deficiencies. The complexity of Earth's systems and their even more complex interactions make it highly likely that we will continue to face unforeseen impacts on health due to climate change and other types of anthropogenic environmental changes. »

In, Planetary Health: protecting nature to protect ourselves
Howard Frumkin, IslandPress, 2020

From climate change to human health



Source: "Understanding the Connections Between Climate Change and Human Health" United States Environmental Protection Agency (EPA), 2023



“Adapting to the Tide”
a short film on how humans should adapt creatively to the environment instead of manipulating it to meet their needs.

© What's left Photo by Agathe Bissierier



2. The two sides of the risk

Brief background
& context

Portugal, a country (particularly) exposed to environmental risk

Portugal is particularly vulnerable to the risks of climate change due to its geographical location. The country is located between the Mediterranean basin and the North Atlantic, a region where average temperatures have increased beyond global levels and where rainfall levels are decreasing; it is already being considered by experts as a “climate change hotspot”¹.

The geographical location helps explain, at least partially, phenomena such as heatwaves, drought, soil desertification and, of course, water scarcity, which are more frequent and severe. Data from the Portuguese Institute of the Sea and the Atmosphere (IPMA) show that periods without precipitation occur more and more frequently in the humid months – from October to March – and that the drought pattern has changed; they are more frequent, more prolonged and covering a greater percentage of the territory. In August 2023, 97% of Portugal was in drought, with 46% at severe or extreme levels².

Additionally, “Portugal is, according to a report by the European Central Bank, one of the countries with highest climate and environmental risk because we have forests, and we are on a coastline”³. In addition, we have a chronic problem of unplanned land use, which makes low resilience to climate change even more evident.

Most of the national territory is covered by forest spaces (64%), and the vast majority of the total forest area (89%) is held by hundreds of thousands of private land owners; it is

estimated that a high percentage of forest land in the North and the Centre has unknown owners⁴. The excessive fragmentation of the property is closely linked to a historically injudicious construction policy, with obvious consequences in forestry planning.

The most evident consequence of forest mismanagement is rural fires. Although in the last decades the trend is decreasing, in 2022 Portugal was the second-most forest-fire affected country in Europe, with 153 fires destroying an area of 949 km², according to a report from the European Environment Agency⁵.

Mainland Portugal also has 987 km of coastline, 25% of which is affected by coastal erosion⁶. Although the coastal areas most exposed to average sea level rise are already well identified, large-scale construction and increased human presence in some coastal areas especially vulnerable to more extreme phenomena [such as floods or storms] have not yet been stopped.

Data from the APA show that between 1958 and 2020, the country lost 13,13km² of its coastal area, equivalent to 1,313 football pitches and, although there are no new areas with significant erosion, the phenomenon intensified between 2010 and 2020⁷. In a country where about 75% of the population lives by the coast and where 85% of GDP is concentrated there⁸, being already particularly affected by the occurrence of extreme events [see next page], climate change worsening will be a huge challenge.

¹ Filipe Duarte Santos, National Council for the Environment and Sustainable Development

² Monthly Climate Bulletin – August 2023, IPMA

³ Portugal is one of the countries with highest climate and environmental risk’ in Saber Viver (2023)

⁴ ‘Forest Adaptation to climate change’, ICNF (2013)

⁵ ‘Extreme summer weather in a changing climate: Is Europe prepared?’, EEA (2023)

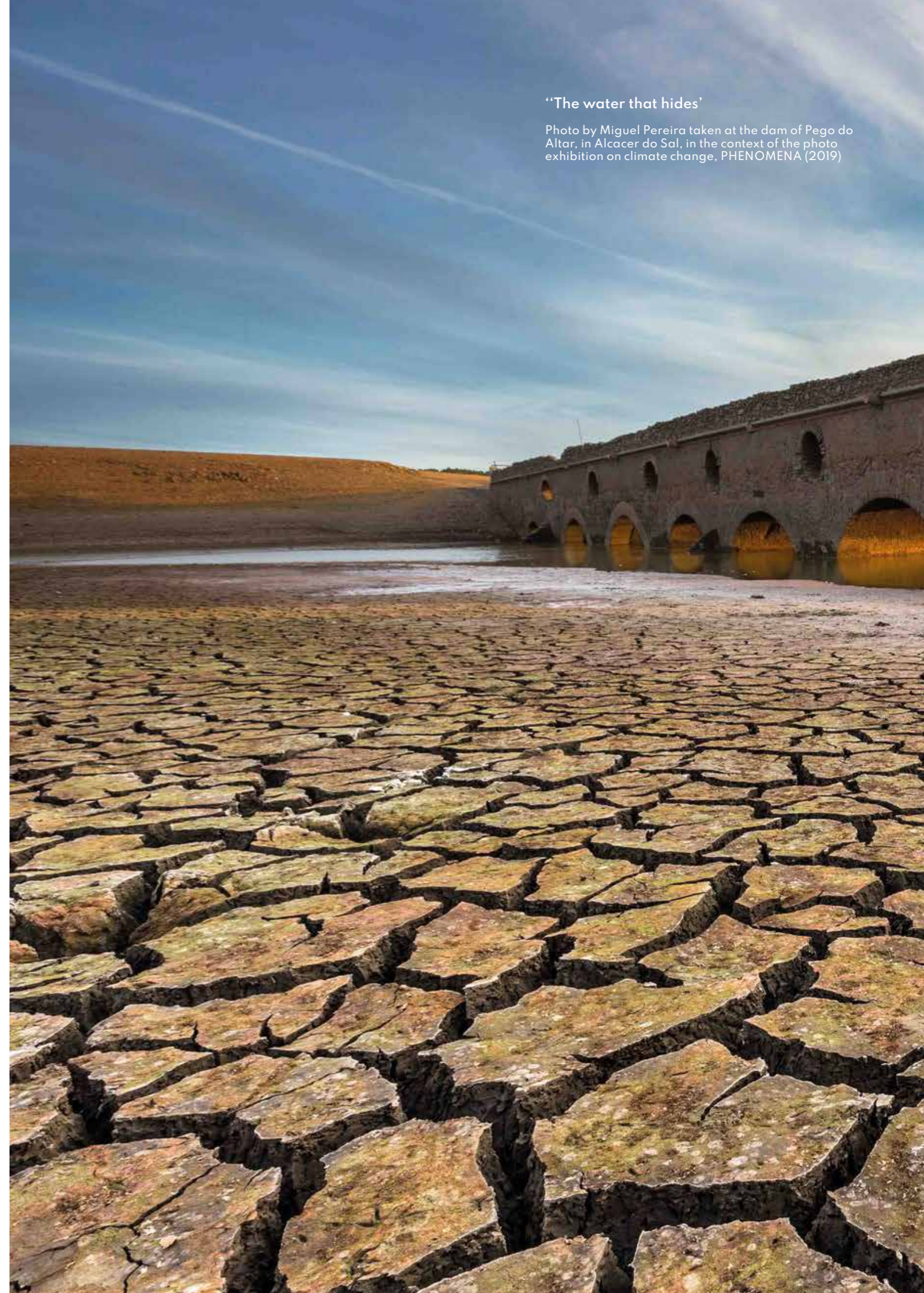
⁶ Report ‘Coastal Planning and Beach Management’, by the Portuguese Environment Agency based on Siam II (2020)

⁷ State Environment Report 2020/21, Portuguese Environment Agency (2021)

⁸ Challenges for Adaptation of the Coast to Climate Change, APHR (2020)

“The water that hides”

Photo by Miguel Pereira taken at the dam of Pego do Altar, in Alcaccer do Sal, in the context of the photo exhibition on climate change, PHENOMENA (2019)



«Portugal is one of the [European] countries most affected by losses related to events associated with climate change or even climate change that is already happening.»

Associação Zero, 2022

Portugal among the European countries most affected by extreme weather events

Some facts

Portugal is one of the European countries most affected by extreme weather events, according to a study by the European Environment Agency (EEA)¹.

According to the EEA, extreme weather events, which are expected to increase in the coming years due to climate change, must have caused between 85 to 145 deaths in Europe (mostly as a result of heatwaves), and resulted in costs of up to 520 billion euros in the period from 1980 to 2020. The calculated losses result from different types of extreme events directly or indirectly linked to climate: i) meteorological events, such as storms, ii) hydrological events such as floods, or iii) climatic events such as heatwaves, cold waves and droughts. Meteorological and hydrological events each accounted for between 34% and 44% of total losses, and climatic events accounted for between 22% to 24%.

Among the 32 European countries analysed, Portugal ranks an alarming 5th place (1st place being the worst) in terms of premature deaths, with 9,267 deaths over the last four decades. Also, in terms of economic losses, extreme weather events cost the country 13,461bn euros, ranking Portugal 7th among the countries analysed.

It should be noted that, from this amount, only 478 million euros were covered by insurance (Portugal ranks 16th in this indicator). The study shows that, regarding extreme weather events, Portugal is one of the countries that suffer the greatest economic impact due to climate change by GDP – 1.5% to 2.5% between 2005 and 2014.

Based on these results, ZERO highlights some worrying data. Between 1980 and 2020, Portugal:

- was one of the countries with the highest losses' values per km² (100 to 200 thousand Euro of economic losses per km²).
- had significant costs – 1,000 to 1,500 euros per person over the 40 years covered (an average of €25 to €37,50 per year).
- is one of the countries with the lowest levels of insurance cover in case of extreme weather events (less than 5% of the damage value).

It should also be noted that only 3% of the identified events were responsible for about 60% of the economic losses over the analysed period.

Note: The data available in the study were determined through the CATDAT (RiskLayer GmbH) and NatCatSERVICE (Munich Re GmbH) databases.

¹ European Environment Agency, 'Economic losses and fatalities from weather- and climate-related events in Europe', 2022

² ZERO alerts to climate change high costs in Portugal (Feb 2022)

The omission of medicine [regarding environmental health]

‘Saúde planetária’, um termo vulgarizado em discursos de ambientalistas, ganhou impulso quando, ‘Planetary Health,’ a term popularised in environmentalist speeches, gained momentum when in 2015, a philanthropic foundation [The Rockefeller Foundation] joined one of the leading medical journals [The Lancet] in a collaboration that aimed to look at health, equity, and climate change. The concept of ‘Planetary Health’ is based on the premise that long-term human well-being depends on the Earth’s well-being, including its living and non-living systems. This approach competes with others on how to deal with health in the 21st century, suggesting a step beyond Public Health (which approaches health and well-being as a collective achievement), Global Health (which considers socio-economic factors) or even the concept ‘A Health’ (which adds natural life systems to the previous approaches).

Indeed, the relation between Health and the Environment is being increasingly recognised, starting with World Health Organisation [WHO], which refers to climate change as “the greatest threat to health that humanity faces.”

Between 2019 and 2022, the number of Brazilian medical schools that began to include the effects of climate change on health in the curriculum almost doubled – reaching 86 of the 155 schools in the country¹. Harvard University also announced a curriculum review to look at the subject from various angles; more than one discipline on climate change, it aims to add a climate lens to the various contents of the course of medicine.

But the US (or Harvard) seem to be an exception. A 2020 study², that surveyed students from 2,817 medical schools in 112 countries, shows that only 15% of educational institutions included, to date, the link between climate change and health in the curriculum.

To include climate in curricula, rather than ad-hoc training on heatwaves or carbon neutral emissions hospitals, is argued by some experts because “climate change increases the risks of certain conditions and diseases which creates challenges for doctors – for example, the side effects of some medicines are more pronounced during a heatwave” [Alice Bell, Head of Policy, Climate and Health of Wellcome Trust].

In Portugal, although the subject is addressed in some disciplines, there are none specifically oriented to it, let alone an approach that includes climate in a structured way in the courses. Luís Campos, doctor and president of the Portuguese Council for Health and Environment [CPSA], has been warning to this omission in medical training. “These topics have been systematically ignored in all health courses – and not just in medicine. It is important that all professionals are aware of the climate issue. Everything is yet to be done.” According to the expert, health professionals’ training “is undoubtedly the most important challenge that we face in the future of health care.”³

Michael Pinsky’s Pollution Pods is a travelling exhibition that allows visitors to experience the poor air quality of some of the world’s most affected cities – London, Beijing, Sao Paulo, or New Delhi. In 2021, the exhibition travelled to COP26 in Glasgow, accompanied by employees from six UK paediatric hospitals, who cycled 800km from London to Glasgow to alert the international community about the impact of climate on health. This was the first edition of a UN Climate Summit in which health was considered one of the priority scientific areas.

Michael Pinsky Pollution Pods at Somerset House. Photo by Peter Macdiarmid



¹ ‘Climate Action in Academic Medicine’, Associação Americana de Escolas de Medicina (Nov 2022)

² ‘Envisioning planetary health in every medical curriculum: An international medical student organization’s perspective’ publicado na Medical Teacher (2020)

³ Are we training future doctors to treat “climate diseases?”, Público, March 2023



3. How do the Portuguese feel?

A perceived or understood threat?

The Portuguese and climate change

Responding to ‘how do you feel’ requires a retrospective analysis of the relationship between the Portuguese and the environment

“At the turn of the 80s, we got on the bandwagon of the market economy and consumer euphoria (...). Rubbish, which is one of the most perverse results of consumerism, grew exponentially (...). It is interesting to see that many election boycotts in the 1990s happened because of environmental issues: basic sanitation, no access to water, rubbish dumps that were not shut down.”¹

This journey to the past is essential to pinpoint the moment when the Portuguese were forced to acknowledge a relationship between environment and health. This brief testimonial by Luísa Schmidt helps us to go back to the 80s and 90s, when the country had more than three hundred open-air dumps and many Portuguese beaches and riverbeds were contaminated due to marginal discharges from urban sewers or factory facilities.

This generation realised for the first time the connection between health and environment due to their proximity to toxic conditions, although the concern was limited to those who lived near a dump, polluted river or were exposed to factory pollution.

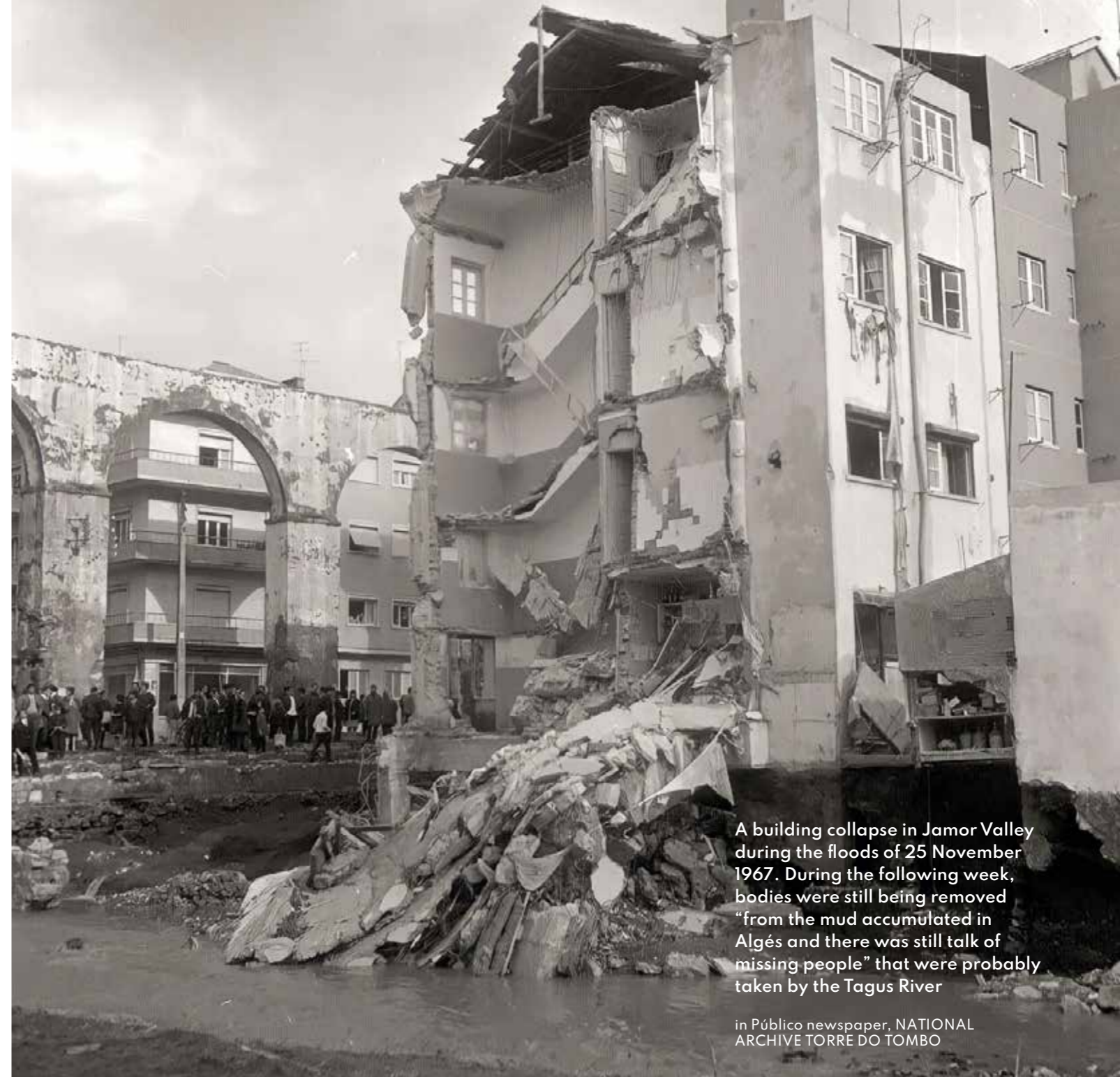
Portugal entry to the European Union (then EEC) in 1985 meant a convergence of the Portuguese people with the rights and duties of other European citizens, inducing a series of initiatives that, by education or law, raised awareness to the problems and to the respect one must have for the environment.

Even though many environmental rules have been bypassed and the country has generally lagged its European counterparts - dictated by a process of late development - environmental issues have entered public policy and the country has improved its performance. Today, for example, it is one of the countries with the highest number of blue flags on sea and river beaches in the world.

Although, in general, we began talking about ozone and global warming in the 20th century, awareness to climate change, and the notion that the consequences for human health could affect an entire population, would only concern people in the middle of the last decade. New formats, such as documentaries, but also increased media coverage on CC contributed to this and now, in the present sample, only 10% consider themselves to be poorly informed about climate change.

What this introduction aims to highlight is that, although the relation between environmental conditions and health is not new to the Portuguese people, awareness of the problems that result specifically from climate change is quite recent. What was experienced in the 80s and 90s can explain, partially, why the Portuguese easily relate health and climate change, as shown below.

¹ Luísa Schmidt, entrevista Anabela Mota Ribeiro, 2003
“Ambiente no Ecrã - Emissões e Demissões no Serviço Público Televisivo”, Luísa Schmidt, 2003



A building collapse in Jamor Valley during the floods of 25 November 1967. During the following week, bodies were still being removed “from the mud accumulated in Algés and there was still talk of missing people” that were probably taken by the Tagus River

in Público newspaper, NATIONAL ARCHIVE TORRE DO TOMBO

Big Floods of 1967: The “Charneira Event” in Portugal

700 deaths resulted from this incident. 1,100 people became homeless, and hundreds of homes were destroyed or submerged in the municipalities of Loures, Odivelas and Alenquer.

On a night when the city of Lisbon suffered heavy and concentrated precipitation, the floods - associated with in-

creasing urbanisation, excessive soil sealing, destruction of green areas and inadequate drainage systems, as intentionally stressed by Gonçalo Ribeiro Telles in an interview with RTP - led to what is considered *the evento-charneira* or pivotal event, as it was “the first time when social processes, and development policies met environmental issues” in Portugal. (Schmidt, 2003)

The Portuguese and the environment: Brief chronology

THE THREAT OF POLLUTION The environmental problem is a local problem

THE 80S

A growing number of polluting industries become based in Portugal, tons of waste (urban and toxic) is disposed outdoors.

1987

Joining EEC prompts the creation of the Framework Act on the Environment, which integrates laws in various areas such as air and water pollution, noise pollution, waste management, coastal protection, and species protection.

1990

Environmental issues take centre stage prominence; the Secretary of State for the Environment is promoted to Ministry of Environment and Natural Resources.

2000

Strategic Plan set targets of 90% and 95% by 2006 for levels of sewage service and water supply to the population (none met on time).

INFORMATION CONTENT



1993

NEW FORMS OF JOURNALISM IN PT

The new private TV channels (SIC and TVI), play a fundamental role in exposing the waste situation in Portugal, giving voice to a population forgotten and unhappy with the location of waste treatment plants.



2004

PORTUGAL, AN ENVIRONMENTAL PORTRAIT

In a series made up of images captured by RTP, Luisa Schmidt portrays a country deteriorating — landscape degradation, rivers' pollution unbreathable air, dumps, fires — and an increasingly aware population.

2007

The Portuguese Environment Agency is created, which includes the mission to fight climate change.

2011

Portugal already has 206 wind farms. The commitment to renewable energy starts to be visible.



2006

AN INCONVENIENT TRUTH

Documentary on global warming – Oscar for best documentary film in 2007 –, by Al Gore, who earned the Nobel Peace Prize "for his efforts to create and disseminate greater knowledge about the climate change created by men."

2015

The Paris Agreement involved all countries in the world (represented at the UN) in the fight against climate change. Political leaders from the 195 countries made a commitment for the first time to reduce greenhouse gas emissions by adopting measures leading to a low-carbon economy – significantly reducing the use of fossil fuels, investing in renewable energies, and limiting the temperature rise to 1,5°C in relation to pre-industrial times.

2015

Green Tax Reform in Portugal:

- Fee on light plastic bags for retail establishments
- Tax incentive for the use of car and bike sharing, and electric cars
- Tax incentive for scrapping cars
- Tax incentive for forestry activities



2015

LAUDATO SI

Encyclical Letter of the Pope Francis, in which he criticises irresponsible consumerism and development. Makes a call for change and global unification for actions to fight against environmental degradation and climate change, challenging his readers directly

THE THREAT OF CLIMATE CHANGE The environmental problem becomes a global problem

2021

End of coal generated electricity in Portugal. The two thermal power plants – Pego and Sines – are shut down.

2022

The Framework Law on Climate comes into force and recognises the situation of climate emergency and establishes that a stable climate is humanity heritage (Portugal was the first country in the world to do so).

NEW LANGUAGES AND AWARENESS FORMATS



2016

BEFORE THE FLOOD

The documentary by Leonardo DiCaprio and Martin Scorsese is a warning to climate change issues. Recorded over three years, includes, among others, discussions with politicians and scientists. Besides being available online, it was broadcast on prime time RTP1



2019

COVERING CLIMATE NOW

The Nation and Columbia Journalism Review magazines point the finger to media's inertia regarding climate change. Together they launch the initiative 'Covering climate now'. In Portugal, the challenge has been taken up by the newspaper Publico, the website SAPO24, Shifter and Greensavers magazines.



2022

CLIMATE JOURNALISM

In recent years, much has changed and all media have been giving growing emphasis to news and warnings related to climate. In 2021, Publico released 'Azul,' a project dedicated to environmental issues. Likewise, in 2022, Expresso newspaper launched the SER platform – Sustainable, Economic, Responsible.

Illustrative, not exhaustive

The easy relationship between climate change and health

The respondents were asked to choose from a list the topics of greatest current concern and Climate Crisis came in 5th place (out of 12), almost alongside the 'current condition of the NHS' and above problems such as the current conflict in Ukraine or social inequalities. [see next page]

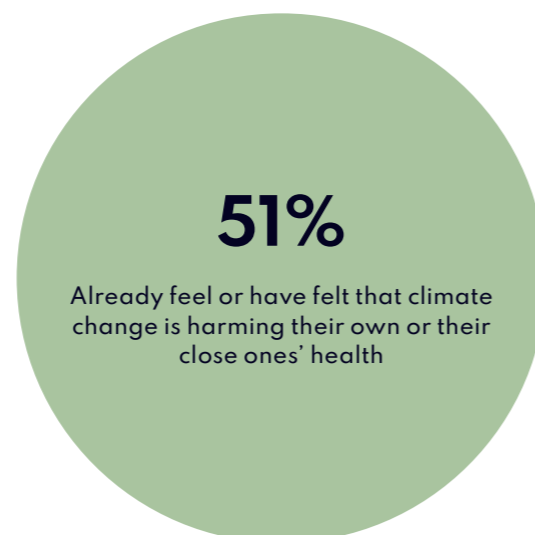
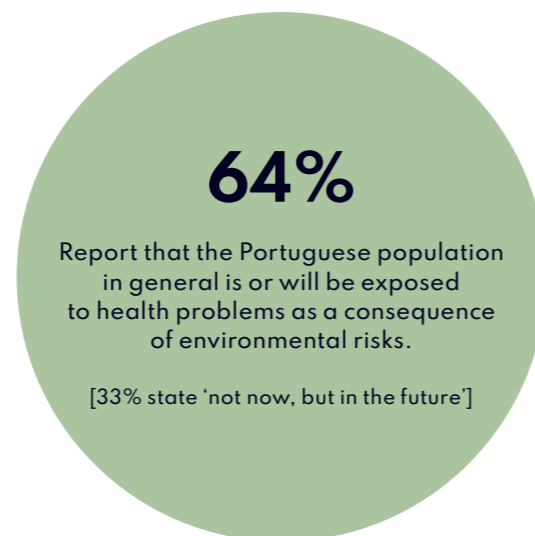
67% of the respondents believe that climate change is already impacting quality of life and the same majority (64%) agree that the Portuguese in general are already exposed to health problems as a consequence of environmental risks. Moreover, 51% recognise that the problem is already affecting their health or their close ones' health, 61% among those have heart or respiratory diseases.

Experts like Anthony Giddens¹ have been arguing that climate change and CO₂ emissions can rarely be heard, smelt or seen, which is what best explains why there isn't enough alarm and action to eliminate or reduce the threat. Apparently, Giddens' paradox no longer applies to the Portuguese; as for them the threats have become notorious – drought, soil desertification, fires and floods are increasingly seen, heard or smelled. Additionally, as we are already experiencing the effects of extreme events, our sense of interoception, i.e., the information that reaches the brain about what happens to our bodies, is also activated.

– allergic reactions, itchy skin, sweating, heavy legs or increased heart rate in response to extreme heat. The body warns us.

In Portugal, for the majority of the population that reports being fairly or very informed (89%) and fairly or very concerned (95%), it is no longer the invisibility of the threat that best explains low mobilisation or inaction regarding climate issues, but realising its insignificance, and the smallness of the country considering the scale of the problem. As heard in the focus groups, about the effort made for more sustainable behaviours, "I feel as if the boat is sinking, and I am bailing out with a cup."

¹Giddens, Anthony. "The Politics of Climate Change." Polity Press, 2009.



In Direct Discourse

"[With climate change, we face the risk of] major natural disasters; those will also affect human health. I speak for myself, I never had allergies, nor sinusitis. Now I suffer a lot from these allergies. (...) Sun allergies are not normal at this time of year, with these temperatures. In Vilar Formoso, it was once unthinkable to be in the pool on the 1st of May. And yet yesterday we went to the pool."

W, 49, seamstress, Vilar Formoso

"I will just mention one [thing], which is the one that concerns me the most: Health. The continuous pollution that we see, especially in industrialised countries, leads to chronic diseases, especially chronic obstructive pulmonary diseases, which kills many people every year. And those who live in big cities are more prone to it. Many people don't realise how much pollution can affect us."

M, 50, airport security, Porto (chronic allergic rhinitis)

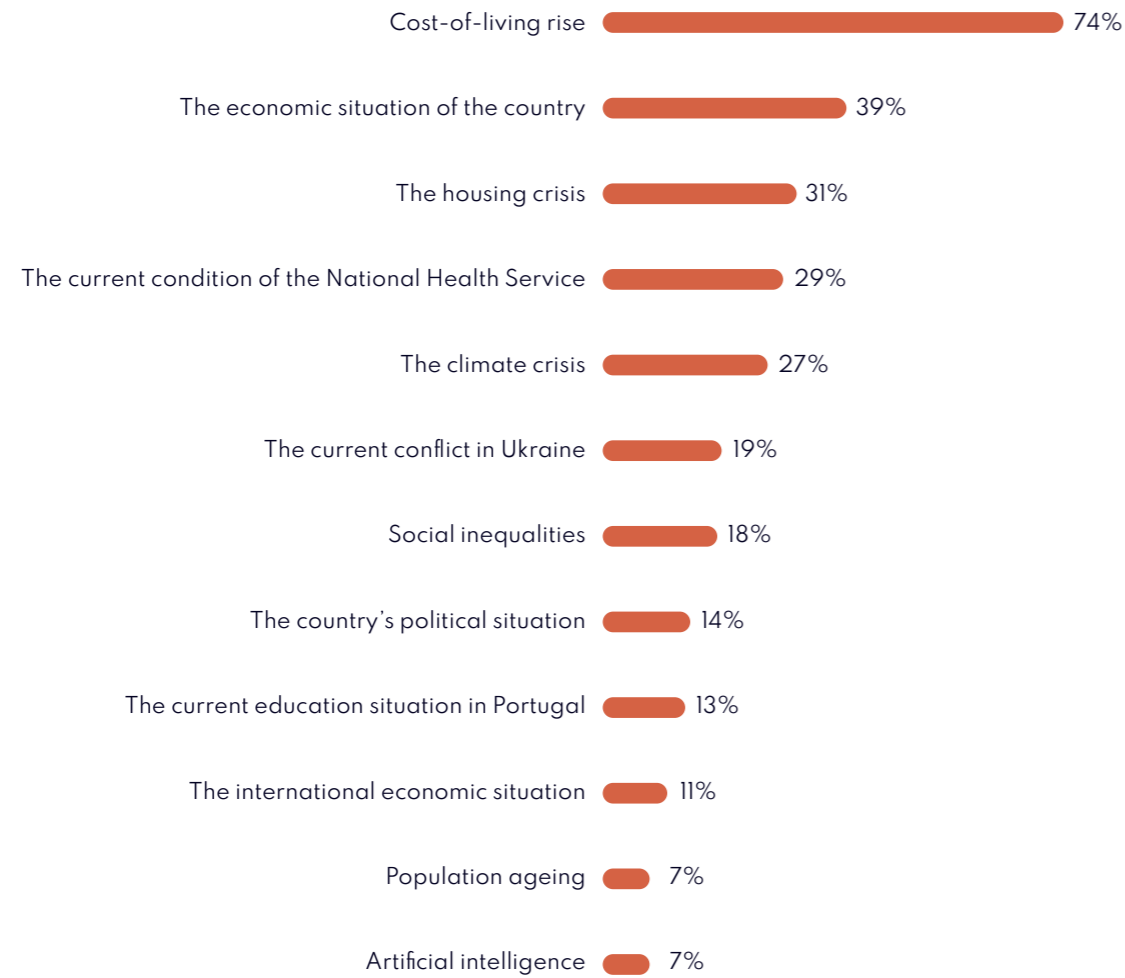
"Above all, it will have a great effect on people's health. We already see other things that before didn't exist, younger people with respiratory, oncological problems ... I think this is all due to the unnatural things that we are ingesting in food, in the air, the particles that are always in the air... and we see that it is not natural, this heat is not natural! It seems like that we get sort of sick because it is not natural for us. It greatly influences health, or lack of health, in this case."

W, 52, elementary school teacher, Leiria

Spontaneous reactions in Focus Group to the question "With climate change are we at risk of ...?"

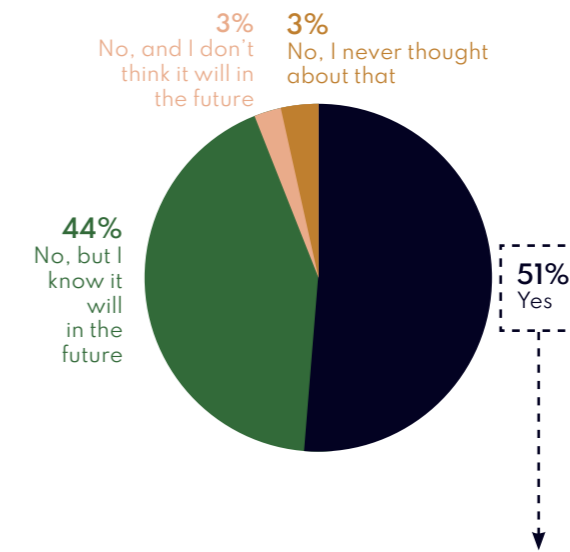
Out of the following topics, which are your major current concerns? (max. 3)

N=800



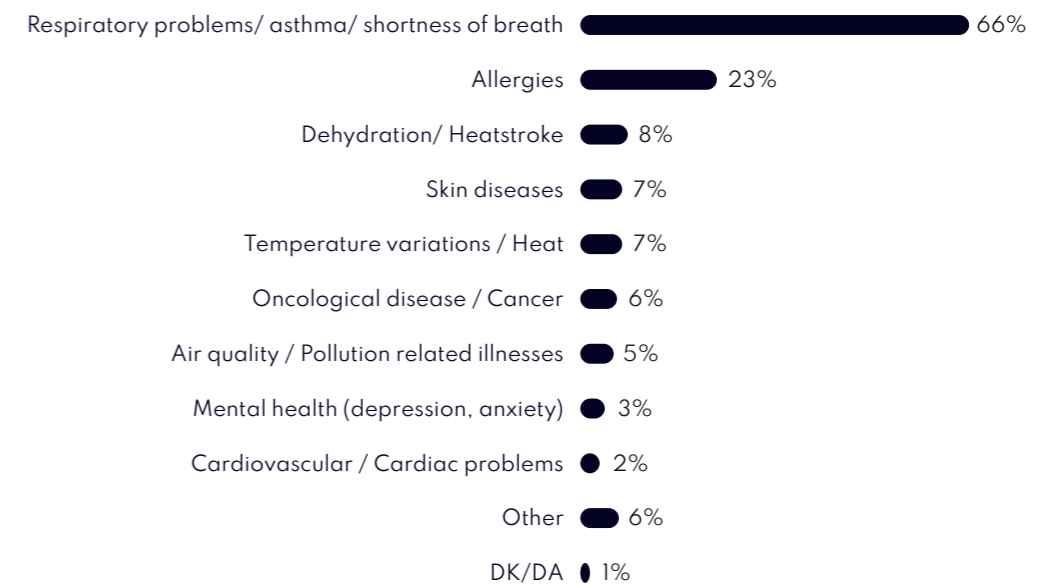
Have you ever felt that climate change is harming your own or your close ones' health?

N=800



What health problems do you associate with climate change?

(Base that answered affirmatively=N 405)
SPONTANEOUS



In discussion, some participants who are better informed or closer to environmental risks are able to identify specific health risks that can result from climate change

Extreme-heat-related problems	Allergies and respiratory problems	Vector-borne infectious diseases	Consequences for mental health	Effects on nutrition	Effects on reproductive health
<p>“I also thought about cardiovascular diseases. Why? These changes in temperatures... my parents always have unregulated blood pressure, problems, arrhythmias, something... and those always get worse during these temperature peaks.”</p> <p>W, 46, Odivelas (Urban target)</p>	<p>“Respiratory diseases, because as I have asthma that affects me directly. (...) The vegetation cycle is different. Pollination will happen more (...) Some plants are almost constantly at the stage they cause allergies. I will have to start pollen allergy desensitisation shots again.”</p> <p>W, 44, Porto (Urban target)</p>	<p>“In my village, I see more flies and mosquitoes, and they are, or can be, disease transmitters (...). When we hear about malaria and cholera, these are diseases from underdeveloped countries, and we think they will not show up here. But where are all these mosquitoes coming from? It’s like the Asian wasps. They’re everywhere wiping out the autochthonous ones. (...) Diseases are starting to appear that we thought to be extinct.”</p> <p>W, 52, Leiria (Rural target)</p>	<p>“Air pollution also affects our brain. For example, the car exhaust emits a type of pollution with particles, which means that it is not just gas, it has solid particles. These solids have different sizes and can cross our encephalic barrier and reach our brain, even though our blood flow. This can lead to neurodegenerative diseases such as Parkinson’s and Alzheimer’s.”</p> <p>M, 30, Lisbon (Informed target)</p>	<p>“The loss of biodiversity and the mass extermination of pollinating insects. The most obvious are the bees, but they are a tiny part of pollinating insects and other animals, such as birds (...). This will reduce species diversity; the reduction of species reduces the diversity of food products. More and more, we will be working with more processed and less diverse food products. This will affect our diet.”</p> <p>M, 46, Maia (Informed target)</p>	<p>“This is a statement without any scientific substance, I don’t know what I’m saying, but I fear that changes in hormonal cycles result from exposure to very acute pollution levels... Altered periods, less fertility....”</p> <p>W, 34, Lisbon (Informed target)</p>
<p>“I heard that there were many elderly people in a nursing home suffering from dehydration and they said this happened more because older people may not feel thirsty. (...) Dehydration can’t be seen, while a skin or cardiovascular problem, for those looking from the outside, show obvious signs. Dehydration is more silent. I’m not a health professional, but I’d say other diseases are more evident.”</p> <p>M, 27 anos, Loures (Rural target)</p>	<p>“In 15 years’, I predict a huge increase in pulmonology patients. No doubts here. (...) all kinds of lung diseases will see a galloping increase. It’s even more serious, cases of chronic asthma. It is very serious. People don’t realise, but chronic asthma can lead to death.”</p> <p>M, 50 anos, Porto (Urban target)</p>	<p>“Higher incidence of infectious diseases. With the south advancing north, we may have diseases such as dengue, malaria, diseases that today are not very prevalent in Europe, but may become so.”</p> <p>W, 34, Lisbon (Informed target)</p>	<p>“Another aspect is related to mental illness. There is already talk of stress and anxiety, and they are even called the diseases of the century. (...) The issue of climate change, environment, all of this, creates a lot of anxiety on the top of everything else in our lives. It’s everywhere, everything is related, and it doesn’t look good.”</p> <p>W, 34, Tomar (Rural target)</p>	<p>“It seems that nothing grows any more, the fruits on the trees don’t grow, oranges come out dry from the trees. Shortly we’ll no longer have natural products. One of these days if we want fruit, we’ll only have those hybrids. Hybrid corn, hybrid milk, genetically modified.”</p> <p>W, 49, Vilar Formoso (Rural target)</p>	<p>“I’d like just to mention one more thing, which is fertility. I don’t know if it’s totally related to pollution, but also to pesticides. All products that are being used in agriculture end up affecting us. 30 years ago, there weren’t such high infertility rates as there are now.”</p> <p>W, 39, Lisbon (Urban target)</p>

The focus groups were organised into three criteria based on awareness or proximity to climate risks: Urban target: People with greater tendency to develop health problems due to heat or pollution
Rural target: People living in places of greater risk / proximity to extreme weather events (e.g. Droughts, fires) Informed target: People more aware or informed about health and/or environmental issues

Climate and health relationship: more perceived than understood

Considering the late awakening to environmental issues in Portugal, the initial hypothesis for this research was that the relationship between climate change and health would still be unclear to Portuguese people.

In a survey, when asked an open question about the impact climate change could have on the quality of life of the Portuguese, 10% explicitly mentioned health problems such as diseases and allergies, and the same percentage mentioned “lack of food products/ lack of food/ famine” from a list that essentially described the main environmental risks that Portugal could face due to climate change (“drought/ lack of water” and “temperature amplitudes/disasters” were the most common responses).

Despite the fact that people are more likely to spontaneously refer to environmental risks than to health risks, the research shows that even among those who are not particularly informed or exposed to environmental risks, when discussing this topic, they can easily establish the causal link between these risks and health. Moreover, the study shows that citizens who are closer to or more concerned about environmental issues can perceive what are the main impacts of climate change on health [see previous page].

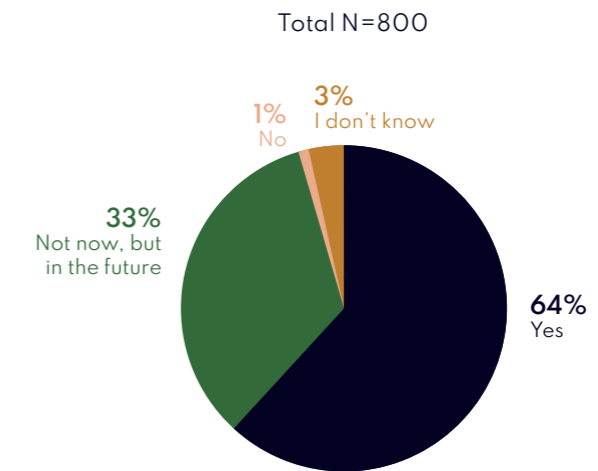
The history of the relationship of the Portuguese with environmental problems such as pollution (see page 28), the growing media attention and the significant percentage of the population (51%) that already felt symptoms in themselves or in their close ones, will help to explain this.

However, from perceiving the problem to actually understand it, there is still a long way to go. It doesn't require much skill to realise that pollution causes or aggravates respiratory problems; but it does take knowledge or critical thinking to make the link between air pollution and mental illness or infertility. Even if we know in theory that extreme heat is dangerous for the elderly and heart patients, misunderstanding the scale of the risk may mean that the most vulnerable populations are not being properly protected, as would be recommended.

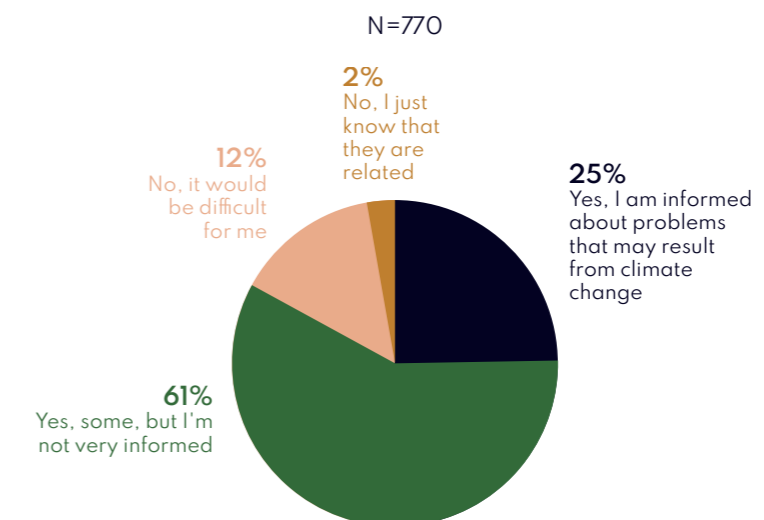
The survey confirms this hypothesis: when people who are already feeling the effects of climate change on health answered an open question “What health problems do you associate with climate change?”, most answers were respiratory problems, followed by allergies; only 8% said dehydration or heatstroke and only 2% mentioned cardiovascular or cardiac problems (although heatwaves/extreme temperatures are among the most commonly identified environmental risks that threaten our quality of life). In fact, only about 1 in 4 report being informed about the health risks that may result from climate change, and the vast majority, even though they can identify some risks, admit that they are not very informed.

The risk-by-risk analysis performed during the study, and the awareness that there is a lack of in-depth and accessible content to lay people on this subject, advises some caution in reading these data. We suspect that even those who consider themselves informed about health risks, do not fully understand the problems.

Do you think that the Portuguese are or will be exposed to health problems because of environmental risks?



Could you identify those health risks?



The bottom line is: the Portuguese already easily perceive that health is threatened by climate change. However, from this perception to people knowing exactly what health risks they are exposed to or understand the seriousness and extent of these risks, there is a long way to go.

It is even more likely that the climate problem's "awareness" (which is recognised by the overwhelming majority) is more related to people's perception or their feeling of familiarity with the subject than with a deep understanding, as they know that this depends on facts or information that can only be acquired by experience or education.

Recognising a lot of concern – as we'll see later, risk-by-risk – but then not taking action (in protecting health and/or the environment), also empties the value of this reported concern - something that is not surprising considering the difficulties that Portuguese people face in their daily lives.

In any case, we believe that there are accelerating factors in this 'from perception to understanding' process, that lead people towards the recommended action. In the following pages, we will look briefly at these.

"I'd just like to say one thing: It's not just about knowledge. Of course, it is important to have the right interlocutors in every sector, – health, culture... but the main issue, I believe, is that we don't feel these problems in our 'gut', it is not part of our experiential, sensory and emotional universe. Until we feel this on our skin, and I'm not just talking about consequences, but actually feeling how serious this issue is for us... so I think this should be addressed not only through information, but also at a sensory level. And artistic experience is one means, but there are others we should consider. (...)

For me, the best news is not technological progress, I'm a bit suspicious about that... when it comes to new technologies to extract carbon, it is the same paradigm - generating more to mitigate a problem. But when there's news regarding legislation (...), and other efforts that are being made to recognise ecocide, the right of non-humans, rivers, water, the living world... if we haven't been yet able to register this in our feeling system, it must start with legislation."

W, 34, Cultural Producer, Lisbon

3.1 Accelerating factors

Three threats: Drought, heatwaves and fires are already present in Portuguese life and will be accelerating factors in understanding climate change’s impact on the quality of life and, inherently, on health.

As much as we realise that the environmental problem went from being local to global with climate change [see chronology on page 30], it is when the threat is local that the consequences become more obvious, and it is from that place (or from the first-hand experience) that people start realising the impacts on health.

