

CLIMATE CHANGE IMPACTS ON LIFE AND HEALTH AND POTENTIAL EMERGING RISKS FOR THE INSURANCE AND IORP SECTORS

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EXECUTIVE SUMMARY

Heatwaves are already the dominant climate-related health risk in Europe, accounting for 97% of fatalities from weather- and climate-related extremes in the EU-27 since 1980. While floods and storms dominate discussions on physical asset losses, heatwaves are responsible for most of the climate-related mortality and therefore represent the most significant climate-sensitive risk for life, health and longevity outcomes.

As the fastest-warming continent, Europe faces growing climate-sensitive health risks that fall disproportionately on vulnerable populations, creating interconnected climate and social resilience challenges. Rising temperatures are increasing exposure to heat stress across large parts of the population, with disproportionate impacts on vulnerable groups - elderly people, children, people with pre-existing medical conditions, and certain occupational groups - and implications for future mortality and longevity trends.

Climate change is creating a growing liability risk for life and health (re)insurers and occupational pension providers, not only an asset-side risk. The liability risks are increasing for life and health insurance due to climate change, with heat emerging as a key transmission channel. Increasing heat-related mortality, worsening health impacts from wildfires and smoke, and the spread of vector-borne diseases have direct implications for mortality, morbidity and longevity assumptions that underpin insurance and institutions for occupational retirement provision (IORP) business models. In this report, the focus is on mortality, longevity and health only and second order impacts or chain reactions arising from climate change on life insurers are not considered.

Climate-driven health impacts are a financial risk for IORPs, not just an ESG sustainability topic. Climate change challenges the traditional longevity assumptions on which pension systems and IORPs depend. Changes in mortality, morbidity, healthy working lives and retirement patterns can affect pension adequacy, liabilities, funding dynamics and the long-term sustainability of retirement systems, requiring climate risks to be integrated into longevity assumptions, scenario analysis and risk management frameworks.

Rising climate-related health risks could challenge affordability and insurability of certain life insurance products, increasing the need for prevention and public-private collaboration. As insurers adjust pricing, reserving and underwriting to reflect higher expected claims and greater uncertainty, there is a risk of widening protection gaps and anti-selection for products exposed to an increased mortality or morbidity risk, reinforcing the importance of resilience measures, early warning systems and coordinated action between the public and private sectors.

Based on existing Solvency II reported data, a methodology is developed in this report for the changing heatwave risk for life and health insurance. By analogy to a methodology used by EIOPA for the impact from climate change on physical assets, a heatwave scenario, vulnerability indicators and technical provisions for the exposure were developed to estimate the impact of climate change on types of undertakings, lines of business and countries.

A risk-scoring approach - combining hazard, vulnerability, and exposure - is suitable for assessing climate change impacts on life and health insurance, just as it is for property. The case study on heatwaves demonstrates that this framework can translate climate-driven changes in extreme-temperature days (hazard), demographic and societal sensitivity (vulnerability), and insurers' technical provisions (exposure) into comparable risk scores across countries and lines of business.

The analysis also shows that data from Qualitative Reporting Templates (QRT) at Line of Business (LoB) level are too limited to support firm conclusions. The results from the case study are therefore illustrative. The indicators used, in particular on the exposure are coarse, with different products affected differently by climate change within a LoB. In addition, the case study uses a single climate scenario resulting in several (major) markets showing no change in hazard. More granular data on the transformation from apparent temperature to excess mortality, refined vulnerability metrics and product-specific exposure modelling will be required before this methodology can underpin robust supervisory assessments.

In summary, the two guiding questions in this study can be answered as follows:

- ▶ Are climate-related changes to extreme events and their life and health impacts affecting (or expected to affect in future) the life and health (re)insurance and IORP sectors?

Currently, the impact from climate change on life and health insurance and IORPs is not considered material. However, as Europe is the fastest warming continent, with demographic evolutions where people aged 80 and over are the fastest-growing age group, this might change in future, especially if this age cohort will become more relevant for insurance business. The reduced cold season excess mortality is not expected to offset the heat excess mortality in Europe.

With effects on mortality, morbidity and longevity, the solvency impacts from climate change might be different for different LoBs – some of them even affecting the solvency position in a positive way. As a societal impact, heatwave excess mortality in Europe might – in extreme cases - be of the same order of magnitude as COVID-19, putting public healthcare under

pressure.¹ Public healthcare might be underprepared for these risks, while they might affect large parts of population (and not only those traditionally vulnerable for heat risks). However, when it comes to solvency impacts these might be different due to the characteristics of the products in the different LoBs.

- ▶ Is the awareness in the insurance and occupational pensions sector in line with the risk these events cause or will likely cause in the future?

From the different reports published by the insurance sector and different insurance undertakings (and to some extent also on pensions), **attention for the topic increased over the last 5 years.** However, in the own risk and solvency assessment (ORSA) for life insurers - where life and health risks are linked to short- and long-term climate scenarios - only a few participants explicitly mention life and health related risks, according to the ORSA high-level survey on climate risk assessment, while others see the impact as non-material.

At supervisory level, there is growing attention to the topic, with several authorities undertaking analyses and engaging with supervised firms to assess climate-related risks in life and health business. Supervisors are reviewing ORSAs to understand how sustainability risks are defined, the analyses used to support assessments, and the materiality attributed to these risks.

¹ Recent modelling indicates that, if historical European heatwave conditions such as those of August 2003 were to recur at 3°C, they could result in around 32,000 excess deaths in a single week across Europe, comparable to peak weekly COVID-19 figures. (Callahan, et al., 2026)

1. INTRODUCTION

Climate change is having an impact on our environment and society. It gradually affects us, by sea level rise or shifts in average temperatures, seasonal rainfall distribution etc. but also with changes to the frequency and intensity of extreme events. Weather- and climate-related extremes like floods, windstorms or wildfires cause losses to all kind of assets and EIOPA has looked at the (changes in the) impact of these events and/or solutions to increase resilience in multiple projects ⁽²⁾. However, next to affecting these economic assets, weather- and climate-related extremes also impact the environment and (human) health, which – in return - also has an impact on the liabilities of life (re)insurers and occupational pension funds.

In this study, we will look at the direct impact of weather- and climate related extremes on health, mortality and longevity ⁽³⁾, and consequently how this affects the insurance and IORP sectors. As a result, indirect links on health ⁽⁴⁾ and impact on the health system ⁽⁵⁾ will not be part of this study. Similarly, the paper does not cover the broader indirect macroeconomic impacts of weather- and climate related extremes and their potential effects on the life and health insurance business. An overview of climate-sensitive health risks and health outcomes is given in Figure 1.

In Europe, public health and healthcare delivery remain primarily national responsibilities, while the EU's role is supporting, coordinating, and complementing Member State action. This supporting role includes mainstreaming health into EU climate and environment policies. This is done in the EU Adaptation Strategy (EC, 2021), where smarter adaptation is one of the guiding principles. Under this heading falls a better understanding of climate-related risks and losses, but also the need for a deeper understanding of the climate-related risk for health and the resilience

² For example, in the [protection gap dashboard](#), the [reassessment exercise for the SII NatCat standard formula](#), the consultation paper on [adaptation measures in NatCat insurance under Solvency II](#), or [PROTECT – a risk and prevention awareness tool for natural catastrophe risks and prevention measures](#). (EIOPA, 2025a, 2025b, 2025c, 2026)

³ For brevity, and unless stated otherwise, “health” in this report encompasses both health status and demographic impacts, including mortality and longevity (life expectancy) effects.

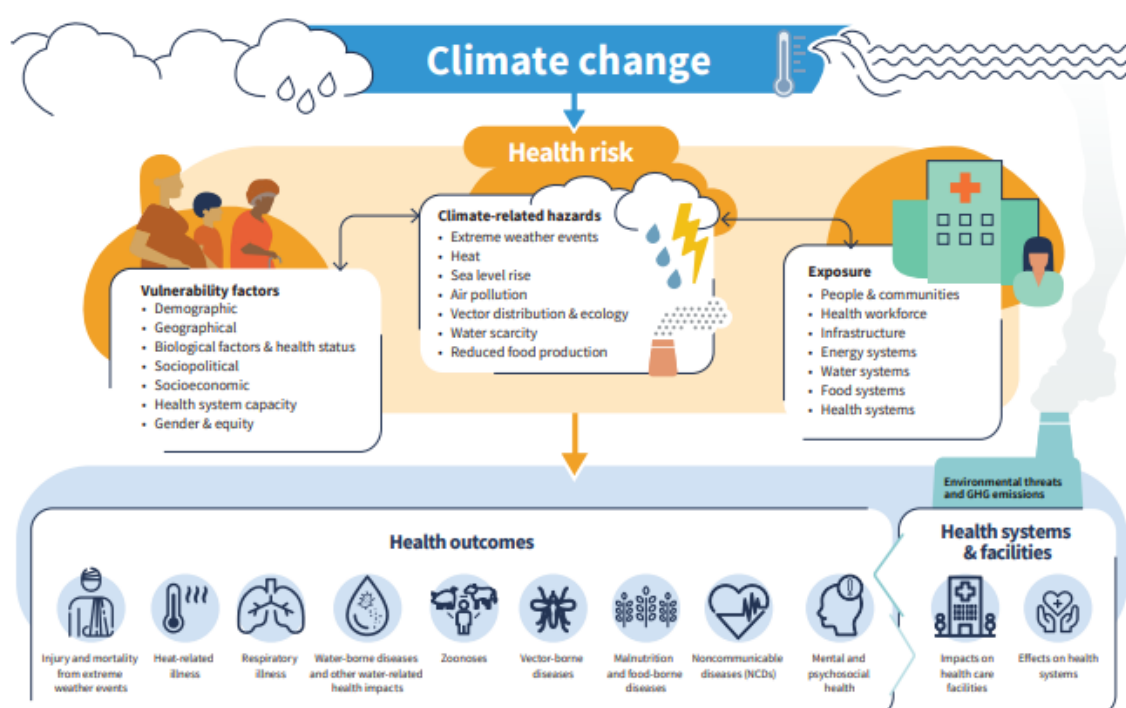
⁴ One can think about the health impacts on plants and animals, or the health impacts on humans through failed harvests, or through polluted water sources after inundations or periods of drought (EC, 2026).

⁵ This includes the inability to take care of patients due to physical damage to the health infrastructure or because of necessary healthcare cannot be provided to other patients due to the influx of additional; patients during extreme weather- and climate-related events.

Solely the direct impact of climate change is considered and this report does not look at the potential chain reactions that could generate an indirect impact on the financial position of insurers. As an analogy, one can look at COVID-19, where - even when most of the vulnerable groups (with the largest fatality and hospitalisation rate) were not privately insured and therefore not a direct solvency risk for the insurer - the consequential impact of actions taken to manage COVID-19 created a material risk for the sector.

and capacity of the health system. In this context, a [climate and health observatory](#) was created in 2021 under the umbrella of [Climate-ADAPT](#). Currently, the European Commission is developing an [integrated framework on climate risk and resilience management](#). Together with other (already existing and to be developed) EU policies, the integrated framework will contribute to the protection of our health and well-being (EC, 2026). The scientific advisory board on climate change presented recommendations for an effective EU adaptation policy framework, including the mobilisation of private investments, health and well-being (ESABCC, 2026).

Figure 1 - Overview of climate-sensitive health risks, their exposure pathways and vulnerability factors



Source: WHO (2024, p. 3).

Drawing on relevant sources and existing literature, this study will focus on two specific questions:

- ▶ Are climate-related changes to extreme events and their life and health impacts affecting (or expected to affect in future) the life and health (re)insurance and institutions for occupational retirement provision (IORP) sectors?
- ▶ Is the awareness in the insurance and occupational pensions sector in line with the risk these events cause or will likely cause in the future?

1.1 IMPACT FROM DIFFERENT PERILS

Overall, different perils have a different impact on physical infrastructure and health (Table 1). In line with recent literature ⁽⁶⁾, the three most important hazards to look at for the impact on life and health are:

- ▶ Heatwaves;
- ▶ Wildfires (because of smoke and air quality);
- ▶ Vector-borne diseases (and their availability to survive and reproduce in new regions ⁽⁷⁾).

Heatwaves are prolonged periods of abnormally high temperatures, often combined with warm nights and high humidity, that significantly increase heat stress, excess mortality, and pressure on health and social systems, particularly in urban areas and among vulnerable populations (EEA, 2021a). According to [EM-DAT](#) and [CATDAT](#), heatwaves caused between 250 000 and 320 000 deaths, since 2000 in the European Economic Area (EEA). Numbers about injured and affected people are not mapped well, neither is there a good overview of immediate and of long-term additional healthcare needs.

Wildfires are uncontrolled fires occurring in forests, shrubland or other vegetated areas, whose frequency, intensity and geographical spread in Europe are increasingly driven by heat, drought and fire-weather conditions, with major impacts on health (smoke exposure), ecosystems, infrastructure and climate mitigation (EEA, 2021b). According to [EM-DAT](#), wildfires caused around 500 deaths since 2000 in the EEA but affected over 325 000 people (including those injured and/or homeless).

Vector-borne diseases are infectious diseases transmitted to humans through vectors such as mosquitoes or ticks, whose emergence and spread in Europe are increasingly influenced by climate change, environmental conditions, and human mobility. For many vector-borne diseases, the current spreading in Europe and surrounding areas is known (ECDC, 2026), but there are no good values about the number of affected people and/or fatalities. So far, the risk of re-establishment of e.g. malaria remains low in Europe but more suitable climatic conditions and repeated importation of climate-sensitive diseases can lead to new epidemics (with possible cascading effects to national or even regional scale) (Belesova, Anisimov, & Magnan, 2023).

⁶ E.g. Geneva Association (2024), Swiss RE (2023), Generali and UNDP (2025) or the European Climate Risk Assessment (EEA, 2024).

⁷ More research on this topic is needed to fully understand these patterns of transmission and reproduction. E.g. the Chikungunya virus is transmissible at lower temperatures than previously estimated and resulting in a larger part of Europe at risk (Tegar, et al., 2026).

Table 1 – Natural perils and the different impact on physical infrastructure and on life and health

Hazard type	Impact on physical infrastructure	Impact on human life and health
Flood	High to very high impact on all types of infrastructure	Medium to high impact due to fatalities and injuries, mental health impacts and displacement stress, and (although less relevant for Europe) waterborne diseases and contamination-related issues
Windstorm	High impact on all types of infrastructure	Medium impact due to injuries and fatalities from flying debris and falling trees, increased accident risk and indirect effects during prolonged outages of essential services
Hail	Medium impact on multiple types of infrastructure (roofs, windows, vehicles, solar panels ...) and on crops (incl. those in greenhouses)	Low impact due to injuries or increased accidents
Wildfire	High and locally very high impact on all types of infrastructure (incl. tourism assets) and large damage to forests and ecosystems	High impact, mainly through respiratory and cardiovascular impacts from smoke (particulate matter, black carbon), direct contact and evacuation-related injuries (and occasionally fatalities) and long-term mental health impacts
Heatwave	Low impact, although certain infrastructure (e.g. rails or electricity grids) might be impacted	Very high as the excess mortality (especially amongst elderly and vulnerable groups) is the largest share of all fatalities due to weather- and climate-related extremes in Europe worsening cardiovascular and respiratory diseases, plus heat stress, heat stroke and dehydration; Tropical nights disturb sleeping patterns, increasing accident risk (e.g. increased drowning). Different mental health impacts.
Drought	Medium impact on certain infrastructure (e.g. reduced hydropower, cooling-water or river transport availability), subsidence might damage buildings and pipelines, cause of agricultural losses	Low to medium through indirect health impacts (link to heat and air quality/smoke) and (although less frequent in Europe) effects from reduced drinking water supply, stress and mental health conditions (especially when taking longer)
Vector-borne diseases	(Almost) None	Low to medium - but increasing - impact as a second order effect of changes in temperature and/or rainfall, making it suitable for these vectors to thrive in new regions; health effects can be long-term.

Wildfires, through smoke affecting larger communities, also outside the burning area, impact the air quality. Especially particulate matter and black carbon can cause health issues with over 180 000

premature deaths from exposure to fine particulate matter (PM2.5) in the EU in 2023 ⁽⁸⁾. Next to fine particulate matter, desert dust storms (DDS) are another natural hazard causing health issues (Milidonis, et al., 2024). However, air quality is also largely influenced by all kinds of individual, agricultural and industrial operations, making it very difficult to disentangle air quality deviations from wildfires from other sources.

With continued societal electrification - based on renewable energy sources - air quality is – in general - expected to improve further over time. Nevertheless, there is the caveat of potential regional/temporal deterioration when wildfires or DDS take place (as their frequency/severity has increased over recent years and might increase further). Notwithstanding still being large numbers, premature deaths attributable to PM2.5 fell by over 50% in the last two decades (EEA, 2025a; ETC HE, 2025).

Heatwaves on the other hand are widespread phenomena (from large regions up to covering multiple countries), **responsible for the very vast majority of fatalities from weather- and climate-related events in Europe over the last decades** (EEA, 2025b). As Europe is the fastest warming continent, at a rate of almost twice the global average, heat is the largest and most urgent climate-related hazard for human health (EEA, 2024a). Heat affects large groups of citizens, but climate-sensitive health risks are disproportionately felt by the most vulnerable and disadvantaged population groups (e.g. children, elderly, people with disabilities or pre-existing medical conditions). In addition, heatwaves are a gender-sensitive risk disproportionately affecting women due to biological, demographic and socio-economic factors. At the same time, men in Europe are disproportionately affected at work due to the nature of their occupation outside in construction and agriculture, or as fire-fighters (EEA, 2024a). The mechanisms, on how heatwaves and heat stress physically affect humans, the vulnerability factors as well as potential adaptation measures are further developed in Annexes to this report:

- ▶ Annex I a – Physical impacts from heatwaves on life and health;
- ▶ Annex I b – Vulnerability factors;
- ▶ Annex I c – Adaptation measures.

As heatwaves are potentially affecting large groups of people during a single event, are the peril with the highest number of fatalities in the past and where the impact on life and health is considered the largest (Table 1), the case study in this report will focus on heatwaves.

⁸ Premature deaths defined as fatalities that could have been prevented if air pollution was reduced to the World Health Organization (WHO) 2021 air quality guideline levels (WHO, 2021). In addition to deaths from PM2.5, people also suffer from air quality deterioration from ozone (> 60 000/year) and nitrogen oxides (> 30 000/year). These numbers cannot be added to each other, as it will introduce double counting.

1.2 HEATWAVES IMPACTING LIFE AND HEALTH

In the EU-27, for the period 1980-2024, 97% of fatalities due to weather- and climate-related extremes result from heatwaves ⁽⁹⁾ (EEA, 2025b). The year with the highest excess mortality due to heatwaves in Europe is 2003, but also the years 1994, 2006, 2015 and all years in the period 2018-2024 ⁽¹⁰⁾ have recorded a significant number of fatalities due to heatwaves. Given the severity of the situation in 2026, it is likely the year will be added to the list.

Especially for the years 2022-2024, annual heat-related mortality in (32 countries in) Europe is estimated above 50 000 people per year (Janos, et al., 2025). The WHO (2026a), for 39 countries in its European region, comes to similar estimates and sees a 30% heat-related mortality over the last two decades. Climate models expect the frequency, intensity and duration of heatwaves to increase further over the coming decades. Projections indicate that annual European heat-related mortality could exceed 120,000 deaths by mid-century under scenarios with insufficient adaptation, although estimates vary substantially depending on climate, demographic and adaptation assumptions (Ballester, et al., 2023; WHO 2026b). While these numbers for heatwave fatalities are large, it might be difficult to get a clear understanding about their significance. Box 1 puts them in the context of the COVID-19 pandemic.

Heatwaves are conceptually defined as prolonged periods with abnormally high temperatures ⁽¹¹⁾. A case study on how to harmonise information for three clusters of European countries and the impacts from heatwaves on excess mortality can be found in Annex II – Heatwave effects in Europe – case study.

Climate change will not offset increased heatwave mortality with reduced mortality during the cold season, as the effects of climate change are not just a shift to higher temperatures but a change to the temperature distribution. Climate change, especially when called global warming,

⁹ In absolute terms, this is a group of over 425 000 people.

¹⁰ 2024 is the latest year where comparable information is available. Although European countries were affected by (multiple) heatwaves and record-breaking temperatures in 2025, estimates of excess mortality due to heatwaves is much lower (<20 000). For the heatwave in June-July 2026, preliminary numbers are > 10 000 and increasing, but current data is too incomplete to support strong claims about the heatwaves in 2026 (see e.g. Weise (2026) or McCaughey (2026)). E.g. France estimates the excess mortality between May and July 2026 to 7300 people (Le Monde & AFP, 2026), Belgium to 1747 people for the heatwave end of June–early July (Sciensano, 2026) and Spain to over 4600 people since the start of the seasonal surveillance of heat excess mortality 15 May 2026 (MoMo, 2026). The Guardian report at least 35 000 excess deaths during the summer of 2026, covering only half the continent and not including August totals (Henley, 2026).

¹¹ Currently, there is no common (scientific or political) heatwave definition on temperature thresholds, duration, etc. across European countries, nor an agreed method to calculate excess mortality (Zhao, et al., 2024). Therefore, WHO data is used instead combining heterogeneous national data. A temperature threshold, even when combined with a number of days the threshold should be exceeded can never capture the differences between e.g. Scandinavia and the Mediterranean. For each location, there is a J- or V-shaped temperature graph defining the mortality. At its minimum, it defines the minimum mortality temperature for that location, and it can be used to define the excess mortality when temperature decreases or increases. This is location specific at a more detailed level than per country (Chapter 3).

creates the impression that negative effects from heatwaves and heat stress might be offset by opposite effects during winter. “Annex III – Heat stress and cold waves: impacts in opposite directions?” describes why the effects of climate change are not just shifting temperatures and how cold season excess mortality is not the same as cold wave excess mortality. A good example was the winter of 2026, marked by a significant cold snap in Europe and the continent experiencing its coldest January since 2010 (Copernicus, 2026a).

BOX 1 - PUTTING THE NUMBERS FOR HEATWAVE FATALITIES IN THE CONTEXT OF COVID-19

For the middle of the century, annual excess mortality from heatwaves is projected to reach 120 000, approximately one-fifth of the COVID-19 at its peak.¹² The Lancet also made a study about the excess mortality due to COVID-19 for the years 2020-2023. For both 2020 and 2021, the excess mortality in 29 European countries was estimated well over half a million per year (or almost 10% more than in an average year) (Pizzato, et al., 2024).

The potential scale of individual extreme heat events can nevertheless be considerably larger than the annual average suggests and reach levels comparable to peak COVID-19. Recent modelling indicates that the recurrence of an extreme European heatwave comparable to August 2003 could generate approximately 17,800 excess deaths in one week at 1.5°C global warming and 32,000 at 3°C, with mortality levels comparable to peak COVID-19 mortality in Europe (Callahan, et al., 2026).¹³

There is not a “single measure” available as a solution to deal with the consequences of heatwaves. The results highlight the importance of considering both annual cumulative mortality and tail-event risk when assessing the potential implications of heatwaves for life and health insurance. While this study only looks at the individual health impacts, it might be clear that a situation similar to COVID-19 will also have a significant impact on the health system as well. A major difference between both is that, once a vaccine was available, excess mortality due to COVID-19 rapidly decreased. For heatwave excess mortality, climate change adaptation plans (a local, regional, national and European level, plus at sectoral level) with multifaceted measures will be needed.

¹² The comparison is indicative, as the COVID-19 estimate represents all-cause excess mortality relative to a pre-pandemic baseline, whereas the heat-related estimate represents deaths attributable to temperature exposure; the estimates also differ in geographical coverage and modelling methodology.

¹³ For example, the most severe 10% of weeks of COVID-19 had between 27,900 and 34,100 confirmed deaths (Callahan, et al., 2026).

Heat-related mortality risk varies strongly across Europe and is closely linked to socio-economic vulnerability, not just temperature exposure. A key insight is that the relationship between temperature and mortality is highly non-linear, with mortality increasing sharply beyond local heat thresholds (Annex V – Heatwaves and excess mortality). Overall, higher mortality burdens are concentrated in regions with lower income levels, weaker healthcare systems, and higher population vulnerability, while wealthier regions show lower sensitivity despite similar or higher heat exposure (Paniello-Castillo, et al., 2026).

There are strong spatial inequalities in heat burden: Southern and Eastern Europe tend to experience higher absolute mortality impacts, while Northern and Western Europe show lower impacts, reflecting differences in adaptation capacity rather than exposure alone. When decomposing the drivers of heat-related mortality, the analysis finds that socio-economic factors explain a substantial share of the variation in mortality risk, alongside demographic factors such as ageing populations. This implies that vulnerability is not fixed but shaped by structural conditions (Paniello-Castillo, et al., 2026).

2. RELEVANCE FOR THE INSURANCE AND IORPS SECTORS

Over the last 5 years, a series of published reports make clear that the relevance of climate change for life and health insurance is increasing (Error! Reference source not found.). So far, the effects of climate change, including heatwaves, on health insurance premiums appear to be limited – although difficult to quantify (Geneva Association, 2024). For life and health insurers, climate impacts are shifting from discrete shocks to having structural impacts and heat is one of the urgent risk channels (Geer, 2025). As an example, Generali works - through a strategic partnership with the United Nations Development Program (UNDP) - on “resilience by design”, a collaboration focussing on modelling the impacts of climate change, the implications for insurance viability and awareness raising and public engagement (

Box 3). Another example is AON’s Climate Risk Monitor (Box 4).

BOX 2 - SELECTED REPORTS ON THE RELEVANCE OF CLIMATE FOR LIFE AND HEALTH INSURANCE

Climate change is undermining insurability across all insurance lines, including life and health insurance, through both direct and indirect effects on people’s health (Crugnola-Humbert, et al., 2026). Climate change affects life and health insurance primarily through gradual, cumulative impacts on morbidity and mortality over an individual’s lifetime, rather than sudden, isolated shocks (Swiss Re, 2023) and climate change is becoming a material long-term risk for life and health insurance (Geneva Association, 2024). Climate change creates a fundamental challenge for life insurance by increasing uncertainty in long term mortality and morbidity trends, with heat risk emerging as a key transmission channel (SCOR, 2022a; Swiss Re, 2023). The main health risk drivers are extreme heat, air pollution, and the spread of infectious diseases (acute events), which are expected to increase excess mortality, cardiovascular, respiratory, cancer, and vector-borne disease burden, particularly among elderly and vulnerable populations (chronic effects) (Swiss Re, 2023; Geneva Association, 2024; SCOR, 2022a; Crugnola-Humbert, et al., 2026). In particular heat exposure is a critical driver which also amplifies indirect risks through dehydration, reduced productivity, and interactions with air pollution and chronic disease (SCOR, 2022a) (Crugnola-Humbert, et al., 2026).