In the focus groups, a resident of Seixal who enjoyed hiking in Arrábida spoke of the “desolating areas” that had burned down; another participant, from Beira Alta, whose family runs a cattle farm, reacted to the lack of water and spoke of how they were affected by the drought. Another, who lives in Odivelas, warned that from that area of the city, the smog caused by pollution could already been seen. It is when people have direct contact with environmental changes that they more rapidly relate climate change and health.

In June this year, a third of the country was in severe or extreme drought. This news will touch closer the 44% of Portuguese who have already experienced lack of water in their area for several days or weeks, with implications for consumption (11% reported that in July this was happening or was happening again).

In 2022, there were six heatwaves in the country, the hottest year since 1931 (1.38 °C above the normal value recorded in the reference period 1971-2000). April 2023, when the focus groups were held, it was particularly hot and dry; July was the hottest on record. In the first fortnight of July – the period in which the survey was conducted – we experienced the hottest days in the planet since records began [World Meteorological Organisation].

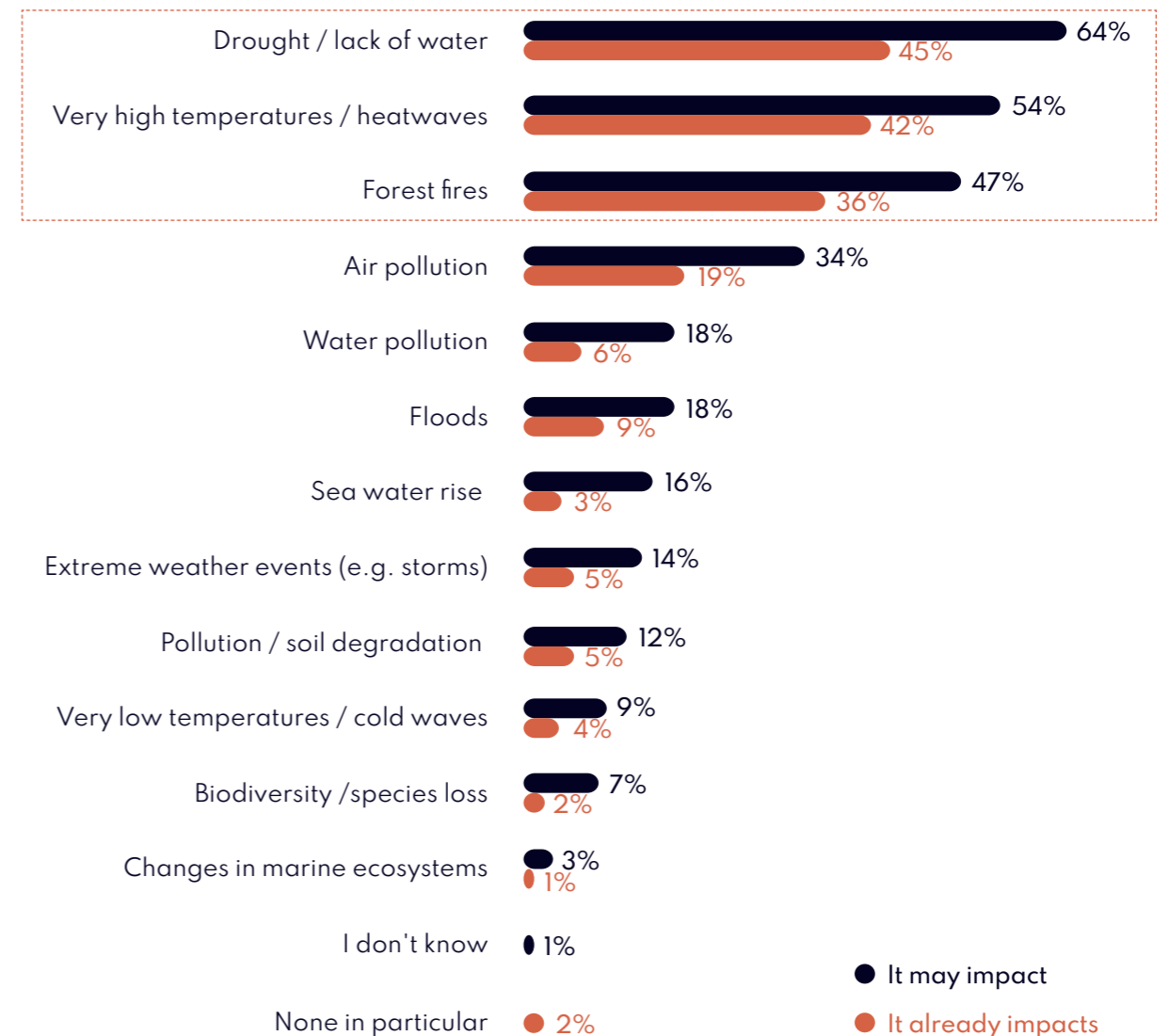
We are historically a country of fires. According to a recent report by the European Commission, Portugal reached in 2022 the third and fourth worst EU ranks in terms of burnt area and number of fires, respectively. In terms of the percentage of territory burnt, calculated according to the size of countries, Portugal is at the top. The Portuguese have been hit hard: 29% of those surveyed have experienced the impact of a forest fire “close to their home or their close ones’ home”.

Also in 2022, the “Célia Depression” spread dust from the Sahara across the Iberian Peninsula - a phenomenon that can affect health. In the news, the Portuguese Society of Pulmonology advised asthmatics to avoid exposure and going outdoors. 89% of the respondents say they have felt the dust in the place where they live.

People tend to consider climate problems to be far from themselves or their homes. These events - in particular, drought, heatwaves and fires, whose frequency and/or intensity worsened in recent years-, are working as accelerators not only concerning the perception of the impact - both current and potential - of climate change on quality of life, but also concerning the understanding of its relationship with health.

The conviction that climate change is already negatively impacting the quality of life of the Portuguese tends to increase the more they are exposed to environmental risks. For example, 77% of those who have already been exposed to a fire close to their own home versus the 61% who have not.

Which of the following environmental risk(s) would you say that may impact the health of the Portuguese the most? (máx.3)



Q: Which of the following environmental risk(s) would you say that may impact the health of the Portuguese the most? (choose a maximum of 3). It included the option “None” (0%). N = 800
 Q: [If any risk is chosen] From these, which one or more do you think is already impacting the health of the Portuguese? N = 796

In Direct Discourse

“Last year, during the fires in Serra da Estrela, the village I was in was surrounded by flames and we had evacuation order. More recently, in December, the floods in Oeiras, (...) someone died. (...) When you start to see these things close by, it is a warning. When this kind of heat comes, I always think of fires, it’s inevitable. There is already an anguish associated with excessive heat.”

W, 47, Social Assistant, Linda-a-Velha

“As well as the dust from Africa, there was the pandemic. Viruses from animals; we’re occupying their habitats. The same way that dust will be more frequent, pandemics can also occur more often (...). Here, the drought and fires have been frightening. They reached absurd levels. Last year we had 45° during the summer and fires until October, very close, all the time. Everything is getting worse.”

W, 33, Tourism Worker, Tomar

“What comes to my mind is worry, about health and inflation. Food will be scarce...when the village doesn’t grow, the city doesn’t eat. We’re not even producing in the village, onions come from The Netherlands. (...) The potatoes boil, it seems like they’re going to explode. (...) We are at risk of not being able to eat the essentials or not being able to eat natural quality products.”

W, 49, Seamstress, Vilar Formoso

“I live in an upland area, outside [of Lisbon] and, for a few years now I can see a cloud: the smog. I see it from an area that a few years ago was mostly countryside. These used to be rural, crop areas, but now it’s an urban jungle and we’re already witnessing phenomena that we used to only see in big cities. As I am at a high point, I can see. Sometimes I can’t see hand in front of face, it’s scary.”

W, 46, Financial Assistant, Odivelas

Portuguese exposed to environmental risks

29%

Have already experienced the threat or impact of a forest fire near to their or their close ones’ home



@ Nuno André Ferreira/Lusa

89%

Felt or saw the dust from the Sahara that reached Portugal last year



@ Rui Gaudêncio/ Público

3.2 'Encounters with the future'

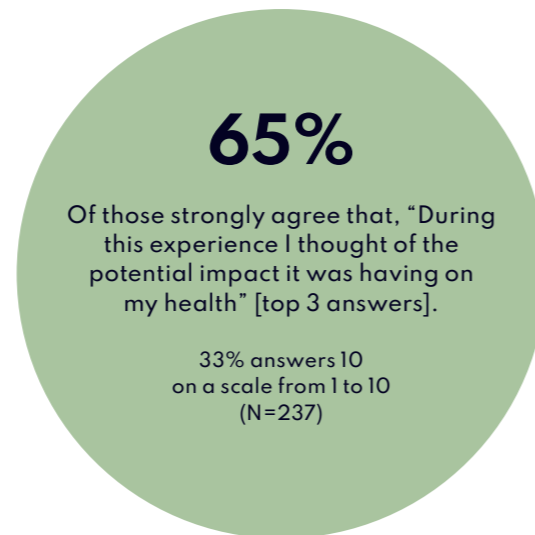
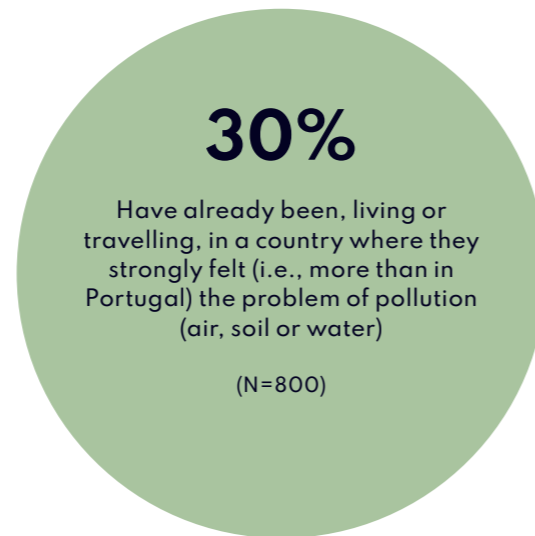
It is not just about the risks we experience in the national territory. Trips to more exposed places contribute to a greater sense of risk and awaken consciousness

«A few years ago, I landed in Bali (...) the beach was an expanse of the rubbish dumps, mostly plastic, cans, organic waste (...) the rubbish disposed of on the sand was floating in blackened waves. The piles of rubbish were meters high. The situation was so catastrophic that workers who collected and burned waste had to take breaks because of its toxicity. They would feel sick (...) Bali was not the only encounter with the future. In New York I was caught in a snowstorm, a weather explosion, a polar vortex.... »
Clara Ferreira Alves, Expresso, 2023

This testimonial serves to introduce an idea that emerged from the focus groups because of its direct intuition that these are 'encounters with the future'. Later, while describing what she experienced in New York, the reporter adds "a terminal experience. Human beings are not fit to survive in these temperatures." Also, the accounts of the participants who "saw the future" indicate that humans are unprepared to being exposed to air pollution, as they described respiratory and skin allergies during a stay abroad.

The figures corroborate the suspicion: among the 30% that have already been in contact with environments where pollution is strongly felt, 65% admit that during the experience they thought about the potential impact it could have on their health and 59% project the memory of what they experienced when they think about what the future of Portugal can be if the negative impacts on the environment are not halted.

Although these experiences are very diverse – in the survey, different countries and continents are mentioned, and situations do not always apply to Portugal – they reinforce the imagery of a dystopian, if not apocalyptic, future, and aware us about the difficult habitability in a world that has not been able to contain the effects of human action over the environment.



In Direct Discourse

"I lived in Macau, and I felt like I was living the future of Europe. I had to consult an app to check the air quality before leaving the house, we couldn't put our clothes outside, they'd become grey... This is talking about air pollution. The typhoons' frequency and levels are much higher than they were before. There, I felt like I was living in the future of Europe. It made me think of Blade Runner; of a world full of smog, deserted (...). Things I felt back in China made me thought about the future here in Portugal: skin diseases, hair loss, everything that is most exposed, becomes fragile."

W, 34, Cultural Producer, Lisbon

"I visited Beijing at a time when there was a pollution Code Red alert. (...). It was before Covid, yet everyone was wearing "turbo-masks", almost diving masks. We saw them everywhere and we didn't really understand why. Then we realised (...) We suffered some consequences from it, such as allergies. It was not so much respiratory allergies, but skin. We had skin reactions, because we could really feel the heavy air. This is psychological, probably, but it felt like things were falling on us, tiny particles. And we had skin reactions."

W, 46, Financial Assistant, Odivelas

"I travelled to India for 15 days. And there the pollution is very evident. There's always that smog in the air, and very thick."

I came back completely... clogged up, with a huge allergy, like I'd never had before! It took almost two months to pass."

W, 39, Landscape Architect, Lisbon

3.3 Populations on the front line

Certain groups that seem to be particularly sensitive to climate issues are in the front line in terms of how they perceive climate change impacts on health. Taking into account these groups, if we increase the general knowledge among the population, what could be the expected change in behaviours?

6%

Nature-related professions

These individuals tend to be more aware of environmental problems: 35% report “I am very aware of this topic and my daily life decisions are very influenced by this concern” (vs. 17% of the sample). At the root of their concern is, more than health, great economic vulnerability. In fact, this group doesn’t show a greater perception of how climate change may impact health, although they are particularly exposed to risks: 22% (vs. 10% of the sample) report that they often experience anxiety related to environmental problems, not in anticipation of what might happen in the future (as most who experience it, do), but because of what they already see that is happening around them, or as a reaction to a traumatic experience they experienced. They are in the front line because of their environmental stress.

35%

Of those who have nature-related professions (e.g. agriculture, forestry, viticulture) state that they are very aware of environmental problems and that their daily life decisions are very influenced by this concern

(N=46)

17% of the overall sample

9%

Residents in rural areas

These individuals are among those who most report being “very concerned” about climate change (65% vs. 52% of the sample). Proximity to nature (and the frequent connection to horticulture and fruit-growing) leads to a great apprehension about hydraulic problems: drought, water scarcity or pollution. In conversations with people living close to the countryside, the risks associated with food were mentioned frequently, anticipating (much more than in other groups) loss of variety and quality in the food industry and scarcity of essential products, and consequent price rises. Among those who learned to follow plant cycles, there is no ease in how heat or drought is experienced; the risk is very clear to them.

52%

Of the respondents living in rural areas report that they are very concerned about the effect that bad quality of food can have on health

(N=69)

41% of the overall sample

9%

Parents of child(s) with health problems that they associate with environment

They are among those who report being most concerned about the different effects climate change can have on health (through heat, air and water pollution and even vector-borne diseases). For these parents, the implications are evident. 73% say that they have already felt that climate change is harmful to their or their close ones’ health (vs. 51% of the sample). While discussing the topic, these parents made associations between health and climate change by identifying problems that they consider now to be generalised among children - allergies, bronchiolitis, eczema, or atopic dermatitis - especially for those born and raised in large cities. More than for their own health, they are driven by the awareness of the environmental consequences for their children’s health.

86%

Of parents with children with health problems (that they associate with the environment) recognise that people are already experiencing health problems as a result of environmental issues.

(N=73)

64% of the overall sample

5%

Self-Conscious

They are people with a high level of awareness and concern about the state of the environment, and this concern guides their daily life decisions and actions (for example, adopting vegetarian diets). Interested and active in gathering information on climate change, they come to the topic of health through contents they access (often referring to international studies and articles). The link between climate change and health comes to them through knowledge. They also frequently suffer from climate anxiety. Concern for their health or the population’s health (they are macro-minded) adds to the arguments that drive them to action.

50%

Of the “Self-Conscious” group consider themselves informed about health problems that can result from climate change

(N=38)

24% of the overall sample

26% dos inquiridos encontra-se pelo menos num dos grupos aqui descritos, cuja selecção é feita em função de respostas a questões de caracterização avançadas em inquérito. Apenas para cálculo dos “Conscienalistas” são exigidos critérios sobre atitudes e comportamentos em relação ao ambiente.

As quotas para efeitos de representatividade da amostra do inquérito quantitativo não foram forçadas nem enviesadas para chegar a estes quatro perfis, pelo que se podem assumir representativos da população portuguesa entre os 18 e os 74 anos (com acesso à internet).

Nature-related professions
(e.g., agriculture, forestry, fishing, viticulture)

22%

Report that they often feel anxiety related to environmental problems

"We also have a cattle farm and we're very affected by drought, we have small vegetable gardens. (...) I live on a farm; we have ponds and wells. We don't have piped water. Not because there is no access, but because we always had water here. (...) I also produce chestnuts, and every year I have less and less because there's no water, no rain. Then we have the wheat crop. This year I don't know if it will be able to cut. It's so small...."

W, 49, Vilar Formoso

"I grew up in a village, now it's a small town. I lived with my grandparents, always working in agriculture. Later I studied... I came to Bragança (...). At the weekends, I work in agriculture. My parents invested in land, olive trees. We have someone who takes care of everything. But when it comes to the plantations, cleaning the olive trees, I want to be present, because I know what I want and how I want. (...) . The land is in chaos. (...) I wish it would rain, a lot of it! I haven't managed to grow potatoes or onions yet. We planted the onions, (...) the peas were blooming... but then it came this rain that was like sulphur. Later I went to check, and after that rain, everything was yellow."

W, 57, Bragança

Residents in rural areas
(urbanization level of the area where people live: "rural" or "not urbanized")

35%

Report that the water scarcity "is happening" or "has happened a few times in that area."

"We live near Lousã. We did not have much water scarcity, because the water table reached our area. This year I am worried because the water level in the wells is very low. And it's May. And it's not just that there's so little water, most of it very poor-quality. (...) I look at the plants and trees, and what I notice is that the lushest parts burn very easily. They can't be burnt by frost because there's less of it. It can only be because there are greater temperature amplitudes than in the past. (...) I used to have cherries, arbutus, and quinces..., I'm left with dry quince trees, I can't use any of the fruit. The cherries don't grow at all. It has been 3 or 4 years that I can't pick any of these fruits that are more fragile."

M, 59, Proença-a-Nova

"We produce for family consumption, we're very close to the river Zêzere, we had a lot of drought last year (...). Regarding agriculture, we have soils exhaustion, we have intensive production and many chemicals on the land. What we eat is what I get from the vegetable garden. Nothing is 100% guaranteed anymore."

W, 57, Bragança

Parents of child(s)
with health problems
(that they associate with environmental problems)

23%

Of parents with children under 20 years old have children with health problems that they associate with environmental problems

"The bigger the cities, the more pollution there is, and the more allergies and asthma there will be; and all the kids are going to be born with problems, with bronchiolitis, atopic skin, eczema... This is going to happen, and it will be worse and worse. I have two kids, who both have eczema and atopic skin. I've spent a fortune. They're both asthmatics, I'm as well... If I count the money I spend on asthma products, I could certainly go for a great holiday every year."

M, 48, Seixal

"I was going to mention atopic skin. My eldest daughter also suffers a lot, during Winter actually. But I don't remember anyone from our generation having atopic skin. Occasionally there was someone with skin problems... Nowadays, it seems like 30% of children have atopic skin, which is a large percentage. (...) I threw in that figure so that I'm not too dramatic. (...) [I relate it with pollution and unregulated pollens] because 30 years ago there wasn't this incidence. And one of the things that changed is air quality."

W, 39, Lisbon

Self-Conscious
(very concerned, aware of environmental problems and behaviours influenced by this concern)

58%

Imagine a high increase, from 3° to 4°C, when they imagine the average temperature evolution in Portugal in the future (e.g. in 20 years)

"Too much pollution in the air creates more respiratory problems. There was a study on pollution in Europe and one of the conclusions is that people are increasingly losing quality of life, becoming ill, or even dying from pollution, because the air is unhealthy. And this is affecting children more and more. Air pollution is making us sicker. This was what I concluded after reading the study, it was what came to my mind."

W, 45, Charneca da Caparica

"Atmospheric pollution is the fifth leading cause of death in the world today, more than road accidents, yes... it's brutal (...). There are already countries with very serious consequences in terms of poverty and at risk of poverty. (...) . And the lack of resources is not evident here because we import food from everywhere, but it is true that there is less production in our agriculture (...). The permafrost: this long, long-frozen soil, is melting rapidly and contains, besides very large reserve of methane, (...), viruses that are, hibernating, and that can come back."

W, 34, Lisbon

Indicators of concern and action

The initial intuition that proximity to environmental or health risks, rather than gender, age, or “administrative region”, might influence perceptions of how climate change can impact health became confirmed.

Not only because of the way people make the link between climate change and health, but also because of the willingness, reported by them, to take action. These groups demonstrate that the environment can also be an important argument for health enhancement.

	Total	Nature-related professions	Residents in rural areas	Parents of child(s) with health problems	Self-Conscious
	N=800	N=46	N=69	N=73	N=38
Think ahead about what the future of the country and the world can be (a lot)	41%	50%	46%	56%	47%
Very concerned about climate change	52%	50%	65%	64%	100%
Very informed about climate change	13%	17%	14%	19%	42%
Consider that quality of life is already being negatively affected	67%	65%	72%	81%	82%
Aware or very aware of environmental problems. Their daily life behaviours are influenced by this concern	58%	67%	59%	64%	100%
Consider that the Portuguese are already or will be exposed to health problems as a result of environmental risks	64%	61%	70%	86%	82%
Consider to be informed about health problems that can result from climate change	24%	33%	25%	40%	50%
Often feel anxiety related to environmental issues	10%	22%	13%	26%	26%
Very willing to take preventive actions regarding health (knowing the effects that CC can have on health)	23%	30%	33%	27%	42%

The Portuguese population is aware of the climate risks. Only 1% believes that climate change will not have an impact on their quality of life.

Most citizens are able to establish the relationship between environmental risks and health risks and some of those, who are more informed or closer to environmental risks, are able to identify many of the expected health problems.

However, recognising the risk does not necessarily mean understanding it in its full scope and complexity. There is a long way to go from perception to a deeper understanding of the problems, as introduced in this chapter.

Even those who are able to relate cause and effect are not necessarily willing to change their health-related attitudes and behaviours. And while it is true that personal exposure to adverse situations, as demonstrated here, tends to increase the perception of risk, it is also possible that repeated exposure to environmental risks without “visible” health consequences for them or their close ones, may desensitise some people to the threat.

Whatever the distance between what is identified and what is individually perceived as risk, the fact remains that the Portuguese people express concern about the various effects that climate change can have on health and, in response to this risk, they report being willing to take more preventive action regarding their health in the near future (23% are very willing). This willingness is not unrelated to the concern that everyone already has for their own health, proving that health paves the way for (more) sustainable choices – as the next chapter will show.

More importantly, the study shows that some Portuguese who, due to personal circumstances are more exposed to climate or health risks, are particularly aware of the impact climate change can have on our quality of life.

Whether it is because they have professional activities that depend on the climate, because they live in regions where the effects of climate change are becoming more visible, or because they have children with health problems that they associate to environment, or because they are highly conscious and informed about environmental issues, there is a significant part of the population (26%) for whom climate issues are more threatening or “visible” and, therefore, they tend to be more willing to take action and find solutions to reduce health risks – be it for their own health, their close ones’ or public’s health.

More than age, gender, or income, it is “the first-person problem” that seems to contribute most to awareness and concern about the effects of climate change, which means that education and culture are fundamental to understand different attitudes. That is also why it is crucial to go deeper and discuss, beyond the global threats, the concrete risks that the Portuguese people (in their different regions, ages, and health status) may be exposed to.



4.
Pro-health
lives
↕
Pro-environment
lives?

Health: environmental-action drive

A segmentation exercise is recovered from the first research of Saúdes' project that organises people according to their pro-health actions. From this, the intersection between concern/taking action for health and concern/taking action for environment becomes evident

In the study “The Health of the Portuguese: An ID” (2021) a segmentation exercise was developed, which organised individuals according to their actions to protect or enhance their own health. While preventive actions were considered, the willingness (and commitment) to enhance well-being (physical and psychological) was considered the main axis of this segmentation. This exercise resulted in seven segments that differentiate individuals according to the level of effort they make to be healthy or healthier. [See table on next page]

Rather than resizing the seven segments, the segmentation exercise was replicated here to understand how environmental concerns would override health concerns.

The first conclusion is that not only there is a strong correlation between pro-health actions and (reported) pro-environment actions, but it is also more likely that someone who has major health concerns, will also have major concerns about the environment than vice versa. In other words, concern for health is more likely to lead to concern for the environment than the other way around (although it also occurs).

Our research experience suggests that very often, individual health motivation is the driving force for adopting more sustainable options. It is undeniable that there is a trend among the Portuguese for adopting behaviours related to

weight, health, and well-being issues. It is also undeniable that there is increasing pressure to adopt more sustainable behaviours, particularly when it comes to lifestyle and food choices. We are, thus, witnessing a powerful combination: individuals who are increasingly aware of health-related issues, and willing to change their everyday behaviours, are being bombarded with discourses about the urgency of changing consumption patterns due to sustainability issues. This turns health into one of the first entry doors to (more) sustainable behaviours – such as eating organic food, adopting vegetarian-based diets, or paying more attention to the quality of water that is consumed.

Even if the initial motivation is not altruistic, there is a coincidence of positive outcomes – an overlap between “good for me” (health and well-being) and “good for all” (environmental impact reduction) - which reinforces arguments for certain choices and turns health into a driving force for more sustainable behaviours.

Despite this coincidence, the slow adoption of more sustainable (and even healthier) behaviours by the Portuguese population tells us that health can be a driving force but will hardly lead to profound lifestyle changes among the majority of the population.

What is the position of each segment regarding climate risk?

In terms of awareness about the health risks to which people may be exposed as a result of environmental risks, there are almost no differences between the segments, proving that the actions they take on health don't result from how they perceive these risks (except in an outlying group). Analysing other attitudes and behaviours requires an understanding of each of the identified segments.

Health hostage boosters: they are individuals mobilised by the fear of being sick. They take great accountability for their own health, translated not only into prevention behaviours, but also by searching out health related information. This explains why they stand out as the ones to most recognise that the Portuguese may be exposed to health problems as a result of environmental risks, and those who are more willing to act preventively on their health (by knowing these effects).

Health boosters for an ideal: Among this segment the desire for day-to-day well-being, as well as the ideal of an energetic body, improved performance, and desire for healthy ageing stand out. Although maintenance of health is a daily task, this group do not express obsessions with health issues. The more optimistic way of being can explain less awareness of climate change risk, even if the drive to better health has made them adopt sustainable behaviours.

Committed: They are health-oriented, but don't see it as a central goal - perhaps because age does not yet require it. They are the ones who most recognise that having a healthy lifestyle is something that defines them. Because of that

they tend to adopt more sustainable behaviours, but they are less willing to act preventively on their health due to climate risk.

Sort of engaged.: The engagement to be healthy is ‘sort of effort’; enough to manage daily well-being and to mitigate some fears. Health is not considered “their self-achievement.” They are, perhaps for that reason, those who report being the least willing to act more preventively on health because of climate change.

Equilibrists: They balance unhealthier behaviours with healthier ones, and it is difficult to determine if they are more health or aesthetic oriented (there are more women than men in this group). They don't differ much from the Committed when it comes to environmental behaviour, but they feel more a sense of guilt.

Distant: They report less well-being, they have higher incidence of diseases, and they tend to take less care of their health. Financial and professional life are more pressing, and they are the group with lower income. This lessens their climate concern.

Quitters: They are dissatisfied with life and report making very little efforts for being healthy or having a healthy lifestyle. When faced with their own malaise, they tend to give up. They are not mobilised for life and well-being in general, and climate threat will not be a factor of mobilisation either.

The health one aims: 7 DIFFERENT POPULATION SEGMENTS

QUITTERS disconnected from the body	DISTANT lack of willpower	EQUILIBRISTS in sums and subtractions
8%	10%	21%
Unstructured lives and bodies	High emotional lack of control and lack of willpower is the common denominator of this group	The on-going balance management in a lifetime of sums and subtractions.
They are not conditioned by illness, age or income, but are extremely disconnected from the body, and from physical and psychological well-being. Satisfaction with life is extremely low. Considering the influence of the different dimensions of life for health, they penalise their work, sleep, love, sexual and spiritual life. A more 'male' way of being	With very low or very inconsistent health care effort. Here we find people who are more penalised by financial and professional difficulties or by the disease. In general, they recognise the distance to the desirable effort, but they believe that making it possible is "distant".	'Healthy life' does not define them. It is a group where men and women reveal different sides of this balancing act. Women take more preventive actions, in greater mental effort and guilt; men are more disconnected or pacified with their inaction.

PRO-HEALTH LIVES

SORT OF ENGAGED well-being driven	COMMITTED pro-health lives	BOOSTERS for an ideal	BOOSTERS health hostages (and fear and disease hostages)
15%	36%	5%	5%
A healthy lifestyle is 'something that defines them as a person' but they don't make a consistent effort in that direction	High conviction that 'a healthy lifestyle is something that defines them as a person', and they act accordingly	The purest intention to enhance health, energy, productivity, and happiness [Health and happiness go hand in hand]	Health and well-being are central goals of their lives, but mobilization is highly contaminated by fears
They place their action more in the field of intentions, without concrete targets. Being 'healthy by nature' or young will be partly at the origin of a level of effort that is necessary to manage well-being in everyday life.	The commitment is undisputed, both regarding physical exercise and diet, with evident intentionality: not only to "feel good everyday" but also to improve physical performance, intellectual and ageing with quality.	Despite this desire (or ideal) for better health seems to be unlimited, they are the ones who consider themselves closest to their maximum threshold. They are a large group who accept their situation, not least because of the high percentage of people aged 65+. Prevention is taken for granted.	They show concern and are extremely cautious, anticipating in terms of prevention the established protocols; they show signs of a high self-monitoring effort. They are the most knowledgeable, which may explain why they are the ones who don't request help when necessary. High % of people aged 65+.

Note: The definition of the 7 segments resulted from a process of comparative analysis of similarities that crosses key variables for health enhancement (i.e., proactive effort in daily life to be healthy or healthier) and preventive behaviours adopted.

For more information, see the study "The health of the Portuguese: An ID", from 2021, in www.saudes.pt

What is the position of the different health-related segments in relation to climate risk?





5. Looking at the main health risks

From the perspective of environmental risks

How do the Portuguese view climate-change-related health risks to which they are or may be exposed in the future?

8 KEY IDEAS

1. Reported concern

There is a consistent percentage of individuals who report that they are very concerned about each of the environmental risks - close to 40% for high temperatures, air pollution and water pollution and 30% for vector-borne diseases. Adding the second level of response - 'extremely concerned' - the vast majority of the population relates to it.

It can be argued that by following a script that presents climate change-related problems, respondents become closer to a reality they don't normally think about, and links and concerns with clinical conditions that normally don't move them are induced.

However, it is worth clarifying that the respondents were always given the option to report low levels of concern because they did not feel personally exposed to such risks (and the anonymity of the survey generally discourages the temptation to be politically correct). We believe that the low response rates to this option is revealing of how seriously the Portuguese view the problem of climate change nowadays.

2. Concern (still) lacking knowledge about the scale of the consequences

Despite expressing concern, the Portuguese are far from realising the scale of each of the climate risk' consequences. This was evident in the discussions; we believe that much of the lack of knowledge was silenced because there were participants unusually well-informed in the various groups.

"I would say leg fatigue, because those who suffer from poor circulation suffer more [from the heat] in summer. But cardiovascular problems, heart attacks... I had no idea." "I see diabetes, Alzheimer's, dementia, liver damage ... I didn't associate them [with air pollution]." These are examples of phrases said during the discussions about health risks. The difficulty of being specific, such as how 'dust' is related to health ends up being general" or even the explicit recognition of doubt in phrases like "I'm not sure what I'm saying, but...", are also signs of lack of knowledge.

Even though respondents were only asked to associate a health risk with a climate issue they already knew about, when we present them with a list of risks, it is difficult to know exactly what they knew before and what they inferred after reading that list.

3. But... concern is not a prerequisite for action

No matter how close the environmental risk gets, the idea of health consequences is still not enough to prompt action. Not least because the lack of knowledge is not just about the health risk; for many it's unclear what preventive action can be taken.

On the other hand, in a general context of many other concerns at the micro level - paying the monthly bills, doubts about pensions, health issues that are much more present - health (or environmental) concerns are easily sidelined.

4. Action depends on (actually) experiencing risk exposure

The concern is great, but we can infer that in most cases it is directed towards the future. As shown in the previous chapter, the majority do not report that exposure to heat or even air pollution is already affecting the quality of life of the Portuguese (although excess mortality and premature mortality related to air pollution are a reality in Portugal).

At the individual level, the risk to health is not yet really sensed, which is why there is little or no willingness to prevent it, and if it exists is directed towards the future. Furthermore, most Portuguese (59%) admit that they don't think much about the future of the country and the world, and when they do, 65% project it into the near future (up to 5 years or less).

5. What degree of action do we aim? Question difficult to answer

Reduced action is in many cases the only degree of action possible. And the degree of action possible for health is not always in line with what is environmentally friendly (e.g. air conditioning).

Furthermore, the degree of action needed can only be assessed and interpreted after each risk occurs. For example, in regard to extreme heat (and even cold), one of the biggest problems is the poor quality of buildings. Even if the awareness of the risk is improved, the action required is not within reach for the majority of the population.

Regarding mosquito vectors, action depends on travellers' awareness that if they return infected, they may cause a disease outbreak. In this case, information is required for action.

Regarding air pollution, not only does the perception of risk vary greatly from one area or region to another but there is also little awareness of how harmful it can be to health. In this case, action fails because it becomes difficult to understand both the risk and the solutions. The lack of water (which is a local problem), on the other hand, no matter how aware you are of the risk to health, is not something that one can easily act upon.

In fact, in many cases, the solution will not be within individuals' reach. It is therefore advisable to calibrate the level of information and action to be taken in response to each risk, as excessive alarm without guidance (or options), nor without visible efforts by the authorities can have consequences for mental health that need to be minimised.

6. The lack of 'formal' sources of information

Information is an obvious way forward, but for the Portuguese people it has been quite lacking: 58% consider that there should be more alarm in the way environmental issues are communicated (only 11% report that this communication is too pessimistic).

Moreover, people have not been receiving this information from doctors, health professionals or formal health entities. Even if some formal entities are taking local and targeted action (e.g., providing information to senior homes or to carers about the risk of extreme heat), it is clear that for the majority, the sources of information are dispersed or, alternatively, the information comes to them empirically – the crops that don't grow, the pollution seen from the window, parents with unregulated blood pressure due to extreme heat, asthma or allergies that become worst.

For those very well-informed, the information comes to them because they are interested and search for studies on the topic (which cannot be expected from the general population).

7. An implicit sense of protection in our health services

Especially when it comes to vector borne diseases, there is a common idea that third-world countries are more exposed. That we will have vaccines. That the authorities will get the problem properly under control.

This idea of "first world" health services (especially when it comes to vaccines) provides a sense of safety and protection.

8. Evidence of a broad spectrum of action (ongoing)

This document brings together around 50 initiatives that demonstrate the efforts being made in different areas and sectors of activity (almost 20 initiatives within urban planning, food retail, furniture, textiles, and puericulture) and in different places in the world (particularly in Europe and the US) to mitigate the impact of various climate risks on health.

The list is illustrative, not exhaustive, of the efforts being made by public and private organisations, large and small, and also by civil society, which have carried out studies, projects, works, services or even concrete products that show room for a more pro-active approach regarding health, in the short or medium term.

Many will depend on whether people adopt them or not, which underlines the importance of being aware of the risks to which they may be exposed.

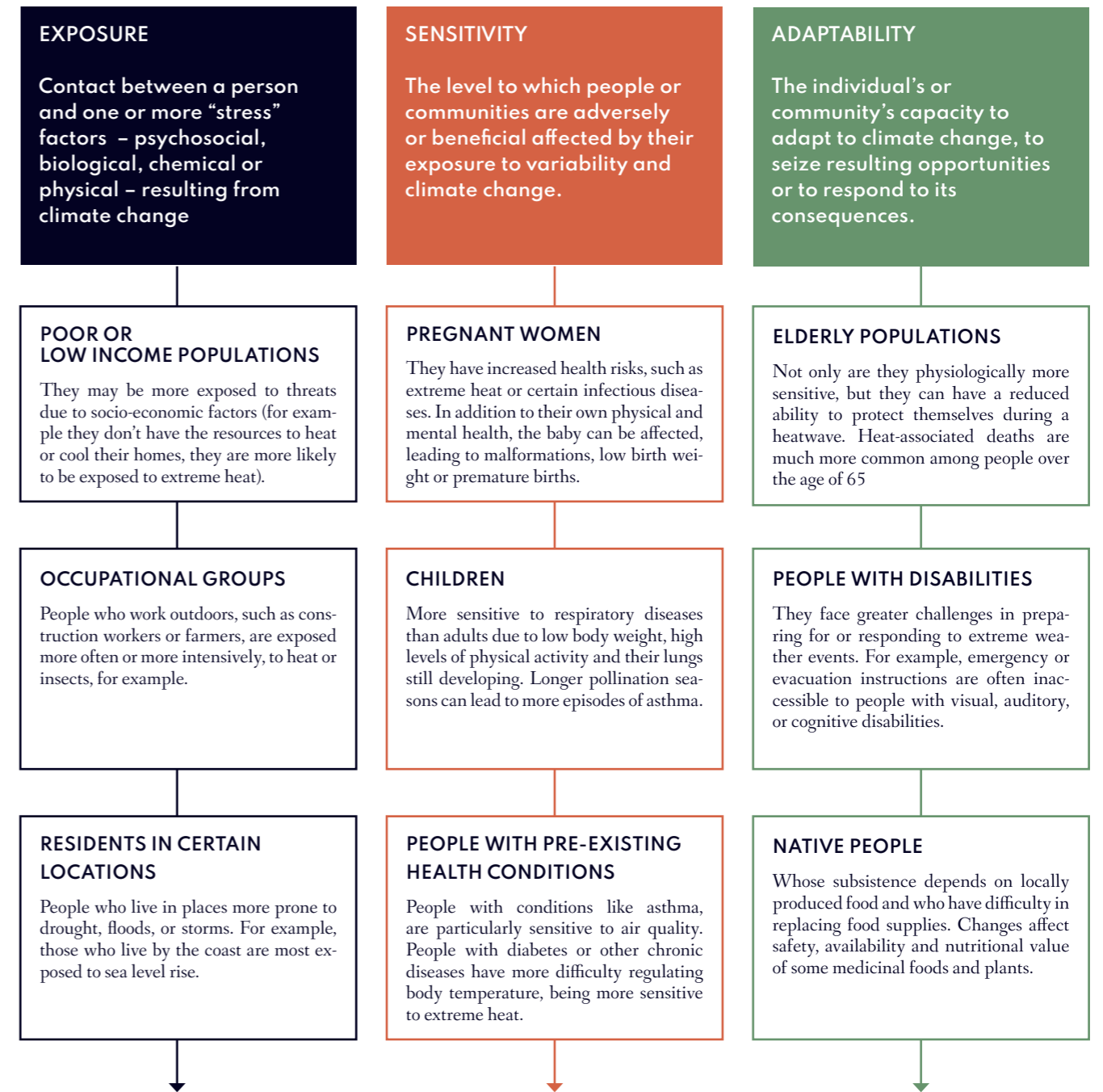
To each, their own risk level

Among the various environmental risks to which the Portuguese are or may be exposed in the future due to the effect of climate change, we selected five issues that experts consider more likely to become harmful in a scenario of significant average temperature increase (for the planet and, in particular, for our country): extreme temperatures or heatwaves, air pollution, water pollution, vector-borne diseases (insects) and mental health (in this case not explored under the perspective of climate risks, but for their possible psychological and emotional consequences). This chapter focuses on these themes, and on the public or individual health warnings that each one addresses.

The way each of these risks affects the population differs not only from the location or region of the country where people live or circulate but, above all, from individual characteristics – socio-economic, age, life cycle, health status, and even genetics.

These characteristics define different levels of exposure, sensitivity, and ability to adapt to climate risks and, therefore, different levels of vulnerability to threats to health resulting from climate change. If it is true that each person has a certain potential for health and well-being, it is also evidenced that each person will have their own level of climate risk.

This reading lens is particularly important in a country that is fast moving toward population ageing, as people over 75 years old are, by default, a greater “climate risk group.”



Health Vulnerability to Climate Change

Illustrative, not exhaustive

Source: USGCRP, 2016: The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment.

The risk of heatwaves

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[See full text, Part II, p. 158]

Of the many climate change threats to health, exposure to high temperatures has been the deadliest, and it is very likely that there will be an increase in the frequency, intensity, and duration of heatwaves in most land areas. According to a report published in 2023¹, Europe is the continent in which the thermometer has been rising fastest in recent decades, recording heatwaves not only more frequent and intense, but covering a greater area (in 2022, London reached 40°C for the first time and it is expected that this will happen again in the next decade).

[What is a heatwave?]

There are different ways to determine a heatwave. According to the World Meteorological Organisation, heatwaves are periods of at least six consecutive days during which the air temperature is at least 5 °C above normal for the season in each region, and may occur in any season of the year.

[What is the impact on health?]

Heatwaves are associated with increases in the number of deaths and number of people with health problems. In Europe, the highest number of deaths are related to extreme climate events.

Their impact on health is greater when they occur in the summer months and when they are accompanied by high levels of humidity, air pollution and high night-time temperatures. On hot, sunny days, high concentrations of ground-level ozone tend to occur, which can cause eye, nose and throat irritation, headaches, chest pain and breathing dif-

ficulties. In addition, particles emitted by air conditioners have an impact on air quality. High night-time temperatures over a long period of time are also a threat to human health because the body cannot recover from continuous heat and that can lead to an increase in heart attacks and deaths.

In addition to the different effects on health, heatwaves affect the functioning of society, the economy, and the environment. Agricultural and livestock production tend to be directly affected, which can lead to disruptions in food supply, as well as decline in labour productivity and increased risk of occupational accidents. There is also an increased risk of disruptions to the electricity grid due to overloading caused by the increased use of air conditioning. Heatwaves can also worsen droughts (droughts and heat waves have inter-related effects) and increase the risk of forest fires.

[What can we anticipate for the future?]

The sixth report of the Intergovernmental Panel on Climate Change identifies as one of the key risks affecting Europe the increase in mortality and morbidity (as well as disruption in ecosystems) due to heat, considering that the number of deaths and people in temperature stress should double or triple. These risks are expected to hit southern and western Europe the hardest, especially in urban areas. In summer, the number of hours of thermal comfort is expected to decrease significantly and could fall by 75% in southern Europe

In mainland Portugal, both the frequency of heatwaves and the number of heatwave days have increased since 1990, according to records kept since 1941 by IPMA. The highest number of heatwave days were recorded in 2022, followed by 2003 and 2006. The most affected regions were the interior north and centre and the Alentejo (Bragança, Vila Real, Viseu, Guarda, Setúbal, Évora and Beja districts).

30%

Percentage of the world population that has already been exposed to temperatures that can increase mortality.

The percentage may increase to 74% in 2100 if greenhouse gas emissions increase.

2022

The hottest year

According to IPMA records, in mainland Portugal, the Summer of 2022 had the highest number of heatwave days since records began.

2200

Estimated number of excess deaths in 2022, as a result of heatwaves in Portugal [Nature Medicine]. According to the same source, there were 61,000 similar deaths across Europe,

¹ Report "European Climate State 2022" of the Copernicus Climate Change Monitoring Service

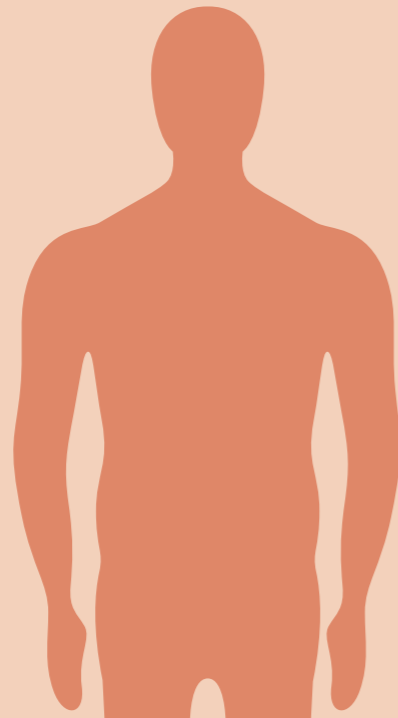
Consequences of high temperatures on the human body

Overload of the cardiovascular system

when the body is exposed to high temperatures, the heart needs to work harder to regulate body temperature. This can overload the cardiovascular system.

Dehydration by perspiration

Excessive sweating, without water replacement, can cause dehydration. When the body is dehydrated it cannot regulate its temperature effectively, leading to “heat stress” and other heat-related diseases.



Impact on some organs

The flowing of blood to the epidermal region for cooling the body can impact the functioning of noble organs, such as the heart, the brain and the kidneys

Cellular damage by heat absorption from the environment

The body can absorb heat from the environment. When the body temperature rises a lot, it can cause cellular damage, leading to various health problems.

The temperature of the human body results from a balance between heat production and loss, with a range of temperatures in which it can function optimally. At high temperatures, the body goes into thermoregulation mode: the heart starts working harder to distribute the blood flow and ensure that it reaches the organs with a lower temperature, and the peripheral areas of the body with a higher temperature, releasing heat through perspiration.

Although heat can directly cause death - the temperature control mechanisms stop working and, without a stable internal temperature, the body goes into shock - most deaths result from the aggravation of pre-existing problems or

illnesses, such as cardiovascular, respiratory or diabetes diseases, which are worsened by the body's efforts to thermoregulate. This explains the vulnerability (and excess mortality) of people over the age of 75.

In addition to the elderly, the effects of the heat can disproportionately affect professionals who work outdoors or do manual labour, babies and children, pregnant and breast-feeding women, as well as people with chronic illnesses, living in urban areas, people in energy poverty, and populations with less ability to protect themselves or adapt (the bedridden, homeless, alcoholics, drug addicts, etc).

Diseases and health problems associated with extreme temperatures / heatwaves

Direct

Heat exhaustion

Heat can cause symptoms such as headache, dizziness, nausea, vomiting, confusion, and even seizures. Heat stroke, which can come on suddenly, can be fatal.

Dehydration

High temperatures can cause the body to lose fluids through perspiration, leading to dehydration. Severe dehydration can cause fatigue, weakness, and fainting.

Cramps

The lack of water in the tissues, as well as changes in the balance of ions (sodium and potassium), can lead to cramps; these are signs of severe dehydration.

Cardiovascular problems

High temperatures can lead to dehydration fainting, increased risk of heart attacks, aggravation of pre-existing heart failure, among other cardiovascular diseases.

Skin problems

Exposure to sunlight and heat can cause skin problems such as sunburn, rashes, and blisters.

Aggravation of diseases

Pre-existing kidney diseases and respiratory problems (e.g. asthma and chronic obstructive pulmonary disease) can be inflamed, hindering breathing.

Indirect

Increased risk of food-borne diseases

Aggravated by the rapid degradation of food in hot weather and toxins in shellfish and seafood.

Problems caused by fires

Burns, respiratory problems and other diseases caused by exposure to smoke during forest fires.

Problems caused by accidents at work

Burns and injuries caused by contact with hot surfaces or errors caused by exposure to heat.

Negative effects on mental and emotional health

Extreme temperatures can lead to an increase in violent behaviours, crimes, and aggravation of psychiatric illness, as well as an increase in suicide (especially among people with pre-existing mental illnesses).

Note: see more details and sources in Part II, "The impact of heatwaves and extreme temperatures on health"

Heatwaves

How do the Portuguese feel?

During the week in which the focus groups took place (in April) the country was in the grip of a “unprecedented” heatwave, breaking temperature records for that time of the year in certain locations of the country, such as Mora. The month of July 2023, when the survey was conducted, was particularly hot, with the hottest day ever in the world since records began, according to the Copernicus European service.

The preamble is necessary to frame the respondents’ attitudes regarding heatwaves’ effects on health and to explain why 37% reports being very concerned with the effects of extreme heat on health. Many were experiencing them in real time, and they would identify symptoms just from observing themselves or their close ones. “Feeling tired”, “heavy legs”, “sun allergies”, “It seems like we get sort of sick,” are examples of various comments by the participants. Some, who are more informed or work in the social area, even mentioned that the elderly would be very vulnerable to these type of events (because of the news and the awareness activities at nursing homes and day centres).
 ncialização que se vão fazendo por lares e centros de dia).

While it is true that heatwaves, because of their current frequency and intensity, are one of the easily identified risks for the health of the Portuguese, it is also true that the understanding people have on the concrete risks, when they exist, tends to be superficial.

Despite the efforts that have been made in providing information, particularly through television and newspapers, the study shows that the relationship between excessive heat and its effects on health are not fully understood by the majority of Portuguese people.

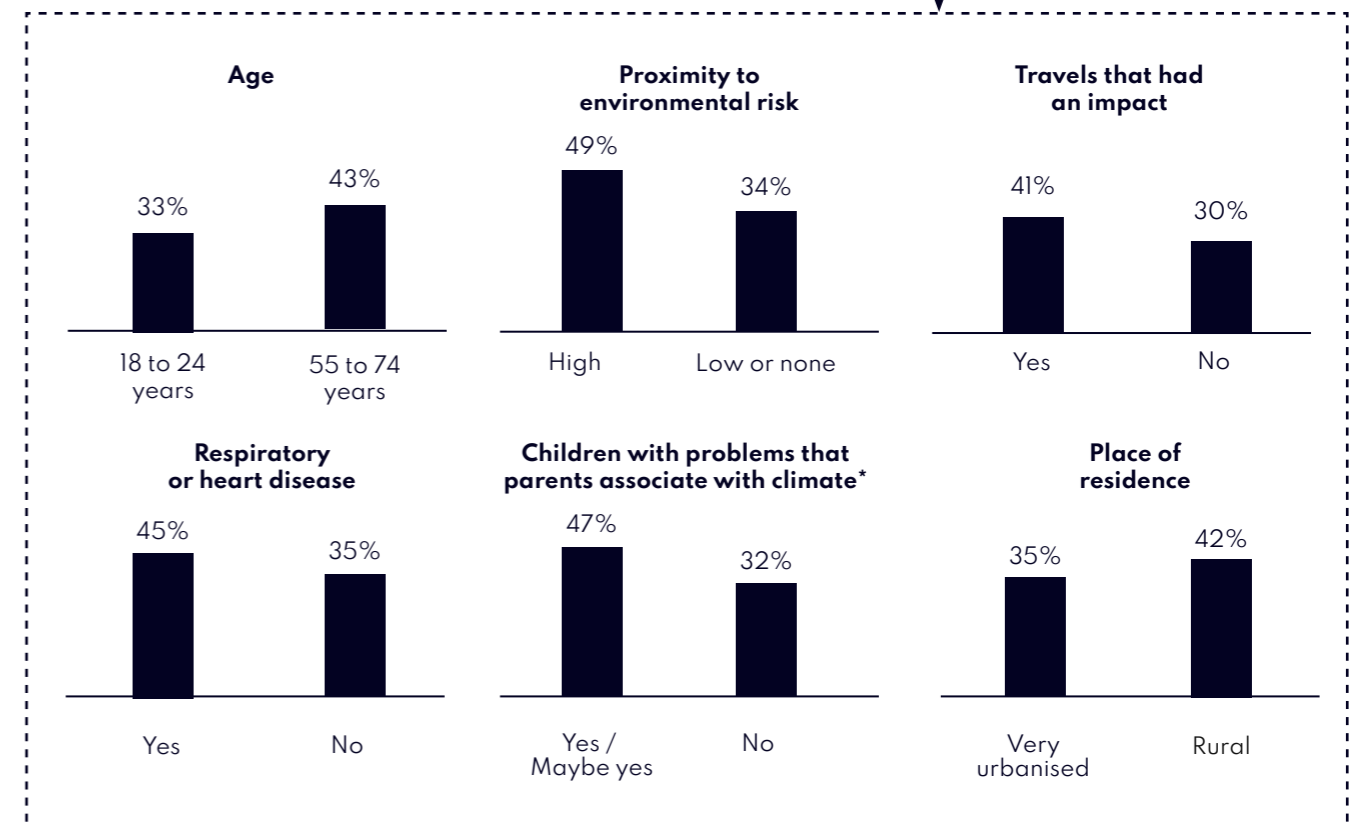
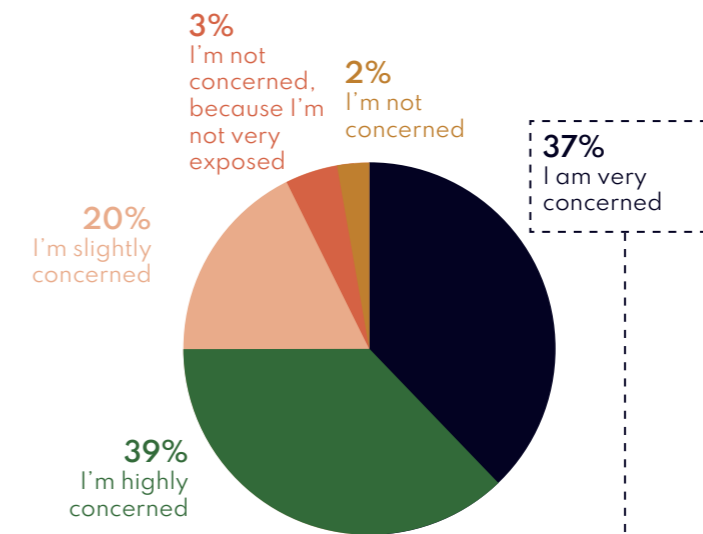
Faced with the list of health problems that can be caused by exposure to high temperatures, several admitted to knowing only a few, - the most obvious - such as dehydration, sunburn or heatstroke. People with respiratory problems or who have close ones with these problems can also identify this as one of the negative effects.

Knowing that heat can lead to dehydration or heatstroke is different from knowing that it can have cardiovascular consequences that can ultimately cause death, and that is necessary to drink water even when one is not thirsty. Even more when it comes to knowing that dehydration is common among older people, because they have reduced sense of thirst, and that they are more likely to have chronic diseases and take drugs that hinder or prevent sweating.

What is also concluded is that, although the majority (71%) of respondents admit they have already thought of taking actions to adapt to living in a country with higher temperatures, for example, making home changes or improvements (26%) or even considering changing regions (7%), there is a good part that admits that they don’t have economic resources for this adaptation (28%) and another (23%) for whom the solution will be to install air conditioning at home – which, in general, benefits neither health nor the environment.

Very high temperatures/ heatwaves?

How concerned are you about the effect they may have on health?
 N=800



* Respondents who have children up to 20 years of age
 See criteria detail on page 224 of the Annexes

In Direct Discourse

“[Consequences of the heat] I had no idea about cramps. Or even cardiovascular problems. I would say heavy legs, because those who suffer from poor blood circulation suffer more in summer (...). but of cardiovascular problems, heart attacks...I had no idea.”

W, 49, Seamstress, Vilar Formoso

“The number of low-degree sunburns increased. It is statistically demonstrated (...) one day it’s 12°, 14° and we go out in a jacket, the next day in a t-shirt, it’s really easy, being as white as we are, to get a little sunburned.”

M, 46, Commercial Director, Maia

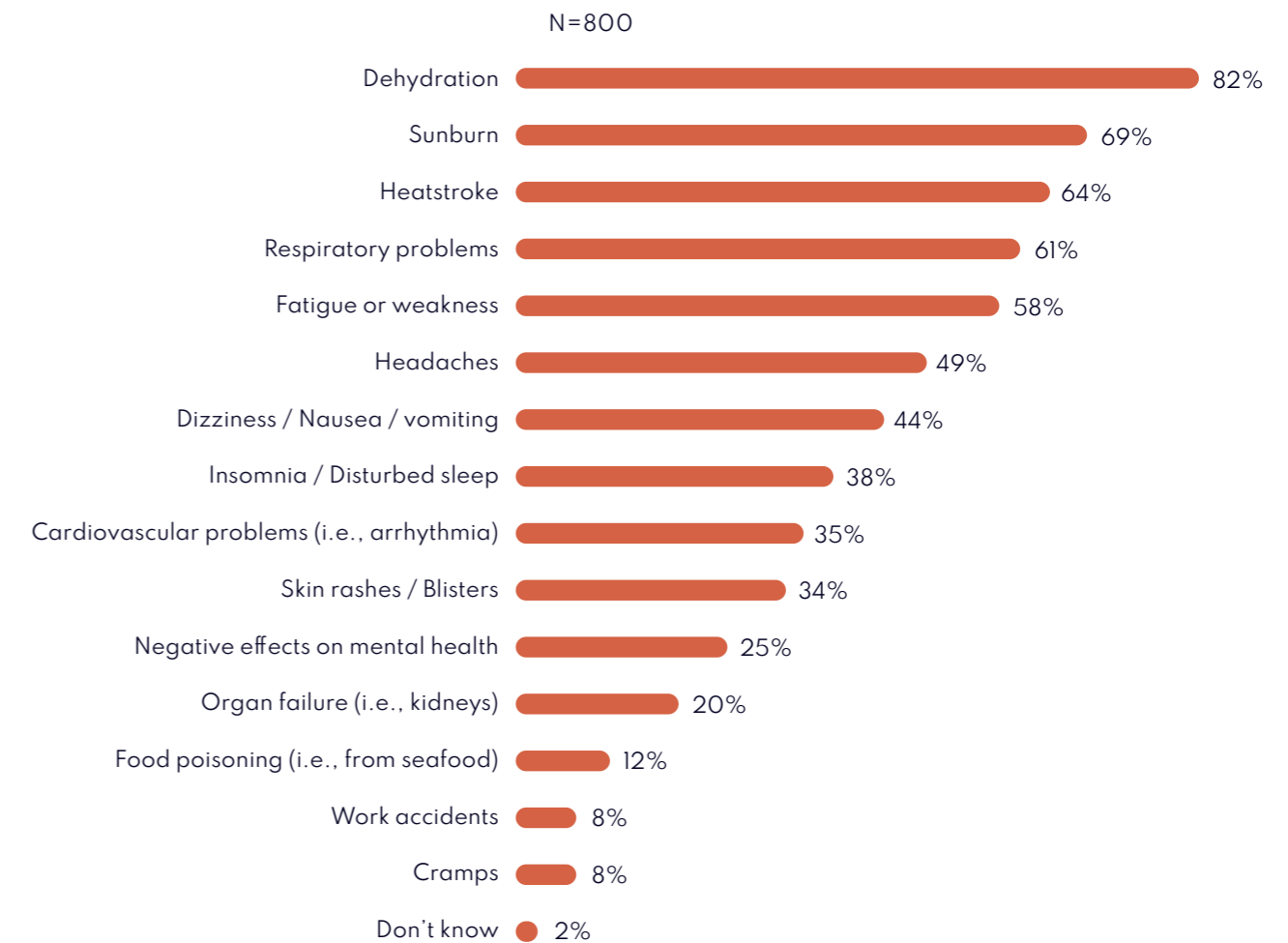
“As an asthmatic, I suffer from this. There are certain times when I even need to reinforce my medication which affects my quality of life. In my case, I haven’t had an asthma attack where I had to go to the hospital, as I have had at other times, but I have to take more medication to be functional. Otherwise, even taking a step is difficult.”

W, 44, Bio researcher, Porto

“I’ve been working with the elderly for 20 years, the fainting, cramps, dehydration – all of this leads to strokes or cardiovascular problems (...) my father is the same; he has a heart condition, he feels very bad in the heat. And in my patients, it’s very evident. Among older people there is normally a big rise in deaths during summer (...) we lose capacity, the body reacts – it’s much more difficult to function in extreme heat.”

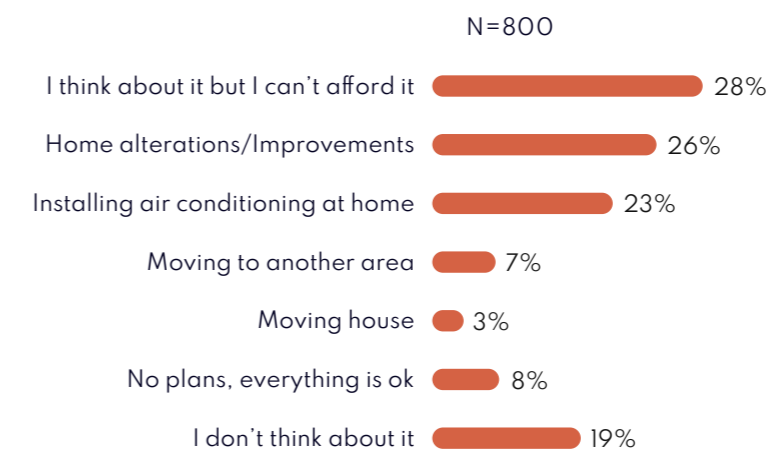
W, 45, Social worker, Charneca da Caparica

Health problems that you associate with heatwaves



Q. Below there's a list of health problems that can result from extreme heatwaves. From these, which ones did you know in advance, before seeing the list, that were caused by heatwaves?

Do you plan to take any measures to prepare yourself to live in a country with higher temperatures?



Q. Have you taken or are you planning to take any measures to prepare for living in a country with higher temperatures? [2% I don't plan to do anything, I believe the rise in temperature will be slight or won't impact me much; 1% Change profession - 4% among professions linked to nature]

Heatwaves

Examples that show the way



Madrid City Hall
Madrid is constructing a 'Wind Garden' to cool the city

In coming years, a new park will be built in Madrid on an artificial platform that will cover Chamartín train station. The “new lung” of the city will be built in Parque Central de Madrid Nuevo Norte whose central point will be a large “wind garden”.

This space, covered by trees and other plant life, will channel the breeze into the structure, creating a micro-climate that will help reduce temperatures.

The park will also have rain gardens, pollinator beds, urban gardens and a vast prairie, that will allow visitors to connect with nature.

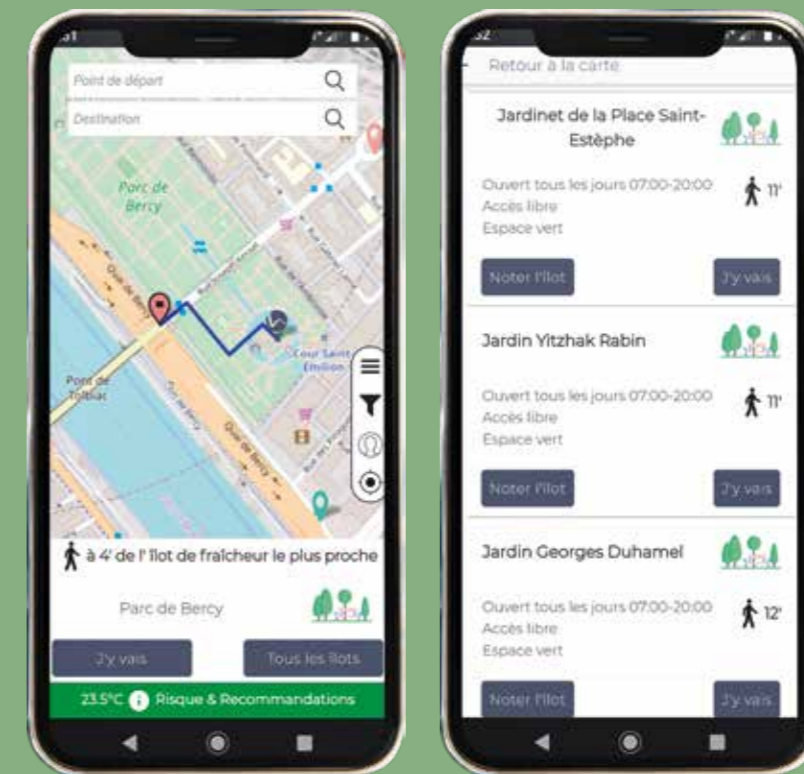
The project will be part of a large system of green areas in Madrid consisting of the Metropolitan Forest, the Arco Verde and a web of New North Madrid parks, designed for a better ecological transition.

Adrienne ARSHT-Rockefeller Foundation Resilience Center (Arsht-Rock)

Pilot project in Seville categorizes heatwaves

Launched in partnership with the Adrienne ARSHT-Rockefeller Foundation Resilience Centre (Arsht-Rock), the proMETEO Sevilla pilot project is the first meteorological alert system that links weather events with potential impacts on human health.

Using an algorithm, it is possible to predict heatwaves 5 days in advance and classify them according to their severity for public health. Heatwaves are categorised from 1 to 3 (category 3 being the most severe) and named in descending order of the Spanish alphabet.



Extrema
An app that identifies cooler routes in various European cities

Extrema is an application created by the Directorate-General for European Civil Protection and Humanitarian Aid Operations to facilitate the identification of “islands” and cooling routes. Available in Paris, Milan, Athens and Rotterdam, the app allows you to i) identify and geolocate green spaces, bathing areas, museums, libraries, churches, etc. in real time, for protection in the event of extreme heat;

ii) to receive alerts and recommendations in the event of extreme heat, and iii) create several profiles - a feature that could be useful for monitoring the more vulnerable, such as children or the elderly, as it checks the temperature where they are and issues alerts in the event of an elevated health risk.

Heatwaves

Examples that show the way

Chief Heat Officer

New public post to mitigate the effects of heat in cities

Aware that it is possible to mitigate the effects of high temperatures and prevent premature deaths, the Adrienne Arsht-Rockefeller Foundation Resilience Centre (Arsht-Rock)*, in partnership with a number of public and private organisations, has created the position of Chief Heat Officer (CHOs).

Eight cities located around the world recently appointed leaders to protect their citizens from the impacts of extreme heat. Among the criteria for choosing the cities were, of course, exposure to heat, but also good examples of climate leadership. Miami was the first to be appointed, in June 2021, and Dhaka the most recent, in May 2023.

The position of Chief Heat Officer also has the distinction of being entirely female. According to Arsht Rock, this is a strategic decision, since 80 % of people displaced by climate change are women; a large proportion are manual workers and perform tasks in closed and/or unventilated environments.

To mitigate the effects of high temperatures in the cities where they operate, CHOs are promoting the installation of floors and roofs with cooling properties, planning cooling routes and planting trees to create shade. These measures can reduce temperatures by between 6 and 7 degrees Celsius.

Part of CHO's work also involves raising awareness and lobbying public and political bodies. One success story is in Los Angeles. Marta Segura, LA's Chief Heat Officer, recently managed to pass a bill to name, classify and categorise heatwaves - as is already the case with hurricanes. The categorisation, she states, will be linked to the impact of extreme heat on health.

*The Adrienne Arsht-Rockefeller Foundation Resilience Centre (Arsht-Rock) is a non-profit organisation created to build individual and community resilience in the face of climate change. It is committed to providing one billion people with resilience solutions against climate change by 2030.



Photo by Lexey Swall for Fast Company

Pictured are the seven Chief Heat Officers working to make their cities more resilient to extreme heat: Krista Milne from Melbourne, Australia, Surella Segú from Monterrey, México, Eugenia Kargb from Freetown, Sierra Leone, Jane Gilbert from Miami, Florida, Marta Segura of Los Angeles, California, Cristina Huidobro from Santiago, Chile, Eleni Myrivili of Athens, Greece and Kathy Baughman McLeod, Head of all Chief Heat Officers. In 2023, Atiqul Islam de Dhaka, Bangladesh also joined the list.

Heatwaves

Examples that show the way



Heimat Berlin x German Cancer Aid

Warning system for the risks of sun exposure

The creative agency Heimat Berlin has created, in partnership with German Cancer Aid (Deutsche Krebshilfe), a flag and a microsite that alerts bathers in real time to the risks of sun exposure. The new alert system, called 'Watch Out at the Beach', warns bathers of the intensity of ultraviolet rays. Whenever the flag is raised, bathers are invited to consult the corresponding UV-Index graph, located at the base of the mast. By scanning a QR code, they can access a website with more information. The campaign was created to show companies and governments how to design creative responses to the climate crisis.

A study by Roche Posay, in partnership with IPSOS, published in 2022 at the 31st European Academy of Dermatology and Venereology Congress, found that 8 out of 10 Europeans think that tanning is associated with beauty and attractiveness, and 73% consider tanning to be healthy. Similar figures were found among non-Europeans. 44% of those interviewed also believe that sun protection is only necessary on very hot days.



'Wearable' cooling devices

Innovation grows in the area of thermoregulation and refrigeration technology

Several companies are stepping up innovation to design clothing that can better withstand extreme heat. Farmers, construction workers, delivery drivers and kitchen staff are all professions where heat stress is a health risk, causing disorientation, dehydration and even death. There is also a financial cost: high temperatures hinder productivity. A Lancet study, referred to in a report by Wunderman Thompson, indicates that 295 billion working hours will have been lost due to heat exposure by 2020. Cooling technology is therefore being introduced into workwear by different companies.



Qore Performance in the US supplies cooling waistcoats to companies such as Boeing, FedEx and the US Air Force. TechNiche, in the UK, develops "cooling clothes" for workers and plans to introduce biometric sensors that can inform about the need for medical care. Eztia, a start-up owned by MIT engineer, Tiffany Yeh, is developing low-cost "wearable" devices (Arctic Patch) for on-the-go cooling. In theory, these devices adhere to the skin, absorb body heat and never need a fridge, and since they can be reused by immersion in water, the additional energy burden on the planet is also minimised.

The risk of air pollution

In collaboration with Susana Viegas
ENSP, Universidade Nova de Lisboa

[see full text, Part II, p. 176]

Climate change is a consequence of air pollution, but it also directly aggravates pollution because warmer weather increases the formation of tropospheric ozone¹, and warmer temperatures and drier environments mean that smaller particles (PM_{2.5}²) remain suspended in the air for longer. Changes in climate patterns, such as variations in precipitation and wind, can affect the transport and dispersion of air pollutants and lead to higher concentrations of pollutants in certain areas.

[What are atmospheric pollutants?]

Air pollutants are substances released into the atmosphere by different sectors of human activity - agriculture, manufacturing and extractive industry, energy supply and consumption, transport, and waste - which have a negative effect on air quality. The source of some pollutants, such as the particles known as PM_{2.5}, determines their toxicity; when these particles are the result of burning fossil fuels, such as coal or diesel vehicle emissions, they are more toxic and more harmful to health. In 2020, energy consumption in residential, commercial, and institutional areas alone was responsible for around 60% of PM_{2.5} emissions in Europe (EU-27).

[What is the impact on health?]

Exposure to air pollution is considered the most important environmental risk to the health of the European population and is one of the main causes of death in Europe. Air pollution also causes morbidity, and significant health care costs, by contributing to or aggravating various diseases, including chronic obstructive pulmonary disease, asthma, lower respiratory infections, and lung cancer, and even diseases not directly related to the respiratory tract.

[What can we anticipate for the future?]

According to the European Environment Agency, air quality in Europe has been improving. However, to date, air pollution remains the biggest environmental health risk in Europe, and exposure to concentrations of air pollutants is still well above the WHO benchmarks. In addition to the risk of rising temperatures (which increase the formation of tropospheric ozone and respiratory symptoms), there is also the risk of fires, contributing to an increase in particles and other pollutants in the air, and sandstorms, which also worsen air quality and have negative effects on people's health.

Although air quality in European Union has improved since 2005, most of the continent still exceed the benchmarks set by the WHO for the various pollutants.

Although the trends in pollution and related mortality are positive, climate change may affect the progress already made in improving air quality.

96%

of the urban population of the European Union was exposed to concentrations of PM_{2.5} (air pollutants) above the value recommended by the WHO in 2020

238K

premature deaths (i.e. before the age of 70) in 2020 in the EU due to long-term exposure to PM_{2.5} particles (compared to 307,000 in 2019). In Portugal, the number of victims of premature death in 2020 due to this was 2600

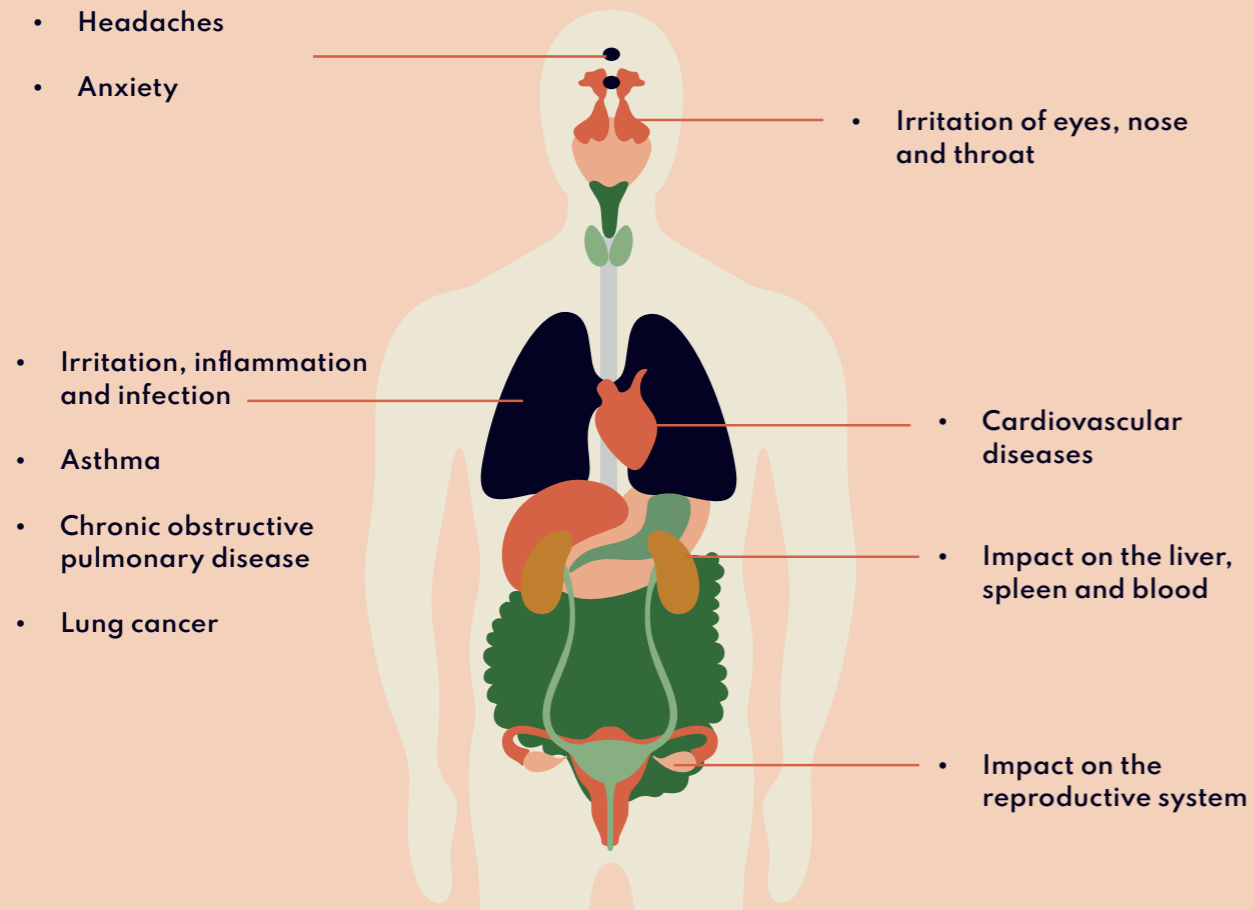
45%

reduction in the number of premature deaths in the EU in 2020 compared to 2005 figures (431,000 deaths) due to exposure to fine PM_{2.5} particles. The aim is to reduce by 55 % by 2030, compared to 2005

¹ Tropospheric ozone is a "secondary" pollutant, formed when gases such as nitrogen oxides and volatile organic compounds, its precursors, react with oxygen in the presence of sunlight." (Portuguese Environment Agency)

² Suspended particles with a diameter of less than 2.5 micrometres

Effects of air pollution on the human body



Air pollution from the burning of fossil fuels is one of the main contributors to mortality and morbidity worldwide¹. Fine PM2.5 particles are particularly harmful as they can enter the bloodstream.

According to Dr Luís Campos², "inhaled particles cause systemic inflammation, have a direct effect on blood vessels and cause dysregulation of the autonomic nervous system. These are the three main mechanisms involved in cardio- and cerebrovascular diseases".

Air pollution does not affect the whole territory equally (it depends on proximity to emission sources such as industries, car traffic or agriculture), nor does it affect those exposed the same way (it depends on each person's sensitivity).

Certain groups of the population are more susceptible to the effects of air pollutants, such as children and people with respiratory problems (such as asthma), but also people with pre-existing cardiovascular and cerebrovascular problems.

¹ Shraufnagel DE, Balmes JB, Cowl CT et al. Air pollution and noncommunicable diseases: a review by the Forum of International Respiratory Societies' Environmental Committee. Chest, 2019

² Interview conducted and published by Expresso newspaper, 21 July 2023 edition

Diseases and health problems associated with air pollution¹

Respiratory diseases

Air pollutants have effects on the development of the major respiratory diseases - respiratory infections, chronic obstructive pulmonary disease, asthma, lung cancer, idiopathic pulmonary fibrosis and bronchiectasis.

Cardiovascular diseases

Studies show the effect of air pollutants on the incidence of acute myocardial infarction, sudden cardiac death, cardiac arrhythmias, and peripheral arterial disease.

Chronic kidney disease

Studies suggest that exposure to air pollution is strongly related with CKD increased risk and progression to end-stage.

Immune system

Inadequate and excessive immune responses are at the root of several diseases, including infections, cancer, and autoimmune diseases.

Risk of stroke

Air pollution is estimated to be responsible for 14% of all deaths relate to stroke.

Mental health and neurological conditions

Research suggest that highly polluted environments are responsible for the onset or acceleration of cognitive decline. Several agents, including particulate matter, have been identified as toxic to the central nervous system.

Ophthalmological diseases

Indoor air pollution, which can be caused by outdoor air pollution, has been associated with several eye diseases, including conjunctivitis, glaucoma, cataracts, and age-related macular degeneration.

Paediatric diseases

Babies and children are particularly vulnerable to air pollution because their organs are still developing, and they inhale more air in relation to their body weight. The health effects include not only aggravation of pre-existing respiratory diseases, but also the development of diseases such as asthma. Other potential consequences include premature births, low birth weight, neurodevelopmental disorders, increased risk of childhood cancer and chronic diseases in adulthood.

Note: see more details and sources in Part II, "Climate Change and the Impact on Air Quality".

Air Pollution

How do the Portuguese feel?

In the focus group with participants who lived in big cities and had pre-existing respiratory problems such as asthma, the problems associated with air pollution were among the first to be mentioned as a consequence of climate change. More than a poor opinion of the air quality in the places where they live (86% of Portuguese consider it to be "generally good" or "generally good, but getting worse"), the fact that they or their close ones were already feeling the effects of pollution or phenomena such as dust from Africa was the main argument for this association.

Concern about children and the problems they believe are becoming more common in children (such as atopic skin or bronchiolitis) were also associated with pollution. Parents of younger children are particularly sensitive to what might compromise a child's health or well-being, as confirmed by the percentage of parents of children with health problems who say they already take enough care in their daily lives to minimise exposure to air pollution (21% vs. 11% of the sample).

The impact of air pollution on health was also the concern reported by those who experienced environmental problems when living or travelling abroad, because it was "visible" or because "the air felt heavy, things falling on us, tiny particles". Finally, those who are more informed on the subject were able to point out that pollution is already one of the main causes of death globally, realising that, in a world that is moving towards urbanisation and is unable to free itself from fossil fuels, what lies ahead for health and quality of life is not good.

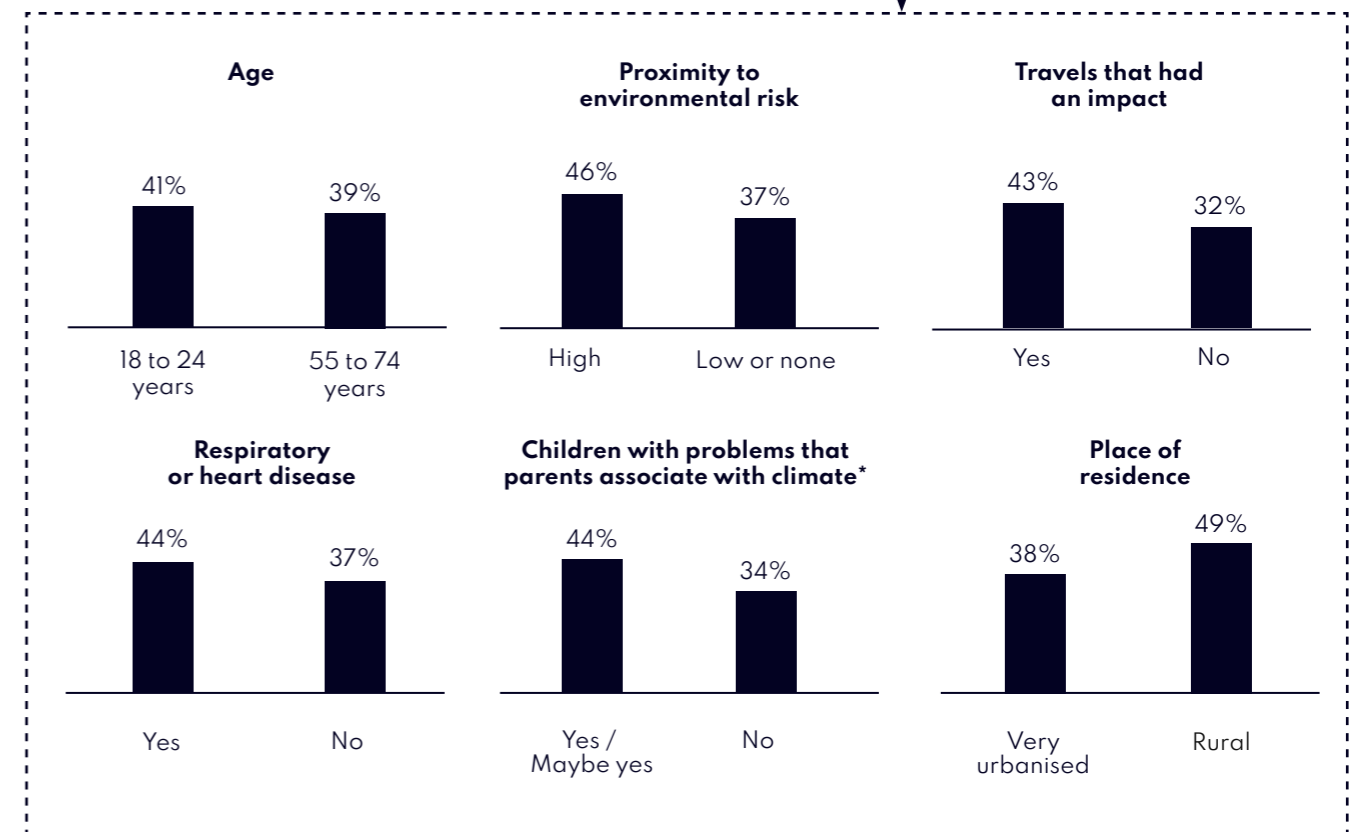
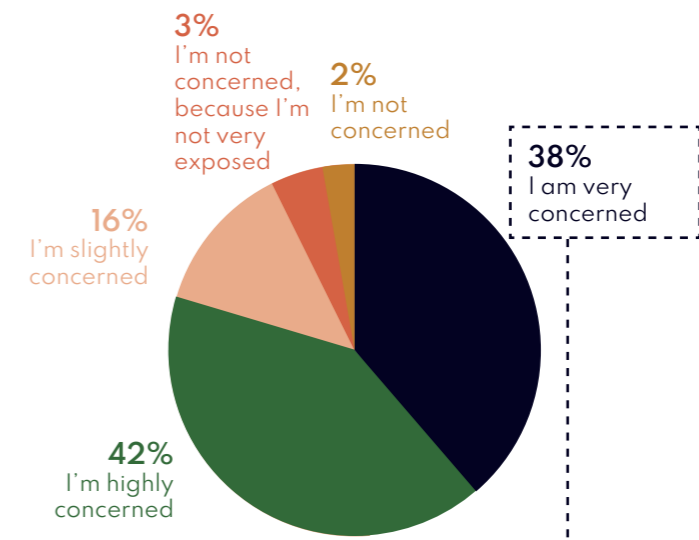
Even without being able to articulate the reasons why the effects of air pollution will become worst with climate change, the fact that pollution and poor air quality are often associated with the imagery of a future in environmental decay makes it easier to anticipate the problems it can pose for health.

The realisation of this threat in respiratory problems is also evident, as the figures show: in a survey, more than 70% associated air pollution to coughing and shortness of breath, respiratory infections and diseases, and allergies.

While the link with air pollution is clear for respiratory problems, the same cannot be said for other health problems, such as cardiovascular or cerebrovascular diseases. For the average citizen, the cause-effect relationship beyond respiratory problems is too elaborate and requires further explanation.

The truth is that as much as science can already prove a link between air pollution and certain health problems, such as the effects on lung tissue, "the nature of this relationship is complex and not yet fully understood", even among experts.

Air pollution
How concerned are you about the impact it could have on your health?
N=800



* Respondents who have children up to the age of 20
See details of criteria on page 224 of the Annexes

In Direct Discourse

“I have asthma and [during the dust episodes in Africa] my symptoms worsened. I now must take medication every day.”

W, 44, Bio researcher, Porto

“[During the dust outbreaks] I wore a mask, it got very dirty on the outside, very, very visible. (...) My wife suffered severe eye irritation due to the pollution.”

M, 50, Airport security, Porto

“There are frightening things here that I wouldn't associate with air pollution. You mentioned the impact on the liver, the spleen, the impact on the reproductive system (...) it's something that makes me wonder... how does air pollution impact the reproductive system?”

W, 52, Primary school teacher, Leiria

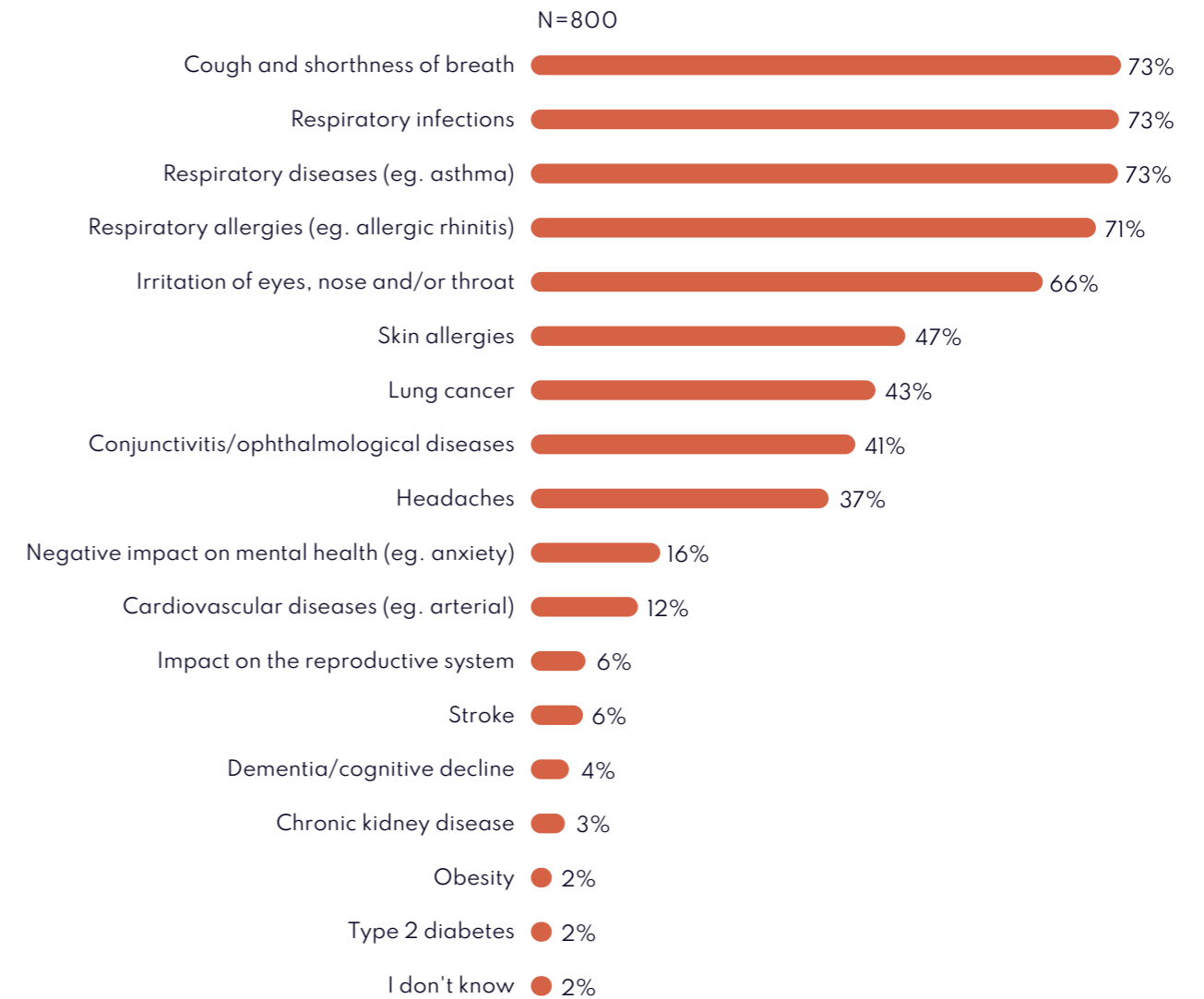
“I see diabetes, Alzheimer's disease, dementia, liver damage here ... I wouldn't associate it [with air pollution] (...) the dust that we're getting more and more is harmful to our health. There are constantly warnings not to leave the house, children, the elderly, it's not good for them. And health-wise it ends up being worse for everyone.”

W, 49, Seamstress, Vilar Formoso

“There's some very far-fetched information. Type 2 diabetes is a very indirect relationship, I think. What kind of pollution are we talking about? Atmospheric? Which system is drastically affected by this? The respiratory system, of course (...) and if it's compromised, the whole cardiovascular system also malfunctions (...) but to get to type 2 diabetes is a bit of a stretch...”