For insurers, climate change therefore challenges pricing, underwriting, and risk modelling, requiring ongoing adjustment as risks evolve (Swiss Re, 2023; Geneva Association, 2024). Climate change causes higher volatility, more frequent shock events and weaker predictability of future claims, complicating pricing, reserving and risk capital management (SCOR, 2022a). As a result, there is a risk for widening insurance protection gaps as premiums rise or coverage becomes unavailable (Crugnola-Humbert, et al., 2026).

The Geneva Association stresses that insurers must adapt through better data, risk modelling and prevention focused solutions. Life insurers must explicitly integrate climate and heat related drivers into biometric assumptions and adopt a forward looking, resilience-oriented risk management approach (SCOR, 2022a). At the same time these reports see opportunities to innovate: rising awareness of health risks may increase demand for life and health insurance, while insurers can play a role in promoting adaptation and enhancing resilience (Swiss Re, 2023; Geneva Association, 2024), including through nature-based solutions and alongside insurance innovation (Crugnola-Humbert, et al., 2026).

In a recent paper from the SOA Research Institute (Arocha & Crugnola-Humbert, 2026), a practical framework for decision making about the mortality and morbidity impacts from climate risks is presented. The report proposes a forward-looking and scenario-based framework designed to evaluate how climate change impacts mortality and morbidity. It also warns against certain pitfalls, such as the choice for models because of they are readily available as they might be driven by variables that ignore critical drivers and recent scientific trends.

Arocha & Crugnola-Humbert (2026) also make the link between insurance and adaptation strategies and the different types of measures presented therein. Adaptation can substantially reduce climate-related mortality and morbidity but has limitations and the risk of maladaptation (even when the measures are well-intended, the long-term effects can be counter-productive).

The report selected heat related mortality risk as a case study for France, Italy and Spain, with projections until the middle of the century under a high-emissions, high warming scenario. The model produces significantly lower incremental climate-related mortality impact for Spain than for France and Italy, which is consistent of the differences observed in earlier studies (e.g. in D'Ippoliti et al. (2010) and Masselot et al. (2023)), but contrasts with the larger future heat-mortality increase projected for Spain by in e.g. García-León et al. (2024).

These differences are not necessarily contradictory, as the studies differ substantially in their exposure definitions, time periods, spatial coverage and treatment of population vulnerability

and adaptation. In particular, the Arocha & Crugnola-Humbert framework reflects Spain's comparatively greater historical adaptation to heat and relatively younger population in its estimated climate sensitivity, whereas García-León et al. focus on changes in temperature-related mortality under future climate conditions. The divergence therefore highlights material model and parameter uncertainty around the extent to which historical adaptation and vulnerability can be extrapolated to future, potentially unprecedented heat exposure, supporting the use of sensitivity analysis and alternative adaptation assumptions when assessing climate-related mortality risk.

Sources: Geneva Association (2024), SCOR (2022a), SwissRe (2023) and WWF, Crugnola-Humbert et al. (2026), Arocha & Crugnola-Humbert (2026).

The share of health spending financed through households' out-of-pocket payments was +/- 15 % across EU countries. However, households had to finance directly more than 30 % of all spending in Lithuania, Latvia, Bulgaria and Greece in 2022 (OECD and European Commission, 2024). Social insurance / public healthcare provides a basic level of protection for health and dependent old age risks, while private health insurance or private pension plans are available to supplement the protection provided through social insurance (OECD, 2026).

Although funding allocated to public social insurance arrangements are historically much larger than the premiums collected by private insurance markets, their relative roles are evolving over time (OECD, 2026). In the EU, publicly funded healthcare systems ⁽¹⁴⁾ are the backbone of health protection (Eurostat, 2025), on average responsible for +/-80 % of total healthcare expenditure (OECD and European Commission, 2022). Private health insurance in Europe plays mainly a complementary or supplementary role. Only in Ireland and Slovenia did voluntary health insurance finance slightly more than 10 % of health spending, compared to the EU average of 3 % (OECD and European Commission, 2024). Private insurance markets have an increasing role in providing financial protection for health and dependent old-age risks. Life and health insurers therefore have limited responsibility for direct healthcare costs from climate extremes, but a growing exposure to indirect and long-term impacts, such as:

- ▶ Increased mortality during heatwaves (life insurance payouts);
- ▶ Long-term morbidity and disability linked to heat or mental health impacts;
- ▶ Rising claims related to chronic disease exacerbation rather than acute trauma.

Product type and policy design will significantly influence the transmission of climate risks to insurers' balance sheets. In terms of own funds, increased mortality will negatively impact products

¹⁴ systems with universal or near-universal coverage operating via tax funding (Beveridge-type) or via social health insurance (Bismarck-type).

exposed to mortality risk (e.g., death risk products or credit protection insurance), but positively impact products exposed to longevity risk (e.g., annuities), while long-term morbidity and disability impacts will mainly affect health insurance products.

European and international institutions consistently mention that climate change increases systemic health expenditure risks, reinforcing the central role of public health systems and public prevention policies, and with private insurance as a secondary financial buffer and protection mechanism (Blom & Fears, 2025; EEA, 2018; OECD, 2023; WHO Europe, 2025).

BOX 3 – THE STRATEGIC COLLABORATION BETWEEN GENERALI AND UNDP: “RESILIENCE BY DESIGN”

A strategic partnership between Assicurazioni Generali S.p.A and the United Nations Development Programme (UNDP) published about emerging health risks driven by climate change. The report explores how these – often overlooked – risks might become explosive when combined with other, already present, vulnerabilities ^(a). Within the partnership, the approach is to understand the system of drivers and pressures that describe how climate change impacts life and health in the society before translating this in the context of Life and Health insurance business.

Climate change is expected to materially increase Life and Health insurance risks, with heatwaves emerging as the dominant driver of excess mortality in Europe. While chronic temperature increases and air pollution show limited or even partially beneficial effects in some regions, acute heat events drive the most pronounced mortality shocks relevant for life insurance liabilities. Model-based scenario analysis indicates that by mid-century and for the most affected countries, excess mortality from heatwaves could reach levels comparable to COVID-19 pandemic peaks ^(b). Going forward, these changes will likely need to be embedded in the insurance reserving and pricing, potentially leading to affordability and anti-selection issues.

Climate-related morbidity risk is projected to rise significantly, particularly due to vector-borne diseases, placing upward pressure on health insurance claims and future demand. Estimates suggest substantial increases in illness incidence, especially in Asia but also in Europe, driven by changing temperature and humidity conditions that extend disease transmission periods. Next to increased claims frequency and severity, this might translate into higher hospitalization rates, pushing the occupancy rate of hospitals to unsustainable levels.

The combination of demographic trends, healthcare system constraints, climate change risks and economic shocks might create a systemic societal risk. Aging populations, already

strained healthcare systems, and limited fiscal capacity of governments amplify the vulnerability to climate-driven health shocks. This “perfect storm” increases the likelihood of negative implications for underwriting, reserving, capital adequacy of life and health insurers.

Insured portfolios exhibit distinct characteristics compared to the general population, particularly in terms of age and geographic concentration. These differences help explain the limited observed impacts of historical events on insurance claims, highlighting the need for forward-looking risk assessments. Existing insurance portfolios tend to be younger and wealthier than the general population, with better access to climate change adaptation measures such as cooling. As a result, observed claims experience does not yet reflect the full magnitude of emerging risks, implying that reliance on historical data alone is insufficient. Insurers will need to transition from backward-looking actuarial assumptions to scenario-based approaches including climate projections and demographic dynamics.

Evidence of climate impacts in current claims data remains limited, but measurement challenges and behavioural effects obscure underlying trends. The absence of significant observed increases in mortality or morbidity claims is partly explained by insured population characteristics and difficulties in attributing cause-specific mortality to heat events. Some early indications point to rising mental health claims severity, which may be indirectly linked to climate stressors, although causal relationships remain uncertain.

Product type and policy design significantly influence the transmission of climate risks to insurers’ balance sheets and might require operational adaptation over time. Features such as repricing flexibility, waiting periods, and product characteristics and duration affect exposure to mortality and morbidity shocks.

Rising climate-related health risks are expected to increase underwriting costs, exacerbate affordability challenges, and eventually cause anti-selection risks, requiring coordinated responses. As premiums adjust to higher expected claims, coverage may become less accessible, potentially concentrating risk among more vulnerable populations. This reinforces the importance of prevention incentives, policyholder engagement tools such as early warning systems, and stronger collaboration between public and private sectors to sustain risk pooling and system resilience.

Public-private collaboration will become essential to address systemic health risks and ensure resilience of (public) healthcare and insurance systems. Technological and organizational investments, including digital health solutions and healthcare system adaptation, will shape the future role of insurers and of the public sector in these partnerships. For the private sector, expertise in risk assessment, advanced data analytics, and AI-driven

health management will support both underwriting and claims management, while contributing to broader health system resilience and taking the necessary prevention measures in the light of climate change.

(a) **Sources:** Generali & UNDP Partnership and Resilience by Design: Strengthening Health and Human Development in a changing climate (Generali and UNDP, 2025).

(b) Please see Box 1.

BOX 4 - AON'S CLIMATE RISK MONITOR 3.0

AON's Climate Risk Monitor 3.0 introduces heat stress analytics that capture how combinations of temperature, humidity and exposure affect businesses and communities, explicitly including health outcomes alongside economic and productivity impacts. The addition of cooling demand analytics further reflects how rising temperatures influence energy use and operational conditions, linking physical climate hazards with infrastructure and resilience considerations.

For clients, these enhancements improve the ability to understand and quantify risks at asset and portfolio level, supported by higher-resolution hazard data and location-specific insights as well as forward-looking climate projections. The platform is designed to inform risk management, underwriting and pricing decisions, enabling organisations to better assess the implications of evolving climate conditions.

Sources: AON (2026).

2.1 IMPACT OF CLIMATE CHANGE ON INSURANCE RISK DRIVERS

Climate change–related physical risks can influence population health and mortality, thereby affecting the liabilities of life and health insurers. Currently, deaths from climate-related extreme events in developed countries remain relatively low compared to other causes. However, over time, increasing physical risks may worsen both mortality and morbidity. Even so, life and health insurers can partly offset these effects through a balance between mortality and longevity products. They are also likely to respond to climate change by raising premiums, lowering benefits, or limiting

coverage—similar to how general insurers adjust pricing and availability in response to rising risks (Prudential Regulation Authority, 2015).

There are several relevant risk drivers for life and health insurers, but the most significant driver for this exercise is the underwriting risk. Other risks include market risk, care cost inflation, geographical concentration/accumulation of risks, demographic and societal risk⁽¹⁵⁾ or model risk/uncertainty risk. The impact of increased frequency and severity of heat stress, vector-borne diseases, or pollution due to climate change on the underwriting risk can be multiple, including:

1. **Mortality risk**, where there are more fatalities happening earlier than assumed;
2. **Morbidity or disability risk**, where more sickness or disability claims are received or of a longer duration;
3. **Claim severity or frequency**, where more frequent and/or severe health impacting events cause higher and/or more volatile claims;
4. **Catastrophe and accumulation risk**, where – through regionally concentrated weather- and climate-related events (e.g. major wildfires) – correlated losses are caused;
5. **Longevity risk** (when considered negatively), where environmental degradation may slow or reverse life expectancy gains in a region⁽¹⁶⁾.

There might also be changes in the interactions, e.g. when increased morbidity leads to higher disability claims and earlier mortality, economic stress might amplify lapses and worsen adverse selection, while regional concentration increases tail risk.

From the perspective of the insurer the changes in the underwriting risk can be neutral, positive or negative, depending on the specific characteristics of the different products offered. The societal effect of, for example, increased mortality risk can, depending on the type of products offered have a negative (e.g. earlier payout) or positive (e.g. less annuities to be paid) effect. The different LoBs as reported under Solvency II do not provide the details necessary to understand the effect of the changed risks on the risk for the insurer. To do so, a more detailed analysis of the portfolio – including more details about the characteristics of the products offered - is necessary.

¹⁵ Migration, urbanization or socioeconomic changes can change the demographic profile of the insured population, altering morbidity and mortality patterns, the continuity of cover, policy persistency or claims behaviour.

¹⁶ Longevity risk: the risk of loss, or of adverse change in the value of insurance liabilities, resulting from changes in the level, trend, or volatility of mortality rates, where a decrease in the mortality rate leads to an increase in the value of insurance liabilities (EU, 2009, p. Art. 105). If longevity gains are reversed, this can be seen as a positive development for insurers exposed to this type of risk.

2.2 LINES OF BUSINESS RELEVANT FOR LIFE AND HEALTH

There are in general certain lines of business (LoBs) that are more relevant to look at in the context of climate change on life and health insurance. These LoBs are spread over both life and non-life (Annex IV – Solvency II lines of business impacted by climate change), and the definitions for the different LoBs can be found in EU (2015, p. Annex I). Box 5 gives examples of how changing temperatures might impact LoBs. From an insurer's solvency perspective not all impacts have to be negative.

From a purely actuarial perspective, excess mortality does not have the same effect on all products related to life and health and in particular for products with a longevity risk, climate change impacts do not bring the same negative effects as for products with a mortality or morbidity risk. An important note is that different life and health product categories, with payments as long as the policyholder lives, at the death of the policyholder and for medical conditions, come with different risks for the insurer.

Longevity is affected by long-term net effects that are the result of negative factors (like (chronic) heat stress, environmental degradation or disease spread) **and offsetting factors** (like medical adaptation, public health measures or improved resilience ⁽¹⁷⁾). The overall effect is highly uncertain and heterogeneous by region and socioeconomic group. Climate-related impacts on the mortality linked-business may be offset by those on the longevity side, thus providing some hedging for companies offering both types of products.