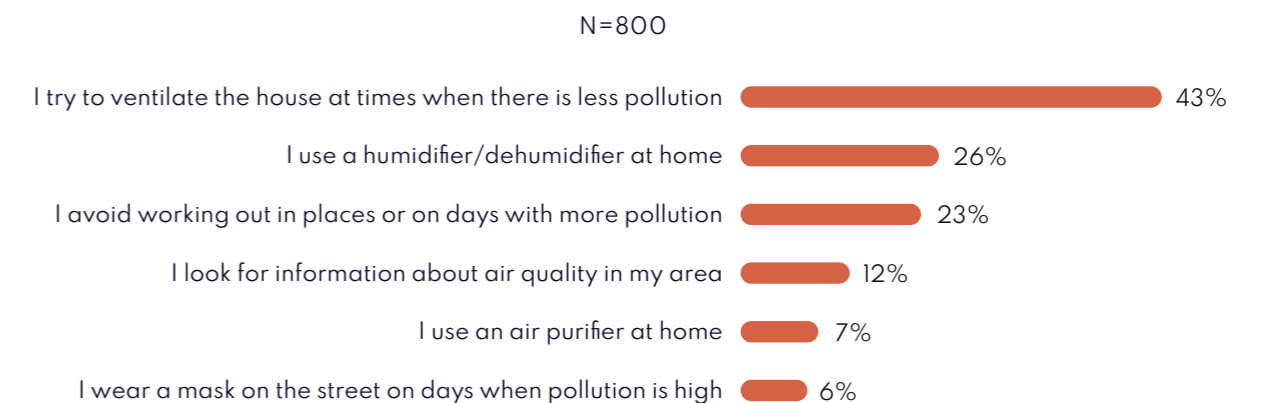
W, 49 anos, Seamstress, Vilar Formoso

Health problems related to air pollution



Below there's a list of health problems that can result from extreme air pollution. From these, which ones did you know in advance, before seeing the list, were caused by air pollution?

Everyday care to minimise exposure to pollution



Question posed to the 61% who report that they take a lot (11%) or some (50%) action in their daily lives to minimise exposure to air pollution, calculated on the total sample base

Air Pollution

Examples that show the way



Google

Partnership creates air quality monitoring system

Google, in partnership with Aclima, created an air quality monitoring system in 2015. Over the years, the Air View Project has equipped the vehicles in Google's Street View system with air pollution sensors to measure the quality of the air on the street, taking more than 500 million measurements. The initiative has also generated sub-partnerships with various European cities such as Copenhagen, Hamburg, London and Dublin, which resulted in the dissemination of knowledge about air quality in their respective cities. Thanks to this information, the city of Copenhagen has been able, for example, to encourage means of trans-

port that are more sustainable and create better cycling and walking routes away from traffic. It was also possible to create "Thrive Zones". These zones aim to build spaces, such as schools and playgrounds, away from areas of high pollution, providing children with cleaner air.

In 2020, the Air View Project's air quality insights were also integrated into Expanse, a project, funded by the European Commission that explores how air pollution affects the health of Europeans.

Transport for London

City creates "Ultra Low Emission Zone"

The Mayor of London, Sadiq Khan, has recently managed to implement some of the most ambitious public policies to reduce air pollution in the city. The most recent measure, the "Ultra Low Emission Zone" (ULEZ), was even a finalist for the 2020-2021 Prize for Cities, an award that highlights innovative approaches to tackling both climate change and urban inequality. Covering the whole of central London, the ULEZ requires that drivers respect strict

CO2 emission standards or pay a daily fee. The aim is to encourage residents and businesses to opt for cleaner means of transport. So far, the initiative has contributed to an almost 50% reduction in toxic nitrogen dioxide pollution in central London. The ULEZ will be expanded to all London boroughs on 29 August 2023, bringing clean air to an additional five million people.



Barcelona Assembly

City closes a third of its streets to traffic to combat air pollution

To combat air pollution in the city, Barcelona City Council has announced plans to turn one in three streets in the Eixample area into green spaces, off-limits to traffic in 2020. As part of the 'Superillas' (super-parks) project, 21 streets and junctions will be converted into small parks and public squares, creating 33.4 hectares of land "where pedestrians and fresh air will take centre stage".

The transformation, which is expected to take 10 years, is an attempt to curb excessive pollution in the Catalan capital and make it a healthier, safer and more sustainable place to live.

In September 2023, the Campo de Ourique neighbourhood in Lisbon will test the 'Superillas' model.

Air Pollution

Examples that show the way

Otrivin x ecoLogicStudio

Partnership produces the world's first air-purifying playground

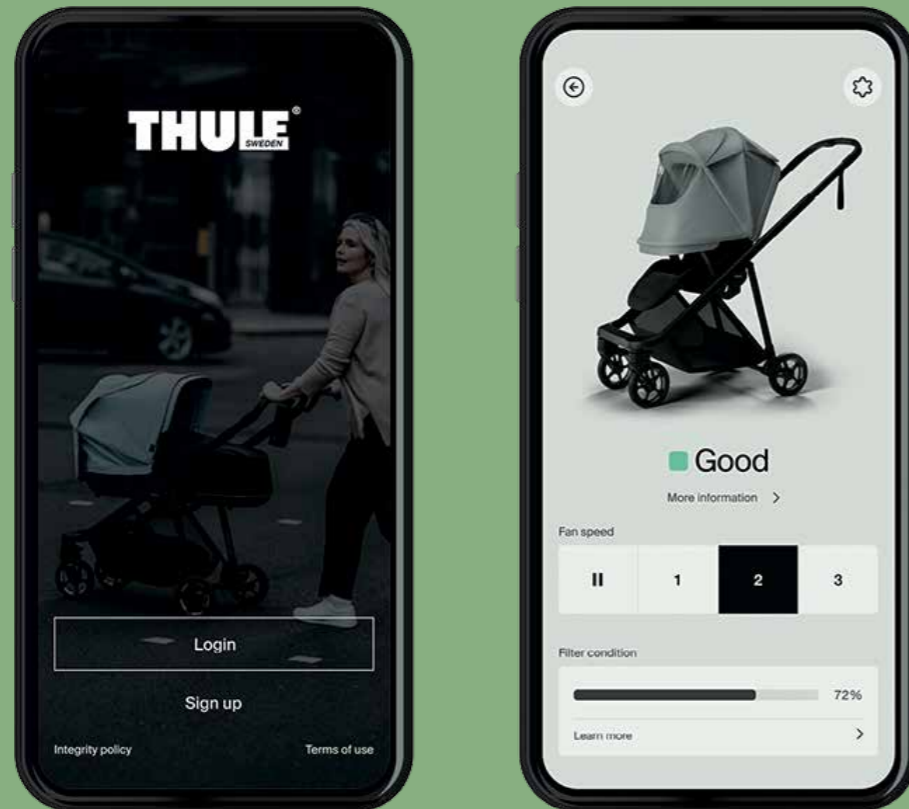
93 % of the world's children play in environments with harmful levels of air pollution. In response, nasal spray brand Otrivin and ecoLogicStudio have created the world's first biotechnological air-purifying playground. The Otrivin AirBubble is part of a campaign to raise awareness of the impact of air pollution on children's health. The playground has been designed in such a way as to clean the air while children are playing.

Fifty-two algae cylinders have been integrated into a wooden structure which, through photosynthesis, filter pollutants from the air and release oxygen. The purification of the air is also powered by the children since their physical activity inside the structure helps to circulate the air through the algae. The playground was installed in Warsaw, Poland, one of the most polluted cities in Europe.



Air Pollution

Examples that show the way



Solutions to mitigate the impact of pollution on children's health

To mitigate the effects of air pollution, different initiatives and solutions are being developed to protect the health of the most vulnerable - babies and children. Mom's Clean Air Force is an American NGO that counts on more than 1.5 million parents to promote, at local and national level, policies that ensure better air quality for their children.

Thule, a Swedish brand that manufactures pushchairs, recently launched the Thule Shine Air Purifier Canopy—a cover that fits over the trolley and uses silent fans and HEPA filters to absorb polluted air and release purified air. This system is accompanied by an app that allows you to check the air quality inside and outside the trolley.

Dymla One is the world's first carrycot designed to protect babies from air pollutants, UV radiation, bacteria and viruses. It has an electric filtering system that creates enough pressure to prevent impure air from circulating around the baby.

Finally, British energy operator E.ON has teamed up with children's fashion brand Scamp & Dude to create a cape that fights air pollution. Thanks to a proprietary fabric mesh, the cape can retain and then discharge pollutants. This material could be integrated into school uniforms.

IKEA

Retailer launches smart sensor to measure indoor air quality

Ikea has launched Vindstyrka, a smart sensor that monitors air quality in real time, indicating pollutant levels as well as humidity and air temperature.

The product is launched at a time when, in a 2022 report¹, the WHO estimates that polluted indoor air kills 3.2 million people prematurely every year, including 237,000 children. Among the main indoor pollutants are fuel-burning appliances such as gas cookers, chemicals used in building materials and furniture manufacture, excess humidity that can produce mould, and even hairspray or dry shampoo.



POUR MOI

Brand creates "first product that protects skin against smoke"

French brand Pour Moi has launched a serum to protect the skin from the harmful effects of smoke and pollution. Smoke Alarm Drops promise to increase the body's defences and prevent inflammation and premature ageing. "This is the first product that protects the skin against smoke... when there is a forest fire, the skin is at high risk," explains the founder.

A recent report² stated that two out of three young Americans plan to buy hygiene or beauty products that guarantee protection against extreme weather conditions.



¹ WHO Ambient Air Quality Database, 2023

² Instagram, "Trend Report," realizado em Outubro de 2022 by WGSN

The risk of water scarcity and pollution

In collaboration with Carla Viegas
ESTeSL- Polytechnic Institute of Lisbon

[see full text, Part II, p. 182]

Climate change is affecting all the processes involved in the water cycle, paradoxically, increasing the risk of both intense rainfall and extreme drought. Warmer air creates the conditions for more intense storms, causing problems such as extreme flooding, especially in coastal areas. On the other hand, rising temperatures lead to increased evaporation, increasing soil dryness and requiring greater hydration efforts. Droughts and/or floods in turn cause water quality degradation, which is becoming one of the major threats to the sustainability and availability of water resources.

[How does climate change affect the quality of water?]

Extreme weather events contribute to water quality degradation in several ways. Intense rainfall washes away large quantities of pollutants present in the soil (mainly from agriculture, mostly nitrates and pesticides) or poorly treated waste, because wastewater treatment plants are unable to retain and treat the increased amount of water. Fires aggravate this phenomenon: the loss of vegetation increase the run-off of pollutants such as heavy metals, toxins and others that result from combustion processes. All of this contributes to the degradation of available water reserves.

[What is the impact on health?]

Water scarcity affects agricultural crops, threatening not only the availability of food in sufficient quantities, but also its quality and nutrition. Quality of water resources' degradation can also increase the spread of water-borne diseases caused by pathogenic microorganisms and pollutants. Poor water quality can lead to an increase in the by-products used to disinfect the water for human consumption, increasing the risk to consumers' health. Contact with recreational waters (coastal or river) can also increase exposure to pathogenic microorganisms and pollutants, due to run-off caused by periods of high rainfall.

[What can we anticipate for the future?]

According to the European Environment Agency, precipitation in Portugal and Spain has fallen by around 15% in recent decades and is expected to fall by between 10 and 25% by the end of the century. The poor water quantity situation in southern Europe is mainly due to over-abstraction for irrigation. Excessive abstraction from coastal freshwater aquifers can lead to saline intrusion of seawater, which can render groundwater unusable for decades or increase the cost of treating it. Climate change is expected to aggravate these problems as demand for irrigation increases in Europe¹.

Although several droughts have been recorded in Portugal since 1940, the IPMA highlights the meteorological drought of 2016/2017 because it worsened significantly at the beginning of autumn, which is an unusual situation (in previous droughts, there was a strong relief in severe and extreme drought in September and October). On 31 October 2017, 25% of the territory was in severe drought and 75% in extreme drought

- 20%

In Portugal, there is less water available this century than in the middle of the last century, with a reduction of around 20%. The scarcity index has worsened in all basins, as a result of reduced availability, but also because of increased consumption²

5°

July 2023 was the fifth driest month in the last two decades. The average precipitation level was only 22% compared to the norm (vs. the period 1971-2000).

The % of water in the soil fell that month, especially in the north-eastern regions of Trás-os-Montes, the Tagus Valley, Alentejo and the Algarve³.

861K

Houses in Portugal that are not connected to the public water network (617,000 are but are not registered, and 244,000 aren't). This means that they use boreholes or wells to collect their own water, which means that its quality is not controlled by the regulator⁴

¹ "Europe's groundwater — a key resource under pressure", EEA, 2022

² According to the study "Assessment of current and future water availability and application of the WEI+ scarcity index", published by the Portuguese Environment Agency

³ INE, Agricultural Forecasts, Information for the Media, August 2023

⁴ "Water and Sanitation in Portugal - The Market and Prices", Portuguese Water Distribution and Drainage Association, 2022 Edition

Climate change and its potential impact on drinking water supplies



Exposure to harmful chemicals

Extreme events, such as storms or fires, contribute to the degradation of water quality due to the run-off of pollutants and pesticides. Exposure to these substances through water can lead to several health problems, including cancer



Reduced availability of potable water

As water sources become polluted, there is less drinking water. The use of water in food production can also lead to water scarcity and less water available for washing, cooking, and personal hygiene.



Use of unsafe water sources

Lower water tables and water flows - such as rivers or streams - can lead to reduced water supplies and increased use of unsafe water sources.



Impact on aquatic life

Higher temperatures create ideal conditions for algal blooms, which can be toxic to aquatic life and have implications for health.



Increased risk of waterborne diseases

As water sources become contaminated with pollutants, the risk of colonization by bacteria, viruses and parasites increases significantly.

The impact of water quality degradation on health¹

Gastrointestinal diseases

Water contaminated by bacteria, viruses, parasites or toxic chemicals can cause gastrointestinal diseases such as diarrhoea, cholera, dysentery and hepatitis A. These diseases can lead to severe dehydration and even death, especially in areas with limited access to adequate health care.

Waterborne diseases

Water pollution can result in the spread of waterborne diseases such as typhoid fever, paratyphoid fever, leptospirosis and giardiasis. These diseases are caused by microorganisms present in contaminated water.

Skin problems

Exposure to contaminated water can lead to skin problems such as irritations, rashes and infections. Toxic chemicals in the water can damage the skin and even cause chemical burns.

Respiratory diseases

The presence of toxic chemical substances in water, such as volatile organic compounds and industrial chemicals, can cause irritation of the respiratory tract, asthma, and other respiratory diseases.

Nervous system disorders

Certain chemicals present in tap water, such as heavy metals (e.g. lead, mercury) and pesticides, can affect the human nervous system. Chronic exposure to these substances can lead to neurodevelopmental problems, cognitive dysfunction, behavioural disorders and even changes in the central nervous system.

Cancers

Some chemicals found in contaminated water, such as synthetic organic compounds and disinfectant by-products, have been linked to the development of certain types of cancer, namely cancer of the liver, kidneys, bladder, and other organs.

Source: Impact of Climate Change on Drinking Water Safety, ACS EST Water 2022, 2, 2, 259–261, 2022, American Chemical Society

¹ Note: more details and sources in Part II, "Climate Change and the Impact on Water Quality"

Water scarcity and pollution

How do the Portuguese feel?

The media coverage of the drought led us to foresee that the issue would be easily identified as a problem resulting from climate change. In fact, not only was lack of water the most frequently mentioned issue when thinking about the impact that climatic phenomena can have on the lives of the Portuguese (46%), but was also the environmental problem that most Portuguese consider that may affect our health in the future (64%).

Where one lives determines different levels of concern about water scarcity: in rural areas this concern is more latent than in urban areas; in the south it is greater than in the rest of the country (59% in the south vs. 39% in the north coast, for example, mention drought spontaneously when thinking about how climate change will impact the Portuguese).

The discussions also show that sensitivity to the problems of water shortages are intrinsically regional. The news may put the whole country on alert, but the ones who speak more intensely about it are people who see the wells they use for their own consumption or for their animals drying up, the cherries and quinces withering, or those who wait for the rain to plant onions. In fact, the greatest concern regarding water scarcity in Portugal is related to its consequences for agriculture and and livestock farming.

When it comes to water pollution, the position of the Portuguese is less obvious. On the one hand, it appears at the bottom of the list of the main environmental problems that could affect the health of the Portuguese, far behind water scarcity (only 18% refer to water pollution as one of the main problems that could affect the health of the Portuguese). [See page 42 - accelerating factors]

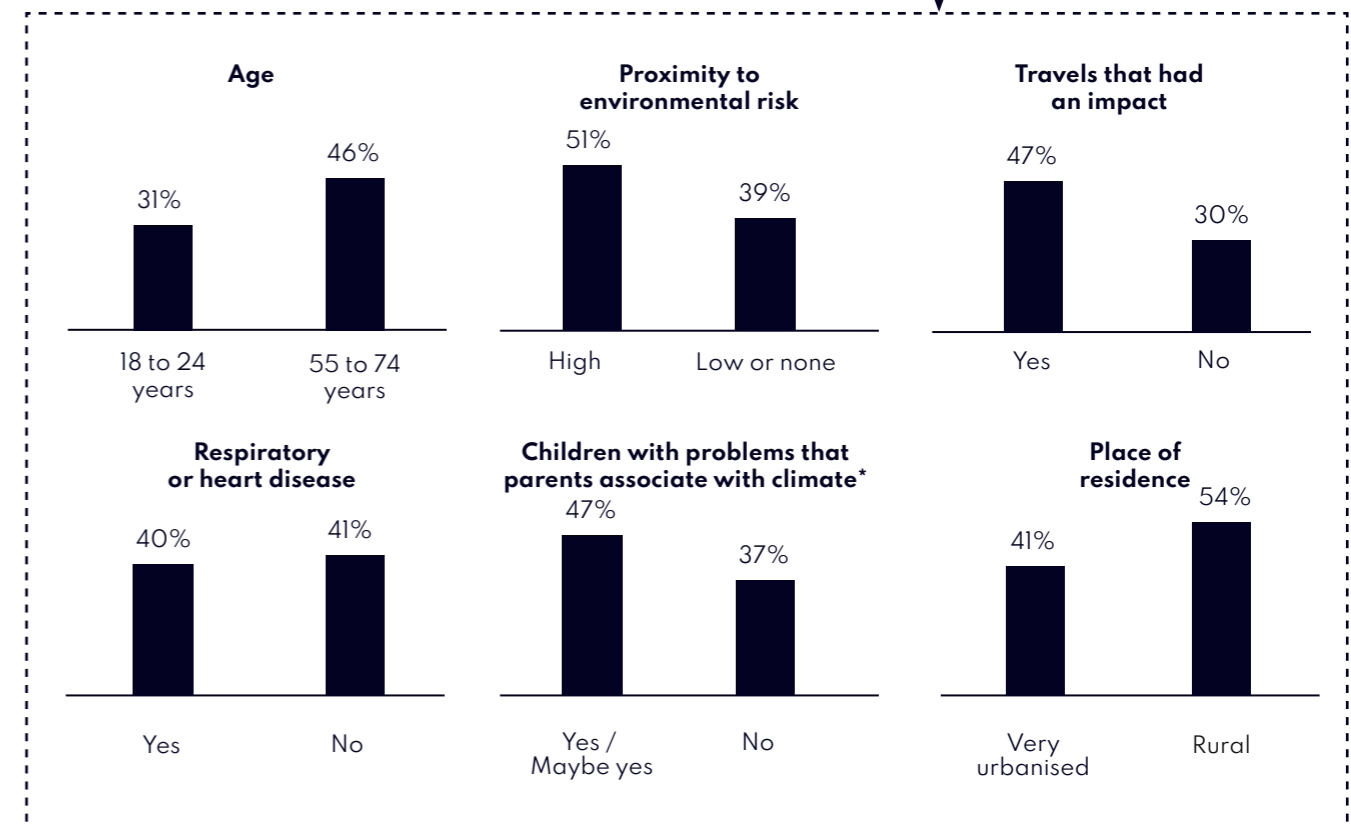
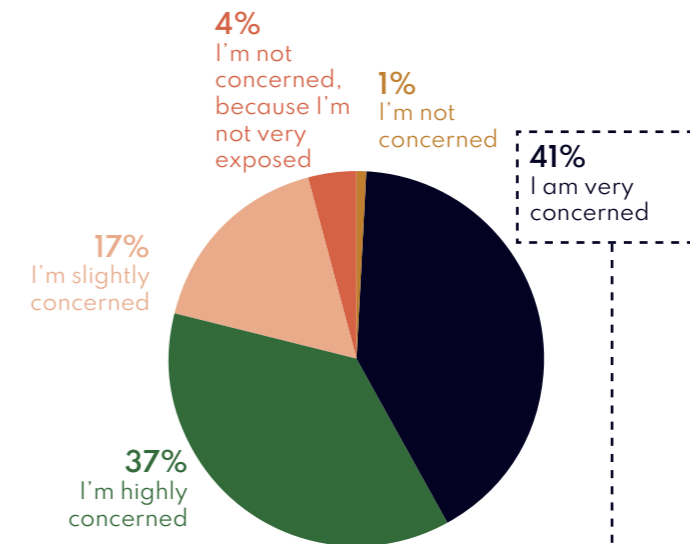
On the other hand, 74% consider water pollution to be an environmental risk in Portugal that will persist or get worse; water pollution is also the problem that most respondents consider to be very concerning in terms of health effects, above air pollution and very high temperatures (although not very distant).

Perhaps the explanation lies in the fact that water pollution is a historical and still unresolved problem for the Portuguese. As a result of the lack of civic-mindedness in the 1980s and 1990s, they realise that clean water is essential, not only for human consumption and the agricultural sector, but even for enjoying recreational waters.

While it is true that pollution of watercourses has been decreasing over the last decade, there are still several with poorer than desired water quality and "black spots" with problems related to industries, agriculture, water treatment plants (WWTPs) or housing (in 2021, the coverage of waste water treatment was 86%). And although tap water is mostly of good quality and safe, there are still many households in the country that are not connected to the public water supply¹.

In the focus groups, poor water quality was mentioned sporadically in association with "sulphur rains" and "brackish water" in coastal areas, but many stated that they trust their municipality's water, ruling out the possibility of contracting diseases due to contamination. So, it's not clear whether the concern stems from an understanding of the relationship between quality and climate change, or from a historical perception of water pollution in Portugal.

Water pollution
How concerned are you about the impact it may have on health?
N=800



¹ Relatório anual dos serviços de águas e resíduos em Portugal, ERSAR 2022

* Respondents who have children up to the age of 20
See details of criteria on page 220 of the Annexes

In Direct Discourse

“There is always water. The problem is the quality of the water; the volume of potable water available is tiny. I lived in the deep Alentejo, in Almodôvar. Twenty-odd years ago, people attached great importance to water. At night, they would turn off the water; if someone washed their car in the street, they would be reprimanded (...)

There was even water rationing. I’ve never felt the need again, but we can get there, and quickly. (...) Near the coast, [the aquifers] can become contaminated with salt water. (...) This happened a lot in the Algarve (...) the water was taken from the coast and came to the tap almost salty. It's a problem that, as a coastal country, we're going to have.”

M, 48, 8th grade teacher, Seixal

“It's already happening. I have clients with gardens in Cascais that have boreholes and a few days ago one of them had their lawn ruined(...). We had the water analysed and it was brackish; it already had a very high level of salt in it. That was what killed the lawn.”

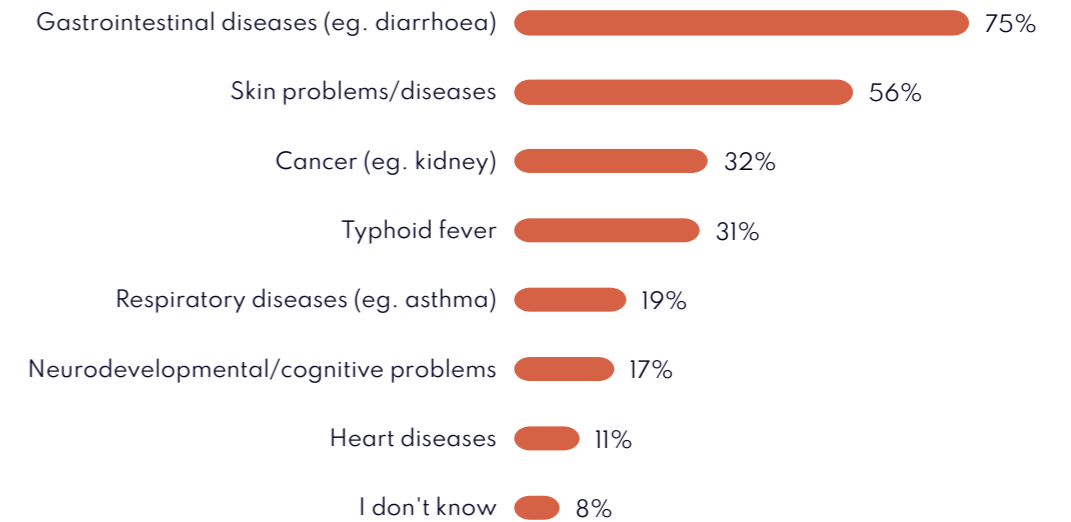
W, 39, Landscape architect, Lisbon

“I think that generally, in Portugal, we trust the quality of our water, we have a scientific basis for that trust. We don't get diarrhoea like most countries without potable water. (...) I don't think we're going to suffer most of these impacts, only those that come through the food chain, because we're very protected in terms of water treatment. I think we will suffer from scarcity, but not from unsafe water sources and contamination in the chain. But through food, yes, so that has to be better cooked, we have to remove peels... and that's not enough!”

W, 34, Cultural producer, Lisbon

Health problems that you associate with water pollution

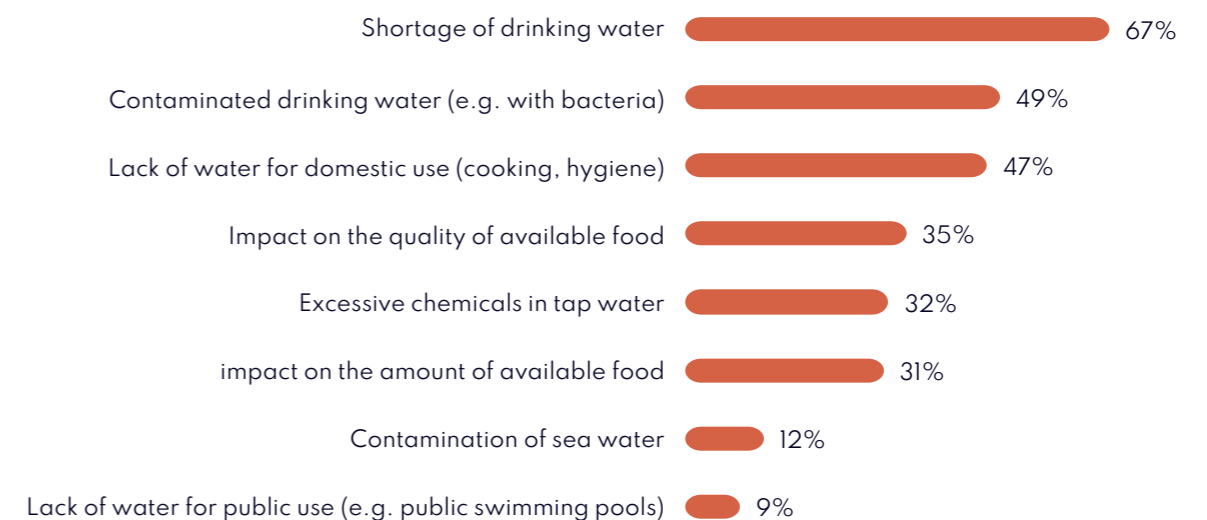
N=800



Q. Below there's a list of health problems that can result from water pollution. From these, which ones did you know, before seeing the list, that were caused by water pollution?

Problems related to water pollution that concern you the most

N=800



Q.: From the list of problems that may result from water pollution/scarcity what are the ones that concern you the most? (max 3)

Zooming-in Food

How do the Portuguese feel?

In the focus groups, the problem of the lack of water (and even its quality) inevitably led to concerns about food. The scarcity, and the possible rise in prices, was obvious to everyone; the risk of reduced variety and quality (including nutritional quality) was discussed above all by those who have always lived close to crop fields, vegetable gardens and fruit trees. Oranges that "have dried out on the three", potatoes that are "bruised" or cabbages that have been covered in "sulphuric rain" anticipate serious problems for future harvests.

For those living outside the big cities, it is also becoming clearer that the chemicals (fertilisers and pesticides) they see being used on intensive crops are going to end up on their plates and, therefore, affecting their health. "This is all related with climate change, with the poor quality of the air, the water, there you go, the rivers... all of this takes the things we've been putting into the soil. (...) In order for agriculture to be more intensive, productive, the plant has to grow more, but the fertiliser you put in to make the plant grow is going to harm the soil and the plant itself. And us, who eat it.."

In quantitative terms, half of the respondents make the association between climate change and the quality of food; of these, only 1% report none. In addition to several diseases that are easily associated to diet, such as diabetes, hypertension, heart disease or food allergies, the consequences of poor food quality include weakened immunity (59%), cancer (41%), and even effects on cognitive development (25%).

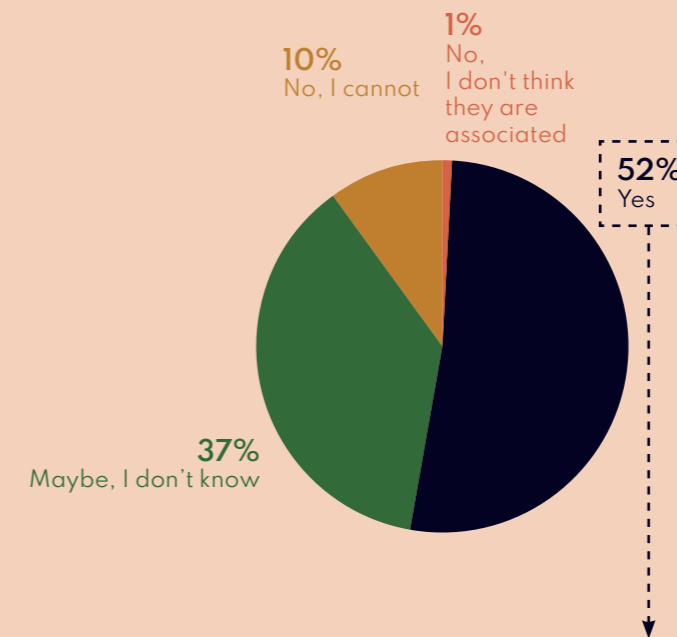
More than the environmental concern, we believe that it is the clear understanding of this relation between food and health that explains why 24 % of the Portuguese consume regularly organic food products.

"It's not just the water that is used to hydrate crops. The point is that we are consuming more and more toxic substances without realising it, but not only that. Substances that are used to make crops grow faster, even though there is a lot of regulation. In fact, a lot is still happening and regulation is relative; what was once great, like DDT, then we realised that it was bad for our health...it was eliminating mosquitoes, saving lives... it's a dichotomy, a big dilemma. But we are consuming more and more a lot of toxic substances in our food, in our water. Our water is still the best in the Western world, because it's treated. But we can't avoid eating food that is treated with these products"

M, 48, 8th Grade teacher, Seixal

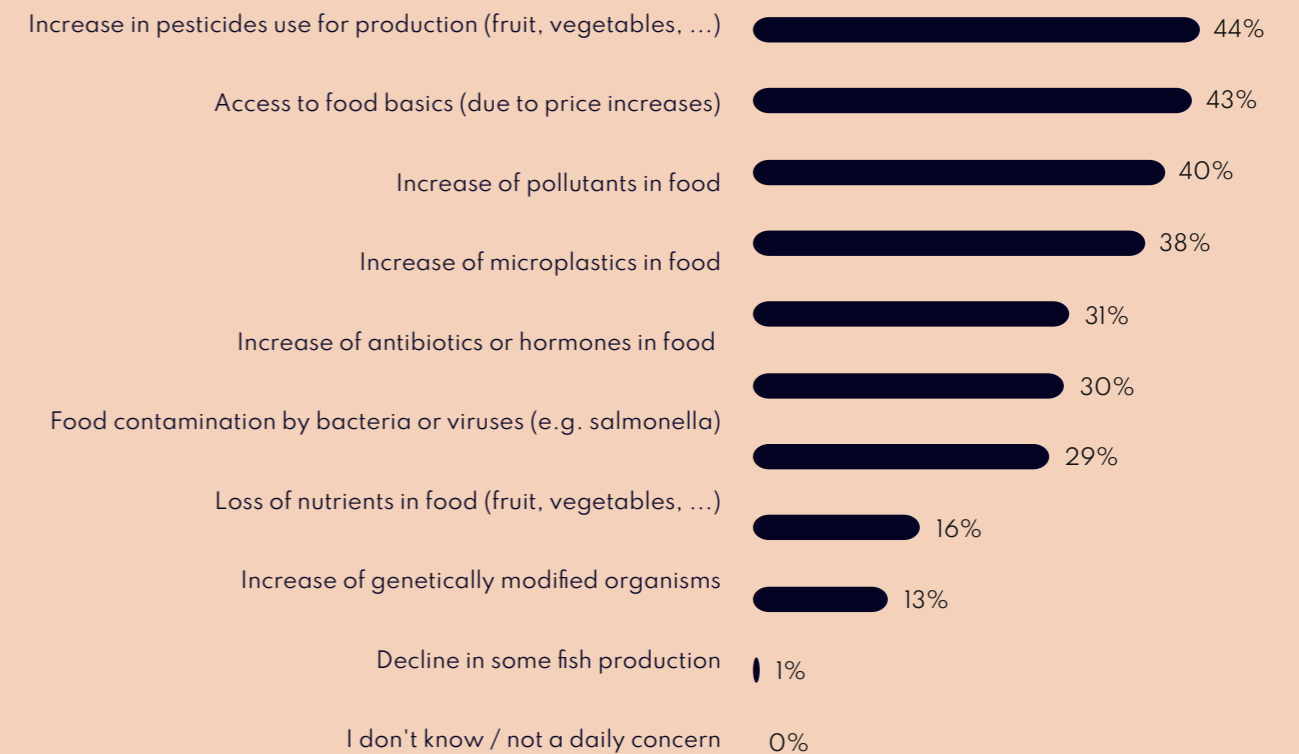
Are you able to associate climate change and food quality?

N=800



Problems caused by climate change that are associated with food quality that concern you the most

N=414



Thinking about the climate problems that Portugal may be exposed to, which of the following food-related problems concern you the most? (maximum 3)

Water pollution

Examples that show the way



In Jornal Público, @ TIAGO LOPES

Fog and mist collectors

Moisture traps used in areas where water resources are scarce

The Un Alto en el Desierto Foundation is preventing drought in the Chilean desert by collecting water for isolated communities. To do this, it uses "atrapanieblas" - which capture mist and fog it into water - a system patented by Chilean physics professor Carlos Espinosa, which has since been donated to UNESCO so that it can be used all over the world. This system is now in use in the Canary Islands, Spain and Portugal.

The Iberian project "Life Nieblas", financed by European funds, aims to improve landscapes degraded by fires and drought and where there has been no natural regeneration, boosting reforestation. Instead of using traditional irrigation, the small trees are being watered using a system that collects water from the mist through meshes placed on top of a metal structure.



Sponge Cities

Sponge cities in China prevent floods and ensure water quality

The Chinese government is promoting the concept of "Sponge Cities". The term was coined by Chinese urban planner Kongjian Yu and refers to cities that are committed to integrated water management plans. "The idea of sponge cities is to allow natural flow. There's a system that acts like a sponge, retaining water instead of draining it," the architect explained to the WEF. In 2020, China invested around 28 billion euros in 30 pilot projects. The ambition is to ensure that, by 2030, 80 % of urban areas can retain 70 % of rainwater locally. The aim is to help cities improve their resilience to climate change.

A case in point is Zhenjiang in southern China. The city requires all urban regeneration projects started after 2015 to be developed in accordance with the requirements of a Sponge City. By 2025, the city aims to have the urban area fully compatible with Sponge City standards. In Zhenjiang, a strategy has been defined to intercept wastewater disposal, purify rainwater and protect the health of watercourses. An analysis was also carried out to measure the sources of various pollutants and a plan was developed to reduce and calculate the amount of wastewater that can be discharged on a daily basis.

Water pollution

Examples that show the way



Publicis Groupe Benelux

Conceptual project shows the impact of water scarcity on the production of everyday goods

The Drop Store is an initiative of the Dutch Ministry of Foreign Affairs and was created by the advertising agency Publicis Groupe Benelux. The conceptual project results in a collection of supermarket products that demonstrate how the most banal products will be affected by water insecurity. Examples include water, corn, cheese, salt, meat, potatoes and toilet paper. Each product has a label highlighting the type of water crisis associated with it - including drought, floods and water pollution - as well as the inflated

price of the products. A QR code on the packaging directs the consumer to a website with a wealth of information on the impacts of water scarcity. "Drinking water and pure, clean water will be very, very scarce. That's the message. We want people to understand that it will be a luxury in the future," said Eduardo Marques, COO of Publicis. The awareness campaign is available online but was also presented live at the United Nations Water Conference 2023 in the Netherlands.

Fresh Belies, Patagonia Provisions & Yolélé

Brands bet on the use of food crops that require low water consumption

Science is increasingly conclusive in proving the link between soil health and nutrient density in food. Drought associated with water insecurity is already having a devastating impact on a wide range of agricultural crops. With this in mind, an increasing number of companies in the F&B

sector are betting on the use of plants with low water consumption - this is the case of sorghum (used by the American baby food start-up Fresh Belies), kernza (used in pasta and beer by the American brand Patagonia Provisions) or fonio (used by the American company Yolélé).



Ryan Waterhouse

Portable device to analyse the health of topsoil

To combat the threat that soil degradation poses to food supply chains, designer Ryan Waterhouse has created a portable device - Terra Nova - that analyses the health of the soil surface. The device measures the humidity of the soil surface and monitors the levels of nitrogen, potassium and phosphorus.

The data collected by the device helps farmers detect soil degradation and offers guidance on how to improve soil quality. "The world grows 90% of its food on topsoil, making it one of the most critical components in our food system," explains the designer.

Water pollution

Examples that show the way



Jolie Skin Co and FilterBaby water filters can be fitted to showers and taps respectively

Jolie Skin Co & FilterBaby

Brands that create solutions to filter tap water and improve the appearance of skin and hair

Jolie Skin Co is a beauty and wellness brand focussed on purifying water quality to treat health conditions related to the skin and hair. The founders believe that municipal water supplies in the USA are compromised and no longer provide 100% clean and healthy water. They therefore created a shower head capable of filtering and removing heavy particles and chlorine from the water. "When we think about the beauty industry and the number of products launched every year that promise to nourish the skin or give shine to the hair, we don't take into account that these products have to exist because of contaminated water," says Jolie's founder.

With a focus on facial skin care, the biotech brand Filterbaby launched a water filter adaptable to bathroom taps in 2022.

In partnership with the Children's National Hospital and the Centre for Advancing Innovation, Filterbaby is also investing in research and development to find out whether the cleanliness of water may be associated with the birth of some children with eczema, rosacea and other skin diseases.



The risk of vector-borne diseases

In collaboration with Sofia Núncio
National Institute of Health Doctor Ricardo Jorge

[see full text, Part II, p. 192]

Many vector-borne diseases [VBDs] have been confined to specific regions - especially in tropical and subtropical areas. This situation is now changing profoundly due to social changes - such as travel and migration - and climate change. Changes in climate not only alters the natural habitats of vectors (usually insects), but also promotes their spread to new regions, exposing new populations to the diseases they carry. The abundance of vector populations, their survival, the duration of their feeding activity and the prevalence of microorganisms in the vector are generally intensified by increases in temperature and relative humidity. With more vectors, the possibility of contact with humans also increases.

[What is a vector-borne disease?]

A VBD is a human disease caused by the transmission of parasites, bacteria, or viruses through the bite of a vector. Vectors are living organisms, such as ticks, mosquitoes, and other flies, that transmit a pathogenic microorganism (capable of causing disease) between humans, from animals to humans, from humans to animals, or between animals. DTVs include a long list of diseases, such as dengue, malaria or zika, among many others.

[What is the impact on health?]

VBDs can be acute illnesses - ranging from asymptomatic or mild presentations to severe, life-threatening - or chronic illnesses, with the potential for permanent disability. These diseases affect hundreds of millions of people worldwide and are responsible for morbidity, long-term disability and stigma, with associated mental health problems, as well as significant mortality.

Farmers, veterinarians, hunters and environmental technicians are more likely to develop the disease due to increased contact or exposure. Children, the elderly and immunocompromised (e.g. due to HIV, chemotherapy or transplants) are more likely to develop more severe diseases

[What can we anticipate for the future?]

Mosquito-borne diseases are emerging in Europe and the range of vectors is expected to further expand in the region. In Portugal, two mosquito species have already adapted to the environmental conditions in our territory and are expanding their geographical distribution in different areas of the country. As vectors of diseases such as dengue and yellow fever, the introduction of these viruses could have outbreaks of these diseases. According to a 2019 study, if nothing is done, by 2050 infected mosquitoes could reach another 500 million more people worldwide than they do today.

In 2005, the presence of the dengue vector mosquito was detected in Funchal (Madeira). In September 2012, the first human cases of dengue fever were reported and, in October, a health warning was announced, with consequences such as a ban on blood donations. 1,080 cases have been confirmed, with no serious clinical cases. As of February 2013, 78 patients were diagnosed with dengue in other European countries after returning from Madeira .

700K

Number of deaths per year worldwide from DTVs. Dengue is the most important, with tens of millions of cases every year, resulting in around 20,000 to 25,000 deaths, most of them children and adolescents

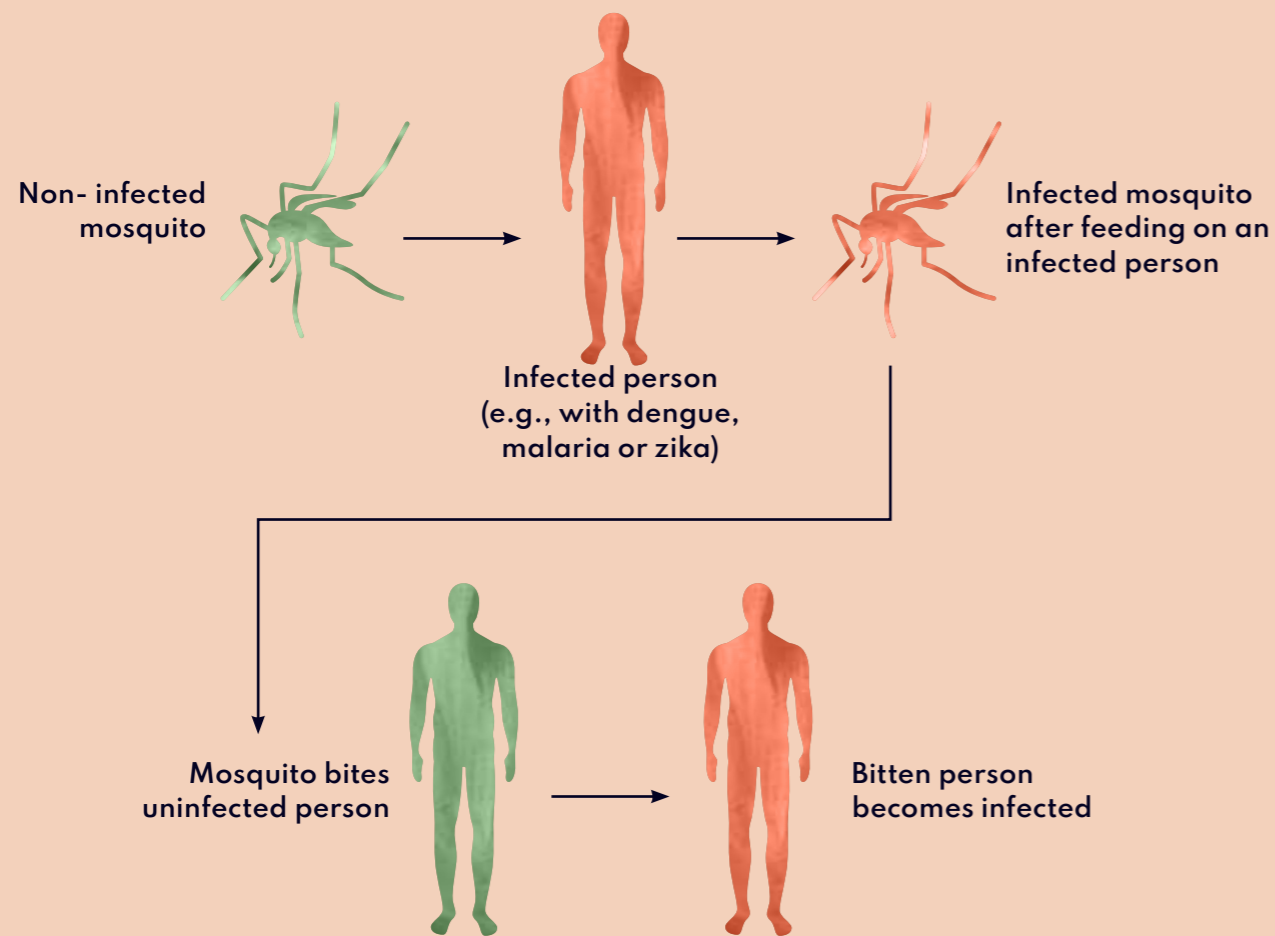
1 IN 5

Vector-borne diseases are responsible for almost a fifth of all infectious diseases. Currently, it is estimated that 80% of the world's population is at risk of developing at least one vector-borne disease.

500K

Number of extra people that mosquitoes infected with etiological agents (parasites, bacteria or viruses) could reach by 2050 (if no action is taken)

How infectious diseases are transmitted via vectors (between humans)



In the image, a mosquito transmits an infectious disease between humans. STDs can also be transmitted from animals to humans, from humans to animals and between animals

Increased temperatures are allowing, for example, 'Aedes' mosquitoes to live longer or thrive in areas where previously the cold did not allow them to survive. The heat can also shorten the time it takes for this mosquito to become an adult and speed up the period between when it becomes infected with a disease and when it can transmit.

The abundance of a population of a certain type of mosquito does not in itself determine the existence of disease. However, if these species are present in large numbers, it is not only possible, but likely, that infected people arriving in the country will be bitten by mosquitoes, which could transmit the disease to other people.

Main vector-borne diseases and their most frequent clinical signs¹

Dengue (transmitted by *Aedes* mosquitoes)

Sudden onset of high fever, severe headache, joint and muscle pain, rash, minor bleeding (such as nose-bleeds or gum bleeds), fatigue. In severe cases, it can develop into dengue haemorrhagic fever or dengue shock syndrome, with a risk of death.

Zika (transmitted by *Aedes* mosquitoes)

Most infected people have no or mild symptoms. However, common symptoms include fever, rash, joint pain, muscle pain, headache, eye irritation and fatigue. It is especially worrying in pregnant women because of its potential to cause serious congenital malformations.

Chikungunya (transmitted by *Aedes* mosquitoes)

Sudden onset of high fever, severe joint pain (usually in the hand and feet), headaches, muscle pain, rash, fatigue. The joint pain may last for months or even years in some cases.

Yellow Fever (transmitted by *Aedes* mosquitoes)

Fever, headache, muscle pain, nausea, vomiting, fatigue, jaundice and, in severe cases, it can lead to organ failure and haemorrhaging.

Malaria (transmitted by *Anopheles* mosquitoes)

Fever, chills, headache, muscle pain, fever, nausea, vomiting. In severe cases, it can lead to organ failure and death.

West Nile Virus (transmitted by *Culex* mosquitoes)

Most people infected with West Nile virus have no symptoms. However, some may experience mild symptoms such as fever, headache, joint and muscle pain, vomiting, diarrhoea or rash. In rare cases, it can lead to encephalitis or meningitis.

Lyme disease (transmitted by ticks)

Skin rash (characterized by a target-shaped rash called erythema migrans), flu-like symptoms (fever, chills, fever, muscle and joint pain), enlarged lymph nodes, headache. In some cases, it can lead to joint inflammation and neurological and cardiac complications.

It should be noted that clinical signs can vary from person to person and can overlap with other diseases.

¹ Note: see more details and sources in Part II, "Vector-borne diseases and climate change"

Vector-borne diseases

How do the Portuguese feel?

Perhaps because there has been a lot of news about climate change in recent months, perhaps because health authorities are already raising awareness in some areas of the country, or simply because it has been observed (in the field) that insect species are changing, some participants in the focus groups were able to spontaneously mention mosquitoes as a health risk associated with climate change, even though they had some difficulty identifying and elaborating on the diseases that these insects can transmit.

In the survey, most recognise their ignorance on the subject: when told that "Europe could see outbreaks of mosquito-borne viral diseases such as dengue or Zika during the summer", 64% reported that they were unaware of the existence of these mosquitoes in the country.

Yet, the lack of knowledge does not prevent the association between the climate issue and potential outbreaks of so-called "tropical" diseases, as demonstrated by the 73% who reported that they relate the problem to climate change (22% say they don't know if there is a relation and only 5% think the issues are not related).

Even without knowing about the relationship between climate change and tropical diseases, the news of the risk concerns almost 80% of the respondents, with differences between groups - for example, 41% of those who have a nature-related job or live in rural areas say they are very concerned about the news, compared to 28% of those who do not have nature-related jobs or to 31% of those who live in highly urbanised areas.

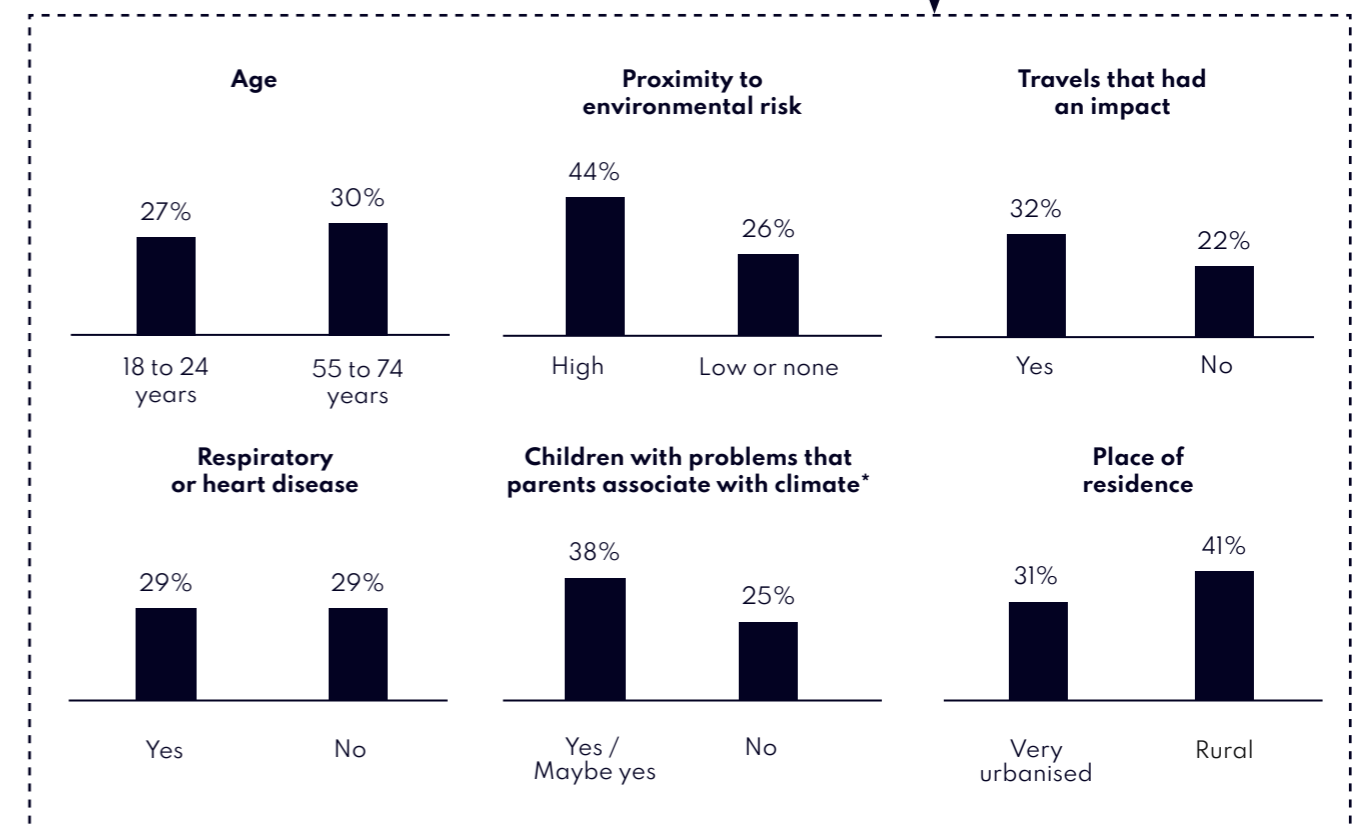
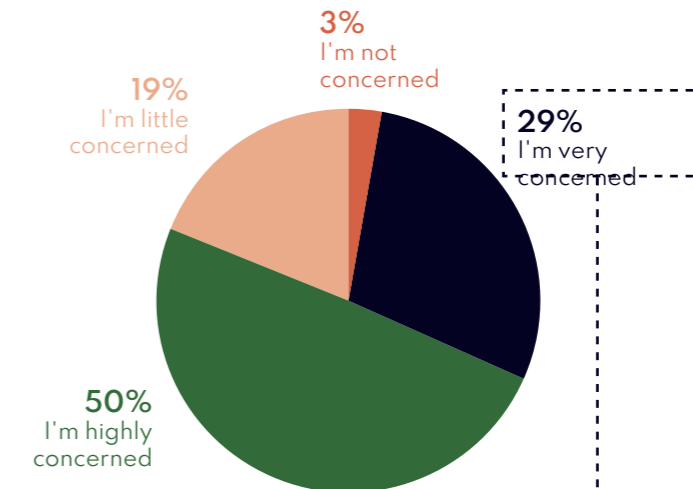
Those who report little concern, justify it with their trust in the authorities to deal with the problem, followed by the idea that there are already vaccines for these diseases - which isn't true in many cases, and even if they exist they aren't always available -, the conviction that it's unlikely that they or their close ones could be affected by these diseases, or the fact that we have a good healthcare system.

The lack of concern about these types of diseases is also visible among the 46% of Portuguese who travel to tropical countries (e.g. Africa, South America, Southwest Asia). While it's true that a large percentage are aware of the health risks, it's also true that only about half of them go to a travellers' consultation (28% don't always do it and 22% don't have this concern or didn't even know about this consultation). This means that a significant proportion of those who expose themselves to the risk of contracting diseases in the countries they visit are not aware of or concerned that they might contract a disease, let alone be an importer of these diseases into their country or region.

(New) mosquitoes that transmit viral diseases

How concerned are you about this news?

N=800



Q: The World Health Organisation has warned that Europe should prepare for outbreaks of mosquito-borne viral diseases during the summer, such as dengue, Zika and chikungunya (...). How concerned are you by this news?

* Respondents who have child(ren) up to the age of 20
See details of criteria on page 220 of the Annexes

In Direct Discourse

“The first health consequence that occurred to me with climate change is this increase in infectious diseases, dengue, malaria, Zika, viruses that exist in other latitudes and which are carried by mosquitoes. These little bugs are starting to arrive here, and they weren’t [here before]

W, 34, Cultural producer, Lisbon

“We have a climate that is almost approaching tropical. And this favours the appearance of those mosquitoes that used to die in the cold, but now don't because they can protect themselves. The ecosystem is becoming favourable to insects that couldn't survive before (...) [When I went to India] I had a traveller's consultation and he advised me to take two types of vaccine and a series of medicines. I went in a group, there were twelve of us, and I was surprised because I think only half of us had been to a pre-travel consultation. The others had gone to India with some Benurons [painkillers]!”

W, 39, Landscape architect, Lisbon

“I associate this type of disease with Africa, where care isn't as good (...) If it appears here, it'll be easier, there's more chance of being treated and things won't develop so quickly.”

W, 44, Bio Researcher, Porto

“[There are vaccines] It helps, otherwise there wouldn't be so much tourism to so many parts of the world with situations like this (...) People feel protected in some way, they go to the pre-travel clinic, they get preventative vaccinations, but it doesn't stop us from contracting certain diseases. We have to be aware, we have this attitude, typical of human beings, that it's always the other person, it's never us.”

W, 45, Social worker, Charneca da Caparica

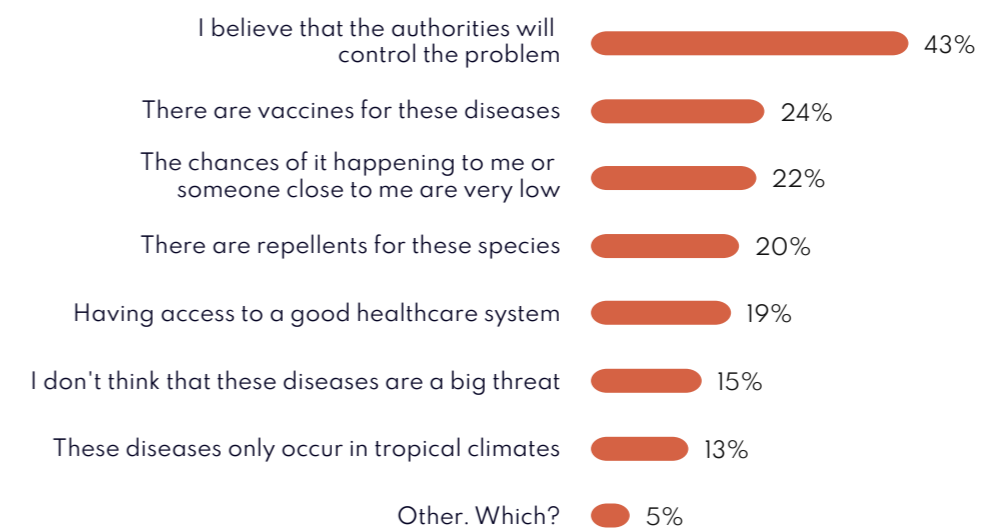
22%

Are little or not concerned about the existence of mosquitoes that transmit diseases such as dengue or Zika in Portugal

N=800

Arguments for low levels of concern

N=174



Q. Why are you so unconcerned about the news? Multiple answers

Do you usually go to a pre-travel consultation?

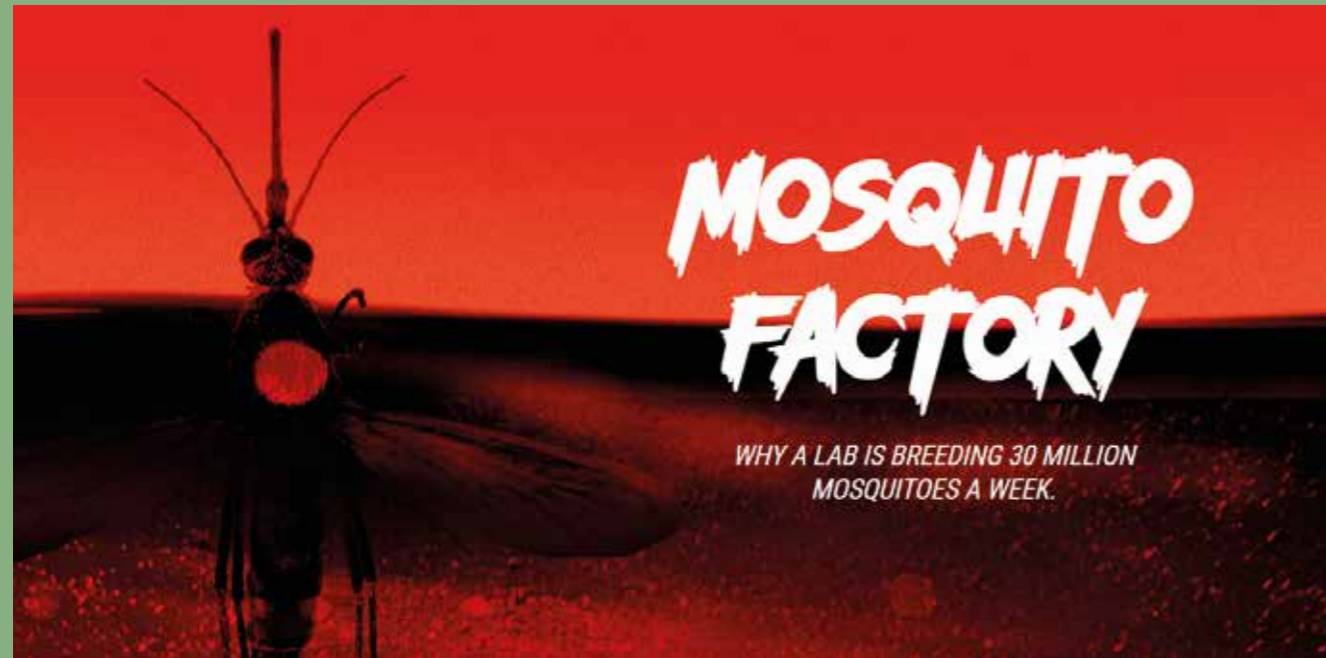
N=366 (base that travels or has already travelled to tropical countries)



Q. When you travel to tropical countries (e.g. Africa, the Middle East, South America, South East Asia), do you usually go to a "pre-travel consultation" to get information about health risks and precautions you should take at your destination? 54% answered "I never travelled to such destinations" (not considered in the analysis).

Vector-borne diseases

Examples that show the way



Bill Gates 'Mosquito Week'

Awareness week
about the health risks associated with mosquitoes

In 2014, Bill Gates, philanthropist and founder of Microsoft, created an annual section on his GatesNotes blog - Mosquito Week - to warn of the health risks associated with mosquitoes. "Mosquitoes kill more people in one day than sharks have killed in the last 100 years," Gates wrote. After a hiatus, the programme returned in 2018 and, since then, Gates has been sharing videos and stories every week to raise awareness of the issue.

In the latest edition of Mosquito Week 2022, Bill Gates shared details about a laboratory in Colombia that, as part

of the World Mosquito Programme, is breeding mosquitoes in Medellín. In the laboratory, more than 30 million mosquitoes are bred every week to be released for mating with wild mosquitoes.

According to Gates, these mosquitoes carry a bacterium called Wolbachia, which prevents them from transmitting dengue, Zika, yellow fever and chikungunya to humans. By breeding with wild mosquitoes, the lab-grown insects will spread the bacteria, which will lead to less disease transmission and prevent the loss of millions of lives.



Microsoft

Platform detects potential pathogens and
vector-borne diseases

Microsoft's Premonition is a kind of weather forecasting system, but applied to biological threats, such as outbreaks of vector-borne diseases. The platform is the result of a partnership between Microsoft and the US National Science Foundation's Convergence Accelerator Programme, academic institutions such as Johns Hopkins University and pharmaceutical giant Bayer. Microsoft Premonition continuously monitors the environment

looking for potential pathogens and disease-carrying animals before they become outbreaks. The system includes robots, machine learning models and tools for analysing data and samples. At this stage, the researchers are focused not only on increasing the sensor network, but also on studying mosquito-borne diseases in greater depth, having already analysed more than 80 billion combinations of genetic material.

Vector-borne diseases

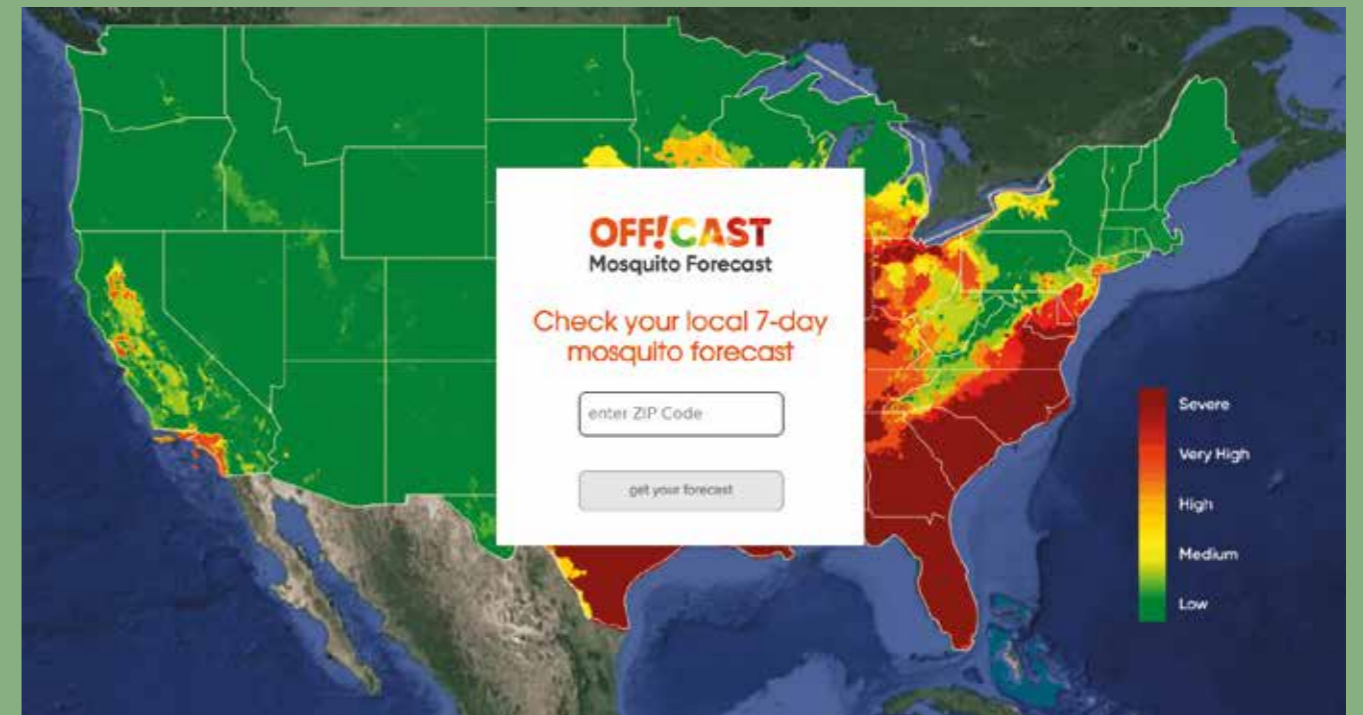
Examples that show the way



Auburn University
Researchers create fabric
that blocks mosquito bites

Researchers at Auburn University in the USA recently developed a prototype fabric that promises to keep users safe from mosquito bites - an innovative mesh with a geometric structure that blocks the needle-like appendage used by mosquitoes to bite. After programming different patterns into knitting machines and testing each fabric on real mosquitoes, the group of researchers created a special mesh (a mixture of spandex and polyester) that can stretch and

fold without leaving room for insects to pierce. The next step is to improve comfort and find clothing manufacturers willing to licence the fabric. According to the researchers, this type of protective clothing could be an innovative solution for countries facing malaria, dengue fever, West Nile virus and a high infant mortality rate due to vector-borne diseases.



Climate Engine, SC Johnson & Google Cloud
A tool to predict mosquito activity

Off!Cast is a new tool that predicts mosquito activity in situ (from "low" to "severe") over a seven day period, using an algorithm that processes detailed climate data from Google Earth Engine. The initiative is the result of a partnership between Climate Engine, scientists from SC Johnson (makers of Off! mosquito repellent) and Google Cloud. The model was created through a combination of many millions of climate data points from Google Earth Engine

together with previous counts of mosquito populations in thousands of locations and a scientific understanding of the mosquito's life cycle. Among the initiative's objectives is personal protection (through the use of repellent), but also the possibility of deciding, for example, whether to postpone a hike or walk. According to the creators of Off!Cast, the tool could also be used by governments and public health organisations.

The risk to mental health

In collaboration with Osvaldo Santos
Institute of Environmental Health of the Faculty
of Medicine of the University of Lisbon

[ver texto completo, Parte II, pág. 200]

Human responses (cognitive, affective, behavioural) are characterised by immense variability and complexity and are extraordinarily difficult to predict. Nevertheless, it is known that the mental health of a significant number of people is negatively affected by the experience (personal or witnessed) or anticipation of problems related to climate changes.

We can organise the impact of climate change on mental health into three main areas: i) the impact of personal experiencing natural disasters; (ii) the impact of prolonged exposure to climate change (heatwaves, cold waves, etc.), observable changes in seasonal cycles, etc.); and (iii) the stress associated with anticipating (more or less) apocalyptic scenarios resulting from climate change. [see next page]

[How can mental health be affected?]

In addition to the social determinants of severe psychological distress [resulting from social, material or environmen-

tal loss or damage], there are physiological mechanisms, i.e. the functioning of the body, that explain why excessive heat (or cold) is associated with disruptive behaviours (increased aggression, reduced ability to make healthy choices, reduced ability to manage family budget, etc.) or with psychological distress, which can manifest as depression, anxiety, or other mental health problems.

These physiological changes include hormonal changes, as a result of exposure to prolonged stress (heat, when intense or prolonged, is a stress factor), with more cortisol being released into the blood; synaptic changes (relationships between nerve cells, particularly in the brain); and changes in the functioning of some brain structures, which can result in reduced reasoning and more impulsivity.

High temperatures also increase exposure to air pollutants (they tend to be concentrated lower in the atmosphere and are more easily inhaled by humans); in addition, heat alters blood flow, which affects cognitive capacity and, in particular, the ability to make informed decisions, with medium- or long-term goals.

In Portugal, the 2017 Pedrógão Grande fire resulted in 66 deaths and the destruction of more than 1,000 homes. The event had a major impact on mental health, with a significant increase in rates of post-traumatic stress, depression and (pathological) anxiety in the affected communities. There was a 50% increase in the risk of post-traumatic stress among those who witnessed (even if not affected by) the fire.

(Santos et al., 2020)

The floods that hit Portugal in 2019 affected more than 100,000 people and caused material damage totalling millions of euros. A study published in 2022 estimated that these floods were associated with a 30 % increase in the risk of suicide at national level.¹

A study reveals that hospital admissions in Portugal related to psychiatric problems increase significantly on days when the temperature is high, particularly above 30°C². Another study on the Portuguese population revealed an association between prolonged drought (affecting agriculture and the availability of drinking water) and an increased risk of depression and anxiety.

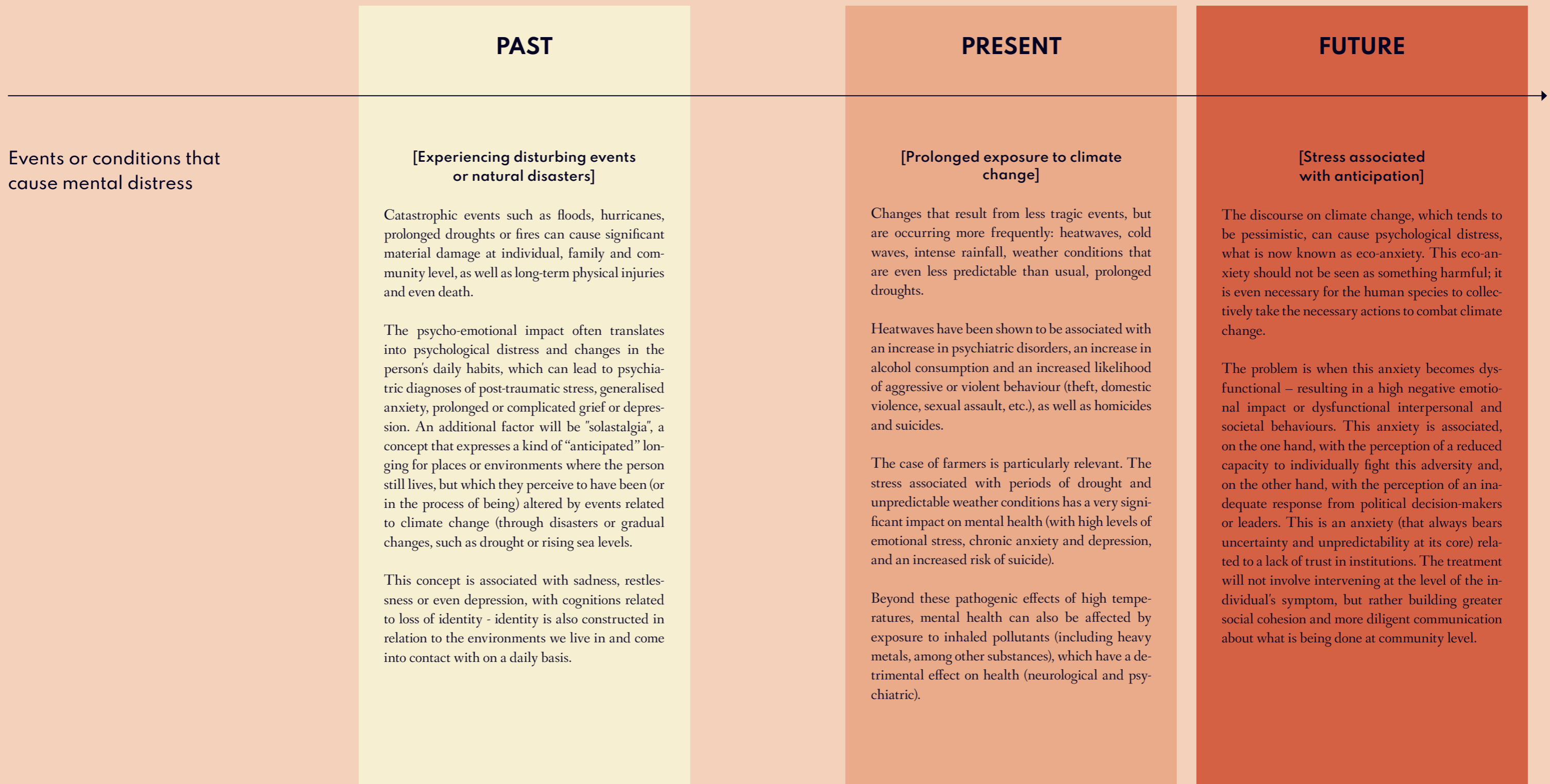
A third study³ involving 10,000 young people aged between 16 and 25 from 10 countries, including Portugal, showed that around 45% recognised that feelings about climate change had negatively affected their daily life and functioning, and many reported a high number of negative thoughts (e.g., 75 % think the future is scary and 39 % are hesitant about having children).

¹ Ribeiro et al., 2022.

² Almendra, 2019

³ "Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey", The Lancet, Planetary Health, 2021

Three types of climate change's impact on mental health



Mental Health

How do the Portuguese feel?

Mental health as a consequence of climate change was mentioned spontaneously in the two focus groups where one or more participants recognised the impact of climate anxiety. In these cases, the symptoms were essentially attributed to the suspicion of a future that they anticipate to be difficult, if not catastrophic, for humanity, blaming the inaction of institutions, but also the people around them. In the survey, only 35% reported that they had never felt any kind of climate anxiety.

The reasons for anxiety are divided into stress from anticipating what might happen in the future (45%), stress from things they already see happening, but that are distant (21%), and stress from what they see happening around them (35%).

Anxiety attributed to situations that have not yet caused direct damage or trauma to those who experience it is therefore the most common form of climate anxiety in Portugal. It is also this type of anxiety that is worrying Portuguese children and teenagers: 30% of parents with children aged between 6 and 20 report that they have at least one child who suffers from some kind of anxiety related to environmental problems [40% of parents with children aged between 15 and 20].

Only 8% say that the anxiety they feel is due to a traumatic event they have experienced or have been close to, a figure that rises significantly among those who are or have been close to an environmental risk such as fire or drought (20

%), and among those who have a nature-related profession (21%).

In the group discussions, it was clear - especially in rural areas, but also among people who have frequent contact with nature in their leisure activities- that they feel affected by landscape changes and biodiversity loss. Even if they don't become anxious or depressed, they feel emotional and a sense of loss when they talk about places that are dear to them and that they think are under threat.

This type of ecological grief has aroused growing interest among mental health specialists, and a new science, "the science of loss", is already being considered to make sense of the feelings associated with the environmental destruction caused by climate change.¹

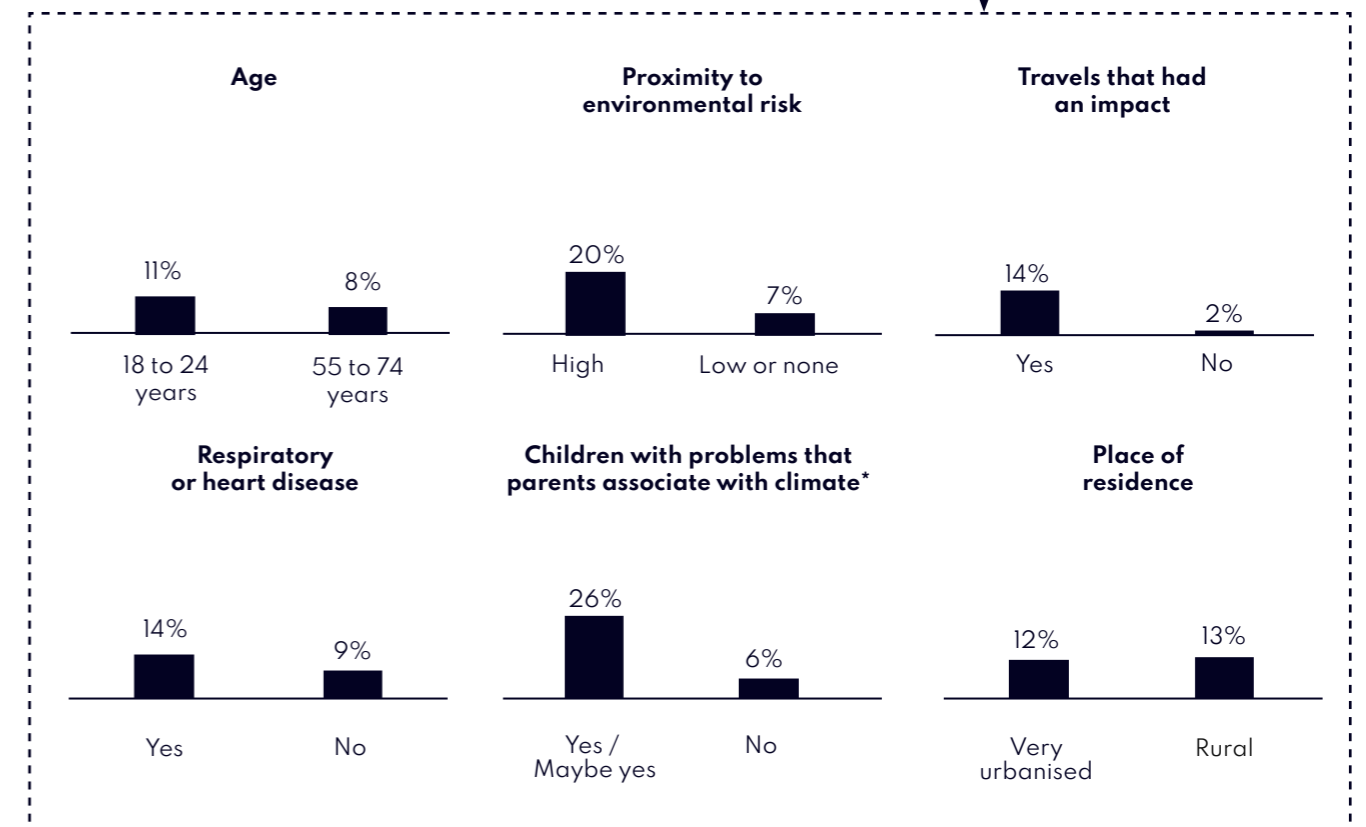
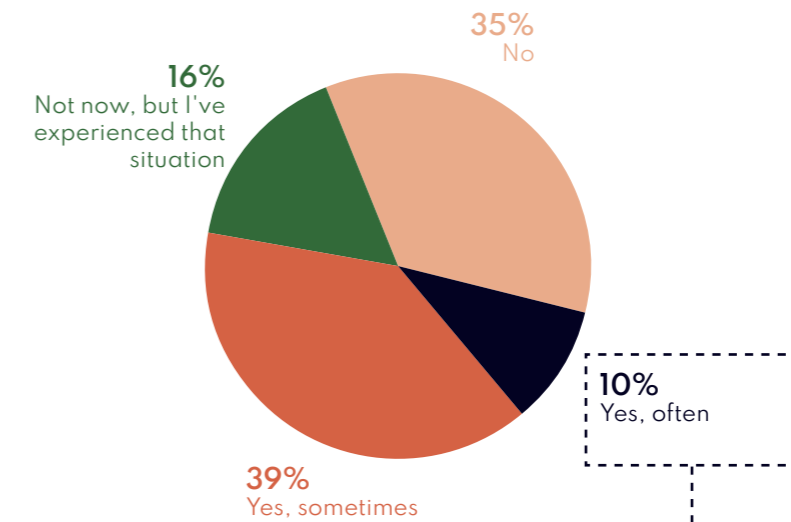
In fact, environmental psychology has focussed on "place attachment", i.e. the meaning that a particular environment holds for a person, and its potential influence on engagement with climate issues. According to some authors, this attachment - be it "place attachment" (the emotional bond), "place identity" (the sense of belonging) or "place dependence" (for fulfilling needs, such as work or leisure) - can have a positive influence on ecological intention or pro-environmental behaviour, being "important predictors for preserving a specific place".²

This study confirms this intuition: those who are connected to nature, by residence or profession, tend to be more aware and take more actions.

Climate-related anxiety

Do you experience or have experienced climate-related anxiety?

N=800



¹ Barnett et al., 2016

² "Representações dos media sobre os impactos psicossociais das alterações climáticas, em Portugal" ISCTE, Rodrigues C., Nov 2022

* Respondents who have child(ren) up to the age of 20
See details of criteria on page 220 of the Annexes

In Direct Discourse

“[I watch the changes in the weather] with anxiety. And I struggle. There are psychological consequences in my case. I'm suffering...there's a mourning for a planet that is disappearing. Every time I realise that there are species on the verge of extinction or that we continue to obliterate in our relationship with nature, it hurts me deeply. With anxiety... it's a feeling of anticipation, of a future that is emptied of meaning when I can't anticipate how it will turn out. And I anticipate that it will be in a less happy way than I would like.”

W, 34, Cultural producer, Lisbon

“I follow a lot of environmentalists on social media (...). They talk about it, there's always a phase when they go through ecological stress. I've been through it too... it has to do with anguish and the feeling of helplessness, you're trying to do something and you start to get nervous, anxious, because it's [already] happening acontecer... "Why isn't anyone doing something? (...) This is something I had to learn how to deal with, or at least try. (...) As for feelings, sometimes I feel angry, other times, I feel anxiety and hopeless.”

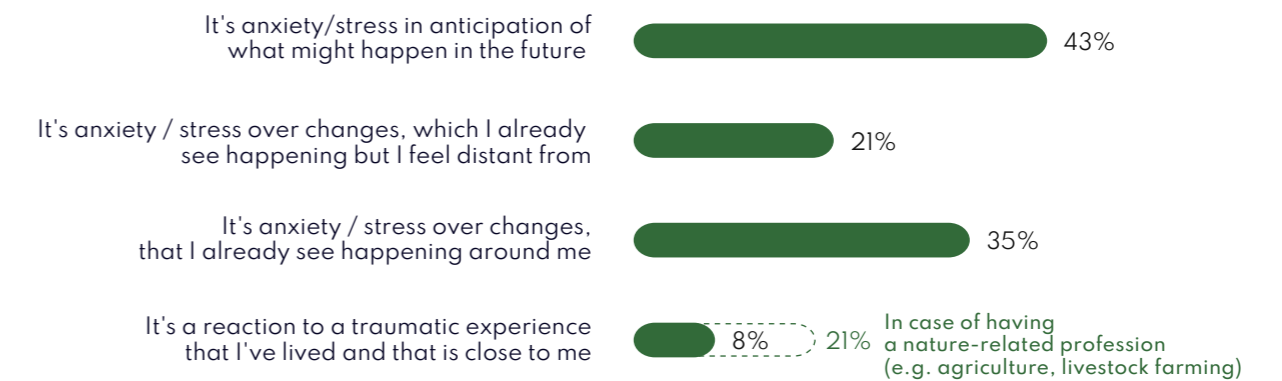
W, 33, Tourism Management, Tomar

“It distresses me to think that I have brought into the world three children who will have a terrible world to deal with, and the problems they will have to face, which could have been avoided. It angers me I'm very angry that these words about sustainability are on the agenda, but that they're hollow, it's all very hollow, it's all green washing, and I'm very angry about that.”

W, 45, Social Worker, Charneca da Caparica

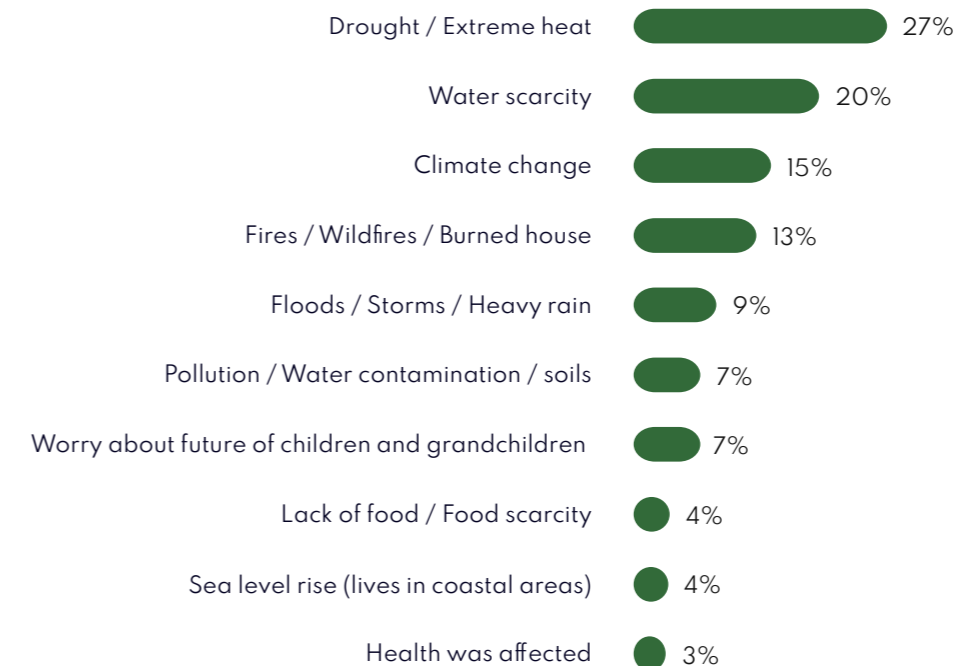
Does the anxiety you feel resulted from an experience you've been through or is related to a feeling of anticipation of what might happen in the future?

N=524



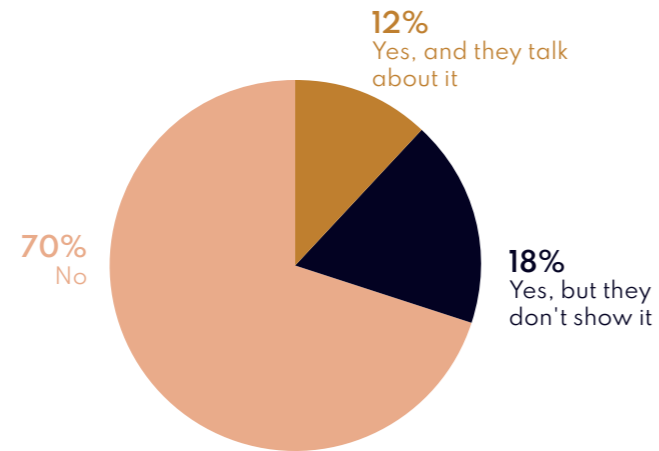
What specific situation are you referring to?

TOP 10 - Open answers
N=524



Does your child, or any of your children, suffer any kind of climate-related stress or anxiety?

N=257



Q. Do you think that your child, or any of your children, suffer from any kind of climate-related stress or anxiety? Base: Parents with children aged between 6 and 20.



	CHILDREN 6-14 YO N=139	CHILDREN 15-18 YO N=78
YES, AND THEY TALK ABOUT IT	15%	10%
YES, BUT THEY DON'T SHOW IT	12%	29%
NO	73%	60%



Of the many pointed portraits of modern parenting offered by the HBO series *Big Little Lies*, the most evocative may well be the episode in which a child (the daughter of wealthy parents) has a panic attack at school and faints. A child therapist is called in to intervene and diagnoses climate anxiety. "Her lesson is obviously about climate change. She's got the message that we're doomed," explains the therapist. The episode leads to a meeting being called where it is concluded that anxiety is "an epidemic in our schools".

The real world confirms this caricature: 57% of the British child and adolescent psychiatrists treat children and adolescents who are distressed by the climate crisis, according to a study by the Royal College of Psychiatrists in the UK¹.

Emotions that children can experience include low mood, helplessness, anger, panic and guilt. The study stresses that "ecological distress is not a diagnosis or mental illness. Feeling distressed or anxious about the world is normal and shows that young people care about the planet, but sometimes these feelings can be overwhelming and difficult to deal with, especially at a young age."

¹ "The climate crisis is clearly affecting children and young people's mental health. Royal College of Psychiatrists online news, Nov 2020

Mental Health

Examples that show the way



Tunne ry, Nyyti ry & MIELI
Mental Health Finland
 Nationwide project provides support for climate anxiety

The project "The mind of eco-anxiety" (Ympäristöahdistuksen mieli in Finnish) was set up in 2020 by mental health and social care professionals concerned about the impact of the climate crisis on the mental health of Finns. Three NGOs (Tunne ry, Nyyti ry & MIELI Mental Health Finland) are behind the initiative that launched the "Let's talk about eco-emotions" awareness campaign in partnership with various mental health organisations.

The campaign involved a series of online events aimed at the social and health sectors, and the launch of a website (Ympäristöahdistus.fi) to share content on eco-anxiety, such as psychotherapeutic approaches and informative articles made in collaboration with experts. At the same time, a podcast has been created (one of the episodes is aimed, for example, at young people who are hesitant about having children because of climate change) and discussion groups have been organised aimed at more vulnerable groups, such as farmers and rural populations.

The campaign reached around 3,570,000 views through various channels. As for psychological support, group sessions were organised for the younger segment, aimed at i) helping to recognise and deal with eco-emotions, ii) teaching coping mechanisms for anxiety and iii) building a support network..

At the beginning of 2022, around 360 individuals (mainly aged between 20 and 30) had taken part in 30 workshops and support groups.

The project also provided training for education, health and social care professionals, enabling them to deal with people suffering from climate anxiety. Around 1,160 professionals (mainly women) took part in around 30 training courses and other events. The European Climate and Health Observatory, under the auspices of the European Environment Agency, considered the "The mind of eco-anxiety" project a case study.