BOX 5 – CHANGING TEMPERATURES IMPACTING DIFFERENT LOBS

Below are examples of how changing temperatures might impact different LoBs. However, as expressed in multiple sections of this report, within a LoB the effect might be different for different (re)insurers, depending on the details of the products in the portfolio.

Worker's compensation insurance

Rising temperatures make workers' compensation insurers increasingly vulnerable as their liability-driven business model makes them sensitive to events like heatwaves that harm insured workers. Outdoor and semi-outdoor workers - especially in agriculture - face the

¹⁷ E.g. declining exposure to extreme cold contributes to reduced cold-related excess mortality. From an insurance perspective, this creates a partial natural hedge: lower mortality during milder winters reduces short-term death claims (benefiting mortality-linked business), while the same dynamic contributes to longer survival and higher annuity and pension liabilities on the longevity side. These benefits are increasingly offset by rising heat-related mortality, making the hedge incomplete and asymmetric over time.

greatest risk due to constant exposure to the heat and close interaction with heavy machinery, while heat-induced cognitive impairment raises accident likelihood (Mandich, 2024).

Medical expense insurance

Rising temperatures and more frequent heatwaves expose medical expense insurers to higher healthcare costs through increased utilisation of healthcare services. Extreme heat has been associated with higher rates of emergency department visits and hospital admissions, particularly among individuals suffering from cardiovascular, respiratory, kidney and other chronic conditions that are vulnerable to heat stress (Xu, et al., 2024; Arsad, et al., 2022). Insurers covering healthcare expenditures may therefore experience higher claim frequencies and increased reimbursement costs during periods of extreme heat, especially in portfolios with a large share of elderly or medically vulnerable insureds. As heatwaves become more frequent and intense, recurring increases in heat-related morbidity and healthcare utilisation may place upward pressure on medical claims experience and increase volatility in healthcare expenditures (Hogekamp, 2024).

Health insurance (SLT)

Health insurance written on a life-technical basis is exposed to rising temperatures through both morbidity and mortality impacts. Heatwaves are associated with higher rates of illness, hospitalisation and mortality, particularly among older individuals and those suffering from cardiovascular, respiratory, kidney and other chronic conditions (Xu, et al., 2024). These impacts may increase benefit payments for products covering health-related events, as higher levels of heat-related morbidity can lead to greater healthcare utilisation and claims. In addition, excess mortality during extreme heat events may affect portfolios that include mortality-related benefits. The impact is likely to be most pronounced in portfolios with concentrations of elderly insureds or policyholders with pre-existing medical conditions, who have consistently been identified as among the populations most vulnerable to extreme heat (Günsche, et al., 2026; Arsad, et al., 2022).

For the risk assessment’s exposure exercise in Chapter 3, expert judgement marked the following LoBs potentially impacted by heatwaves under changing climatic conditions (Table 2):

Table 2 - LoBs potentially impacted by heatwaves under changing climatic conditions

Non-life insurance	Life insurance
Medical expense insurance	Health insurance (SLT)
Income protection insurance	Other life insurance (non-participating)
Workers' compensation insurance	Annuities stemming from non-life contracts relating to health
Assistance	Insurance with profit participation

General liability

Note: based on expert judgement. See Table 6 for details.

2.3 IORPS

For IORPs in Europe, understanding how climate change affects people’s life expectancy, health and morbidity is increasingly relevant because these factors directly influence pension adequacy, liabilities and long-term sustainability. Climate change—especially rising heat and climate related health risks—can alter mortality trends, affect healthy working lives, and increase early retirement, disability and healthcare related benefit claims. This challenges traditional longevity assumptions used in pension planning and can widen gaps between expected and actual retirement outcomes. Poor health linked to heat, air pollution or chronic disease may also reduce labour participation, affecting contributions and increasing dependency ratios.

From a risk-management and governance perspective, climate-driven health impacts are a financial risk for IORPs, not just an “environment, social and governance” (ESG) sustainability topic. Climate-driven health impacts affect funding dynamics, intergenerational fairness and the resilience of retirement systems. Awareness allows IORPs to better integrate climate risk into long-term projections, investment strategy, member communication and social sustainability, aligning with EU expectations on prudent risk management and the long-term interests of beneficiaries.

In Europe, IORPs model climate risk indirectly but increasingly systematically, as climate change affects both sides of the balance sheet over long horizons. It is typically included in a) longevity and biometric risk modelling, b) scenario analysis and stress testing, and c) data enrichment and segmentation practices.

IORPs primarily assess climate impacts through longevity and mortality assumptions, rather than direct claims modelling. For longevity and biometric risk modelling, typical approaches include:

- ▶ Scenario-based adjustments to mortality improvement rates (rather than single best-estimate shifts);
- ▶ Explicit consideration of heat-related mortality, air pollution, and disease patterns as *drivers of divergence* from historical trends;
- ▶ Use of narrative scenarios (orderly transition vs delayed action) rather than point forecasts, recognising deep uncertainty.

This reflects the fact that climate change can both reduce and increase life expectancy, depending on mitigation, adaptation and behavioural change.

IORPs increasingly embed climate scenario analysis and stress testing into their own risk assessment, their strategic funding and contribution adequacy analysis and the analysis of their investment-liability interactions. In Europe, IORPS largely rely on Network for Greening the Financial System (NGFS)-aligned scenarios for these assessments, combining transition risks (e.g. macro shocks) and emerging physical risks (like health impacts over multi-decade horizons) (NGFS, 2024).

2.4 CLIMATE RISK ASSESSMENT AND STRESS TESTING

Climate risk assessment is becoming increasingly important for life and health insurers and pension funds as it provides a structured framework for identifying and evaluating the potential impacts of climate change on mortality, morbidity and longevity. Many climate-related risks are characterised by long time horizons and significant uncertainty, making them difficult to assess using historical experience alone (Guttermann, 2023). In addition, translating changes in the physical environment, for example changes to heatwave characteristics, into impacts on socio-demographic parameters remains challenging due to the complex interactions between environmental, behavioural, medical and demographic factors. Climate risk assessments help institutions better understand these relationships, identify potential vulnerabilities within portfolios and support the integration of climate-related considerations into risk management and strategic decision-making.

Climate stress testing is the use of forward-looking climate scenarios to assess how physical and transition climate risks could affect insurers' portfolios, solvency, pricing and business models over time. It goes beyond historical loss data by simulating extreme but plausible futures—for example, more frequent heatwaves, rising mortality, higher morbidity, asset value shocks or rapid policy transitions—and translating these into impacts on claims, reserves, capital or profitability.

Overall, climate stress testing supports risk transparency, resilience, and long-term market stability in a changing climate. Climate stress testing is important because underwriters need the results to price and design products that remain affordable and insurable as risks evolve; brokers rely on it to advise clients on emerging exposures and appropriate coverage; and supervisors use it to test financial stability, identify systemic vulnerabilities and ensure firms hold adequate capital.

Supervisors are increasingly aware of the relevance of climate stress testing. One of the most elaborate examples is the climate stress test for the insurance sector by the French national bank and insurance supervisor (ACPR) (Box 6). This included health-related scenarios taking into account mortality linked to prolonged heatwaves and other natural hazards (including secondary effects like the spreading of vector-borne diseases), and questions about effects on life and health insurance

and future insurability. The work is supported by several publications on the methodological and main assumptions as well as on the results e.g. (ACPR, 2020, 2025).

BOX 6 - THE ACPR INTERNAL SUSTAINABLE INSURANCE WORKSTREAM: KEY STUDIES AND LESSONS LEARNED FROM THE FRENCH INSURANCE MARKET

The French Prudential Supervision and Resolution Authority (ACPR) analysed the Own Risk and Solvency Assessment reports (ORSAs) of French Life and Health insurers, followed by dedicated meetings with three of these insurers ^(a) to understand:

- ▶ how sustainability risks for Life and Health activities are defined;
- ▶ if specific studies are made to underpin the rationale of these sustainability risks;
- ▶ the materiality of the risks; and
- ▶ the assessment limitations for Life and Health activities.

The relevance of heatwaves for the insurance sector is acknowledged, but not yet material in terms of financial impacts. Analysis of three major French insurers shows that heatwaves are identified as a key physical climate risk affecting Life and Health insurance. However, despite their expected link to excess mortality and morbidity, current quantitative assessments indicate limited effects on the best estimate liability (BEL) or claims, leading insurers to classify the risk as non-material at present.

Empirical evidence suggests that heatwaves have ambiguous and partially offsetting effects on claims experience. One dedicated study on healthcare consumption during heat episodes finds no increase in utilization and even a slight decline, mainly driven by behavioural and seasonal patterns rather than underlying health improvements. This indicates that observable insurance impacts of heatwaves are not straightforward and may be masked by non-climatic drivers such as reduced healthcare demand during holiday periods. On the other hand, healthcare demand may increase in more touristic areas due to a demographic effect rather than heatwave drivers.

Vector-borne diseases are identified as significant long-term risks, due to their potential to structurally increase mortality and/or morbidity. A scenario analysis indicates that, under adverse climate pathways, this risk could generate the largest increase in BEL, albeit still within a limited range. Air pollution, and particularly ozone, appears to be a secondary risk, with only

marginal additional mortality effects projected. Heatwaves' impact on mortality and morbidity may remain limited.

Cross-risk and cross-product diversification significantly reduces net exposure. Insurers emphasize strong internal diversification mechanisms. Climate-induced increases in mortality during heatwaves are partially offset by reductions in winter mortality, limiting the net annual effect. Additionally, portfolio diversification across products results in opposing impacts: higher mortality increases risk in life insurance but creates reduced longevity risk for pension products. These interactions are key to understanding the current low aggregate materiality.

Portfolio structure and demographic factors are critical determinants of climate risk sensitivity. Differences in exposure across insurers largely reflect portfolio characteristics, including age profiles and geographic footprint. Compared to the overall demography, younger populations are less vulnerable to heatwave-related mortality, while limited exposure to high-risk regions reduces the impact of vector-borne diseases. As a result, the same climate hazard can have a different impact depending on insurer's portfolio or when compared to the overall societal impact.

Insurance levers—pricing, underwriting, and prevention—remain largely inactive in response to heatwave risk. Given the low assessed materiality and high uncertainty, insurers have not integrated climate considerations into pricing or underwriting for Life and Health products. Repricing is viewed as operationally complex and analytically challenging, particularly due to the difficulty of isolating climate signals in claims data. Preventive actions are limited and mostly confined to group policyholders.

Methodological and data constraints significantly limit the robustness of current conclusions. The selected in-depth interviews highlight key weaknesses, including restricted access to detailed health data, limited scope of empirical studies, and incomplete modelling of all relevant LoBs. The inability to isolate climate effects from confounding factors further complicates risk quantification. These limitations suggest that current estimates may understate potential impacts.

The main policy implication is that current non-materiality still requires awareness and should not lead to complacency. While reported impacts are small today, the combination of data gaps, model uncertainty, and evolving climate dynamics implies that risks—particularly from heatwaves interacting with other hazards—may become more pronounced over time. Strengthening data availability, expanding modelling coverage (LoBs) and modelled parameters, and improving attribution methodologies will be essential to ensure that Life and Health insurers remain adequately prepared.

(^a) These selected insurance undertakings have different business models and together cover 28% of the French insurance market for Health business.

For IORPs, most stress tests are rather focussed on the asset side (transition risk). The EIOPA/ESRB stress test (2022) confirms the material exposure of IORPs to climate transition risk, but also that only one in seven IORPs made a climate stress test on liabilities. While concluding that the sector appears broadly resilient in the tested scenario, there remains significant vulnerability to climate transition risk, justifying further development of stress testing methodologies and broader integration of climate considerations into pension fund risk management frameworks.

Less literature is available on climate change impacts on the pensions sector compared to life and health insurance. Error! Reference source not found. gives a selection from the wide range of insurance publications available. Some recent publications with relevance for the pensions sector are described in Box 7.

Arising from the direct impact on mortality, longevity and morbidity, insurance stress testing focuses on how physical and transition climate risks could affect insurers' portfolios, solvency, pricing and business models over time, while IORPs stress testing focusses on adequacy, fairness and sustainability. As a result, in Europe, the net impact of climate change on IORPs is generally less immediately negative - and in some scenarios more mixed or even partially positive - than for life & health insurers, but this advantage is conditional and fragile. That is because the longevity effects dominate (longer lifetimes primarily affect liabilities instead of claims cash-flows), there are long adjustment horizons and a pooling via social and policy mechanisms (implicit shared risks with labour markets, healthcare systems and/or public policy initiatives). The advantage IORPs might face disappears under high warming low adaptation scenarios.

The differences in the stress testing goal and the main effects of climate change for insurers and IORPs, results in a different view on climate change adaptation. For insurers adaptation is seen as a risk mitigant, with measures like insulation, (active) cooling, heat prevention plans (at work), etc. Pricing and product design incentivize the uptake of these kinds of measures. For IORPs, adaptation measures are more of a societal choice affecting retirement adequacy. They will more look at general policies, healthcare capacity and broader labour market effects. While climate change adaptation is crucial for IORPs, it is more of an exogenous factor, rather than parameters that can be optimised.

BOX 7 – CLIMATE STRESS TESTING FOR THE PENSIONS SECTOR

Still hot and bothered

Using three climate-conditioned longevity scenarios and explicitly mapped against the IPCC scenarios, the analysis in this report analyses how heat, air quality and behavioural change could either suppress or accelerate life expectancy improvements. The study is explicitly designed for the UK pension schemes and (re)insurers supporting IORP-relevant stress testing but the concept behind is applicable on other markets as well (Walker, et al., 2025).

Longevity Bulletin: climate change issue

This publication brings together different groups of experts in the field, including the Club Vita team (Walker, et al., 2025), consultants and academics not only temperature-linked mortality and disease patterns should be taken into account, but also how systemic tipping points affect actuarial and pension modelling results (and therefore cannot be ignored) (Anderson, 2025).

3. STUDY ON HEATWAVES

The IPCC in its 6th Assessment report ⁽¹⁸⁾ states with high confidence that *“the frequency, intensity, and duration of heatwaves in Europe will continue to increase under all future emission scenarios”* (Seneviratne, et al., 2021). Heatwaves and Heat stress, impacting people’s health and excess mortality, are expected to be (come) a key source of risk and uncertainty for European life and health insurers. Therefore, insurers need to ensure a proper forward-looking risk management of climate change impacts on life and health in their underwriting portfolios.

The relationship between physical climate change and excess mortality ⁽¹⁹⁾ is highly context-dependent and cannot be represented by a universal response function linking both. The relationship is dependent of climate variables like the mean or maximum temperatures, the duration, the time in the year, and a whole set of socio-economic variables describing people’s vulnerability and adaptive capacity. An introduction on the different parameters that might affect the relationship between the physical climate and the impact on people is given in Annex V – Heatwaves and excess mortality.

3.1 CURRENT AND FUTURE POTENTIAL RISKS

3.1.1. HISTORICAL TRENDS

During the last years, temperature records were broken on multiple places in Europe, both in absolute temperatures as well as the length of heatwave periods and specific records for a time of the year (e.g. first heatwaves in 2025 already in April, in 2026 in May). Although the practice already existed earlier in Italy, more countries are naming heatwaves since 2023 – a practice e.g. known from windstorms and hurricanes/typhoons – to increase awareness that heatwaves can occur anywhere in Europe.

Changes in frequency, duration, severity and correlation of heatwave events are expected to impact the liability side of the life and health insurance portfolio in several ways. For example, changes in climate trends may introduce further uncertainty in the underlying assumptions (e.g., mortality rates, life expectancy baselines) used to determine the technical provisions (TP). In fact, historical data for heat stress related claims may no longer be appropriate due to change in climate

¹⁸ Sixth Assessment Report — IPCC (<https://www.ipcc.ch/assessment-report/ar6/>).

¹⁹ The relationship between climate change and morbidity is even more complex. As a result, excess mortality is often looked at as a proxy for changes to life and health.

increasing interconnectivity of risks (i.e. of heatwaves, droughts and wildfires). This could lead to higher-than-expected claims exacerbating the underwriting risk. As the lifetime of insurance contracts in the life underwriting business is typically longer compared to non-life underwriting, it is key for insurance undertakings to increase their understanding of the life and health effects of climate change and periods of extreme temperature in particular to develop analytical capacity and modelling techniques to assess adequately the underlying risks.

The 2025 European record heat shows a protection gap of 95%: of the EUR 43 billion lost in economic output and 24 000 lives lost, hardly 5 % was insured (Moody's, 2026). Governments at different levels bear most of the costs and uninsured losses are a contingent liability on their balance sheet: although rarely quantified before a major event happens but quickly materialising as soon as the event takes place.

3.1.2. MODELLING CLIMATE CHANGE RISKS FOR LIFE AND HEALTH – KEY BUILDING BLOCKS

The analysis in this study combines scientific climate data, global vulnerability indicators and undertaking-level exposure data to define risk indicators. The purpose of these indicators is to identify and highlight important effects of climate change (and in particular heatwaves) on different (life and health insurance) lines of business (LoBs) and countries. The analysis explores how European insurance undertaking' exposures in the life and health LoBs through their cross-border written business may also be affected by an increasing climate change risk.

This study is an exercise to better understand the impact of heatwaves on the mortality, longevity, morbidity and health claims in life insurance and should be interpreted as part of a broader effort to increase the ability to analyse climate change, and not as a final proposal for a methodology. The results presented illustrate how a structured analysis can improve the understanding of how life and health underwriting can be affected by the long-term effects of climate change. Where possible, the methodology used for climate-related weather extremes on non-life insurance – as presented in EIOPA (2022b) – is followed.

As for the modelling of physical climate change risks, the factors to be considered for modelling climate risk for life and health are:

- ▶ the **hazard** describing the physical characteristics, such as frequency and intensity of heatwave days ⁽²⁰⁾;
- ▶ the level of **exposure** estimating the portfolios at risk and their value driven by mortality for life insurance and morbidity for health insurance;

²⁰ The count of climatological hot days in a year. A climatological heat wave is a period of at least three consecutive days exceeding the 99th percentile of the daily maximum temperatures of the May to September season during a reference period (Climate Data Store, 2024).

- ▶ the **vulnerability** of the exposed population to heatwave impacts ⁽²¹⁾.

The interdependencies between hazard, exposure and vulnerability cannot be taken into account in this study, and only the climate data vary in the two scenarios. In this study, only the hazard will vary as the exposure is based on the reported TP while also the vulnerability information is only available for the current situation.

Hazard

For this study, the Climate indicators for Europe from 1940 to 2100 derived from reanalysis and climate projections from the Copernicus climate data store (CDS) were used (Climate Data Store, 2024). The following parameters were selected:

- ▶ Variable: Heatwave days (Heat and cold) ⁽²²⁾;
- ▶ Climate model: IPSL-CM5A-MR (global) and WRF381P (regional climate model) ⁽²³⁾;
- ▶ Experiment: both RCP4.5 and RCP8.5 data were used in the initial analysis;
- ▶ Temporal aggregation: yearly, as also the other information is only available at annual basis;
- ▶ Spatial aggregation: regional layer at NUTS level 0, as also the other data are only available per country ⁽²⁴⁾.

For this study, the following scenarios are considered:

- ▶ 10-year historical average 2015-2024;
- ▶ Mid-century 2050 (2041-2070) RCP8.5 scenario ⁽²⁵⁾.

The output from each indicator in this case study is rescaled (Table 3) to the range 0-5 and scored for each country (Table 4).

²¹ Vulnerability refers to the susceptibility of the insured population to adverse health outcomes or increased mortality resulting from extreme natural events. In the context of heatwaves, vulnerability reflects the likelihood that elevated temperatures translate into excess mortality or morbidity, given the demographic, socio-economic and health characteristics of the insured lives.

²² The count of climatological hot days in a year. A climatological heat wave is a period of at least three consecutive days exceeding the 99th percentile of the daily maximum temperatures of the May to September season during a reference period (1991-2020).

²³ For this scoping study, a single climate model was chosen from IPSL (France). For the scope of this study and to balance output and calculation time, it was not seen as necessary to work with a model ensemble.

²⁴ Overseas territories are excluded.

²⁵ An RCP8.5 scenario is selected as a worst-case, stress testing scenario. RCP8.5 captures upper-tail risks, not a central estimate and is unlikely but still plausible. In addition, the differences between RCP4.5 and RCP8.5 are modest before mid-century. This can also be seen for France, Spain and Portugal in Nikolaus (2026). E.g. García-León (2024) uses an RCP8.5 scenario for their 3° C and 4° C increase scenario for Europe, also using the Copernicus data used in this case study.

Table 3 - Additional heatwave days compared to reference period

Score	Description	
0	No impact	0 days difference compared to the reference period
1	Limited impact	> 0 - ≤ 1 additional heatwave days/year compared to the reference period
2	Mild impact	> 1 - ≤ 3 additional heatwave days/year compared to the reference period
3	Moderate impact	> 3 - ≤ 5 additional heatwave days/year compared to the reference period
4	High impact	> 5 - ≤ 10 additional heatwave days/year compared to the reference period
5	Extremely high impact	> 10 additional heatwave days/year compared to the reference period

Table 4 - Hazard scoring per country for the different scenarios

Country	Historic (2015-2024)	RCP8.5_2050 (2041-2070)	Country	Historic (2015-2024)	RCP8.5_2050 (2041-2070)
AT	2	4	IS	1	3
BE	2	2	IT	3	5
BG	1	5	LI	2	3
CY	2	5	LT	2	3
CZ	2	3	LU	2	2
DE	2	2	LV	2	3
DK	1	3	MT	4	5
EE	2	4	NL	2	2
EL	2	5	NO	2	3
ES	3	5	PL	2	3
FI	2	4	PT	2	4
FR	2	3	RO	2	4
HR	3	4	SE	2	3
HU	2	4	SI	2	3
IE	2	2	SK	2	4

Exposure

The level of exposure is based on the TP data related to direct business and reported under Solvency II S.12 (life) and S.17 (non-life) annual reporting templates. The TP data (scored on a scale from 0-5 as in Table 5), reported by LoB and country of exposure ⁽²⁶⁾ provides an estimate of the insurers' potential exposure to the heatwave risks. The reference year for the TP data is annual 2023 data.

To overcome some of the data limitations, the exposure indicators have been enriched with LoB-specific scores describing the likelihood of each LoB being negatively affected by an increase in frequency and severity of heatwaves. The scores (Table 6) have been derived based on expert judgement. The weight for the scoring for the TP is double ($\frac{2}{3}$) the weight for the scoring of the expert judgement impact of heatwaves on the LoB ($\frac{1}{3}$).

Table 5 -Scaling of the technical provisions per business line

Score	Description	
0	No exposure	0 % of TP
1	Low level of exposure	>0 - <1.1% of TP
2	Medium level of exposure	1.1 - <5% of TP
3	Medium to high level of exposure	5 - <12% of TP
4	High level of exposure	12 - <20% of TP
5	Very high level of exposure	>=20% of TP

²⁶ The TP data reported by solo insurance undertakings in the S.12 and S.17 annual reporting template refers to the undertakings' direct business only (excluding accepted reinsurance) and it is broken down by LoB and country of exposure. Solo undertakings and third-party branches report TP data for the business written in their home countries as well as for material EEA and non-EEA exposures. For this scoping study, only the exposure in countries from the EU-27, Iceland, Liechtenstein and Norway (the European Economic Area countries) are included in the assessment due to the availability and completeness of other data sources (including the hazard data used). Given the lack of geo-localised contract level data needed for a more detailed measurement, the Solvency II TP data is used as proxy for the "worst-case" exposure neglecting diversification benefits (i.e. assuming that all policyholders in a certain LoB are affected by climate change).

Table 6 - LoB-weights based on expert judgement

LoB	Score
Non-life insurance	
Medical expense insurance	5.0
Income protection insurance	3.5
Workers' compensation insurance	3.5
Assistance	3.0
General liability	2.0
Fire and other damage to property insurance	0.0
Miscellaneous financial loss	0.0
Other motor	0.0
MAT	0.0
Credit and suretyship insurance	0.0
Legal expenses	0.0
Motor	0.0
Life insurance	
Health insurance (SLT)	5.0
Other life insurance (non-participating)	4.0
Annuities stemming from non-life contracts relating to health	4.0
Insurance with profit participation	2.5
Annuities stemming from non-life contracts relating to obligations other than health	0.0
Index-linked and unit-linked insurance	0.0

Note: LoB-weights range between 0 (no impact expected) and 5 (very high impact expected).

Vulnerability

A vulnerability component is defined at country level, using sub-indicators from the health and human habitat themes of the ND-GAIN Index (ND-GAIN, 2026). The following sub-indicators were selected (and given equal weight):

- ▶ Health: medical staff;
- ▶ Human habitat: urban concentration;
- ▶ Human habitat: age dependency ratio.

The scores were scaled and normalized- based on the minimum and maximum values for the 30 EEA countries – in the range 0-5 (Table 7).

Table 7 - Scoring per country for each of the vulnerability sub-indicators

Country	Medical staff	Urban concentration	Age dependency ratio	Rescaled vulnerability score
AT	0.47	0.56	0.5	3.00
BE	0.22	0.98	0.55	3.90
BG	0.69	0.75	0.55	4.87
CY	0.74	0.64	0.4	4.00
CZ	0.56	0.73	0.54	4.22
DE	0.46	0.76	0.56	3.99
DK	0.52	0.88	0.55	4.68
ES	0.65	0.8	0.49	4.64
EE	0.67	0.67	0.56	4.52
FI	0.24	0.85	0.6	3.62
FR	0.59	0.8	0.6	4.90
EL	0.66	0.79	0.57	5.00
HR	0.64	0.55	0.56	3.90
HU	0.72	0.71	0.52	4.69
IE	0.41	0.62	0.5	2.97
IS	0.34	0.94	0.47	3.88
IT	0.62	0.7	0.55	4.34
LI	0.22	0.08	0.5	0.00
LT	0.53	0.66	0.51	3.68
LU	0.52	0.91	0.41	4.25
LV	0.75	0.66	0.56	4.82
MT	0.59	0.95	0.46	4.89
NL	0.5	0.93	0.52	4.69
NO	0.23	0.83	0.51	3.13
PL	0.69	0.57	0.5	3.94
PT	0.56	0.65	0.56	4.02
RO	0.63	0.51	0.53	3.56
SK	0.69	0.5	0.49	3.59
SI	0.55	0.53	0.54	3.37
SE	0.49	0.88	0.58	4.73

The ND-GAIN Index provides a useful and harmonised starting point for an exploratory assessment of heatwave-related vulnerability at European level. The selected indicators capture relevant structural characteristics that can influence population exposure and adaptive capacity to heatwaves. Its main advantage is the availability of consistent, internationally comparable country-level indicators, which facilitates cross-country analysis.