Bureau of Linguistical Reality
 Collaborative project helps create a lexicon to express emotions caused by climate change

The Bureau of Linguistical Reality is a conceptual and artistic project created in 2014 by Heidi Quante and Alicia Escott with the aim of collecting, translating and creating a lexicon for the Anthropocene. The initiative was born out of the need to find words to describe the anxiety they both felt during the drought in California between 2011-2017. According to the authors, the world is suffering from a collective "linguistic void", which translates into an inability to express the emotions we feel in the face of climate change. The Bureau of Linguistical Reality proposes the creation of linguistic tools to help express these (new) personal and collective feelings.

Most of the words are coined by the authors during casual conversations at live events, but suggestions are also accepted and can be submitted via a form on the project's website. Among the neologisms are words such as "Shadowtime", described as "a time loop parallel to regular time and manifested in the sensation of living simultaneously on two different time scales" or "technikskreis", suggested by a German engineer and "characterised by the feeling of being trapped in a vicious circle or spiral, thinking that technology will be the solution to the [climate] problems created by technology".

Mental Health

Examples that show the way

Vattenfall

Brand launches therapy sessions with specialised engineers to combat eco-anxiety

According to a study carried out by Swedish energy operator Vattenfall, 80 % of reports on climate change in the media are negative. As a result, 2 out of 3 respondents reported anxiety about the issue, assuming that the lack of news about progress on the climate issue made them less confident about the future. Recognising that repeated exposure to negative reports can lead to apathy, Vattenfall brought together a group of expert engineers to provide clear information and examples of progress in climate action...

Individuals suffering from eco-anxiety were able to book a 20-minute online session with an expert via a website. The campaign was launched on Vattenfall's social and digital channels in collaboration with Swedish 'influencers', including a mini-series in which these influencers talk about eco-anxiety with an engineer. By giving the opportunity to spend time with a credible and informed expert, Vattenfall puts a human face on an emotionally complex issue.



Vattenfall x Spotify

Brand launches playlist inspired by sleep and meditation apps to relieve climate stress

The same company Vattenfall has launched, in partnership with Spotify, the Super-Soothing-Climate-Progress-Engineering-Tracks playlist to not only showcase the progress made in eradicating fossil fuels in its operation, but also to alleviate climate anxiety. With seven different audio tracks on Spotify, reassuring stories about positive developments towards a fossil fuel-free future are made available. Each track consists of a technical deep dive, designed to give listeners a sense of relief.

According to Vattenfall, the aim of this initiative is to provide detailed information on measures taken and progress made on climate issues, reducing the feeling of helplessness and stress caused by the crisis. The campaign was inspired by sleep and meditation apps (eco-anxiety can increase the difficulty of sleeping and relaxing).



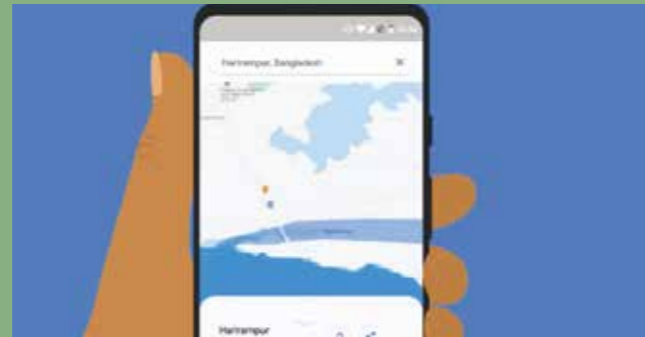
Other initiatives that illustrate ways forward



Claudent

SPF clothing combines fashion and design with UV protection

Claudent is an American brand created to revolutionise the Sun Protection Factor (SPF) clothing market. All the clothes are made from fabric with an SPF 50 rating, allowing only 2% of the sun's rays to penetrate. The target audience is "a young segment unwilling to give up style in favour of functionality". The brand wants to challenge the assumption that clothing with sun protection is only for children and older age groups.



Google

Tool to prevent floods

Flood Hub" is a tool from Google capable of predicting floods seven days in advance. This software uses various data sources, such as meteorological forecasts and satellite images, and combines them with models that make it possible to gauge how much water is flowing in a river, which areas will be affected and what the water level will be. The company recently announced the global expansion of this resource to more than 80 countries, including Portugal.



Noordung

Electric bikes with air-quality sensors

The new 'Noordung Boombox' electric bikes from Slovenian brand Noordung have built-in PM 2.5 and PM 10 particle sensors that monitor air pollution in real time. Users can access the data collected via a proprietary application which, based on the information gathered, indicates the routes with the best air quality. Noordung's e-bikes were honoured at the German Design Awards 2023.



Otrivin x Wunderman Thompson Singapore

Making pencils out of captured air pollution

Breathing polluted air is a daily reality for 98% of schoolchildren in India. Aware of the problem, Otrivin, in partnership with Wunderman Thompson, visited three schools where 22 air purifiers were installed. Over two months, 56 million square metres of air were cleaned. Graphite was added to the residue, resulting in pencils that were then distributed to the schools. In the long term, Otrivin plans to use the sale of "pollution capture pencils" to raise funds to combat air pollution.



IFTNA

Antiviral and antibacterial textiles

Intelligent Fabric Technologies North America is a company that supplies everything from antiviral and antibacterial additives to UV protection for use in textiles. One of the company's main products, PROTX2 AV, is proven to eliminate viruses. Its main clients include athleisure brands such as Lululemon. IFTNA is also developing an antibacterial and antiviral additive for household washing, which can be added in the same compartment as the fabric softener.



Aizome

Range of skincare products made from wastewater

Textile company Aizome recently launched Wastecare, the first range of skincare products made from wastewater collected at its factory. Using only plants, water and ultrasound in the dyeing process, the brand claims that wastewater has natural health benefits, including anti-inflammatory, pain-relieving and skin-rejuvenating properties. According to the United Nations, the use of chemicals in the dyeing process is the second biggest cause of water pollution.



MegaFood, Gaia Herbs & Herb Farm

Brands guarantee nutritional density through regenerative agriculture

Several relevant projects have sought to establish the correlation between soil health and the density of nutrients in food. In this spirit, some vitamin and supplement brands, such as the American MegaFood and Gaia Herbs or the New Zealand Herb Farm, have endeavoured to adopt regenerative agriculture practices that ensure that their products offer the nutritional content necessary for human health.



Climate Council

Study shows impact of climate change on mental health

Climate Trauma: the growing toll of climate change on the mental health of Australians is a pioneering study presented in 2023 by the Climate Council, an Australian NGO specialising in climate change communication. The report analysed the impact of climate change on the mental health of Australians, highlighting a widespread sense of distress following the increasing number of destructive weather events and the consequent increase in insurance premiums.

Final note: a call to action

The aim of this study was to capture the reaction of ordinary citizens to the risks that climate change poses to the health of the Portuguese and to facilitate more informed decisions for protecting their health. However, we hope that the information gathered here will reach other areas.

Without a collective transformation, any exercise in defence or response to the climate problem is inglorious, if not useless. To move a collective to action requires more than an appeal to citizens' consciences. It requires a new intellectual attitude, a new ethic, a new map of moralities to guide new social conduct and behaviour. It requires a vigorous collective drive.

While it is true that risk mitigation requires voluntary action and voluntary compliance from individuals, it is undeniable that it also (or above all) requires decisions and actions from organisations and governments. In this chapter, among the initiatives "that show the way", there are solutions can only be implemented by public institutions, local and municipal authorities, or organisations and companies capable of innovating or acting locally.

For doctors, healthcare providers and public health officials, in whose lap the effect of climate change will inevitably fall, we hope that the document will at least arouse interest in understanding the gap between what is being done (or planned) in terms of prevention and professional training, and what even under the most benign scenarios of climate change evolution is recommended.

Finally, to academia and researchers who study environmental and health issues, we hope to leave clues that will inspire further research. If we have learned anything from the study, it is that knowledge about the consequences of climate change on health is still at an early stage, and we would all benefit from a more enthusiastic dialogue between those who know about the environment, the climate and health.



**6.
Future(s)
to imagine
and build
[a beginning]**

As extraordinary as mankind's advances are, predicting the future is not yet within our grasp. In the case of the climate, not only because we still can't accurately predict scenarios in complex systems with multiple variables and correlations, but also because we can't anticipate our own interference in these systems.

The inability to clearly predict the future does not mean that we are condemned to what is in store for us. We are capable enough to design predictive modelling, that from facts and scientific conclusions, provide undisputable trends. The increase in the planet's average temperature compared to the pre-industrial era over a period that, on a human scale, will be long, is one of them. A subsequent cascade of environmental phenomena leading to threats to our health is another.

We are therefore called upon to make profound changes to modes of production, social organisation, and individual behaviour, if not to reverse these trends, at least to soften their impact.

Changes of this magnitude require prior conditions: awareness of the situation, incentive to transform the situation (whether or not this involves dissatisfaction with it) and a plan (or, for the more practical, a project) to guide efforts to transform it.

At the civic level, most of the efforts made by the environmental agenda are centred on the first point, the awareness of reality. Apparently, among the Portuguese, the effort is succeeding; the majority are familiar with the climate problem.

As awareness proves to be insufficient to bring about change, the incentive for transformation has been legislation and policing. This has its merits, and has been proven in Portugal and Europe to work, but prohibition and punishment don't always elevate our good-will and willingness. Just as pessimistic safeguards about the quality of life of those yet to be born are not enough to co-motivate the Portuguese who today are struggling to live with some dignity.

We can and must keep on pushing for change based on evidence and, from this perspective, the threat to our health, that of our parents and that of our children, is a solid argument.

But it would be naive to attribute inactivity solely to a lack of awareness of the risks. Or even a lack of incentive. We have rooted habits, or above all, we lack orientation towards an alternative. Climate activism shows a lack of creativity when it fails to go beyond proposing a return to the past.

Thinking about the future is not something that many people want to do. As humans and social actors, we tend to focus on the present.

This lack of reflection about the future is well recognised among the Portuguese; in a survey, almost 60% don't consider themselves to be people who give much thought to what the future of the country and the world might be like. And when they do think about it, 65% don't think beyond a five year period. We lack the imagination (and the time and space) to conceive an alternative future).

During this research, we came across a French initiative that inspired this final chapter: the Citizens' Assembly of Imaginaries. Its founder, Valérie Zoydo, argues that, contrary to what has been done, if we present a favourable future, it will be easier to adapt our way of life to the limits of the planet. She therefore calls for the creation of "new imaginaries", collecting stories, ideas and even semantic fields that feed micro fictions (and artistic or aesthetic objects) about the future.

This positive approach to the future is based on the principle that before you can create a different society, you have to imagine it. It is our thoughts and ambitions that allow us to create reality (or the future) and, as we can see here, our imagination today is contaminated with fear, anxiety or scepticism.

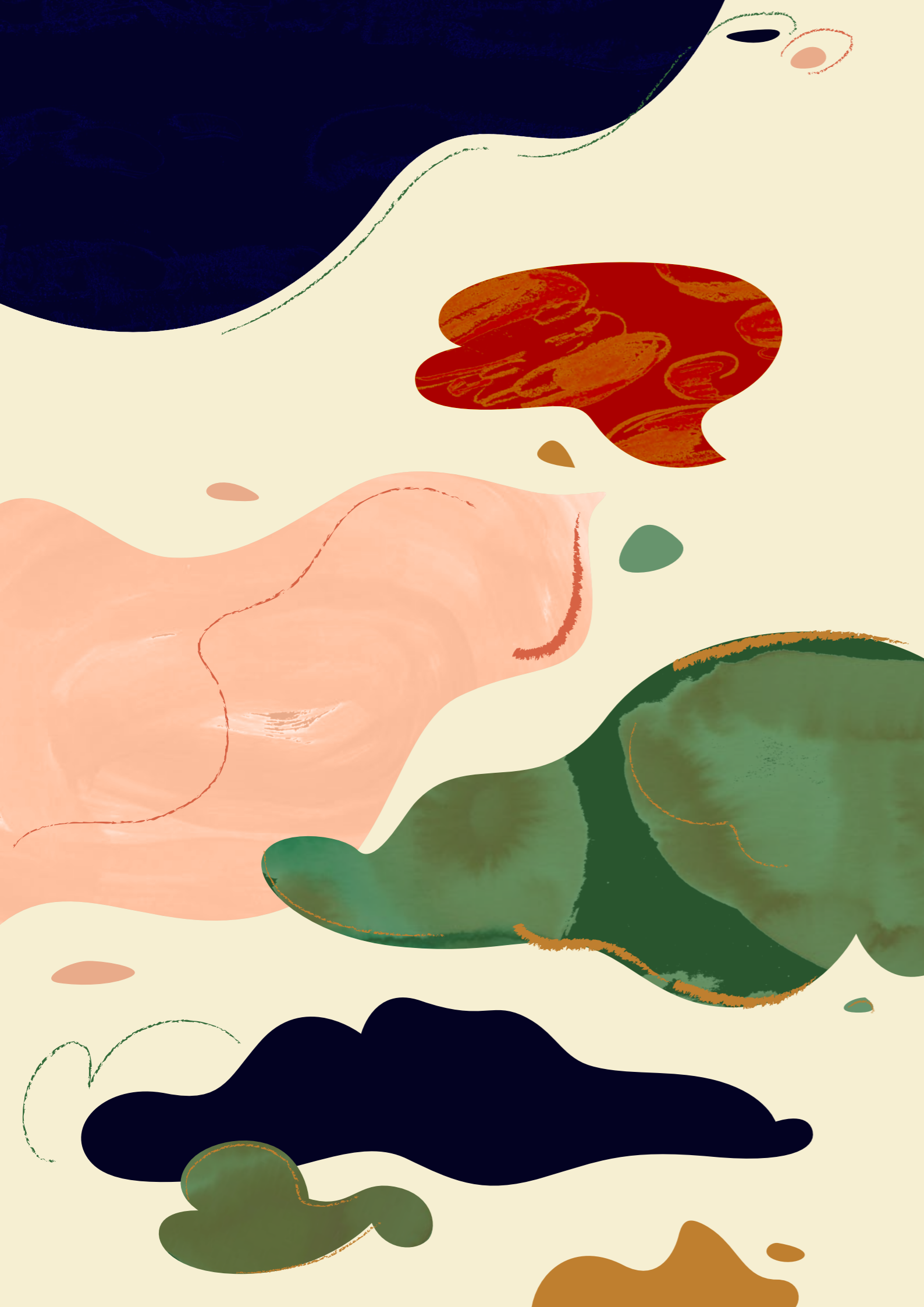
The opportunity lies not only in building laboratories for the future, but also in all initiatives that can effectively address our emotional and sensory life. We would say, as so many others have said [including anthropologist Bruno Latour], that science and art need to be more co-operative.

In line with this belief, we wanted to add here a work of a different nature: a first narrative that, challenged by this research, can show that the future can also have appealing qualities.

Therefore, we invited the writer Gonçalo M. Tavares, whose text 'The future of the climate, the climate of the future' is included here. A short essay, but a long-lasting echo.

«The transformation we need to make in order to move from modernising to 'ecologising' is so far-reaching that it will require us to work on all the themes possible and imaginable, in universities, museums and all institutions.»

Bruno Latour
Anthropologist, French sociologist and philosopher of science



The future of the climate, the climate of the future

short essay

by Gonçalo M. Tavares

1.
The future is somewhere
Between two stones to start a fire
And a far future.
Because there is no future without the next day.

The last of the futures will be either the apocalypse
Or once again the last but one
Or even the first of the futures.

The stubborn time keeps on marching,
Sometimes limping, sometimes accelerating.
Not even the dusty winds dirty all at once
Nor do clear winds
Clean all in one pass.

The climate is, thus, an antique thing.
Sometimes it is a battle between inefficient
and clumsy cleaning
And an army of entropy and rubble.
An army made of rubbish of all kinds, clogging
the healthy circulation
of all possible states of matter.

The different States are united
to produce the good and the evil.
Promoted, plasticised,
resistant and at a good price.

If good and evil
(Let's put it in simple terms)
were next to one another
in the supermarket
One, the good, at a high price,
The other, the evil,
on special offer,
The hasty consumer would without doubt buy
The one that is cheaper at present.
Let there be no doubt about that.

2.
In certain far-sighted countries
Every decent government
has already in their powerful aisles
A ministry of the future.
Citizens vigilant to the urgent needs
of the generations whose parents are yet to be born.

We take care of heritage, of course,
Of old buildings and old languages,
But let's also take care of what we cannot see
nor hear yet,
What doesn't occupy space nor complains,
Of those who don't vote nor yell.
Of the animals and plants, the solids, and the seas
Yet to be born

3.
The climate is, thus, an antique thing.
Way before the dinosaurs
A light breeze was already blowing
Over the natural ground
Pre-made and well prepared
For humans and animals.

4.
The computerised, biblical human
Now is here
Capable of making, with modern technology,
A perfect copy of ancient religious miracles.
Capable of turning, with imagined machines,
dirty smoke into colourless smoke
Colourless, shapeless, and odourless smoke.

One day,
with the right machine and a certain aim
Some lightness will come from the smoke
Something that will not be a weight
Neither to the air, nor to the lungs
Of the many living beings
Who today wander
through the air the earth and the sea.

And let's also take care of the desire
of the fecund and powerful organisms,
that are loaded with future from head to toe,
and in all necessary organs for procreation.
There is only future, and this is biological evidence,
With some desire
Whether from skin, from personal hair
or society as a whole

5.
The factories will produce 100% fresh air
And well-being will be replaced by well-walking
And by well-dancing and by well-singing
And by well-loving because well-being is no longer
enough
For humans, animals or even for the flat plants,
Who in a revolution each day demand everything
Not only water sun and survival
But also, who knows, pleasure.

Yes, even the tree
Is tired of standing still
As its apparent immobility
Meant just to be still and contented.
We know that when it comes to the tree,
Everything that lives and is fast, begins.
And yes: even the tree requires care and affection
Not just the sufficient amount of H₂O.
No organism wants just to survive,
What lives wants that immaterial and ancient thing
that is the largest possible amount of joy.

6.
We need to drain the announced apocalypse
With a thin and accurate needle.
The right action will not come from crazy despair.
Despair movements lead to clumsy movements,
without calmness we miss the target
and not even the GPS will know the target's location.
Is the target in the North or in the South?
East or West? Upward or downward?

The good-hearted ecologist is in despair
lost in time and in actions.
They yell and shoot like they have dementia:
they hit anything that moves
and anything standing still.

All despair
Even the well-intentioned,
creates circular or dead-end ideas.
And every circular movement is predictable
as we learned from geometry,
which knows more about politics
than many written treatises.

“Onwards”, said the oxen
that walked around the water wheel
producing something
that was useful just for their masters.

Every circular political manoeuvre
Will only lead to dizziness
and weariness among the initially enthusiastic spectator
Perhaps replacing the vague cry
directed at the evil machinery announced,
with specific research that counterbalances
the polluting machines with machines
capable of producing
a fluid future, harmony, and peaceful conversations
by the sea.

7.
Let the water air earth and fire
The four old natural elements
Be compatible with the artificial intelligence
that is out there.
Let the machinery moderate the fire that kills
The water that drowns
And the air that suffocates
And the earth that sometimes collapses under our feet.
Because from the human came the beautiful and the ugly,
As a museum picture or under the sun.

From the human came the ugly and the beautiful,
The beautiful and the ugly,
and the very beautiful and the very ugly.

The first future is here, in 2023
Or a couple of years before or after.
The first future will end nothing,
This we already know from the natural order
of simple numbers.

Let there be a second future after the first one,
And a third and so on and so forth
This is what a sensible utopian wishes
and easily divines.

If the first future scares pollutes and smells
makes the lungs and the flowers sick,
infiltrates dust and smoke into pure oxygen
that is so beautifully predicted as a combination
in Mendeleev's table, so straight and ordered,
If the first future scares, then,
I insist, if it pollutes and smells, then
let a second future come rapidly
and that is not made of past and nostalgia
but of balanced and required intelligence.
New weird factories produce mosquitoes and wind.
Sponges are being made to prevent that all of the heat
doesn't go directly into earth and biology.

The quality of the water, yes,
the quality of the air
and yes, why not also:
The quality of the fire.
Because it is the fire that gives form to things
It shapes and transforms them.
Everything that is form comes from the fire.
To improve the quality of the fire
To improve the quality of the form.
To improve also, of course, the quality of the soil.
What you step on is sacred.
Instead of walking of course we should fly,
So that we don't ruin what existed well before us
with our feet and shoes.

But to be a bird is not easy for all animals.
But yes, these are the five goals
for the second upcoming future:
to improve the quality of water, air, fire, and earth,
And to improve the quality of the human,
The 5th element,
This magnificent substance that has been around
and has made so much.

There's no point, the sceptic will say,
In improving the quality of what's around us
if we don't improve humans before.

Then, we think of machines
capable of improving on humans
not the strength, intelligence, or intuitive calculation
for the old arts, but their ethics.
A new machine capable of making the human
more ethically balanced.
Medicine has enough medication for physical,
psychological and even social diseases;
Ethics has no place on pharmaceuticals,
Leaving it for the collective moralists
and helpless parents.
Ethics is not a matter of chemistry, is something
one stands for.

8.
Ethical machines, that is what we've been
asking for long now.
Good-mechanically-hearted machines
Good-algorithmically-hearted machines.
And a utopian proposal would be to demand
something new from these new factories:
Machines that produce ethics instead of objects
for immediate use.
Let what is functional be devalued
in comparison to what brings kindness
to the world and into our days.
A lot of what functions doesn't bring any good
Although kindness is useless
for the overall progress of the technical nations.

Kindness is sometimes a ball and a chain,
For example, waiting for those who are last or
struggling.
The ones who wait for the last, fall behind.
Those who chase first place speed up.
Sometimes ethics and first place
are extremely incompatible
and those who think they are quick and ethical at the
same time are fooling themselves.
Ethics always comes a little bit late,
but it arrives with everyone – even the poor, for example.

9.
Ethics is not a method for winning races,
it is a multiplication process for hospitality,
Of not allowing that a single castaway
stays alone on the high seas.

The extreme temperatures on earth
where our great-grandsons will set up their tents
will demand from humankind extreme modesty
combined with extreme ambition.
We are very minuscule next to the many mountains,
to the world, the sun, to the cosmos and
to faraway galaxies
But, at the same time, we have enormous power
To make the possible change towards the excellent.

Certainly, the climate cannot be changed
As we change a burnt-out or broken light bulb.
The climate is too high and wide
For the bipedal technician's limited hands,
But we have already realised that if the limited hands of
the bipedal technician are incapable of solving it all
and if they are not to blame for it all
(it wasn't them, apparently, that were responsible for
dinosaurs' extinction, for example)
they are at least capable of doing something.

I imagine factories that make trees
Capable of resisting to natural and human catastrophes.
Educational crafts capable of turning a child into a lucid
adult, capable of distinguishing between good and evil, the
wheat from the chaff, the beauty from the ugly, what
saves from what kills, what protects the future from what
hinders it.
This simple ability of being able to distinguish and decide,
to act like patient Buddhist masters who, instead of
making many well-intentioned but bewildered and foolish
movements, make a single perfect movement
at the perfect moment.

There is no useful ecological ethics without some study
of physics.
Like military equipment lost in the
Enemy's camp,
All the energy wasted on a secondary target
Will not be recovered and will be used by the adversary.

Can a plan of zeros and ones create a mild climate,
hinder the excesses that are smashing us.
Benign technology is out there and will perhaps
create good days.

It is not about going back to the forest
and to the day fire was invented.
It is about taking care of the living
and the ones yet to be born,
starting from now.

Decisive blows are of the finest detail.
Every explosion produces rubble and rubbish;
There is no dynamite capable of producing future.
And not everything that humans have made or invented is
destructive.
To start from scratch is to start too far back.



Part II

Scientific evidence

1. The impact of heatwaves and extreme temperatures on health
2. The impact of climate change on air quality
3. The impact of climate change on water quality
4. Vector-borne diseases and climate change
5. Mental health in the context of climate change

Climate change leads to changes in the frequency, intensity, spatial extent, duration, and time of year when extreme weather and climate events occur. Although the climate is naturally variable, climate change can cause unprecedented extreme events. These events include heatwaves, cold waves, heavy precipitation, droughts, or cyclones. This chapter focuses mainly on the former.

Of the many health threats posed by climate change, exposure to high temperatures has been the deadliest, and it is very likely that the frequency, intensity, and duration of heatwaves will increase in most land areas. Although winters are expected to become milder and cold waves less frequent, their potentially increased intensity does not make them any less threatening, and exposure to cold is also associated with significant number of deaths.

Around 30% of the world's population have already been exposed to extreme temperatures that cause increased mortality, and this percentage could rise to 74% by 2100 if greenhouse gas emissions increase.¹

The impact of heatwaves and extreme temperatures on health

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According to the World Meteorological Organisation, heatwaves and cold waves are periods of at least six consecutive days during which the air temperature is 5 °C above or below normal for the season in each region. These events have direct and indirect impacts, not only on people's health but also on the functioning of society, the economy, and the environment.

Crop and livestock production tend to be directly affected, which can lead to disruptions in services and infrastructure and in the distribution of products, as well as decline in labour productivity and an increased risk of occupational accidents (especially in agriculture and construction). There is also an increased risk of disruptions to the electricity grid due to the overloading of the system caused by the increased use of air conditioning. Heatwaves can also worsen droughts and increase the risk of forest fires (especially if they occur during drought periods and are accompanied by strong winds).

Their impact on health is greater when they occur in the summer months and when they are accompanied by high levels of humidity, air pollution and high night-time temperatures. On hot, sunny days, high concentrations of ground-level ozone tend to occur, which can cause eye, nose and throat irritation, headaches, chest pain and breathing difficulties. Particles emitted by air conditioners can also affect air quality.

Energy poor households are particularly vulnerable to cold and heatwaves, given their difficulty in maintaining adequate levels of heating or cooling in their homes. In general, populations in urban centres tend to be more vulnerable to heatwaves, partly due to the 'heat island' effect observed in cities caused by the absorption of heat by buildings, roads and other infrastructure with dark, impermeable surfaces in areas with high urban density without green areas or breezes. Workers in certain sectors are also particularly vulnerable, either because they are exposed to the heat outdoors or because of the heat associated with certain work processes or equipment. Families living on the top floor of buildings with dark roofs and poor insulation may also be more vulnerable. In general, the elderly, children in the first years of life, pregnant women and people suffering from heart, kidney, respiratory diseases, diabetes, obesity and alcoholism are particularly vulnerable to heat-related risks. Increasing importance is also being given to the impact that climate change can have on fertility and reproductive biology.² Finally, social inequalities have been analysed as an important factor regarding the impact of climate change. Age, pre-existing medical conditions and disadvantaged social environments are key factors that make vulnerable people more likely to experience more negative health outcomes related to climate change.³

Effects on health

In situations of exposure to high or low temperatures, the human body can go into stress, as it needs to maintain its internal temperature within certain limits (approximately 36.5°C), resorting to physiological changes (such as dilation or constriction of blood vessels, sweat production or shivering, among others) to maintain thermoregulation. This adaptation effort represents a health risk, especially for the most vulnerable groups.

Both heatwaves and cold waves tend to be associated with increases in mortality and morbidity, i.e., an increase in the number of deaths, but also in the number of people with health problems. However, in terms of mortality, heatwaves tend to have a more immediate effect, while cold tends to have a more prolonged effect over time, associated with the effort to adapt to the cold and greater viruses' spread. There is a regular seasonal increase in mortality in winter, so in general the whole winter period (and not just cold waves) is associated with an increase in mortality.

Heatwaves can have acute direct health effects such as dehydration, feelings of exhaustion, cramps, fainting, rashes or heat stroke, which can be fatal.

These mainly affect professionals who work outdoors or do manual labour, the elderly, children, pregnant and breastfeeding women, as well as people with chronic illnesses, residents in urban areas, people living in energy poverty, the homeless and those with limited economic resources, bedridden people, and drug addicts.

In addition, heatwaves are associated with the following indirect effects on health:

1. Aggravation of pre-existing cardiovascular and respiratory diseases, and kidney problems;
2. Burns and injuries resulting from accidents at work due to errors caused by exposure to high temperatures or contact with hot surfaces, especially by agricultural, forestry, fishing, construction and industrial workers;
3. Increased transmission of food-borne, water-borne, vector-borne (such as mosquitoes, ticks, fleas) and zoonotic diseases, aggravated by the rapid degradation of food in hot weather and toxins in shellfish and seafood;
4. Burns, respiratory problems and other conditions caused by exposure to smoke during forest fires, mainly affecting firefighters and civil protection agents, and people with chronic respiratory and cardiovascular diseases;
5. Negative effects on mental and emotional health, which can lead to an increase in violent behaviour, crime, and suicide (especially among people with pre-existing psychiatric illnesses).

As for the direct health effects of exposure to low temperatures, they are hypothermia, which can be fatal, and skin lesions (ulcers, frostbite, chilblains). These effects mainly affect workers in sectors such as agriculture, fishing and construction, the homeless and those living in precarious housing, babies and the elderly. The main indirect health impacts are:

1. Aggravation of pre-existing chronic cardiovascular, respiratory and musculoskeletal diseases;
2. Injuries and traumas resulting from road accidents or falls on icy sidewalks, but also accidents at work, especially in the professions most exposed to the cold, such as fishermen and workers in the transport, energy and water sectors;
3. Poisoning by inhaling carbon monoxide, which can be fatal, and results from the use of combustion appliances such as fireplaces, braziers or gas heaters;
4. Increased transmission of infectious diseases (such as influenza and other viral respiratory diseases), which can lead to disruptions in health care, with congestion in hospital emergency rooms;
5. Effects on mental health and well-being, such as increased anxiety, especially among people with pre-existing mental problems and low incomes.

Here some other of the most relevant sub-issues for global health that can be deleteriously affected by climate change, in the form of heat or cold waves:

Allergies ^{4,5}

Patients with chronic respiratory diseases, such as asthma and allergic rhinitis, are at increased risk of aggravation from exposure to pollen and air pollutants. According to the American Academy of Allergy Asthma & Immunology, heatwaves have increased the intensity (abundance of pollens) and duration of allergenic pollen season. An environment with less cold temperatures, drier and hotter summers is altering existing ecosystems, with changes in vegetation areas.

Microbiome

The scientific community has been giving increasing importance to the microbiome, i.e., the community of microbes that inhabit the human gastrointestinal tract. The composition of the microbiome is highly variable in early life and tends to stabilize in adulthood. These bacteria play an active role in human immunity and in maintaining barrier defences against the development of diseases. Dysbiosis, i.e., the imbalance that occurs in the relative and absolute abundance of these species of microorganisms, can lead to the development of infectious and immune-mediated diseases. Climate change, particularly temperature change, is leading to a loss of biodiversity, which could be a possible vector for the development of dysbiosis.

Mental Health ^{6,7}

There is evidence that mental health can be directly affected, particularly after acute weather events, in the form of anxiety, post-traumatic stress, depression, substance abuse, and domestic violence.

Women's Health ^{8,9}

There is evidence that women may be more affected by floods and heatwaves due to the specific roles they play in certain societies (responsible for domestic and agricultural work, as well as being the main caregivers for children), and to their physiological and nutritional needs during menstruation and pregnancy.

There is also a very close relationship with paediatric health. Birth outcomes and child health are also affected by the impact of climate change on maternal health. Exposure to extreme temperatures during pregnancy has been reported to be associated with foetal malformations in several areas of the world

General Directorate of Health recommendations for protection against extreme heat

1. Look for cool, airy or air-conditioned environments;
2. Increase your water intake to at least 1.5 litres/day, equivalent to eight glasses. Drink natural fruit juices with no added sugar and avoid alcoholic drinks;
3. Avoid direct exposure to the sun, especially between 11am and 5pm. Use sunscreen with an SPF of 30 or higher and reapply it every two hours or after swimming at the beach or pool;
4. Wear loose, opaque clothing that covers most of the body, a wide-brimmed hat and sunglasses with ultraviolet protection;
5. Avoid activities that require a great deal of physical effort, particularly sports and leisure activities outdoors;
6. Choose the coolest hours to travel by car. Do not stay in parked vehicles exposed to the sun;
7. Pay particular attention to more vulnerable groups, such as children, the elderly, chronically ill people, pregnant women, people with reduced mobility, outdoor workers, people who engage in physical activity, and isolated people;
8. Chronic patients or those on medication and/or special diets should follow the advice of their doctor or the SNS 24 helpline;
9. Ensure that children drink water or natural fruit juices frequently and that they stay in a cool, ventilated environment. Children under the age of six months should not be exposed to direct or indirect sunlight;
10. Contact and accompany the elderly and other isolated people. Ensure that they are properly hydrated and stay in a cool and ventilated environment;
11. Take special care, namely: moderate physical activity, avoid direct or indirect exposure to the sun, and ensure frequent fluid intake.

Source: <https://www.dgs.pt/em-destaque/recomendacoes-da-dgs-para-protecao-contra-o-calor.aspx>

History of heat/cold waves in Portugal and Europe

In Europe, heatwaves cause the greatest number of deaths related to climate extremes, but in addition to health impacts, they have also been associated with forest fires and losses in agricultural production among other impacts. For example, the summer 2003 heatwave in Europe, believed to be the hottest in the last 500 years, caused 70,000 excess deaths; in 2007, the hottest heatwave in Greece since 1891 caused devastating fires; and in France, the 2011 heatwave reduced cereal harvests by 12%. July 2023 was the hottest month on record, according to the European climate monitoring programme Copernicus, and the heatwaves hit several regions of the northern hemisphere particularly hard, especially southern Europe.

In mainland Portugal, both the frequency of heatwaves and the number of heatwave days have increased since 1990, according to records kept since 1941 by the Portuguese Institute of the Sea and Atmosphere (IPMA). In the summer of 2022, the country's weather stations recorded the highest number of heatwaves days (918), followed by 2003

(687) and 2006 (667). The most affected regions were the interior north and centre and the Alentejo (Bragança, Vila Real, Viseu, Guarda, Setúbal, Évora and Beja districts).

The major heatwaves in Portugal had high impact on mortality. The 1981 wave caused around 1900 excess deaths, the 1991 wave around 1000, the 2010 waves together caused 2167 deaths, the two main waves of 2013 caused the deaths of 1684 people and the 2003 wave caused 1953 deaths, mainly elderly people aged 75 and over.¹

As a result, in 2004, the Directorate-General for Health (DGS) created a Contingency Plan for Heatwaves, which was subsequently updated by successive Contingency Plans for Extreme Adverse Temperatures, the most recent in 2022/23. In the summers of 2013, 2018 and 2022, extreme heat occurred again. According to a recent study, heatwaves could have caused more than 61,000 deaths in Europe, in 2022, and 2,200 of those happened in Portugal.¹¹

Regarding mortality associated with exposure to cold, it has been observed that it varies widely across Europe. Contrary to what might be expected, it is in the warmer countries of the South (including Portugal) that there has been an excess of deaths in winter. Therefore, it is not temperature alone that explains these differences, but various social vulnerability factors, including energy poverty and low levels of development, and public spending on health. The elderly and disadvantaged social groups are particularly affected.

According to the IPMA, the frequency of cold waves in Portugal has decreased significantly in recent decades. Since records began (1941), they have been more frequent in the 40s, 50s and 70s. The cold wave of 1956 stands out for its duration, geographical extent, intensity and severity. Geographically, cold waves tend to have a greater impact in the north and the central interior - the districts of Viana do Castelo, Braga, Porto, Vila Real, Bragança, Viseu, Guarda and Castelo Branco.

Number of heatwave days recorded at weather stations in Portugal, 1960-2022

Periods of time	Viana do Castelo	Bragança	Porto	Castelo Branco	Lisboa	Beja	Faro	Funchal	Angra do Heroísmo
1960-1989	72	308	62	284	62	166	6	6	0
1990-2022	224	880	240	483	241	557	67	0	0

Source: IPMA

Note: The weather station in Faro started operations in 1966, the one in Porto in 1967, and 1970 for the stations in Viana do Castelo and Angra do Heroísmo

Energy poverty in PT

17,5%

Population that declared that they will not be able to afford to heat their home adequately in 2022. The EU27 average is 9.3% (EU-SILC)

Source: Eurostat

25,2%

Portuguese, who in 2022, were living in houses with leaks, humidity or rot. The EU27 average is 14.8%.

Source: Eurostat

69,5%

Weight of houses assessed in 2019 in Portugal with an energy performance class between C and F (the least efficient classes).

Source: Adene

15%

Of the people surveyed in this study report that the cold/humidity in their home affects their or their family's health very much or a lot.

37%

Would like to take measures to improve the thermal comfort in their home (to protect from the cold and/or heat) but cannot afford them

N=800

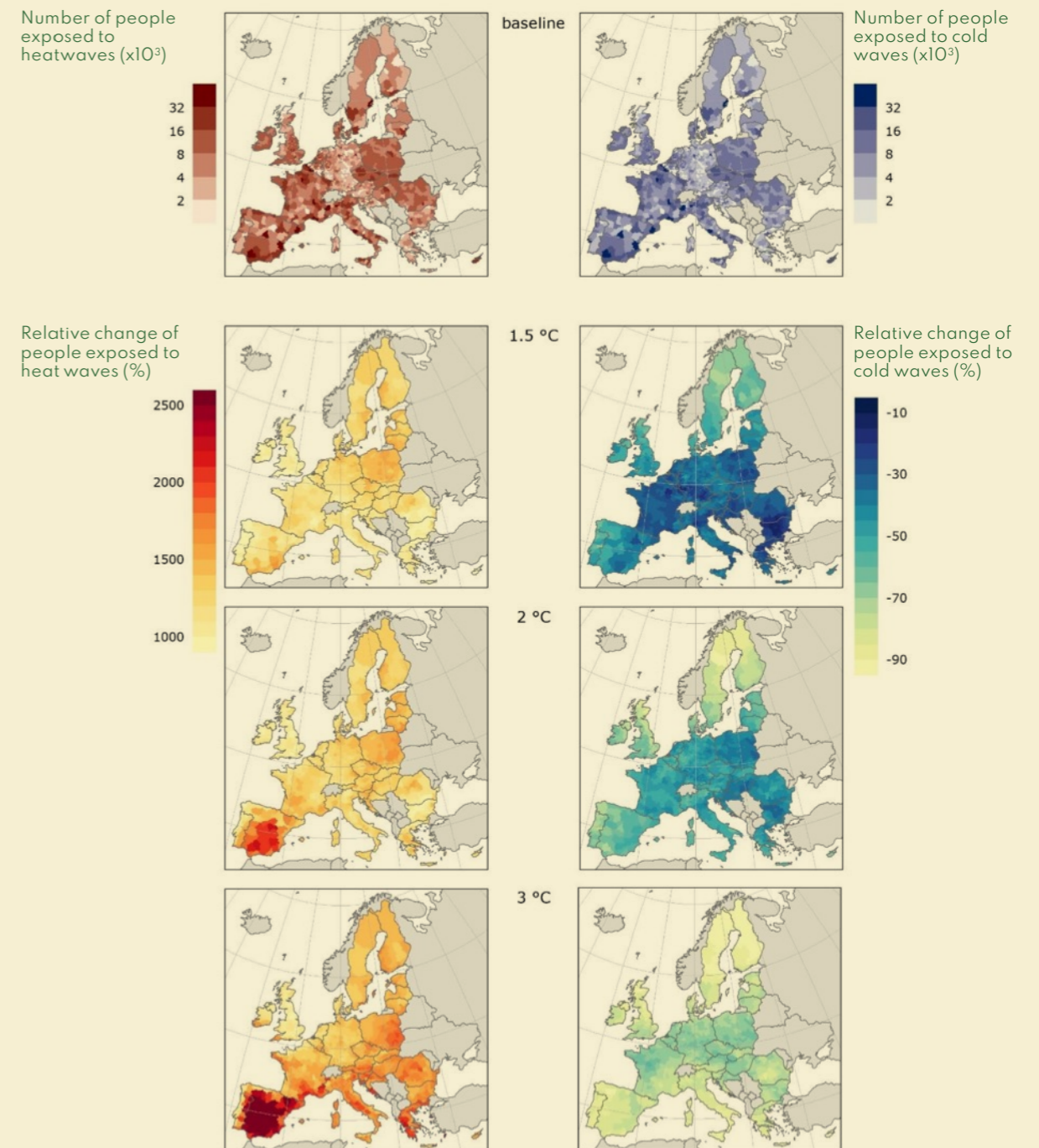
What can we anticipate for the future?

The sixth report of the Intergovernmental Panel on Climate Change identifies as one of the key-risks for Europe an increase in mortality and morbidity (as well as disruption to ecosystems) due to heat, considering that the number of deaths and people suffering from 'temperature stress' is expected to double or triple. These risks are expected to hit southern and western Europe the hardest, especially in urban areas. In summer, the number of hours of thermal comfort is expected to decrease significantly and could fall by 75% in southern Europe.

Under a 3°C global warming scenario, the number of people exposed to these risks and the economic losses are expected to at least double in Europe. In every scenario, southern Europe will experience an increase in prolonged periods when both temperatures and humidity are very high - a particularly dangerous combination for health.³

Thus, while the number of deaths associated with heatwaves is currently around 2,700 per year (from 1981 to 2000), by 2100 the annual number of deaths in Europe could rise to 28,800 in a scenario where global warming is limited to 1.5°C; to 49,400 in a scenario where global warming rises to 2°C; and to 89,000 deaths per year in a scenario where global warming rises to 3°C.

Number of inhabitants exposed annually to heat and cold waves between 1981 and 2010 (baseline) and in the global warming projections of 1.5°C, 2.0°C and 3.0°C



Source: Naumann G. et al. (2020) Global warming and human impacts of heat and cold extremes in the EU, EUR 29959 EN, Publications Office of the European Union, Luxembourg

Towards the future

On the other hand, the intensity and frequency of cold waves are expected to gradually decrease and, consequently, resulting in fewer deaths. While from 1980 to 2016 there were 80 deaths per year in Europe related to cold waves, in a 1.5 °C global warming scenario, the number of annual deaths would be 33, in a 2 °C increase scenario, deaths would decrease to 19 and, in a 3 °C increase scenario, the number of deaths would fall to 8.¹²

According to the Intergovernmental Panel on Climate Change's worst-case scenarios, Portugal will experience an increase in minimum, average and maximum temperatures of up to +5°C by 2100, especially in summer and in the interior of the country. This temperature increase is likely to be accompanied by an increase in the number of days with maximum temperatures above 35°C (especially in the interior south), an increase in tropical nights (i.e. with minimum temperatures above 20°C) and longer, more intense, and more frequent heatwaves (especially in the interior northeast). The season of heatwaves (typically spring and summer) will also tend to extend into autumn. However, the average temperature increases are likely to be lower, ranging from 2 to 3°C.

During both heat and cold waves, segments of the population that are not usually in energy poverty can suddenly become vulnerable if there are power cuts associated with peak demand. In addition, in a country like Portugal, where vulnerability to energy poverty is so widespread, it is im-

portant not to overlook the effects of chronic exposure to cold in winter. Housing conditions have been recognized as one of the most important factors influencing health. In the context of the European Union, Portugal is among the countries where there are more homes with leaks, humidity, rots, or lack of insulation, and not only is the energy performance of most of the country's residential buildings low, but the population finds it difficult to adopt measures to improve the energy efficiency of their homes, making them more vulnerable to both the cold and, above all, excessive heat, as it is even more difficult to find defence mechanisms against the heat indoors.

Some factors, such as an increasing ageing population (with a high prevalence of chronic diseases), the increasing urbanization, land use patterns or changes in socio-economic conditions influence the vulnerability of populations.

According to the European Environment Agency, the evolution of the first two factors - ageing and the urban growth - means that Europeans will become more vulnerable to heatwaves in the coming decades. However, society's responses and the evolution of people's living conditions, including the fight against poverty and social inequalities, will determine the impact of climate change on human health.

It will be necessary to take measures to promote strategies for the population's adaptation and resilience to the effects of climate change, but also to prepare medical emergency, social disruption and civil protection plans, which involve mitigation measures and capacity-building for health professionals and security forces.

According to the European Environment Agency, almost all deaths related to high temperatures in Europe can be prevented. To this end, given the multifaceted nature of exposure and vulnerability, it is necessary for each country's policies to include disaster risk considerations, as failures in these policies can increase vulnerability (either in the short or long term), and to develop actions targeted at the most vulnerable groups and areas. There is also a need for cooperation between various sectors of society, such as health, construction/housing, urban planning, employment, research, civil society organisations, as well as action strategies at different levels (individual, family, local, regional, etc.).

It is also important to identify differences at a geographical level, as the effects of excessive heat and cold vary across the country. To do this, it is essential to know the local realities. In this sense, mobilizing local authorities to implement both structural measures and contingency plans can be decisive, especially to protect the homeless and the most vulnerable.

In order to adopt the necessary strategies, obstacles such as the lack of commitment by the various stakeholders, lack of political leadership, or a lack of a sense of urgency need to

be overcome. Although the Portuguese population shows a high level of concern about climate change, it also has a low capacity to act due to low economic resources and lack of knowledge on the issue. Social inequalities are a fundamental dimension regarding the exposure and vulnerability of populations. Poverty in general, and particularly housing, energy poverty and educational capacity, influence and determine the ways in which vulnerable populations can cope with and adapt to these events, which is why the adoption of measures to promote social well-being and quality of life contribute to making society more resilient.

Another key area of action concerns buildings, as they can protect people from both heatwaves and cold. By renovating buildings is possible to improve the protection they offer, while reducing the energy consumption required for cooling or heating. Given that using air conditioning is very problematic, as it contributes to peaks in electricity consumption (increasing the risk of blackouts and CO2 emissions) and to the heat island effect in cities, it is essential to improve the energy efficiency of buildings.