For underwriting-risk analysis, however, the indicators should be interpreted as broad vulnerability proxies rather than insurance-specific risk measures. The ND-GAIN indicators describe the general population and national socio-economic conditions, which may differ from the characteristics of the insured population. For example, the age profile, access to healthcare, housing-related adaptation and geographic concentration of policyholders may differ materially from those of the overall population. Consequently, the effects of heatwaves on the mortality of insured population might be lower compared to the general population.

These considerations do not preclude the use of ND-GAIN; rather, they highlight opportunities for further refinement. For this first exploratory analysis, the index offers a transparent and comparable basis for identifying broad differences in heatwave vulnerability across European countries. Future iterations could enhance the analysis by complementing ND-GAIN with insurance-specific exposure data and more granular indicators of housing characteristics, cooling access, healthcare capacity and socio-economic vulnerability. This would progressively improve the ability to distinguish general population vulnerability from the vulnerability of insured portfolios and strengthen the basis for quantitative underwriting-risk assessment.

3.1.3. DEFINING RISK SCORES

The concept of risk is described in detail by the IPCC in the preparation for the 6th Assessment Report (IPCC, 2020). For this scoping study, it is sufficient to define risk as:

$$\text{Risk} = \text{hazard} * \text{exposure} * \text{vulnerability} \text{ (Equation 1)}$$

In particular, each of the parameters is given an equal weight and they are combined using a multiplicative equation for each insurer (i), country where the exposure takes place (j) and LoB (z):

$$\text{Risk}_{i,j,z} = \text{hazard}_j^{1/3} * \text{exposure}_{i,j,z}^{1/3} * \text{vulnerability}_j^{1/3} \text{ (Equation 2)}$$

For the different hazard scenarios, exposure and vulnerability are kept constant in this scoping study. For this analysis, the scores of all variables in the equation (and hence the resulting Risk) are defined to vary between 0 and 5. The risk scores for the two hazard scenarios (10-year historic data and mid-century RCP8.5) are calculated considering all methodological aspects, assumptions and limitations described above. Following this, risk scores are obtained at the lowest level of granularity on company-, LoB- and country of exposure-level. These sub-scores are then aggregated as weighted averages according to TP shares.

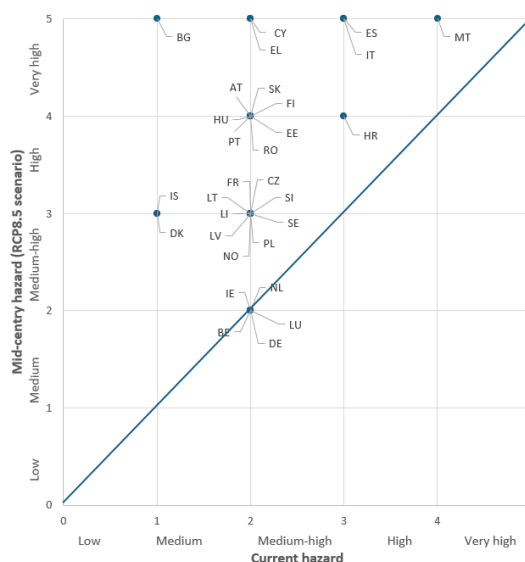
3.1.4. FINDINGS

The results from the case study should be interpreted carefully, as the quantitative analysis has data and methodological limitations (e.g. the use of the LoBs while these might contain products with different characteristics). In this case study, methodological choices are made to have results

for the hazard, exposure and vulnerability despite limited availability and quality of data. Therefore, the results in this section should not be seen as general conclusions on the materiality of the impact on heatwaves on life and health insurers in Europe but as a description on how such an assessment could look like at different levels (solo, group, national or European) and where attention should be given to better data.

When comparing the current and mid-century hazard scenario, the selected scenario has the highest increase for Bulgaria while there is no change for Belgium, Germany, Ireland, Luxemburg and the Netherlands. When looking to the hazard scenario (Figure 2), the score in the current scenario can be compared with the mid-century scenario (“2050-scenario”) for the chosen model combination. The further the countries are from the diagonal, the larger the impact from the hazard component on the difference in the risk ⁽²⁷⁾. Countries on the diagonal will see no change between the current and mid-century scenario for the hazard. The change is in the number of days above a country-specific threshold. While the countries with the largest change (i.e. (eastern) Mediterranean countries) might be the ones with the largest acclimatisation and adaptation to heat, an increase in the number of days with very high temperatures also increases the probability of longer heatwaves, while the length of heat stress periods might have a larger impact on mortality and morbidity than the maximum temperatures reached (Annex V – Heatwaves and excess mortality).

Figure 2 - Comparison of the hazard score in the current situation compared to the mid-century scenario

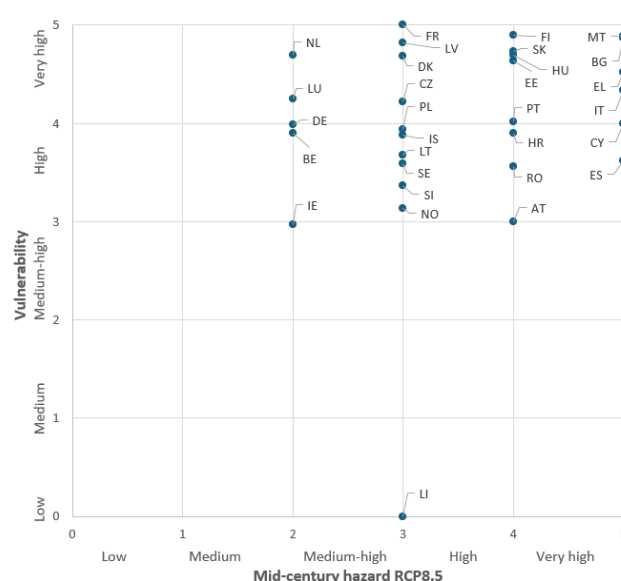


²⁷ In the case study presented, the vulnerability and exposure are kept constant between the current and mid-century situation. Therefore, only the hazard drives the difference in the risk. In reality, vulnerability and exposure might change due to the change in hazard but those changes could not be implemented at the scale and with the data available for the case study.

For the vulnerability, the sum of the three sub-indicators ranges from 0.80 to 2.02, a range rescaled from 0 (Liechtenstein) to 5 (France) (Figure 3). For the hazard, there were no countries without an increase of average number days above a certain threshold, hence no country was scored 0 (the lowest score in the current situation was 1⁽²⁸⁾, and in the mid-century scenario 2). As can be seen in Figure 3, the 0.80 for Liechtenstein is significantly lower than all other scores⁽²⁹⁾, with Ireland having the second lowest vulnerability score (2.97). In this exercise, France has the highest vulnerability score, with Bulgaria, Finland, Latvia and Malta all having scores above 4.8.

The weight of the different vulnerability sub-indicators might need to be revised when applied at national scale or on an individual portfolio, and important aspects of vulnerability might not be captured by the available indicators. The qualitative scale of the vulnerability needs to be seen in the context of the EEA-30 economies. Globally, the range of vulnerability scores for the selected sub-indicators is much larger, with most countries scoring (significantly) higher than the EEA Member States.

Figure 3 – Comparison of the hazard (mid-century scenario) and vulnerability scores



The largest TP is linked to insurance with profit participation (both life and composite), General liability insurance (non-life), health insurance (non-life) and other life insurance (life) (see Annex IV – Solvency II lines of business impacted by climate change for potential negative impacts, main risk drivers and expected relevance per LoB). Figure 4 provides the share of TP for each LoB where

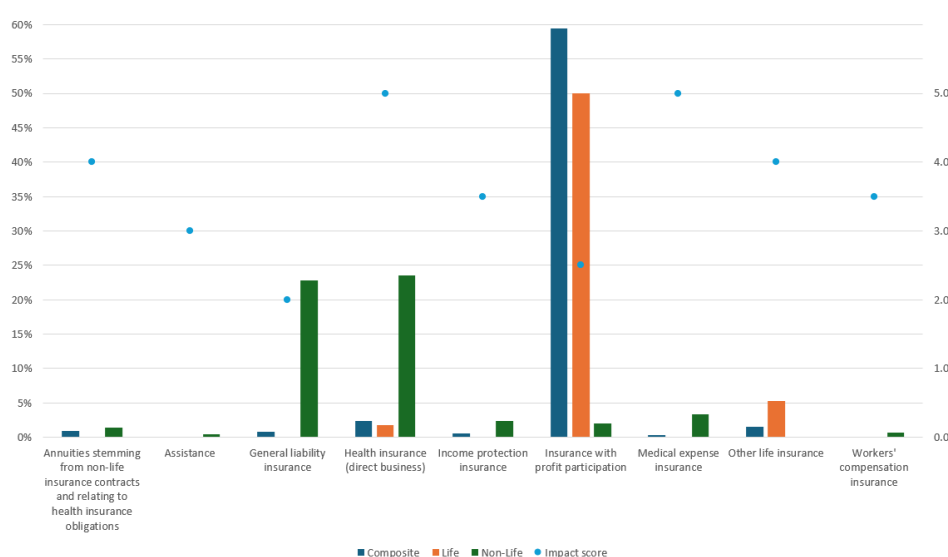
²⁸ Because the current hazard refers to the period 2015-2024 and is compared to the baseline period 1991-2020.

²⁹ With a vulnerability of 0, the risk for Liechtenstein would become 0 in this exercise. In the exposure, due to the limited number of data points for Liechtenstein the country had to be excluded from the results anyhow.

the scoring is larger than 0 split for composite ⁽³⁰⁾, life and non-life undertakings. The largest TP is linked to insurance with profit participation (both life and composite), General liability insurance (non-life), health insurance (non-life) and other life insurance (life). As the TP for non-life is 5 to 6 times smaller than the TP for life and for composite (8% of the total TP for non-life compared to 44% for composite and 48% for life), the TP for general liability insurance (non-life) or health insurance (non-life) is in absolute values smaller than the TP other life insurance (life). As a result, in absolute terms the TP for insurance with profit participation is for both composite and life above EUR 1000 billion, and around than 10 times bigger than the TP for general liability insurance (non-life), health insurance (non-life) or other life insurance (life).

The most relevant LoBs based on the TP have an impact score ranging from 2 (general liability insurance) to 5 (health insurance). The very important LoB insurance with profit participation has an impact score of 2.5. The exposure consists of two elements: the TP and the expert judgement weight score for each LoB. The weighting should reflect the importance of climate change on the LoB, keeping in mind that this might be different for an individual portfolio depending on the type of products provided.

Figure 4 - Share of TP per LoB and per type

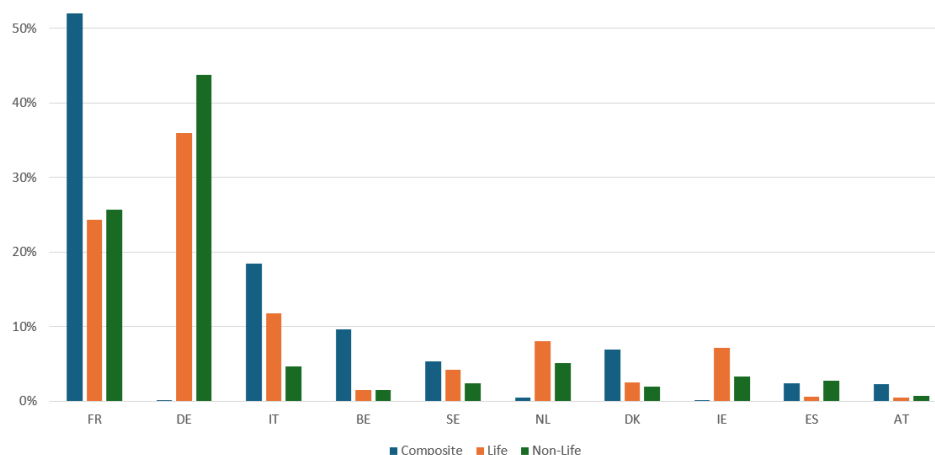


Note: Only for LoBs with an expert judgement score for the relevance of climate change on the life and health insurance larger than 0 (see Table 6). Impact score on right-hand scale.

³⁰ When presenting the results per type of undertaking, composite undertakings include both those under Art. 73(2) and Art. 73(5). (EU, 2009). For example, France only has Art.73(2) composites - newly authorised composite undertakings under a limited derogation, underwriting life LoBs plus non-life LoBs accident and sickness (classes 1 & 2) – and no composites underwriting any combination of life and non-life LoBs (Art. 73(5), grandfathering provision). In both cases, the life and non-life business have to be managed separately (Art. 74(2)). Notwithstanding the differences, many reporting and capital treatment provisions apply equally to both categories (EIOPA, 2016).

When looking at the share of TP per country of exposure, the very vast majority is linked to France, Germany and Italy. Figure 5 presents the countries where the overall share of TP is more than 1% of the total. The largest shares are for France (composite ⁽³¹⁾), Germany (life), France (life), Italy (composite) and Italy (life).

Figure 5 - Share of TP per country of exposure and per type



Note: In absolute terms, composite consists of 44%, life of 48% and non-life only for 8% of the TP. See also footnote 30 on the similarities between composite under Solvency II Art.73(2) and life undertakings (EU, 2009). The figure only includes countries where the overall share of TP is more than 1% of the total TP for all countries together.

The change in hazard for each country, the vulnerability and the exposure (both the share of the TP and the potential impact for each LoB) can be summarised as the change in risk between the current and mid-century scenario, as shown per LoB for each type of undertaking in Figure 6.

The vertical distance to the diagonal is a measurement for the change in risk.