It is therefore necessary to prioritise the construction and renovation of buildings to minimise the need for energy consumption for cooling, using passive techniques such as solar orientation and building shape, soundproofing, insulation, ventilation, and natural cooling (green roofs and walls, patios and atriums, or low-consumption ceiling fans), in other words, prioritising passive cooling and heating techniques. Roofs should reflect the sun's rays, remaining cooler and transferring less heat into buildings.

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Another priority area is to combat the heat island effect in cities through nature-based solutions, such as increasing urban vegetation, especially in more vulnerable areas such as around schools, hospitals or disadvantaged neighbourhoods, creating wind corridors, and using shading infrastructure or surfaces with low solar radiation absorption. It is also important to ensure that urban populations (especially in deprived areas) have access to parks and green spaces, and to adapt public buildings to function as cool temperature centres open to the public.

Other important measures include developing health action plans and strengthening the hospital care system, raising public awareness and promoting behaviours that protect health from excessive heat, adjusting working hours and conditions to ensure that workers have adequate access to water, shade, and breaks.

In line with European Union and the WHO guidelines, in 2023 the Ministry of Health updated the guidelines for health institutions regarding the specific response needs of the coldest and hottest periods of the year, as these are periods of increased demand for health services. As a result, there is now a Strategic Seasonal Health Response Plan.

This plan includes a surveillance and monitoring system, and a set of prevention and control measures to be implemented by the National Health Service to protect the most vulnerable people and ensure access to health care, as well as health literacy initiatives for the general population.

Climate change has become an existential threat to human survival. In particular, cold and heatwaves are a significant global health issue that should be considered a global priority for governments, communities, and individuals. Temperature changes lead to an increase in natural disasters, vector-borne diseases, poor air quality, and extreme temperatures variability that directly and indirectly affect human health. All these consequences are further influenced by factors such as poverty, food insecurity, geographical isolation, and unfavourable social environments. Understanding how climate science related to public health practice is an essential step in enabling an adaptive response and improving human resilience to climate change.

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Atmospheric pollutants and greenhouse gases usually come from the same emitting sources¹, but they are conceptually different. Air pollutants are substances emitted into the atmosphere that adversely affect air quality, with negative impacts on human health, ecosystems, and the environment. Greenhouse gases are substances that contribute to the greenhouse effect, a natural and necessary phenomenon for life on Earth, as these gases absorb and emit infrared radiation, retaining heat in the atmosphere and increasing the average temperature of the planet. However, when the levels of greenhouse gases increase significantly due to human activity, such as the burning of fossil fuels, industrial processes or deforestation, the greenhouse effect increases and, consequently, global warming occurs. Examples of greenhouse gases include carbon dioxide (CO₂) and methane (CH₄). Although some atmospheric pollutants can be greenhouse gases (e.g. methane), not all pollutants are and not all greenhouse gases are considered pollutants. Moreover, carbon dioxide (CO₂), as it exists naturally in the atmosphere, is essential for photosynthesis, which is the basis of food for all living beings.

The impact of climate change on air quality

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Atmospheric pollutants come from different sectors of human activity - agriculture, manufacturing and extractive industries, energy supply and use, road transport, and waste². Some atmospheric pollutants remain in the environment for a short time, such as particles or particulate matter (known as PM) PM_{2.5} (particulate matter with a diameter of 2.5 µm or less) and PM₁₀ (particulate matter with a diameter of 10 µm or less), which tend to settle.

In the case of PM_{2.5} particles, the source of the emissions determines their toxicity; if they come from the burning of fossil fuels, such as coal combustion or emissions from diesel vehicles, they are more toxic and therefore more harmful to the health of the population¹. In 2020, energy consumption in residential, commercial, and institutional areas alone was responsible for around 60% of PM_{2.5} emissions in Europe (EU-27)².

Other short-lived pollutants [that tend to degrade quickly after emission] include methane, hydrofluorocarbons, and ground-level ozone¹. Although short-lived, these pollutants play a relevant role in the phenomenon of climate change, which means that measures to reduce emissions of these pollutants also lead to climate change mitigation.

Total emissions of all atmospheric pollutants have been decreasing in the European Union, maintaining the overall downward trend for the main pollutants observed since 2005².

Between 2005 and 2020, emissions of PM₁₀ and PM_{2.5} fell by around a third, while emissions of nitrogen oxides (NO_x), black carbon (BC) and carbon monoxide (CO) also fell by more than 40%. sulphur dioxide (SO₂) emissions fell by around 80% over that same period, mainly as a result of reduced coal use².

Based on this progress, the EU seems to be on track to meet the target of reducing premature deaths related to air pollution by 55% by 2030 (compared to 431,000 premature deaths in 2005)⁵.

This perspective on mortality trends assumes that the trends of urbanisation and ageing in Europe are not sufficient to counteract the health gains associated with reducing pollutants, as older populations tend to be more sensitive to air pollution and higher urbanisation rates generally mean more people exposed to high concentrations of PM_{2.5}.

¹ <https://www.lung.org/clean-air/climate-change/climate-change-air-pollution>

² <https://www.eea.europa.eu/publications/air-quality-in-europe-2022/sources-and-emissions-of-air>

The impact of air pollution on health

Exposure to air pollution is considered the most important environmental risk to the health of the European population (WHO, 2016)⁴ and, although it is difficult to pinpoint a figure, scientific evidence indicates that it is one of the main causes of death in Europe.

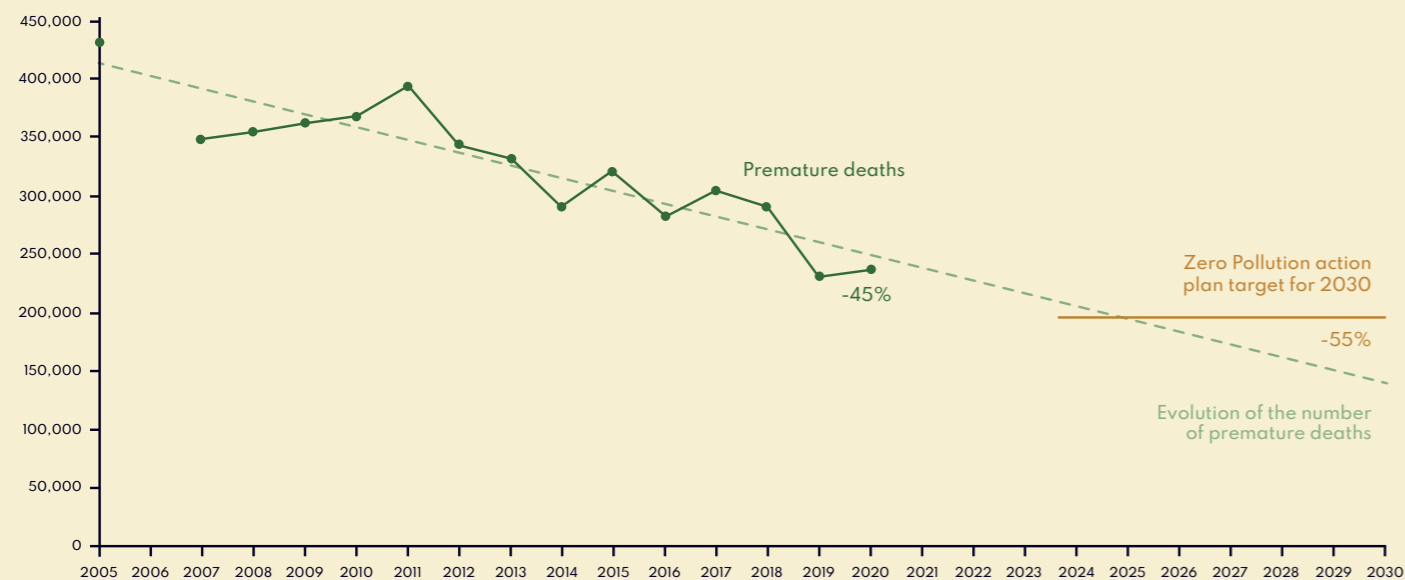
Although the European Environment Agency's Air Quality Report shows significant improvements in air quality since 2005 (EEA, 2022), almost all of Europe still record levels exceeding the benchmarks set (by the EEA and the World Health Organisation) for the various pollutants⁴.

In particular, exposure to PM2.5 concentrations (one of the most serious pollutants in terms of health effects) above the WHO guideline level for 2021 is estimated to have caused 238,000 premature deaths in the EU-27⁵.

Currently, particulate matter, nitrogen dioxide, and tropospheric ozone are generally recognised as the three pollutants that most significantly affect human health. Long-term and peak exposures to these pollutants vary in terms of severity of the effects, from respiratory system damage to premature death.

Around 90% of the residents in European cities are exposed to pollutants at concentrations above the air quality levels considered harmful to health. For example, particulate matter (PM2.5) in the air is estimated to reduce life expectancy in the EU by more than eight months.

Premature deaths in the EU-27 due to PM2.5 levels above the 2021 WHO guidelines and gap to the zero pollution target, 2005-2020

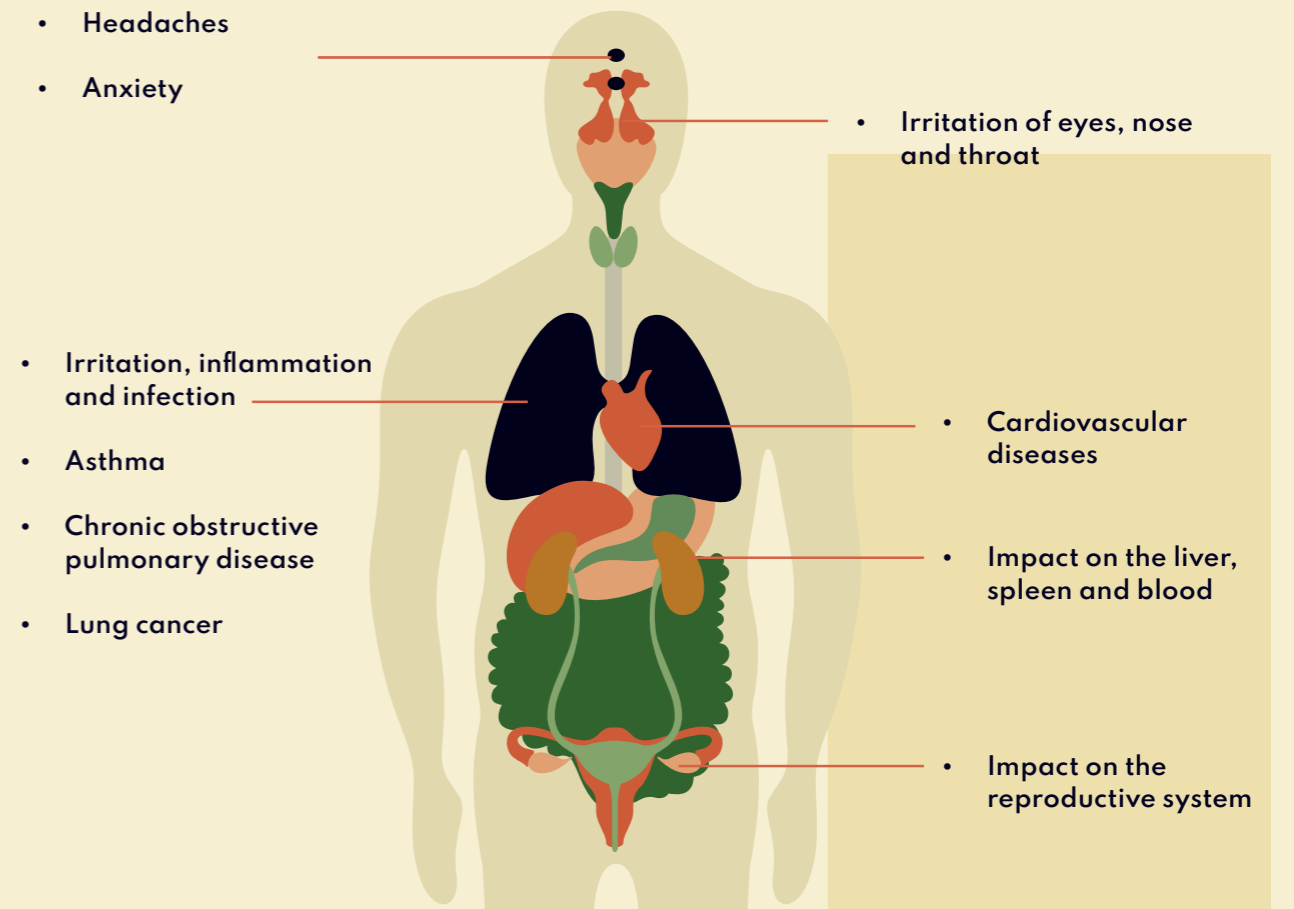


Source: European Environment Agency, Air Pollution and Health, Dez 2022

⁴ <https://climate-adapt.eea.europa.eu/en/observatory/evidence/health-effects/air-pollution>

⁵ <https://www.eea.europa.eu/publications/zero-pollution/health/air-pollution>

Potential consequences of air pollution on health



Source: European Environment Agency, Air Pollution and Health, Dez 2022

Despite good mortality figures, air pollution also causes morbidity, causing people to live with illnesses, leading to personal suffering and significant healthcare costs. Exposure to pollution contributes to or aggravates a wide range of diseases, including chronic obstructive pulmonary disease, asthma, lower respiratory infections and lung cancer, and even diseases not directly linked to the respiratory tract. There is evidence of associations between exposure to air pollution and type 2 diabetes, stroke, obesity, systemic inflammation, Alzheimer's disease, and dementia⁵.

While air pollution affects the entire population, certain groups of people are more likely to suffer from exposure, such as children, the elderly, pregnant women and people with pre-existing health problems⁵.

Another aspect to consider is the fact that pollution levels (and health impacts) are consistently higher in Europe's most disadvantaged regions. Indeed, there is evidence that people of lower socio-economic status are more exposed to air pollution (EEA, 2018). In many regions of Europe, it is plausible that poorer people live close to busy roads or industrial areas and are therefore exposed to higher levels of pollution⁵.

Looking at trends in the population-weighted PM2.5 concentrations in the most and least disadvantaged regions (in terms of GDP per capita), it can be seen that although air quality has improved in all regions, there are differences to be noted: between 2009 and 2019, concentrations of air pollutants fell by 36% in the richest regions and by only 25% in the poorest regions⁵.

Various mechanisms have been described through which atmospheric pollution impacts health. These effects can occur directly or through genetic changes, which can have implications for biological processes such as development, ageing, and disease. Specifically, air pollution can have the following impacts on health:

- Respiratory diseases: air pollutants have a significant effect on lung tissues although the nature of this relationship is complex and not yet fully understood, with consequences for the development of the major respiratory diseases- chronic obstructive pulmonary disease, asthma, lung cancer, idiopathic pulmonary fibrosis, respiratory infections, bronchiectasis - by short- and long-term exposure ^{6,7,8}
- Cardiovascular disease: many studies show the effect of air pollutants on the incidence of acute myocardial infarction, sudden cardiac death, cardiac arrhythmias, and peripheral arterial disease. Recently, some studies have suggested that air pollution may be associated with cardiac arrhythmias ^{6,10}
- Chronic Kidney Disease (CKD [5,6]) is a pathology with a significant global impact and high mortality rates, manifested by a progressive loss of nephrons, the structural units of the kidney. Recent studies suggest that exposure to air pollution is closely related to an increased risk and progression of CKD to end-stage.⁹
- Immune system: several diseases, such as serious infections, cancer and autoimmune diseases, are caused by inappropriate or excessive immune responses. Although inhaled air pollution is mainly deposited on the mucous membranes of the respiratory tract, it can also affect the gastrointestinal tract or the musculoskeletal system.^{11,12}
- Risk of cerebrovascular accident (CVA): CVA/stroke is one of the leading causes of disability and the second most common cause of death worldwide. Air pollution levels are estimated to be responsible for 14% of all stroke-related deaths.¹⁴
- Mental health and neurological disease: recent research suggests that highly polluted environments are responsible for an increased risk of cognitive decline. Several agents have been identified as toxic to the central nervous system, including particulate matter (PM2.5, PM5, PM10).¹⁵
- Eye diseases: indoor air pollution, which can be caused by outdoor air pollution, has also been linked to various eye diseases, including conjunctivitis, glaucoma, cataracts, and age-related macular degeneration.¹⁶
- Paediatric diseases: babies and children are particularly vulnerable to air pollution because their organs are still developing and they inhale more air than their body weight. The health effects include not only the aggravation of pre-existing respiratory diseases, but also the development of diseases such as asthma. Other potential consequences include premature births, low birth weight, neurodevelopmental disorders, increased risk of cancer in childhood, and chronic diseases in adulthood.^{8, 17, 18}

In 2020, the vast majority of the urban population in the European Union was still exposed to harmful levels of air pollutants. In particular, 96% of the urban population was exposed to PM2.5 concentrations above the WHO-recommended level.

The infographic below shows the percentage of the urban population exposed to levels of air pollutants above EU standards and WHO guidelines (which are higher than those set by the EU).

Bringing the EU PM2.5 limit value closer to the WHO guidelines would bring significant health benefits to the EU population, an important step towards cleaner air in Europe, and an important contribution to reducing climate change⁵.

Percentage of the EU urban population exposed to air pollutant at concentrations above the EU standard and WHO guidance values in the EU-27, 2020



⁵ <https://www.eea.europa.eu/publications/zero-pollution/health/air-pollution>

Climate change risks to health

Climate change could affect efforts to improve air quality in the European Union.

Climate change is a consequence of air pollution, but it also directly aggravates it, because warmer weather increases the formation of tropospheric ozone, and warmer temperatures and drier environments mean that smaller particles (PM2.5) remain suspended in the air for longer or are re-suspended by the wind². Changes in climate patterns, such as variations in rainfall and winds, can affect the transport and dispersion of air pollutants and lead to higher concentrations of pollutants in certain areas.

When extreme heat occurs together with high levels of air pollution, the health effects become even more serious and can lead to an increase in the frequency and severity of respiratory diseases such as asthma and bronchitis, as well as an increase in cardiovascular problems such as heart attacks and heart failure⁴.

Climate change also aggravates air pollution indirectly, as high temperatures and dry environments can lead to forest fires, which contribute to an increase in particles and other pollutants in the air. It is known that the frequency and intensity of forest fires has been increasing worldwide due to high temperatures and prolonged periods of drought fuelled by climate change².

Still in the context of the indirect contribution of climate change to air pollution, a recent study³ shows that global warming will make sandstorms more intense in the Mediterranean and Atlantic regions.

² <https://www.eea.europa.eu/publications/air-quality-in-europe-2022/sources-and-emissions-of-air>

³ <https://doi.org/10.1029/2019JD030725>

⁴ <https://climate-adapt.eea.europa.eu/en/observatory/evidence/health-effects/air-pollution>

A recent study¹⁹ shows that global warming will make sandstorms more intense in the Mediterranean and Atlantic regions.

The study explains the connections between sandstorms, long periods of drought, volcanoes and warming in the Mediterranean, Europe and Asia, and warming in the Mediterranean, Europe and Asia and reveals that the strong sandstorms in the Sahara that occurred during previous warming periods provide an estimate of what can be expected in the future with climate change.

Thus, more particles in the air due to more frequent sandstorms will worsen air quality, which will have health implications for the population

¹⁹ A 2000 Year Saharan Dust Event Proxy Record from an Ice Core in the European Alps
Image: Espanha, 2022, Carlos Barba/EPA-EFE/REX/Shutterstock

What can be done to reduce the risk?

Measures that contribute to mitigating climate change also contribute to mitigating air pollution and vice versa, resulting in greater protection of the population's health.

There are government measures, supported by the policies of National and International Agencies with responsibility in the areas of Air Quality and Climate Change. Some of these measures will involve implementing policies aimed at and promoting:

- Opting for renewable energy sources (e.g. solar and wind energy). This reduces air pollution and greenhouse gas emissions that contribute to climate change.
- Provision of a public transport network that meets the current and future mobility needs of the population.
- Monitoring and control of the main sources of pollutants.
- Promoting green spaces in urban areas that help reduce the impact of heatwaves, promote the conservation of biodiversity, contribute to the retention of pollutants and promote health (e.g., mental health and physical exercise).
- Forest management to prevent the occurrence of forest fires.

Individual measures, on the other hand, are essentially behaviours and/or choices made by the individual themselves that either contribute to reducing air pollution or reduce exposure to pollution.

- Regularly consult national and European air quality monitoring networks and adjust behaviour to reduce exposure to air pollutants (e.g., avoid exercising outdoors at times of the day when air pollution is highest).
- Opting for more sustainable means of travel through more frequent use of public transport instead of cars, and by train whenever possible. Cycling should also be considered, given that as well as being a more sustainable means of mobility it also encourages physical exercise.
- Contribute to the prevention of forest fires by adopting appropriate behaviour during times of greatest risk, following the guidelines issued by the national authorities in this area (e.g., Civil Protection Authority).
- Promote indoor air quality by opening windows every day, particularly during periods of lower outdoor air pollution.

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« The number one victim of climate change is water. There's either too much, or too little, at the wrong time.»

Johan Rockstrom

Internationally recognised scientist on global sustainability issues, with more than 25 years' experience in applied water research in tropical regions and more than 150 research articles¹

The impact of climate change on water quality

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Johan Rockstrom's phrase seems increasingly applicable to Portugal. In addition to droughts (a problem of water availability that stems from an annual precipitation deficit), Portugal is a candidate for being at high risk of scarcity or 'water stress' in the medium term [according to projections by the World Resources Institute for 20404], i.e., of having a demand that exceeds the supply of accessible water of the quality required for its use. Although the situation in the country is not uniform (the region below the Tagus is the most vulnerable), in recent years droughts in Portugal have become more frequent, longer and more widespread.

Due to the increased frequency of extreme weather events, climate change has an impact not only on the quantity but also on the quality of water resources. Although the water cycle persists, it is not available in the quantity and quality required.

As global temperatures rise, there are implications for water vapour concentrations, clouds, precipitation patterns and river flow patterns - all related to the water cycle. The water cycle is a process of water transformation in an infinite, circular movement, through which water from the land and sea evaporates into the air.

Climate change is affecting all the processes involved in this cycle and is increasing the risk of both intense rainfall and extreme droughts.

In simplified terms, it can be said that warmer air creates conditions for more intense storms, causing problems such as extreme flooding, especially in coastal areas. Rising temperatures also lead to increased evaporation, fuelling soil drying. Dry, hardened soil does not retain water; even when it rains heavily, the water runs off and the soil remains dry, promoting more evaporation and an increased risk of drought phenomena.

The lack of water is thus exacerbated by climate change, especially in arid and semi-arid areas that are already under water stress. Droughts and/or floods are in turn the cause of water quality degradation, which is becoming one of the greatest threats to the sustainability and availability of water resources, in addition to the negative impact on all ecosystems.¹

¹ International Science School

² Water Quality and Climate Change Research | US EPA

⁴ <https://www.wri.org/insights/highest-water-stressed-countries>

Impact of climate change on the water cycle²

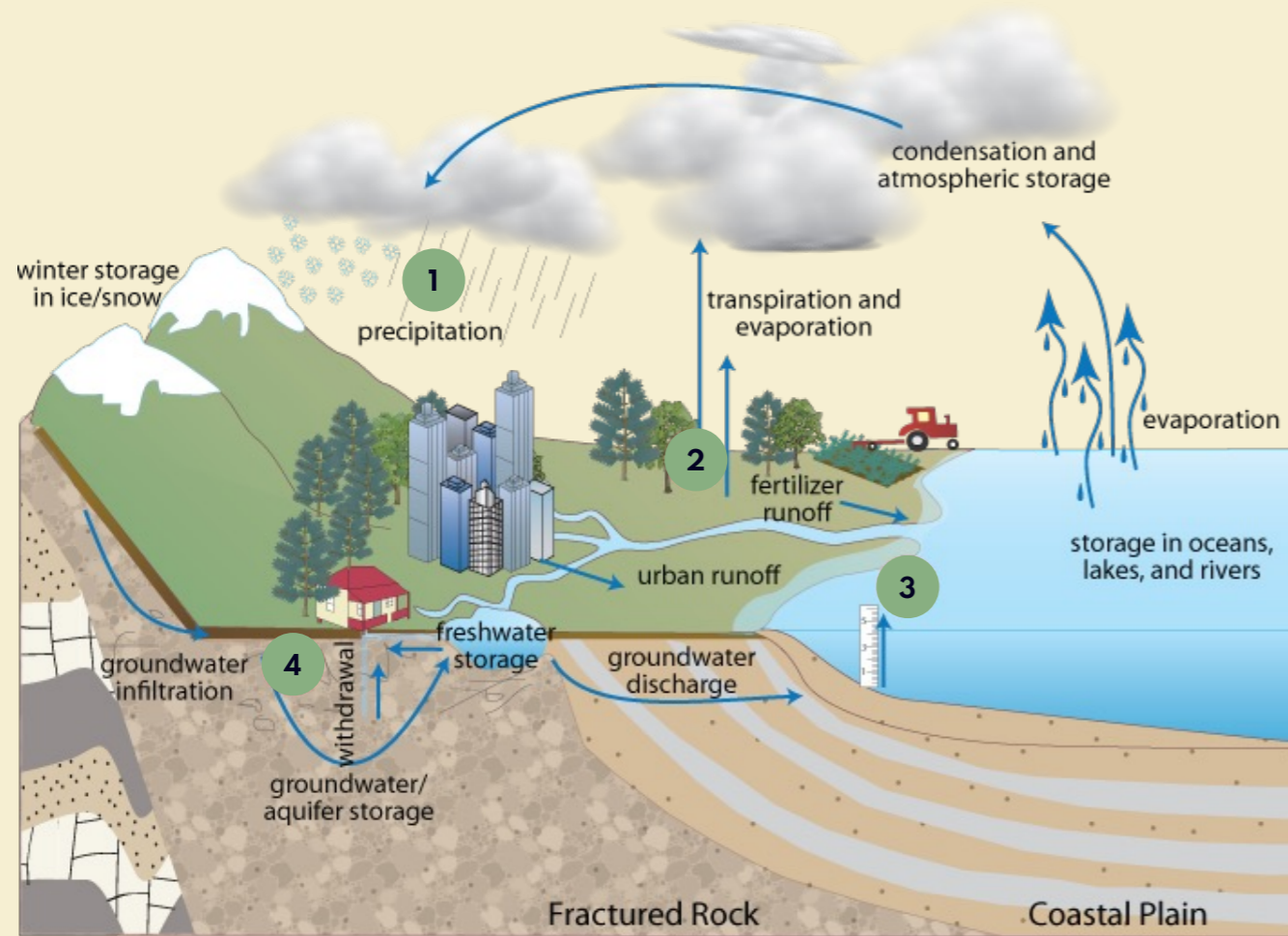


Diagram courtesy of the integration and application network (ian.umces.edu), University of Maryland Center for Environmental Science. Source: Boesch, D.F. (editor) 2008.

- 1 Increased frequency and variability of extreme rainfall can lead to floods, surface runoff and high energy flows, affecting water quality, urban drainage infrastructures and water and sewage treatment infrastructures
- 2 Increased likelihood of drought in summer can affect ecosystems in watercourses, lead to an increase in demand for irrigation and result in water shortages
- 3 Saltwater intrusion into freshwater resources can occur as a result of the combined effects of rising sea levels and storms, and also due to increased rates of groundwater extraction
- 4 The increase in extraction due to the drought could reduce the reserves of groundwater

² Water Quality and Climate Change Research | US EPA

Climate change and its potential impact on drinking water supplies¹²



Exposure to harmful chemicals

Extreme events, such as storms or fires, contribute to the degradation of water quality due to the run-off of pollutants and pesticides. Exposure to these substances through water can lead to several health problems, including cancer.



Reduced availability of drinking water

As water sources become polluted, there is less drinking water. The use of water in food production can also lead to water scarcity and less water available for washing, cooking and personal hygiene.



Use of unsafe water sources

Lower water tables and water flows - such as rivers or streams - can lead to reduced water supplies and increased use of unsafe water sources.



Impact on aquatic life

Higher temperatures create ideal conditions for algal blooms, which can be toxic to aquatic life and have implications for human health.



Increased risk of waterborne diseases

As water sources become contaminated with pollutants, the risk of colonisation by bacteria, viruses and parasites increases significantly

¹² Impact of Climate Change on Drinking Water Safety, ACS EST Water 2022, 2, 2, 259–261, 2022, American Chemical Society

The impact of water scarcity and pollution on health

Extreme weather events, such as storms, contribute to the water quality degradation in several ways: intense rainfall washes away large quantities of pollutants present in the soil or poorly treated waste, because wastewater treatment plants are unable to retain and treat the increased amount of water². In addition, fires, that have been occurring with greater frequency and intensity, aggravate this phenomenon. The loss of vegetation increases the run-off of pollutants - such as heavy metals, toxins and others that result from combustion processes. All of this contributes to the degradation of available water reserves².

Finally, higher temperatures create ideal conditions for algal blooms, which can be toxic to aquatic life and have implications for human health².

The degradation of the quality of drinking water due to climate change can cause short-term risks due to the contamination of water by pathogenic microorganisms (due to wastewater runoffs) and, in the medium or long term, due to the presence and higher concentration of chemical pollutants.

Direct recreational contact with water on coastal or river beaches can also increase exposure to pathogenic micro-

-organisms and pollutants due to run-off caused by periods of intense rainfall² and due to increased temperature of freshwater sources, which contributes to microbial growth and algal blooms⁵.

Rising temperature leads to an increased use of disinfection by-products, such as trihalomethanes, in water. This is due to the increase in dissolved organic carbon in rivers, lakes and groundwater resources available for human consumption. This situation jeopardises water supplies worldwide, as it increases the risk to consumers' health and makes the water treatment process more expensive⁶.

The deterioration in the quality of water resources could lead to the spread of waterborne diseases caused by pathogenic microorganisms and pollutants².

In addition to these health risks, adverse climatic events jeopardise the quantity and quality of water available for human consumption and for irrigation, which is essential for agriculture. Water scarcity affects agricultural production and, consequently, food availability and diversity, threatening not only the existence of sufficient food products, but also their safety and the adequate nutritional availability of agricultural products⁷.

Concrete health risks of water quality degradation

Water plays a fundamental role in health. The health effects of water pollution and contamination can vary depending on the type and quantity of pollutants and contaminants present, as well as the duration and intensity of exposure. Specifically, water deterioration can have the following health impacts:^{8,9}

Gastrointestinal illness

Water contaminated by bacteria, viruses, parasites or toxic chemicals can cause gastrointestinal diseases such as diarrhoea, cholera, dysentery and hepatitis A. These diseases can lead to severe dehydration and even death, especially in areas with limited access to adequate health care.

Waterborne diseases

Water pollution can also result in the spread of waterborne diseases such as typhoid fever, paratyphoid fever, leptospirosis and giardiasis. These diseases are caused by microorganisms present in contaminated water.

Skin diseases

Exposure to contaminated water can lead to skin problems such as irritations, rashes and infections. Toxic chemicals in the water can damage the skin and even cause chemical burns.

Respiratory illness

The presence of toxic chemical substances in the water, such as volatile organic compounds and industrial chemicals, can cause respiratory irritation, asthma and other respiratory diseases.

Nervous system disorders

Certain chemicals present in contaminated water, such as heavy metals (e.g. lead, mercury) and pesticides, can affect the human nervous system. Chronic exposure to these substances can lead to neurodevelopmental problems, cognitive dysfunction, behavioural disorders and even brain changes.

Cancer

Some chemicals found in contaminated water, such as synthetic organic compounds and disinfection by-products, have been linked to the development of certain types of cancer, particularly cancer of the liver, kidneys, bladder and other organs.

² Water Quality and Climate Change Research | US EPA

⁵ Climate Change and Harmful Algal Blooms | US EPA

⁶ Predicted Impact of Climate Change on Trihalomethanes Formation in Drinking Water Treatment. 2019 Jul

⁷ "Water scarcity means less water for agriculture production which in turn means less food available, threatening food security and nutrition" (fao.org)

⁸ Azizullah Azizullah et. al, 2011, Water pollution in Pakistan and its impact on public health — A review

⁹ Lin Li et. al, 2022, Effects of Water Pollution on Human Health and Disease Heterogeneity: A Review

The health risks of climate change

Extreme weather events cause water scarcity, make water quality more unpredictable due to rainfall patterns and, consequently, more contaminated and polluted³.

The increase in average temperature not only has an impact on the evaporation of surface water, particularly in dams, but also causes more water loss in plants (evapotranspiration), requiring greater hydration (or consumption). The increase in water consumption for food production, particularly meat and crops used for biofuels, increases the risk of water scarcity³.

Climate change threatens to limit the diversity of agricultural crops and, consequently, the quantity and quality of food. The very destruction of vegetation due to fires leads to greater soil erosion and reduces the recovery capacity of underground aquifers, increasing water scarcity and food insecurity³.

Droughts and fires also increase the likelihood of unforeseen contact with micro-organisms, increasing the risk of water-borne infectious diseases. Floods and rising sea levels can lead to the contamination of soil and water resources with salt water and faecal matter, causing the quality of water (groundwater and surface water) to deteriorate.³

Finally, the melting of glaciers alters the banks of riverbeds, in many cases leading to the destruction of homes and farming areas, and surrounding ecosystems, affecting and destabilising communities and consequently encouraging migration³.

³ Water and Climate Change | UN-Water (unwater.) org



A study released by the Portuguese Environment Agency¹⁰ states that since 2000, floods in Europe have caused at least 700 deaths, the displacement of around half a million people and at least 25 billion euros in economic damage.

¹⁰ Assessment of current and future water availability and application of the Scarcity Index

What can be done to reduce the risks?

Wastewater should be seen as an alternative source of water supply in order to preserve water resources for human consumption. Using treated wastewater for purposes other than human consumption is a way of optimising the use of available water resources. At European level, the importance of reusing treated wastewater has been emphasised, and this is now seen as a raw material in water plants. In Portugal, as in other European countries, legal references have been issued encouraging the reuse of treated wastewater and indicating the requirements that wastewater, once treated, must meet for its intended use.

By reusing treated wastewater, we can reduce water scarcity, contribute to protecting the environment and public health, boost the circular economy and increase national and global resilience in the face of climate change.

The protection of water resources must be considered an urgent issue in public policies at local, national and international level. Sustainable water management increases society's resilience to climate change and protects people's health. There are various solutions for the sustainable management of water resources, including³:

- Protecting the different ecosystems on which the water cycle and its purification depend
- Protecting coastal ecosystems that can act as a barrier to the advance of the ocean, preventing flooding and soil erosion
- To store rainwater in order to minimise the impact of droughts, losses and run-off into the sea, promoting infiltration and the balance of underground aquifers

- Adopt agricultural techniques suited to the climate of each region, reduce waste after harvesting crops and transform waste into sources of nutrients or biogas
- Reuse wastewater for irrigation, industrial applications, washing municipal areas, among other uses
- Making sustainable use of groundwater to supply the growing population

Individual measures, on the other hand, are essentially behaviours and/or choices made by the individual themselves that contribute not only to reducing freshwater consumption¹¹, but also to making the right public health choices:

- Using water at home efficiently: Close or re-stop taps that pour water, use the washing machines and dishes when they are full;
- Purchasing energy-efficient washing machines and dishwashers to save water and energy;
- Using native and/or heatwave-resistant plants in home gardens
- Taking quick showers instead of baths;
- Turning off the tap while brushing your teeth or washing;
- Favouring beaches (coastal and river) that have a blue flag and that monitor their condition;
- Consuming drinking water that has been properly monitored and controlled by the competent authorities

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VBD

A vector-borne disease is a human illness caused by the transmission of parasites, bacteria or viruses through the bite of a living organism, called a vector.

Vectors are living organisms (most often arthropods such as ticks, mosquitoes or flies) that transmit a pathogenic microorganism (capable of causing disease) between humans, from animals to humans, from humans to animals, or between animals. Vector-borne diseases (VBDs) can present as acute illnesses, which can range from asymptomatic or mild presentations to serious, life-threatening illnesses or chronic illnesses with the possibility of permanent disability.

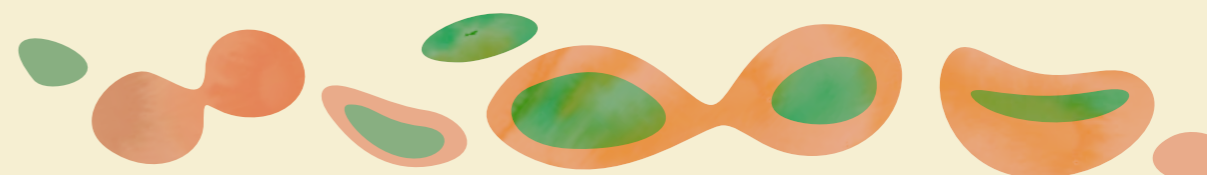
It is currently estimated that 80 % of the world's population is at risk of developing at least one vector-borne disease. They are responsible for almost a fifth of all infectious diseases and cause more than 700,000 deaths a year worldwide.

According to a 2019 study, if nothing is done, by 2050 mosquitoes infected with aetiological agents will be able to reach 500 million more people than today.

Vector-borne diseases and climate change

Sofia Nuncio

Ricardo Jorge Institute for Health



Today, vector-borne diseases affect hundreds of millions of people worldwide and are responsible for morbidity, long-term disability and stigma, with the associated distress and mental health problems, as well as considerable mortality. In addition to the health burden of vector-borne diseases, the economic impact is enormous, especially as they disproportionately affect the world's poorest countries, particularly those in Africa, South America and South-East Asia.

Such diseases include nodular scabies fever (aka tick fever), Lyme disease, dengue fever, malaria, Zika, among many others. Humans serve as primary hosts for some vector-borne diseases, including malaria, dengue, chikungunya and Zika, while other vector-borne diseases have more complex transmission dynamics. For example, in the case of Lyme disease, small mammals and birds are the competent hosts (reservoirs, i.e. they are infected by the infected tick while taking a blood meal, remain with the bacteria in the bloodstream and can then pass the infectious agent on to other uninfected ticks); deer and other large and medium-sized mammals serve as incompetent hosts (they supply blood to the ticks, but are not infected); and humans are final hosts (they are infected, but are unable to ensure transmission to other ticks).

At the end of the 20th century, with the discovery of new antibiotics, the development of effective vaccines and the discovery of the insecticidal action of chemicals such as DDT (dichlorodiphenyltrichloroethane), it was thought that these diseases would be eradicated or at least manageable, and that in the short term they would no longer pose a threat to public health. The continuous emergence of new pathogens, the appearance of resistance mechanisms to the main insecticides in the vector population and antibiotic resistance in bacteria, together with climate change, contradict this assumption.

In recent decades, major outbreaks of dengue, malaria, chikungunya, yellow fever and Zika have afflicted populations, overburdened health systems in many countries and caused high mortality. The burden of vector-borne disease in Europe is less severe than in other regions. This region has populations of mosquitoes, wild rodents, flies and ticks, along with animals that help maintain transmission cycles, so it meets the conditions for the occurrence of vector-borne diseases, which include Chagas disease, chikungunya, Crimean-Congo haemorrhagic fever, dengue fever, leishmaniasis, Lyme disease, malaria, plague, tick-borne encephalitis and West Nile fever.

Main VBDs, including their most frequent clinical signs¹⁻⁶:

Dengue

(transmitted by *Aedes* mosquitoes and caused by the Dengue virus): sudden onset of high fever, severe headache, joint and muscle pain, rash, mild haemorrhages (such as nose or gum haemorrhages), fever. In severe cases, it can develop into dengue haemorrhagic fever or dengue shock syndrome, with the risk of death.

Virus Zika

(transmitted by *Aedes* mosquitoes and caused by the Zika virus): most people infected with the Zika virus have no or mild symptoms. However, common symptoms include fever, rash, joint pain, muscle pain, headache, conjunctivitis and fatigue. Of particular concern is the disease in pregnant women due to its potential to cause serious congenital malformations.

Chikungunya

(transmitted by *Aedes* mosquitoes and caused by the chikungunya virus): sudden onset of high fever, intense joint pain (usually in the hands and feet), headache, muscle pain, rash, fatigue. Joint pain can persist for months or even years in some cases.

Yellow Fever

(transmitted by *Aedes* mosquitoes and caused by a flavivirus, the Yellow Fever virus): fever, headache, muscle pain, nausea, vomiting, fatigue, jaundice and, in severe cases, it can lead to organ failure and haemorrhage.

Malaria

(transmitted by infected female *Anopheles* mosquitoes and caused by the *Plasmodium* parasite): fever, chills, headache, fatigue, nausea. In severe cases, it can lead to organ failure and death.

West Nile Fever

(transmitted by mosquitoes of the genus *Culex* and caused by a flavivirus, the West Nile Virus)

Most people infected with West Nile fever do not show any symptoms. However, some may experience mild symptoms such as fever, headache, joint and muscle pain, vomiting, diarrhoea or rash. In rare cases, it can lead to encephalitis or meningitis.

Lyme disease

(transmitted by ticks and caused by the bacterium *Borrelia burgdorferi*): skin rash (characterised by a bullseye rash called erythema migrans), flu-like symptoms (fever, chills, fatigue, muscle and joint pain), enlarged lymph nodes, headache. In some cases, it can lead to neurological problems, joint inflammation and heart problems.

It is important to emphasise that clinical manifestations can vary from person to person and overlap with other diseases.

VBDs in Portugal

In Portugal, the impact of VBDs has been well known for centuries. For example, at the end of the 19th century until the middle of the 20th century, malaria had a significant impact on people's health, with approximately 100,000 cases of malaria per year between 1920 and 1942, resulting in 4,000 deaths per year.

With the eradication of malaria in 1968, the impact of these diseases on public health in our country was greatly reduced. The VBD with the highest number of cases/year became a tick-borne disease called nodular scabies fever (or tick fever).

In the 1980s, the number of cases of VBDs also increased in Portugal, new diseases were detected in the territory, such as Lyme disease, so, foreseeing the increased impact and importance that these diseases would have in the future, the Dr Ricardo Jorge National Health Institute took advantage of the former facilities of the Malariology Institute and created the Doctor Francisco Cambournac Centre for the Study of Vectors and Infectious Diseases, commonly known as CEVDI..

Since its foundation, CEVDI has been the National Reference Laboratory for VBDs, carrying out activities such as laboratory diagnosis, research, continuous training and surveillance. The CEVDI ensures the surveillance of human cases by notifying laboratory results to the Portuguese Health Authority (DGS) and the surveillance of vectors and the main infectious agents that pose or may pose a threat to the health of the Portuguese population..

This programme, the Vector Surveillance Network (REVIVE), is in place to monitor the species of mosquitoes, ticks and sandflies that exist in Portugal or that may be introduced into our territory, as well as the etiological agents that they have the capacity and competence to transmit, including various viruses and bacteria.

The first REVIVE protocol (2008-2010) was created as a network between the Directorate-General for Health, the Regional Health Administrations of the Algarve, the Alentejo, the Centre, Lisbon and the Tagus Valley and the North, and the Ricardo Jorge Institute. The second REVIVE protocol (2011-2015) extended surveillance to include ticks that are of public health importance in Portugal..

In 2022, the fourth REVIVE protocol was signed by the ARS, the DRS of Madeira and the Azores, the DGS and the INSA. Recently, the scope of REVIVE was broadened and entomological surveillance is currently carried out on mosquitoes (Culicidae), ticks (Ixodidae) and sandflies (Psychodidae).

With regard to the surveillance of etiological agents in ticks, in addition to borreia and rickettsiae, surveillance of the Crimean-Congo haemorrhagic fever virus was included.

In addition to REVIVE, Portugal has had a National Plan for the Prevention and Control of Vector-Borne Diseases since 2016 (Law no. 4/2016, of 29 February).

Vector-borne diseases and climate change

The impacts of the increase in global average temperature of 1°C above pre-industrial temperatures have been profound, including a decrease in cold days and nights, an increase in hot days and nights, an increase in extreme heat events, a decrease in snow cover and an acceleration in sea level rise.

Climate can affect the transmission dynamics, geographical distribution and resurgence of vector-borne diseases through multiple pathways, including direct effects on the pathogen, the vector, the non-human host and humans. The climate changes we are observing could alter the habitats of entire ecosystems (including urban habitats), in which vectors and/or non-human hosts could increase in abundance or become extinct.

Potentially, climate change could increase the distribution or abundance of animal reservoirs or arthropod vectors (Lyme disease and arthropod-borne viruses); prolong the transmission cycle (West Nile virus and Rickettsioses such as nodular scabies fever); favour the successful importation of animal vectors or reservoirs (dengue, Zika) and increase the risk of zoonotic diseases (tularaemia and q fever). Climate change that has facilitated vector transmission has caused increases in the incidence and prevalence of more than 100 vector-borne diseases.

Many VBDs have been largely confined to specific regions - especially in tropical and subtropical areas. This situation is now undergoing profound change due to a number of factors, including climate change, increased global travel, refugee migratory movements, global trade, deforestation, changing human behaviour and unplanned urbanisation, to name but a few..

These changes not only modify the natural habitats of the vectors but also promote their spread to new regions, exposing new populations to the diseases they carry. Thus, although climate and climate change are crucial factors for the increase in the incidence of VBDs, it cannot be proven that this is their main driver.