For all LoBs together, the change in risk per type of undertaking is summarised in Table 8.

Table 8 - Change in risk per type of undertaking

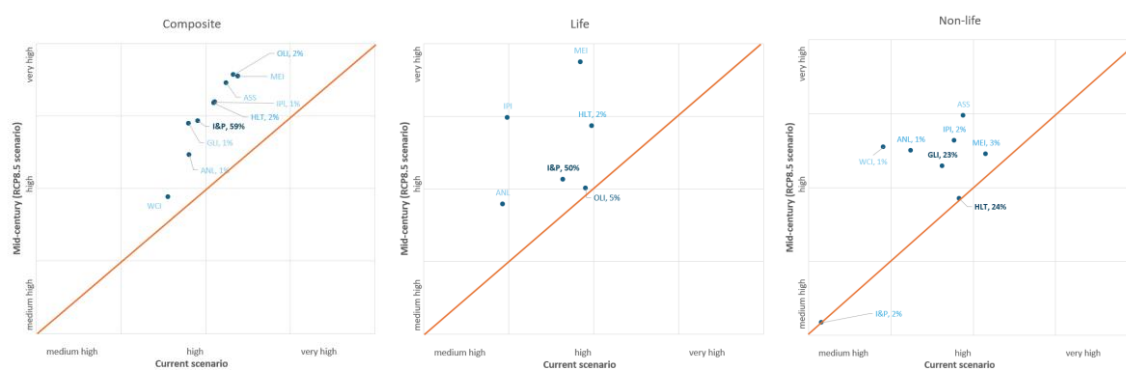
	Current scenario	Mid-century scenario (RCP8.5)
Composite	3.3	3.9
Life	3.2	3.5
Non-life	3.2	3.5

The case study shows the methodology to check change risks due to climate change on life and health insurance, but one should be careful with conclusions as those are driven by methodological choices and data issues (Annex V – Heatwaves and excess mortality). Four out of ten countries with the highest TP based on the country of exposure – Germany, Belgium, the Netherlands and Ireland - do not show a difference in risk as the hazard scoring in the current and

³¹ See also footnote 30.

mid-century scenario is the same (Figure 2, Figure 5). The difference in risk change between composite and life might be impacted by France (composite, although all of the type of Art. 73(2) (EU,2009)) and Germany (largest share of TP life, but no change in hazard between the two scenarios). In addition, the result is largely influenced by the TP of a single LoB: insurance with profit participation. As explained earlier in this chapter and in Annex V – Heatwaves and excess mortality, a LoB can contain different products that are impacted by climate change in a different way. In no way can the scoring be understood as a ratio: an increase in risk score e.g. for composite from 3.3 to 3.9 is never to be interpreted as a risk increase of $\pm 20\%$.

Figure 6 - Current versus mid-century risk for each LoB - per type of undertaking



Note: a) composite, b) life, c) non-life. Share of TP in % (if larger than 0%) (Table 5). Only LoB with an impact larger than 0 are included (Table 6). Compared to Figure 4 and Figure 5, these figures cover only the upper-right quadrant (scores 2.5-5.0 for both x and y axis). **Abbreviations:** ANL: Annuities stemming from non-life insurance contracts and relating health insurance obligations, ASS: Assistance, GLI: General liability insurance, HLT: Health insurance (direct business), IP: Income protection insurance, I&P: insurance with profit participation, MEI: Medical expense insurance, OLI: Other life insurance, WCI: Workers' compensation insurance.

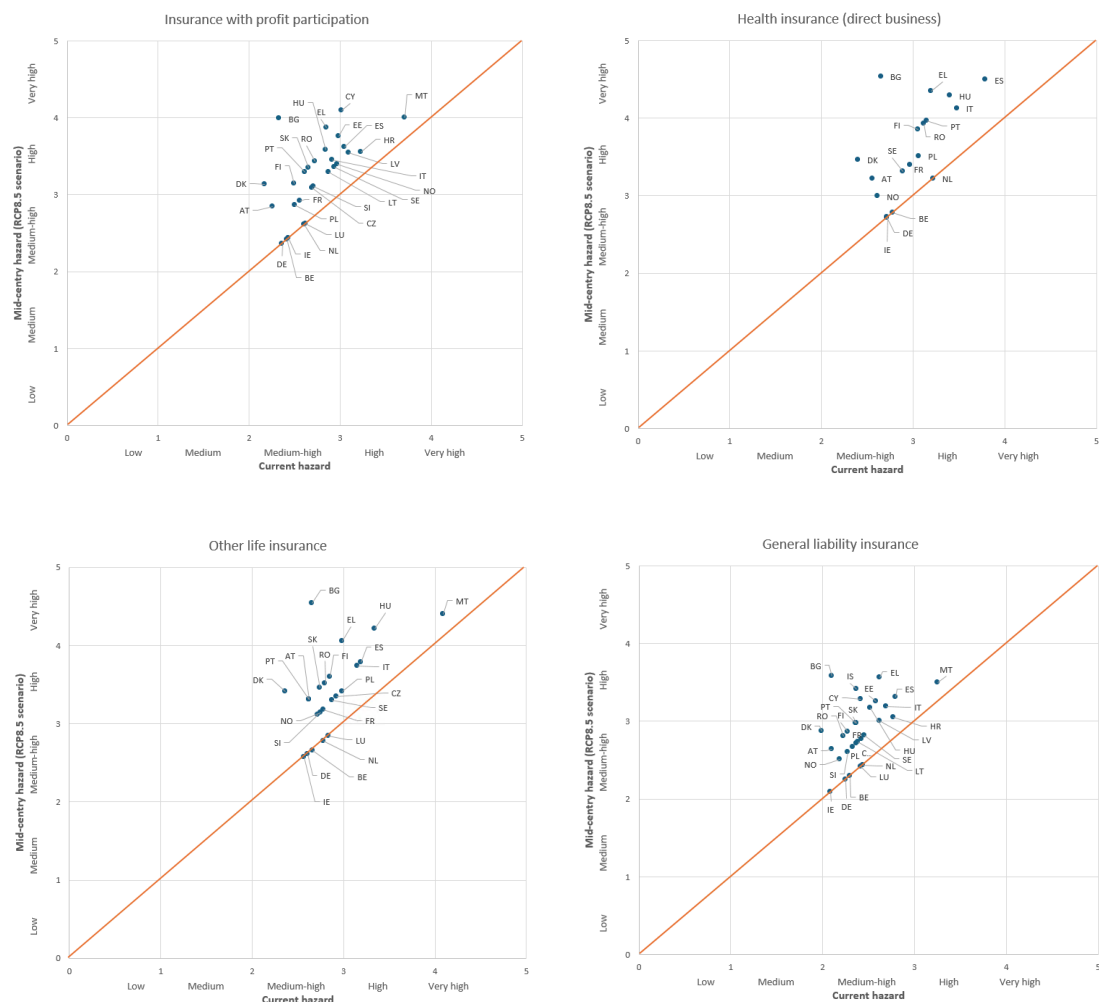
For illustration purposes, the change in risk (shown by the vertical distance to the diagonal) - for all countries ⁽³²⁾ with three or more data points - **is given for the four most important LoBs** (Figure 4): **insurance with profit participation, other life insurance, health insurance (direct business) and general liability insurance**. The impact of the chosen hazard scenario is visible in the results, but by presenting different LoBs, also the impact at country level of the vulnerability aspects and the specificities of the exposure (both the impact scoring of the LoB and the relative TP of each LoB) are reflected in the results (Figure 7).

In conclusion, the case study in this section shows that a risk methodology as used for assets and property (EIOPA, 2022b) **can also be used to estimate the impact of climate change – and in this case in particular of the effect of changing heatwaves - on life and health insurance**. To be applied at solo, group or national level, some refinement of the methodology and of the data will be needed to make stronger conclusions on the materiality of the change in risk:

³² The score for the current scenario and mid-century scenario for a country is the average of the score of all undertakings.

- ▶ **Hazard:** using multiple scenarios and where possible transfer the information on the physical climate in location-specific mortality data, e.g. by using minimum mortality thresholds (see Annex V – Heatwaves and excess mortality for details);
- ▶ **Vulnerability:** using more specific vulnerability data reflecting characteristics of the population affected (e.g. age groups, outdoor work) and environmental characteristics (e.g. urban heat island effect or access to active cooling);
- ▶ **Exposure:** by further estimating the impact of climate change on mortality, morbidity or longevity on the different products offered rather than at the level of the LoB (as explained earlier in this chapter and in Annex V – Heatwaves and excess mortality).

Figure 7 - Current versus mid-century risk for each country - for specific LoBs



Note: Contrary to Figure 6, the whole risk range (0-5) is presented in the figure.

BOX 8 - MATERIAL LOB AND GEOGRAPHICAL AREAS

Based on the quarterly S.05.01 dataset for life and non-life premiums, an evolution over time of claims data, gross and net written premiums (year-on-year and quarter-on-quarter changes) was made per LoB. The aim was to check if there was an increase in claims and or premiums in years with more severe heatwave events. To assess whether specific trends could be identified by LoB and location of risk, the analysis focused on premium and claims data reported on annual basis from S.04.05 “Activity by country - location of risk” ^(a).

For non-life and life insurance, YE2024 annual solo GWP and claims were analysed. Quarterly data of YoY changes for the relevant individual LoBs are given as examples in Figure 8 for medical expense insurance which constitutes approximately one quarter of the total non-life GWP.

The current assessment cannot meaningfully determine how climate change affects life and health insurance because the temporal scale of climate-related events does not align with the reporting cadence or the length of available data series. Quarterly data are available since 2016 - and more reliable/complete since 2017 – until 2024. As a result, this 8-year time series has in the middle the years 2020 and 2021, years that when it comes to health-related data are overshadowed by the Covid-19 pandemic. Quarterly insurance claims data are too coarse to capture the short-lived and often lagged effects of heatwaves or other natural hazards. These events unfold over days (or maximum weeks), and their impacts are easily obscured by broader seasonal patterns that dominate quarterly—and sometimes annual—reporting cycles.

Quarterly data are available since 2016 - and more reliable/complete since 2017 – until 2024. As a result, this 8-year time series has in the middle the years 2020 and 2021, years that when it comes to health-related data are overshadowed by the COVID-19 pandemic.

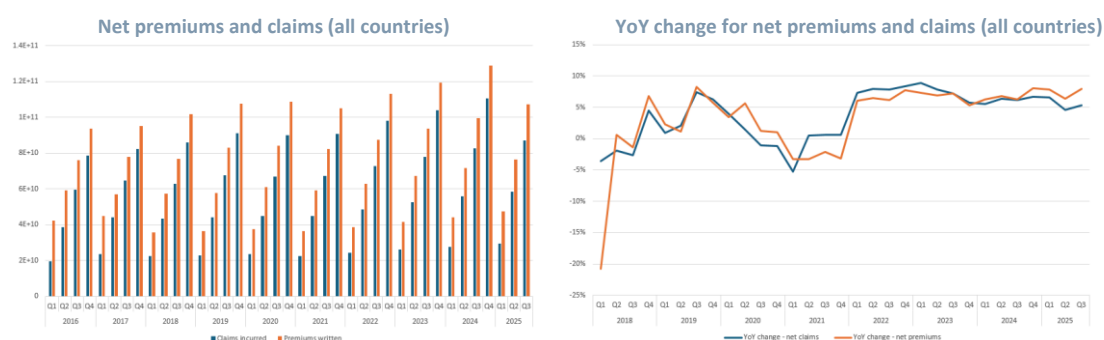
To assess whether specific trends could be identified by LoB and location of risk, the analysis focused on premium and claims data reported on annual basis from S.04.05 “Activity by country - location of risk” ^(a).

Quarterly insurance claims data are not suitable to measure the causal impact of heatwaves or other NatCat events. Rather than using the QRT data reported, a robust internal awareness and stress testing should be used to check the materiality of the impact on specific LoBs over time. It is hard to isolate effects – or to detect causal impacts – of heatwaves taking place on a temporal scale of days to weeks, with lagged effects and to compare them

with quarterly (and sometimes annual) data that anyhow include seasonality not affected by NatCat events. To overcome this, it is preferable to look at daily claims data.

^(a) In the case of policies of a duration of four months or less covering travel or holiday risks, whatever the class concerned, the country where the policy holder took out the policy was used.

Figure 8 - Examples of YoY changes for medical expense insurance LoBs



3.2 POTENTIAL IMPLICATIONS AND OUTLOOK FOR THE LIFE AND HEALTH BUSINESS

While the financial impact of climate change on life and health insurance might still be limited as of today, awareness of these possible future impacts should be on the radar of all actors in the insurance industry. More and more, this is taking place, but at an unequal rate as shown in the results from the survey on climate risk assessment in the own risk and solvency assessment (ORSA) for life insurers (Box 9).

BOX 9 - SURVEY ON CLIMATE-RISK ASSESSMENT IN THE ORSA FOR LIFE INSURERS

One way to look at the materiality and risk awareness for life and health risks is looking at the own risk and solvency assessment (ORSA) and how life and health risks are mentioned there in relation to short- and long-term climate scenarios.

A survey collected responses from 139 life insurance companies, and a detailed analysis was conducted on the responses from 90 life insurers that assessed physical risks or transitional and physical risks in their own risk and solvency assessment (ORSA). These risks may impact the liability side or both the asset and liability sides of their portfolio. The sample was diverse,

with more than half of the respondents (47 insurers) having total gross written premiums (GWP) below €1 billion, while only 7 companies had GWP exceeding €5 billion.