The relationship between climate change and the increase in the number of cases associated with VBDs (which is happening) is due to the fact that arthropods are ectothermic (i.e. cold-blooded animals), so the abundance of their populations, their survival, the period of their feeding activity and the prevalence of microorganisms in the vector, in general (this can vary depending on the species), are intensified by the increase in temperature and relative humidity microorganisms in the vector, in general (it can vary depending on the species of vector in question), are intensified with the increase in temperature and relative humidity. As there are more vectors, the possibility of contact between vectors and humans also increases.

This explains the influence of climate change on these pathologies, with long-term consequences and implications for the prevention and control of VBDs. Among the various factors associated with climate, average air temperature and rainfall are the most influential. However, other parameters, such as the length of daylight hours, wind and the occurrence of extreme events, also influence the occurrence of VBDs.

There are many regional and local signs that climate change has already affected or is likely to affect the transmission or spread of vector-borne diseases. For example, a time-series analysis of monthly malaria cases in the highlands of Colombia and Ethiopia provided evidence of a shift in the altitudinal distribution of malaria to higher altitudes in warmer years, suggesting that, in the absence of intervention, the malaria burden will increase at higher altitudes as temperatures rise.

Although generally speaking, 'warmer is better' for vectors, the relationships between temperature and vector survival, abundance and feeding behaviour are often complex. For example, in the laboratory, *Aedes aegypti* survival during its life cycle (from egg to adult) increases linearly if the temperature increases (from 0 % at temperatures of 15°C or less to around 90 % if the temperature varies between 20°C and 35°C). From temperatures of 35°C or more, the survival rate drops slowly to around 60 %.

The relationship between rainfall and vector abundance is also complex and varies depending on the context. Continuing with mosquitoes as an example, an increase in rainfall can provide more natural breeding sites for these vectors; however, drought can also provide more artificial breeding sites, due to the increased use of containers for collecting and storing rainwater - favoured breeding sites for *A. aegypti*.

The abundance and behaviours of non-human and human hosts can also be influenced by climate directly, or indirectly through ecosystem change, which can affect the abundance of food sources, predators and pathogens, making habitats more or less hospitable.

For example, birds serve as a reservoir for West Nile virus. The change in bird migration patterns and the decline in bird populations in North America, caused by various factors - including climate change - can affect the transmission of West Nile virus from *Culex* mosquitoes to humans. Likewise, the massive displacement of human populations, caused by climate change such as rising sea levels, can spread the vector or pathogen to new locations or can bring immunologically susceptible populations into contact with the vector and pathogen.

The rise of risk in Europe and Portugal

The effect of climate change on the dynamics of VBDs is already observable, even in the regions least susceptible to its impact. Mosquito-borne diseases are emerging in Europe and the range of vectors may be expanding even further in the region. For example, outbreaks of West Nile fever and chikungunya were detected in 2000 and 2007 respectively, with the 2007 outbreak marking the first appearance of chikungunya on the European continent; West Nile fever numbers increased between 2000 and 2010; other mosquito-borne diseases that have affected Europe include dengue fever and malaria, with indigenous cases appearing. In southern Europe, in areas where *A. albopictus* mosquitoes are already well established, there have been local (autochthonous) outbreaks of dengue and chikungunya, when infected travellers passed on the etiological agent (such as viruses or bacteria) to the mosquito vector, which in turn caused secondary cases of human infection.

Although such outbreaks are still rare, and the current risk of outbreaks with considerable temporal duration is low, as climate change worsens, vigilance is needed to prevent sustained outbreaks or the establishment of endemicity in the future.

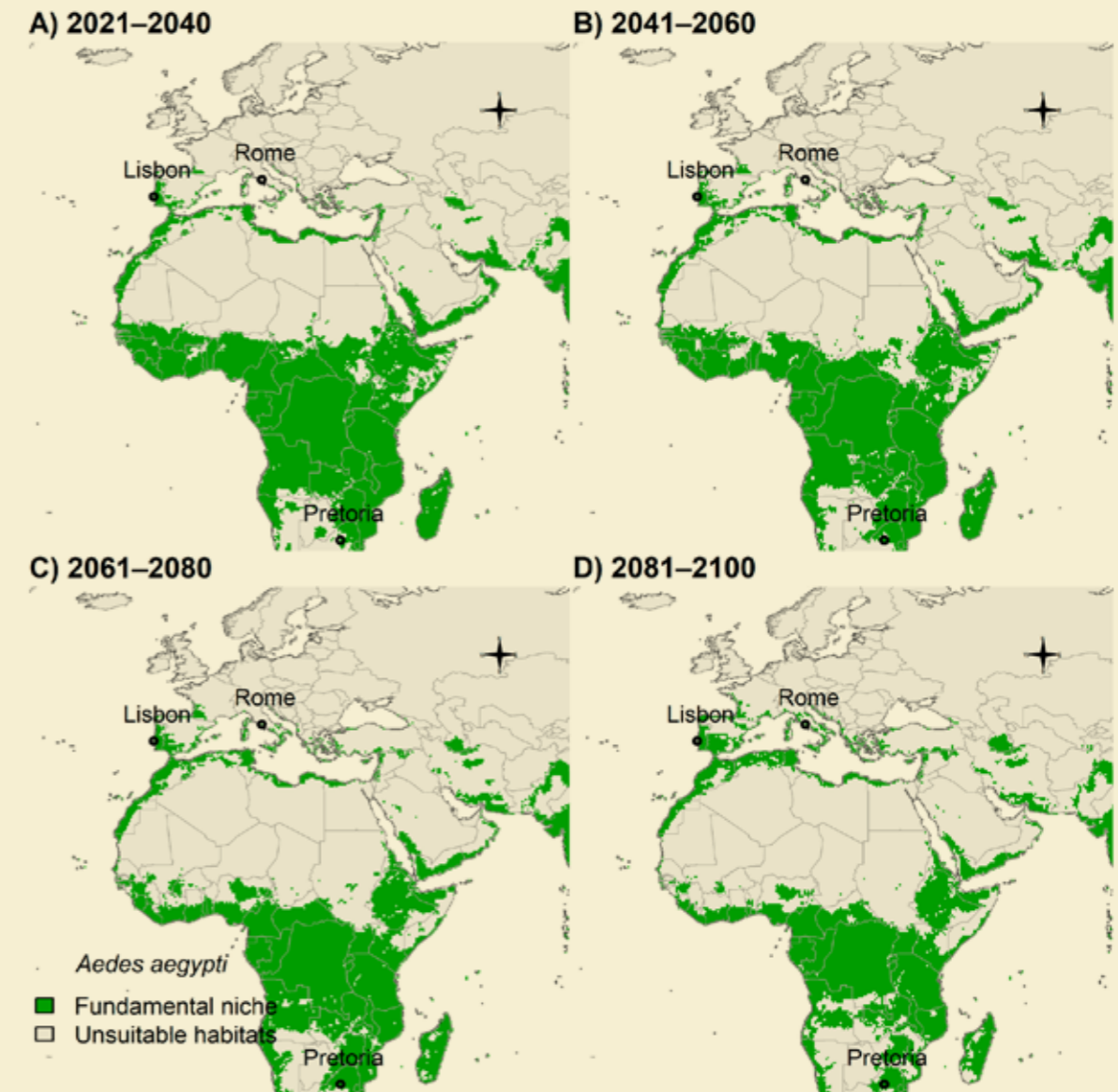
Climate change is also influencing and expanding the range of tick habitats, which means an expansion of tick-borne diseases across the continent. These include tick-borne encephalitis (TBE), Lyme disease, Crimean-Congo haemorrhagic fever and diseases caused by bacteria of the genus *Rickettsia*.

Tick-borne encephalitis alone has approximately 5,000-12,000 cases reported annually across Europe. So far, there are no indigenous cases of this disease in Portugal, but it is already possible to see some effects of climate change on vector populations.

As far as mosquitoes are concerned, there has been a recent introduction of exotic mosquito species of the *Aedes* genus into mainland Portugal and the Autonomous Region of Madeira (*Aedes albopictus* and *Aedes aegypti*, respectively). These two species have already adapted to the environmental conditions of our territory and are currently expanding their geographical distribution in various areas of Portugal. As vectors of etiological agents of pathologies such as dengue fever and yellow fever, if these viruses are introduced, we could have outbreaks of these diseases.

As far as ticks are concerned, the effect has mainly been to change the periods of activity of these vectors. For example, the *Rhipicephalus sanguineus* tick was usually only active in the spring-summer months and, as a result, cases of tick fever were only seen at these times of year. Nowadays, specimens of these ticks are caught in the autumn and even winter months, making it possible for transmission to occur outside the usual seasonal period.

Potential future distribution of the mosquito *A. aegypti* in Europe and Africa (dengue, zika and chikungunya vectors)



(A) 2021–2040; (B) 2041–2060; (C) 2061–2080; and (D) 2081–2100. Future climate projections based on NOAA's GFDL-ESM4.1 global climate model in the SSP3-7.0 shared socioeconomic pathway of regional rivalry. The location of the countries' capitals are shown for reference.

Source: Laporta, G.Z.; Potter, A.M.; Oliveira, J.F.A.; Bourke, B.P.; Pecor, D.B.; Linton, Y.-M. Global Distribution of *Aedes aegypti* and *Aedes albopictus* in a Climate Change Scenario of Regional Rivalry. *Insects* 2023, 14, 49. <https://doi.org/10.3390/insects14010049>

Prevention and control of VBDs

Observational studies that elucidate how meteorological variables affect the incidence, length of the transition season and spread of VBDs, and the development of predictive models based on scenarios of the effects of future climate change, can assist in long-term planning for the prevention and control of VBDs.

Addressing the adverse impacts of climate change will require urgent and rapid reductions in greenhouse gas emissions, as set out in the Paris Climate Agreement's goal of limiting global warming to 1.5°C above pre-industrial levels. This will require immediate and sharp reductions in greenhouse gas emissions through rapid and far-reaching changes in energy use, land use, transport, urban, built environment, food and industrial systems.

Currently, greenhouse gas emissions continue to rise and there is no evidence of global political commitment to deviate considerably from "business-as-usual", which could lead to an increase of 4 to 5°C by 2100. Prudence therefore demands planning using a series of possible future scenarios.

Globally, it is necessary to continue carrying out observational studies to understand the relationships between meteorological and climatic variables (based on greenhouse gas reduction projections). This implies the development of predictive models, either empirical or based on DTV transmission processes, validated by analysing data accumulated over time.

The simplest approach is to do this without incorporating scenarios for non-climatic events which, as mentioned, can also influence the dynamics of VBDs such as travel, socio-economic factors, advances in public health policies or changes in human behaviour. Of course, this kind of simplified approach only produces indicators of what could happen if nothing is done about it. They are useful for indicating trends, but on their own they are not enough to produce highly accurate scenarios.

Despite these limitations, short-term models (i.e., weeks to months) are currently being developed for VBDs with sufficient validity to be used in early warning systems, which will allow for the implementation of appropriate and timely preventive public health and control measures capable of preventing the occurrence of VBD outbreaks. Incorporating a variety of intervention actions into scenario modelling can help to atomise combinations of interventions that will respond to the ongoing challenges of preventing and controlling VBDs in the face of ongoing climate change.

In addition to the development of predictive models, prevention and control efforts need to be stepped up, including vector control and prevention of exposure to vectors, improving methods of early diagnosis and treatment of diseases (to remove sources of infection available for vector feeding), developing new vaccines, improving water and sanitation systems and educating and involving populations, among various other possibilities for intervention.

A crucial element in reducing the impact of VBDs is changing the behaviour of populations at risk, which can be achieved through education and improving public awareness so that people know how to protect themselves individually and in the community from mosquitoes, ticks and other vectors.

Other individual measures include

- Before travelling to areas endemic for vector-borne diseases for which an effective vaccine exists, it should be used. Very effective vaccines are available to prevent yellow fever, Japanese encephalitis and tick-borne encephalitis (TBE).
- Consult your doctor 4 to 6 weeks before departure to review your self-protection measures (e.g. which anti-malarial drugs to take if malaria is endemic at your destination).
- Wear long-sleeved shirts and light-coloured long trousers.
- Wear long-sleeved shirts and light-coloured trousers tucked into socks or boots, and use insect repellent.
- Wear long-sleeved shirts, tucked into socks or boots, and use insect repellent on your skin and exposed clothing to avoid being bitten by mosquitoes, midges or ticks. Temperature, relative humidity and time of day affect the likelihood of being bitten. There are times of day when the risk is higher and measures should be reinforced.
- Install mosquito nets on windows and doors in areas where mosquitoes are active.
- Use mosquito nets at night, especially if you are in a malaria-prone area.
- Check your body regularly for ticks or bite marks. If you find a tick, remove it immediately with tweezers and apply a skin disinfectant.
- Avoid contact with blood, secretions, organs or other body fluids of infected people or animals.
- If you are bitten and need treatment, complete the treatment prescribed by your doctor and, if you become ill after returning from an endemic area, inform your doctor immediately.
- Avoid the accumulation of materials that could facilitate the survival of ticks (e.g. piles of firewood or brush) and/or remove artificial mosquito breeding sites without lids (e.g. water containers without lids, flower pot bases, etc.).

Conclusions

Combating DTVs is fundamental to achieving many of the United Nations' Sustainable Development Goals, from poverty eradication to quality education, from clean water and sanitation to reducing inequalities and developing sustainable cities and communities.

In the fight against the impact of VBDs, WHO Member States have adopted a collective strategy to strengthen vector control in all regions. The Global Vector Response 2017-2030 serves as a global and comprehensive framework to strengthen the capacity of countries and territories to effectively manage vectors and VBDs. Key objectives include reducing mortality by at least 75 %, reducing case incidence by at least 60 % and preventing epidemics of vector-borne diseases worldwide by 2030.

This approach is taken up in the adopted WHO Immunisation Agenda for 2030, since vaccines are critical in the battle against emerging and re-emerging infections. To achieve these goals, accessible and effective prevention and treatment strategies are needed, as well as multidisciplinary collaborative efforts with populations and between various professionals, including public health specialists, health professionals, researchers, veterinarians, environmental technicians, mathematicians, and others.

Climate change will continue to affect the health hazards of human infectious diseases, limiting the transmission of some diseases but creating opportunities for others. Reducing vulnerability by adopting adaptation measures is among the most effective approaches for society.

Identifying the most effective adaptation measures requires scientific and social advances in several respects. Firstly, scientific advances are needed to go beyond empirical observations of an association between climate change and changes in infectious diseases to reach more explanatory conclusions. Progress depends on knowing the health implications in all aspects of infectious diseases (relationship between agent, vector, reservoir and environmental conditions).

Secondly, there is a need for better understanding and modelling of the spatio-temporal process of climate change (including extreme weather events and meteorological hazards). Being able to map this process of change in time and space is the basis for predicting health impacts and adopting appropriate adaptation measures.

Finally, effective early warning systems for climate change health impacts must be established and their durability over distance and time ensured, as well as the strengthening of rapid response systems to the occurrence of VBD outbreaks, including the existence of National Health Systems with resilience capacity.

There is a need for information-sharing protocols, public health awareness-raising campaigns among vulnerable populations and investment in human and financial resources to enable Public Health to play a more effective and active role.

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«A couple of fishermen with a child and a house close to the Portuguese sea, as befits their life. The little one is already learning the ways of the fisherman. He often sees his father coming in from the open sea with a load of fish preserved in ice. The hustle and bustle of the fish market. Conversations about tides, the moon, where the most prized fish are. Far, far away, making sounds that are impossible for the family to hear, blocks of ice fall and increase the level of the seas, millimetre by millimetre, from Scandinavia to here, including the sea where this family lives. All linked by webs that are difficult to discern by those who fight the waves night after night. And then there's the cold. Colder and colder. And the rain, stronger and stronger, stinging the water ever more visibly. And the heat, ever more predictable, longer-lasting, hotter, beating down on the back of this father who patiently fulfils the daily routines of working at sea.

The fish are increasingly on the run, looking for other temperatures and, of course, not realising why the hell they no longer meet their usual aquatic companions. In the meantime, they've given up on the increased temperature of the waters or the acidity that erodes and alters long-standing balances. What is certain is that, as the fishing nets become less and less heavy, the pockets become lighter and lighter, making it difficult to make ends meet. Month by month, from bad to worse.

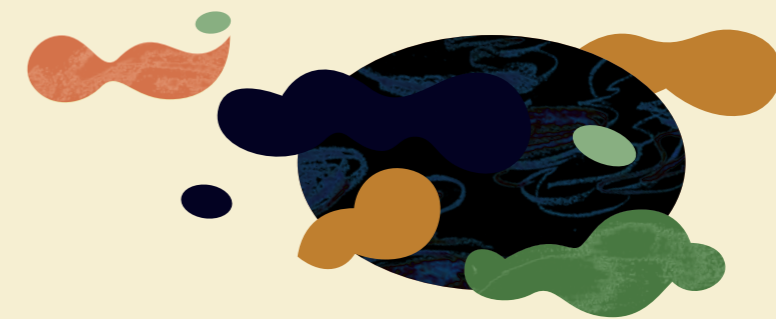
Problems never come alone. The only thing missing was the increasingly frequent flooding at home. Last week, the water arrived in force and decided to alter the architecture of the house, knocking down doors and furniture. Stealthily, she decided to take possession of the photographs and the few pieces of silverware, the bequests of long-gone family members.

The family decides to leave. Few fish, even scarcer money, unpredictable damage to the house. At great cost, already homesick and mourning, they look forward to other landscapes. The little boy, now no longer so little, watches his father and mother, now without a view of the sea, in the middle of Beira Alta, immersed in memories as they learn new trades, but without the sparkle in his eyes from when his father used to return from the sea at dawn. Now the father drinks a little too much. The arguments increase. The money is still uncertain. They're far from everything and almost everyone they used to know. Fewer roots. The heat. It doesn't let up, it's stubborn. Out of time. Betting on dehydrating the little garden...as uncertain as the fish.»

Mental health in the context of climate change

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The imaginary story with which this chapter begins is just a possible sketch of the potential impacts of climate change on people's lives. What reactions does the story provoke? What psychological impact does news about natural disasters have? There are myriad factors that interact in a complex way on an individual level to ultimately trigger emotions or feelings.

In some cases, it can cause a slight increase in heart rate, an increase in the galvanic response of the skin of the hands and dilation of the pupils. These are the results of a physiological response associated with the perception of threat. But this will depend on a unique combination of individual variables: the tendency to recognise a threat (e.g., having a more easily stimulated amygdala, a brain structure responsible for processing and regulating emotions such as fear and anxiety), hormone levels favourable to the perception of threat (for example, a higher level of testosterone than usual), personal styles in dealing with threat (more actively or more passively, for example), genetic determinants, life experiences that make this type of report more anxiety-inducing.

Other people may have experienced little emotional activation, and this is also a perfectly appropriate response, resulting from less willingness at the moment to "feel" the

emotional dimension of the story, or even from the fact that the story seems improbable to them because it is so distant from their current situation. A certain psychological detachment. This is, in fact, the technical term used for a general attitude of distance from discourse on climate change.

This psychological distance is easy to understand when the discourse associated with climate change is generally associated with phenomena that are presented far beyond the human scale, i.e., "megatons of carbon dioxide", predictable collapses for a distant future, 50 or 100 years from now, a problem for other generations, disasters in distant places like the melting of polar ice caps; all this discourse points to outcomes that are not very tangible, far from the here and now, from current circumstances, thus creating a barrier to embracing behaviour that will combat climate change (Jones et al., 2017).

This range of reactions to the initial text of this chapter illustrates that natural human responses (cognitive, emotional, behavioural) are extraordinarily difficult to predict. They are characterised by immense variability and complexity. Despite this, it is known that the mental health of a considerable number of people is negatively affected by experiences (personal or witnessed) or anticipation of problems related to climate change.

Different speeds in the impact of climate change on mental health

Scientific literature on the effects of climate change on **MENTAL HEALTH** can be divided into three main areas:

1. Experiencing events

Scientific evidence on the impact of personal experience of natural disasters

2. Everyday life

Scientific evidence on the impact of prolonged exposure to climate change (heat waves, cold waves, observable changes in seasonal cycles, etc).

3. The future: from uncertainty to pessimism

Scientific evidence on the stress associated with anticipating (more or less) apocalyptic scenarios resulting from climate change.

MENTAL HEALTH

This concept is understood as a "mental state characterised by emotional well-being, appropriate behavioural choices, the absence of anxiety or disabling symptoms, and the ability to establish constructive relationships and cope with common demands and sources of stress" (American Psychological Association, 2020). This ability to process information and make appropriate decisions is naturally affected by (or linked to) emotional stimulation. Adversity, when perceived in reasonable doses, provokes emotions that generally lead to more efficient performance. However, if the stress factor is too intense or too persistent, the capacity for more rational, strategic decision-making can be seriously diminished.

1. Experiencing events

Climate change is associated with natural phenomena that can be adverse in some way. In fact, catastrophic events such as floods (being the most frequent form of catastrophic events associated with climate change), hurricanes, prolonged drought or fires cause very significant material damage at individual, familiar and community level, and are associated with long-lasting injuries and even death.

In the last two decades, there has been an increase in research about the impact of these events on physical health, particularly with regard to respiratory diseases resulting from fires (due to exposure to particles resulting from combustion), injuries from accidents related to floods or cyclones, outbreaks of infectious diseases due to the spread or increased activation of vector-borne insects, malnutrition associated with periods of drought, or forced migration due to natural disasters or dramatic changes in family finances, etc.

On the other hand, research about the impact of these events on mental health is more recent (only from 2007 onwards; WHO, 2022), and with fewer resources. Despite this, and according to the most recent report by the Intergovernmental Panel on Climate Change (IPCC, 2023), the

evidence is already very solid that the psycho-emotional impact of these catastrophic events often translates into psychological distress and changes in the person's daily way of being:

- The psychiatric diagnosis of post-traumatic stress disorder;
- Diagnosis of generalised anxiety disorder (when the person feels excessive restlessness and worry about different activities or events for a period of at least six months, which severely affects normal functioning in interpersonal, social and work life, and causing significant distress to themselves and/or their significant others);
- Diagnosis of phobic anxiety disorder (an unreasonable fear of some situation or trigger that are no real danger, which hinders people from carrying out daily activities and cause great suffering to themselves and/or their significant others);
- Prolonged grief disorder (intense and persistent emotional pain as a result of the loss of someone/thing, apathy and lack of interest in daily activities, denial of the loss or avoidance of memories associated with the loss, symptoms that last for more than a year after the loss in adults or six months in children or adolescents);
- Diagnosis of depression.

Post-traumatic stress disorder is probably the diagnosis most strongly associated with catastrophic events related to climate change. There are indeed events that trigger very strong emotions of fear, helplessness and horror, which can cause post-traumatic stress disorder. These events can be experienced by the person themselves or indirectly (for example, witnessing accidents that result in serious injuries or deaths, learning about very serious events that have happened to family members or close friends). It is thus a chronic mental health disorder that results from exposure to an event that is highly stressful for the individual, such as situations of armed conflict, sexual assault, traffic accidents, or natural or man-made disasters.

Symptoms that last for at least a month include nightmares related to the event, feeling/acting as though the event is happening again, intrusive and recurring disturbing memories. The person attempts to avoid thoughts related to the stressful event and may avoid places or people related with the event but is unable to avoid thinking of it. Additionally, there is often loss of memory of significant parts of the event (dissociative amnesia); feelings of personal guilt or accountability for what happened; persistent negative emotional states (fear, panic, guilt, anger, shame); loss of interest in activities that they used to enjoy; pushing away significant people; difficulty sleeping; irritability; hyper vigilance, etc.

A study on the health effects of a severe flood in Spain (which occurred in 2012) concluded that the percentage of people affected by the flood who experienced post-traumatic stress was around eight times higher than the percentage of post-traumatic stress observed in people from nearby locations that were not affected by the flood, with symptoms persisting for many months after this traumatic event (Fontalba-Navas et al., 2017).

In Portugal, the Pedrógão Grande fire in 2017, in addition to the deaths and very high material damage (66 people died and more than 1,000 houses were destroyed), had a very significant impact in terms of mental health, with a significant increase in the rates of post-traumatic stress, depression and (pathological) anxiety in the affected communities. There was a 50% increase in the risk of post-traumatic stress among those who witnessed (even if they weren't affected by) the fire¹. The floods that hit Portugal in October 2019 (the worst since 1983) affected more than 100,000 people and caused millions of euros in material damage. A study published in 2022 estimated that these floods were associated with a 30% increase in the risk of suicide at national level². The more sceptical may question the role of climate change in such events. But the point here is to understand the relation between the experience (personal or witnessed) of this type of event and its impact on mental health.

¹ (Santos et al., 2020)

² (Ribeiro et al., 2022)

Addictive behaviours (alcohol, drugs or other forms of dependency) may also emerge as a chosen, albeit dysfunctional, way of coping with the suffering associated with natural disasters.

The impact of these events on mental health can last a few days to a few decades (in some cases, for the rest of their lives), with very significant costs (emotional and financial, for the individual, their family and the community). They can even lead to suicide attempts. The intensity and level of dysfunction of these psychological changes are not, of course, the same for everyone who experiences a natural disaster.

Naturally, those with pre-existing vulnerabilities are at increased risk of experiencing more intense psychological distress in the aftermath of a natural disaster. Among the most vulnerable groups are those with a pre-existing physical or mental illness, those in a situation of financial insecurity, social minorities- for example, migrants - those with little social support, women, children or the elderly (particularly the ones who are socially isolated).

A concept proposed by Albrecht (2007) illustrates an additional factor of psychological distress associated with disasters or the processes described in the next section ("Everyday life").

The concept of solastalgia expresses a kind of "anticipated" longing for places or environments where the person still lives, but which they perceive to have been (or in the process of being) altered by events related to climate change (through catastrophes or gradual changes, such as drought or rising sea levels).

This concept is associated with sadness, restlessness or even depression, with cognitions related to loss of identity - identity is also constructed in relation to the environments we live in and come into contact with on a daily basis.

Changes in these environments (due to catastrophes or gradual changes), or forced displacement to other environments (for example, due to the need to move or emigrate, the loss of a home or workplace) can lead to loss of identity.

And it is important to stress that it is estimated that there will be a total of 200 million climate refugees by 2050, as a result of climate change and related phenomena (Myers, 2002).

2. Everyday life

There is a second, less obvious level at which climate change impacts on mental health. These are changes that don't result from large-scale events, but rather by events that are occurring more frequently: heatwaves, cold waves, more intense rainfall, less predictable weather conditions than usual (with an impact on agriculture or animal care), prolonged droughts.

These are less dramatic phenomena, but in the medium or long term, will lead to reduced access to water or food, an increase in temperature-related physical illness or deaths, the spread of vector borne diseases by insects or other animals, respiratory problems and allergic reactions, foetal and infant development problems (for example, associated with air pollutants, which can become more harmful to human health as the air warms).

Increasingly frequent and prolonged heatwaves are associated not only with increased physical illness and death, but also with increased psychiatric illness.

Around a fifth of the Portuguese people suffer from a psychiatric disorder (22.9%), making it the country with the second-highest prevalence of psychiatric illness in the European Union (just after Northern Ireland, with 23.1%).

(Eurostat 2018)

A recent study showed that the number of psychiatric emergency consultations in adults increases on days of extreme heat (Nori-Sarma et al, 2022). Another study showed that, in Portugal, hospital admissions for psychiatric problems increase significantly on days with high temperature, especially above 30°C (Almendra, 2019).

It is known that people suffering from psychiatric disorders can have reduced thermoregulatory capacity: due to the effects of psychotropic drugs; the psychiatric condition itself (excessive heat alters the functioning of the serotonergic system); reduced heat-protective behaviour; poorer sleep quality; and/or increased isolation (during heat waves - as with cold waves - there is a natural tendency to stay indoors more, which can lead to less social contact, and this is a risk condition in the case of psychiatric disorders). There is also strong evidence that alcohol consumption increases during heatwaves.

At the end, it is estimated that people with a psychiatric or neurological condition, particularly those suffering from psychosis, substance abuse or dementia, are two to three times more likely to die during a heatwave than those without such conditions. (Lawrance et al. 2021).

These events, which are increasingly frequent and prolonged, are also associated with an increased likelihood of aggressive behaviour, violent behaviour (robberies, domestic violence, sexual assaults, etc.), and homicides, in other words, phenomena of violence at both an interpersonal and collective levels: studies show that hate speech (e.g. related to racism, xenophobia and other "isms"), and the likelihood of armed conflict between nations increases during heatwaves periods (Burke et al., 2015, Stechemesser et al., 2022). As might be expected, the most significant increase in conflict between social groups, associated with rising temperatures, occurs in low-income regions with a high dependence on agriculture.

A study that analysed armed conflicts over 30 years found that around 10% of these conflicts occurred during periods of heatwaves or more severe droughts (Schleussner et al., 2016). The need to migrate due to climate change is also a highly relevant determinant of conflict between social groups.

The number of suicides also increases with temperature. A study published in 2017 estimated that rising temperatures have been responsible for around 60,000 suicides in India over the past 30 years (Carleton, 2017).

In Portugal, a study analysing temperature and mortality data from 1990 to 2015 also found that rising temperatures and precipitation were associated with an increase in suicide rates. In fact, the relationship between these phenomena is so strong that a systematic review and meta-analysis study found a 1% increase in the risk of suicide for every 1°C increase in temperature, above a certain temperature threshold, which varies according to location (Gao et al., 2019).

Another study, this time on the Portuguese population, revealed an association between prolonged droughts (affecting agriculture, energy production and the availability of drinking water) and an increased risk of depression and anxiety. In all these cases, there is an uneven distribution in the way these phenomena affect mental health across different social groups.

The most vulnerable are, once again, people who are financially disadvantaged, in more energy poverty, often associated with food insecurity (i.e., difficulties in securing the purchase of essential food), ethnic minorities, the chronically ill (physical or mental pathologies), and occupational groups more dependent on climatic conditions (farmers, fishermen, construction workers, etc.) among others.

The case of farmers is particularly relevant as they are a social group whose life depends entirely on stability, with relatively well-defined cycles of temperature, humidity and rainfall. The stress associated with periods of drought, the unpredictability of the weather, with disruption of time and seasonal conditions, has a very significant impact in terms of mental health (with high levels of emotional distress, chronic anxiety and depression, and an increased risk of suicide) in this professional group.

A landmark study on farmers (Mani et al., 2013) revealed that the ability to make good decisions, varies throughout the year, depending on when crops are grown and when they are harvested. To summarise, the authors found that after the harvest (with the resulting financial contribution), farmers' performance on cognitive tasks related to strategic

decision-making decreased as the time between one harvest and the next increased.

In other words, as financial capacity declined and the notion of unpredictability regarding the quality and productivity of the following year's crop became more present, the ability to reason was also declined.

And this ability to make decisions is expressed in all areas: financial expenditure, food choices, consumption (alcohol, tobacco, drugs), etc. This study illustrates very clearly the potential negative impact that climate change can have on farmers, who are especially vulnerable to droughts, fires and floods, but also to unpredictable weather. And what applies to farmers, also applies to fishermen.



In addition to the social determinants of severe psychological distress, there are physiological mechanisms, i.e., the functioning of the body, that explain why excessive heat (or cold) is associated with disruptive behaviour (increased aggression, reduced ability to make healthy choices, reduced ability to manage the family budget, etc.) or psychological distress, which can manifest as depression, anxiety, or other mental health problems.

These physiological changes include hormonal changes, also as a result of exposure to prolonged stress (heat, when intense or prolonged, is a stress factor), with more cortisol being released into the blood, but also synaptic changes (relationships between nerve cells, particularly in the brain) and even in the functioning of some brain structures, which can result in less rationality and greater impulsivity.

As mentioned above, excessive heat increases exposure to air pollutants (they tend to be concentrated lower in the atmosphere and are more easily inhaled by humans); on the other hand, heat alters blood flow, which affects cognitive capacity and, in particular, the ability to make informed decisions with medium- or long-term goals.

3. The future: from uncertainty to pessimism

This brings us to a third way in which climate change causes psychological distress. The tendentially pessimistic discourse on climate change and human inefficiency in adopting behaviours that reduce greenhouse gas emissions (and thereby reduce or reverse the global warming that is at the root of climate change) can cause psychological distress.

The concept of eco-anxiety has attracted the attention of researchers and the media. It's important to stress that anxiety in itself is not a mental illness. Anxiety, up to a point, prepares the individual to act in order to solve problems more efficiently. Therefore, this ecological anxiety should not be seen as something harmful (APA, 2021; Dodds, 2021); on the contrary, it is even necessary, so that the human species to collectively and globally take the necessary actions to combat climate change.

The problem arises, and more frequently among the youth (before their twenties), when this anxiety becomes dysfunctional (with an excessive emotional charge or with dysfunctional behaviour, interpersonally or socially). A study involving 10,000 young people aged between 16 and 25 from 10 different countries found that around 60% of respondents were worried or very worried about climate change (65% for Portugal) (Hickman et al., 2021)

However, it is worth repeating that having negative emotions (worrying about the future, being frightened by

apocalyptic news, being frustrated by the inaction of decision-makers, feeling guilty or ashamed of inaction) can be perfectly adaptive and does not necessarily foreshadow an illness.

In fact, several authors argue that the solution is not to clinically "treat" people with eco-anxiety, but to take advantage of this anxiety and work harder to increase the sense of social cohesion necessary for a more effective (and possible) global solution, as we have seen in the way the COVID-19 pandemic has been dealt with globally).

In contrast to this anxiety, it is possible to hypothesise that we are also experiencing a kind of "climate honeymoon" associated with climate change, which can be generalised to many parts of the globe. In many parts of the world (particularly in Portugal), the increase in average temperature is associated with more days with higher temperatures in winter (despite greater unpredictability, for example, in terms of rainfall) and more days at the beach. In other words, even in the short term, climate change also brings tangible gains. And the human species is clearly better at thinking in the short term, especially when the short term brings satisfaction, than in the long term. This happens on an individual time scale (for example, in the tension between choosing more palatable foods, often with more sugar and fat, and worrying about controlling body weight). It also happens, of course, on an intergenerational level.

In this sense, and also according to the study by Hickman (2021), anxiety related to climate change is associated, on the one hand, with the notion of a reduced capacity to fight this adversity as an individual, and, on the other hand, with the perception of an inadequate response from political decision-makers and leaders

This anxiety (which always has uncertainty and unpredictability at its core) is related to a lack of trust in institutions. The treatment of this anxiety will therefore not involve intervention at the level of the individual's symptom, but rather building greater social cohesion and more diligent communication about the actions that are being implemented at community level.

Ways to promote and protect mental health while promoting “climate health”

Many climate change mitigation and adaptation measures alone have a positive effect in terms of promoting mental health. In fact, as mentioned above, the concept of eco-anxiety stems from a certain lack of confidence in the ability (and determination) of institutions to invest in measures that prevent or mitigate climate change.

It follows that government actions, particularly those that promote the involvement of entities with executive capacity at a multi-sectoral level in the fight against climate change, and especially when these actions are accompanied by effective communication (in terms of the nature of investments, objectives and targets), can have a restorative effect on individuals with a high level of awareness of the dangers inherent in climate change. In other words, they can restore confidence in institutions, promote a greater sense of security, and increase perceptions of self-efficacy and community effectiveness in mitigating or adapting to climate change (in the short, medium or long term), as well as greater social cohesion.

On the other hand, there are several actions to fight climate change that have a direct impact on the promotion of mental health. For example, reducing the use of fossil fuels is certainly an action to mitigate climate change by reducing the likelihood of high temperatures and thus the aforementioned pathogenic effects of high temperatures on mental health; but it is also an action to protect mental health by

reducing exposure to inhaled pollutants that have adverse effects on mental health (neurological and psychiatric). Reducing the use of fossil fuels also promotes the opportunity of improving social equity, as more economically disadvantaged areas also tend to be more exposed to poorer air quality associated with burning this type of fuel (Lawrance et al., 2021).

Other examples of actions with a positive synergy between tackling climate change and mental health problems include: promoting energy efficiency in homes and reducing the heat-island effect (actions that reduce carbon emissions, and will also increase in thermal comfort in homes on the other); creating and optimising the use of green spaces and active mobility, which also reduces emissions and the heat island effect, while promoting the widely recognised positive mental health effects of contact with nature (restorative effect; Kaplan, 1995), as well as interpersonal contact and social cohesion.

It is also important, of course, to promote skills that increase individual resilience at all stages of the life cycle (starting, of course, with interventions in schools). Resilient people anticipate risks and take action to reduce their vulnerability to risks (particularly those associated with climate change), responding more effectively to negative events and recovering more quickly.

Promoting resilience at the individual level is, of course, very complex (there is no one-size-fits-all solution), but it includes collective actions that¹:

- Promote a community’s belief in its own capacity for resilience (e.g., promotion of physical and mental health literacy associated with climate change);
- Foster (realistic) optimism and hope;
- Cultivate active self-regulatory, behavioural and emotional mechanisms;
- Promote a strong sense of social support in times of need;
- Promote care and social connection for the young and old;
- Promote a perceived capacity to cope with everyday events or extreme events associated with climate change;
- Promote a sense of security and self-identification with the place where you live and work.

The ability of individuals to mitigate risks associated with catastrophic events is also influenced by community policies and actions that promote a sense of security and stability. This sense of living in a resilient community is determined by (among other things):

- Communities that make a visible investment in addressing the local impacts of climate change, as well as an investment in connecting with (and participating in) global initiatives to fight global warming;

- Communities that systematically plan and share contingency plans for potential natural disasters, and plans for mitigating and adapting to climate change (accompanied by effective communication, adapted to different audiences and maintained over time);
- Communities that focus on social cohesion by creating programmes and spaces that promote social contact, particularly by building and creating green spaces and blue spaces (by the sea, lakes, rivers, water fountains, etc.) and by pedestrianising streets);
- Communities that seek to reduce social inequalities (notably through cultures of tolerance and the reduction of stigma associated with mental illness);
- Communities that encourage contact with nature;
- Communities that respond quickly and proactively to catastrophic events, showing proximity between decision-makers and affected populations;
- Communities that rely on science to monitor and intervene effectively to mitigate or adapt to climate change, and to deal effectively with extreme events associated with climate change;
- Communities that promote collective knowledge about climate change, mental health (how to protect, identify, and access treatment for mental health problems) and the relationship between the two.

¹ Clayton et al., 2021

In a recent report (2022), the World Health Organisation highlights the following aspects for mitigating the effects of climate change on mental health, particularly among the most vulnerable groups (2022): taking climate change into account when defining mental health policies and programmes, including strengthening access to mental and psychosocial health support in the context of extreme events, particularly for groups previously identified as more vulnerable (namely people with pre-existing physical or psychiatric illness); integrating mental and psychosocial health support mechanisms into climate change-related policies and programmes, namely: interventions to promote active transport (beneficial for physical health and mental health, on the one hand, and relevant for promoting social interaction and access to health care, on the other); implementation of multisectoral and community-based approaches, focusing on mental health in the context of climate change, and in particular on reducing vulnerability and social and mental health inequities.

Global problems require global action. The human species struggles to organise itself globally. But never before has the human species been so well prepared for this collective endeavour.

The ability to articulate and, above all, to communicate, rapidly and in different ways, allows for the exchange of good practices and the creation of healthy cultures which, if replicated (which necessarily implies effective support between social groups, both more and less privileged in technological and financial terms) have an economy of scale effect, particularly in the fight against climate change and the promotion of mental health.

Strategies such as redefining urban designs with reduced carbon emissions based on accumulated evidence, for example by adopting the concept of superblocks (Egimann, 2022) or 15-minute cities (Allam et al., 2022), with more green and/or blue spaces, with a focus on houses that promote indoor thermal comfort, are obvious examples of strategies that also promote mental health. Similarly, educating individuals and families in terms of literacy, in terms of their ability to make informed decisions and to manage their emotions, all of which promote resilience and protect human health, particularly in the context of uncertainty and negative life events, whether related to climate change or, is fundamental.

Investing in mental health means investing in human capital and in the skills to deal effectively with challenges. In short, medium, and long-term. In the everyday life, and in the case of experiencing extreme events or climate change related catastrophes.



“Dear Earth: Art and Hope in a Time of Crisis” Hayward Gallery, Southbank Centre, London (2023)

“The exhibition highlights the ways in which artists are helping to reshape and deepen our psychological and spiritual responses to the climate crisis, in the hope of inspiring joy and empathy, as well as fostering a sense of political and social activism. The 14 artists explore the interdependence of ecologies and ecosystems, as well as our emotional connection with nature.”

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Data sheet

Qualitative study

Methodology: A qualitative methodology was adopted, with three online Focus Groups, lasting an average of 2h30

Total sample: a total of 21 individuals took part, with different profiles in terms of health, level of awareness and engagement with the issue of climate change:

Focus Group 1: Highest health risk: Men and women aged between 35 and 65 with health problems that can be aggravated by environmental conditions but are not serious/manageable on a daily basis. Residents of the Lisbon and Porto metropolitan areas.

Focus Group 2: Higher environmental risk: Men and women aged between 35 and 65, living in rural areas prone to rural fires, extreme drought or near coastal areas more prone to environmental risk.

Focus Group 3: More sensitive to environmental or health issues: Men and women aged between 20 and 50 living in different cities across the country. Informed and attentive, they are sensitive to topics such as nutrition, healthy eating, mental health, climate change, etc.

Fieldwork: Held between 26th and 28th April 2023.

Quantitative study

Total sample: 800 individuals [416 women + 384 men]. This sample size corresponds to a margin of error of +/- 3.46 %

Fieldwork: Between 30th June and 6th July 2023.

Universe: Representative sample of the Portuguese population aged between 18 and 74, with access to the Internet, belonging to the Netsonda Panel. A maximum quota of 45% was set for respondents with higher education.

Methodology: Quantitative study through the submission of an online questionnaire to the Net-sonda panel.

Sample characterisation

AGE	M
20 to 24 yo	13%
25 to 34 yo	19%
35 to 44 yo	24%
45 to 54 yo	25%
55 to 64 yo	15%
65 to 74 yo	5%

CARACTERÍSTICAS DO LOCAL ONDE VIVE	
Very urbanised, high density (mostly buildings)	18%
Very urbanised, high density of houses and buildings	23%
Urbanised, but with ample spaces	38%
Slightly urbanised: scattered houses, predominance of open space	13%
Rural, not urbanised	9%

EMPLOYMENT SITUATION	
Employee - large private company	24%
Employee - small/medium-sized private company	27%
Employee - civil servant	17%
Self-employed / independent	5%
Self-employed / business owner	4%
Unemployed / looking for first job	7%
Student	7%
Retired	6%
Housekeeper	2%

REGION	M
Greater Lisbon	24%
Greater Porto	11%
Northern Coast	20%
Central Coast	16%
Northern Interior	19%
South	11%

AVERAGE HOUSEHOLD NET INCOME	
Under 500€	1%
From 501 to 750€	5%
From 751€ to 1000€	12%
From 1001€ to 1200€	11%
From 1201€ to 1500€	16%
From 1501€ to 2000€	20%
From 2001€ to 3000€	18%
Above 3000€	8%
DK/DA	10%

EDUCATIONAL QUALIFICATIONS	
Up to Basic Education: current 5th to 9th Year	7%
Secondary Education: current 10th to 12nd Year	42%
Technical courses	8%
Higher education: Degree/Master's/PhD	45%

Environmental risk

Proximity to environmental risk

- High proximity: if you have ever experienced the threat or impact of a forest fire in the vicinity of your home or that of people close to you, and/or recognise that water shortages are happening or have happened a few times in your area, affecting supply in your home or around you for several days or weeks, and/or have been in a country where you felt strongly about pollution and fully agree that this memory comes to mind when you imagine the future of the country.
- Medium proximity: if you have experienced the threat or impact of a forest fire in a region you visit regularly or not close to home, and/or recognise that there has once been a water shortage in your area that has affected consumption at home or around you for several days or weeks, and/or you have been in a country where you felt strongly about pollution and moderately agree that this memory comes to mind when you imagine the future of the country.
- Low proximity: all others

Trips that had an impact

- Yes (or a lot): if you've ever been to a country where you felt strongly about the problem of pollution and you totally agree that this memory comes back to you when you imagine the future of the country
- Average: you've been to a country where you felt strongly about the problem of pollution and you moderately agree that this memory occurs to you when you imagine the future of the country
- Low or none: all others

Attitude to environmental protection

- Self-conscious: indicates awareness and great concern for the environment, with day-to-day decisions marked by this concern and a vegetarian or vegan diet

Risk to health

Parents of children with problems they associate with the environment

- Yes: if you have children up to the age of 20 with any health problems that you know or suspect are associated with environmental problems or that may be aggravated by these environmental problems
- No: if you have children up to the age of 20 but the children have no illnesses or no illnesses that you associate with environmental problems
- No children up to age of 20: all others

Respiratory or heart disease

- You have any of the following health problems with a confirmed diagnosis: respiratory disease (asthma, apnoea, chronic obstructive pulmonary disease) and/or heart disease
- All others (non-disease sufferers or sufferers of other diseases)

Geographical risk

Characteristics of the place of residence

- Very urbanised: high density (mostly buildings or high density of houses and buildings)
- Urbanised, but with ample space
- Slightly urbanised: scattered houses, predominance of open space
- Rural

Economic risk

Nature-related profession

- Professional activity related to forestry, agriculture, livestock, fishing or other forms of food production (e.g., production of cheese, olive oil, wine, etc.)

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