Only 8 insurers relied solely on quantitative methods while 38 insurers relied only on qualitative methods. The remaining 44 insurers employed combined quantitative/qualitative techniques. Furthermore, 57 insurers included both long-term and short-term scenarios in their ORSA assessments.

The survey also found that 71 insurers incorporated a short-term climate change scenario analysis into their ORSA, ranging from a time horizon of less than a year for only 5 insurers and of 1-3 years, 3-5 years and more than 5 years for more or less equal groups of insurers. Similarly, the survey also found that 67 insurers incorporated a long-term climate change scenario analysis into their ORSA, with half considering a time horizon of 20-30 years and one-third considering more than 30 years. The remaining group considered a time horizon of less than 20 years, with on 3 insurers using a long-term scenario of less than 10 years.

However, a significant majority (68 insurers) of the sample considered physical risks to be non-material. Only few participants explicitly mentioned health or life related risks.

4. CONCLUSIONS

The materiality of heatwave risks – lessons from a case study

Heatwaves represent a potentially future material but still insufficiently quantified source of risk for life and health insurance, yet insurers and supervisors currently lack the granular, forward-looking data needed to translate this public-health reality into robust liability-side risk metrics. Heat is already the leading cause of climate-related mortality in Europe, exceeding mortality and morbidity from other weather extremes. While the case study - combining data for hazard, vulnerability and exposure - demonstrates that heat-related risks can be assessed using methodologies similar to those applied to property risks, the underlying data gaps prevent firm conclusions on trend and materiality. As noted, there is little data available on how voluntary health insurance populations in Europe differ from the general population in their sensitivity to climate impacts, and current mortality and morbidity effects are not seen as very significant by NCAs (Prudential Regulation Authority, 2015).

Assessing the impact of heatwaves on life and health insurance remains constrained by significant data gaps. While high-resolution meteorological data is increasingly available, linking temperature extremes to mortality, morbidity, and insurance claims at the necessary geographic and temporal granularity poses a major challenge. Heat-related deaths and illnesses are rarely attributed directly to extreme heat, complicating efforts to isolate climate-driven impacts from other influencing factors such as ageing populations, pre-existing health conditions, healthcare advancements, and socioeconomic disparities. The reliance on aggregated annual or quarterly premium and claims data, combined with the short time series of Solvency II QRT reports and the infrequency of extreme heat events, further limits the detection of clear trends.

The general population data may not fully represent insured portfolios, requiring more granular information. To improve assessments, harmonised data on insurance products, age cohorts, geographical distribution, and vulnerability factors—such as adaptation levels, socioeconomic status, and pre-existing health conditions—is needed. This would help better understand European exposure to heatwave risks.

Although it might seem that the population with additional voluntary health insurance will be less impacted than the general population by impacts from climate change on life and health, there is little data available. Therefore, it will be important for insurers and reinsurers to be aware

of the potential for an increase of health-related claims (including mental health conditions) and to monitor the development on an ongoing basis ⁽³³⁾.

The literature also highlights that adaptation and behavioural change significantly influence materiality over time. Evidence from epidemiological research shows declining heat-sensitivity of injuries (Park, et al., 2015) and region-specific optimal temperatures that shift with acclimatisation (Gasparrini, et al., 2015; Hogeekamp, 2024). These findings imply that future mortality and morbidity outcomes will depend not only on physical climate trends but also on socio-economic conditions, demographics, and access to cooling or preventive measures. For insurers, this means that materiality cannot be assessed solely through climate projections; it must incorporate behavioural and technological adaptation pathways. On the long-term, tackling the underlying causes for climate change remains the most effective: the insured can opt for measures (e.g. nature-based or energy-passive solutions) that increase the resilience while not increasing greenhouse gas emissions, while the insurer can look at the asset side of the balance sheet and the type of investments made therein.

Finally, one should be aware that a case study based on LoBs does not address the difficulty that the impact from climate change might affect different products differently when it comes to mortality, morbidity or longevity effects. Heatwaves are likely to negatively affect the own funds of insurers through products exposed to mortality and health related-risks, but not through products exposed to longevity risk. Larger European life insurers hold substantial annuity portfolios, meaning that negative mortality shocks could be partially offset by changes in longevity (Prudential Regulation Authority, 2015). Conversely, health insurers may face increased claims from heat-related illnesses, mental-health impacts, and infectious diseases whose transmission conditions change with temperature and humidity (IAIS, 2025). The potential materiality is product-specific, time-dependent, and highly sensitive to data quality, reinforcing the need for supervisory caution in interpreting early quantitative results due to methodological and data-related issues.

A comprehensive approach integrating multiple data sources and scenario analysis is essential for robust risk assessment. To strengthen assessments, insurers should combine climate, epidemiological, demographic, and insurance data while explicitly accounting for uncertainties. Supplementing historical analysis with scenario-based modelling can help evaluate different hypotheses and improve long-term risk management strategies.

³³ E.g. Birgit König, global head of health at insurer Allianz, said at the European Congress of Actuaries in Paris (18/06/2026) that insurers needed to change the way they model claims, arguing chronic and mental health conditions develop over long periods and that the industry should become “a partner with interventions” for customers rather than only as a claims payer (Assmann, 2026).

Climate change impacts on life and health insurers on the radar of the sector

Heat-related climate risks are increasingly recognised by supervisors and insurers, but they remain unequally integrated into prudential practice, especially on the liability side. Supervisory publications acknowledge that climate change affects both assets and liabilities, yet the quantification of life and health impacts remains less advanced (EIOPA, 2024). Heatwaves, despite being the leading cause of climate-related mortality, are not often explicitly treated as standalone stress scenarios and are instead captured indirectly through other hazards or macroeconomic channels (EIOPA, 2022a). This asymmetry reflects the sector's historical focus on property and on climate-related risks where modelling maturity is higher (e.g. flood).

Based on the expert insight of the NCAs, insurers rarely refer explicitly to climate change in life and health pricing or technical provisions, although impacts may be implicitly embedded. According to supervisory insight, insurers rely on life-expectancy studies and long-term mortality trends that may already incorporate climate-related effects without naming them (Prudential Regulation Authority, 2015). This implicit treatment suggests awareness but not necessarily operationalisation. Moreover, prudential supervisors have the mandate to incorporate climate risks into their frameworks without legislative changes (Khanolkar, et al., 2026), yet current supervisory practice varies, reflecting differences in disclosure requirements, modelling maturity, and the extent to which climate risks have been integrated into prudential processes.

Overall, the topic of climate change impacts on life and health insurance is gaining visibility, but operational readiness is still limited, i.e. modelling maturity is limited, heatwaves not included as standalone stress scenario or quantification of the liability side is less advanced. Supervisors acknowledge that climate-related disclosures will vary across insurers, depending on whether they write life, health, or non-life business, as well as on factors such as where the insurer operates, which risks are considered material, the range of products offered, and whether reporting is done at group level or for a single entity, in accordance with the proportionality principle. They also expect that, over time, insurers will report and reflect climate-related risks more consistently (IAIS, 2025). Insurers are aware of emerging risks such as vector-borne diseases, mental-health impacts, and heat-related morbidity, but these remain peripheral in ORSAs and stress testing. The broader supervisory community recognises that data gaps, modelling inconsistencies, and limited forward-looking tools are major obstacles to fully integrating heat-related risks into prudential oversight (EIOPA, 2022a, 2024, IAIS, 2025).

Outlook

Vector-borne diseases and their conditions for transmission might be more under the radar and something to keep an eye on. This report focuses on heatwaves, because the impact mechanisms might be better understood and the data availability higher than for other climate-related impacts. Notwithstanding the problems with European level data for heatwaves, the situation for other perils relevant for life and health might be worse. Certain measures - in particular air conditioning – available more to those with the ability for voluntarily insurance than to the general population might increase the transmission of certain diseases such as tuberculosis (air-borne) or legionellosis (vector-borne) (SCOR, 2023).

Past experience with asbestos-related illnesses, where losses increased many years after the exposure, illustrates how similar long-tail patterns could arise in the context of climate-related litigation. While health insurance coverage is written for a single year, claims connected to that policy can surface long after the policy period has ended (Khanolkar, et al., 2026).

Guidance on the ORSA climate change risk scenarios explicitly notes that climate change can lead to a changing life expectancy (mortality/longevity), thereby directly linking climate risks to health insurance and life underwriting outcomes. In its climate stress testing principles, EIOPA also highlights that physical risks include direct impacts of extreme events on insurance liabilities, which conceptually encompass health-related losses (EIOPA, 2021, 2022a). Despite the recognised link between climate hazards and human health, literature research and the case study in chapter 3 indicates that quantitative modelling of mortality and morbidity impacts remains at an early stage. The ORSA show significant differences across insurers in methodologies and depth of analysis (Box 9).

The European Extreme Events Climate Index (E³CI) results point to a clear pattern: extreme events with direct implications for life and health—especially heat stress and forest fires—are becoming more severe and more frequent across Europe (Table 9). Compared with the 1981–2010 reference period, recent observations match or exceed earlier trends, with 2024 marked by intense droughts and notable wildfires and with expectations of increasingly dangerous heatwaves in the years ahead. These developments indicate a worsening trajectory for the types of extreme conditions most closely linked to mortality and morbidity, as reflected in the rising likelihood of events surpassing high-severity thresholds in the E³CI dataset.

Table 9 - Probability of exceeding 1981-2010 threshold and odds ratios, at Europe level

Year	Heat stress	Cold stress	Forest fire	E ³ CI
2012	50%	29%	50%	51%
2013	17%	25%	8%	14%
2014	38%	1%	2%	2%
2015	67%	0%	31%	54%
2016	45%	0%	30%	24%
2017	48%	0%	34%	40%
2018	57%	4%	67%	59%
2019	62%	0%	48%	50%
2020	55%	1%	66%	66%
2021	41%	3%	11%	33%
2022	76%	0%	69%	61%
2023	67%	0%	61%	60%
2024	78%	0%	54%	54%
Average 1981-2010	6%	6%	6%	6%
Average 2011-2024	54%	5%	42%	44%
Odds ratio 2011-2024	8.7	0.8	7.0	7.7
Odds ratio 2024	12.6	0.0	9.1	9.4

Note: Selected perils. E³CI = European Extreme Events Climate Index.

Source: Milliman (2025).

Recent observations, in particular from the summer of 2026, where heatwaves and forest fires in multiple countries all over Europe were prominent in the news as early as May, confirm or even exceed observations that only a few years ago were seen as exceptional (Henley, 2026). Climate change will likely lead to higher losses, evolving risk patterns and increasing pressure on the insurability of risks, including broader socio-economic consequences. This includes indirect impacts on human welfare, such as affordability of insurance coverage and the widening protection gap. At the same time, data gaps, methodological inconsistencies and limited modelling maturity, in particular for life and health impacts, remain major obstacles to fully integrating climate risks into prudential frameworks.

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ABBREVIATIONS

A/E	Actual over Expected
ACPR	French Prudential Supervision and Resolution Authority
BEL	Best Estimate Liability
CATDAT	Catastrophe Database, from RiskLayer GmbH received under institutional agreement
CDS	Climate Data Store (Copernicus)
DACH	Germany, Austria and Switzerland
DDS	Dessert dust storms
E ³ CI	European Extreme Events Climate Index
EEA	European Economic Area (EU27 + Iceland, Liechtenstein and Norway)
EEA	European Environment Agency
EM-DAT	Emergency Database, created by the Centre for Research on the Epidemiology of Disasters
ESG	Environmental social and governance
GWP	Gross Written Premium
HPP	Heat Prevention Plan
IORP	Institutions for occupational retirement provision
IPCC	Intergovernmental Panel on Climate Change
LoB	Line of Business (Solvency II)
NatCat	Natural Catastrophe
NCA	National Competent Authorities
NGFS	Network for Greening the Financial System
ORSA	Own risk and solvency assessment
PM2.5	Fine particulate matter
QRT	Qualitative reporting template (Solvency II)
RCP	Representative Concentration Pathways (IPCC)
SSP	Shared socio-economic pathways (IPCC)

TP	Technical provisions
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organization
WMO	World Meteorological Organization
YE	Year-end
YoY	Year-on-year

ANNEX I A – PHYSICAL IMPACTS FROM HEATWAVES ON LIFE AND HEALTH

The direct health impacts from heat include deaths from heatwaves, heat stress, work-related injuries and disrupted sleep patterns (Dasgupta, et al., 2021; van Daalen, et al., 2022; Minor, et al., 2022) ⁽³⁴⁾. Heatwaves have a specific and “different from other natural hazards” impact on human health (EEA, 2024a):

- ▶ Heatwaves act “invisible” and affect entire populations simultaneously;
 - Unlike floods or storms, heatwaves do not cause immediate visible destruction;
 - Heatwaves develop over a period of days or weeks;
 - Heatwaves affect entire regions, including urban and indoor environments.

These characteristics make it harder to perceive and respond to heatwaves, both for individuals and institutions, while the exposure is widespread and prolonged (EEA, 2024a). Where most other natural hazards are relatively short-term exposure events harming health through trauma (injuries, drowning, burns, etc....), heatwaves act differently and their effect on human health is a combination of multiple factors.

- ▶ Heatwaves directly stress the human physiology rather than causing injuries;
 - Heatwaves act directly on thermoregulation, cardiovascular strain, hydration balance and respiratory functions;
 - Heatwaves exacerbate pre-existing chronic diseases;
 - Heat induced mental impacts and well-being issues ⁽³⁵⁾.

These stresses are, for example, leading to or exacerbating (climate) anxiety, mood disorders, substance use disorders or even violence and self-harm (SCOR, 2024; Crugnola-Humbert, et al., 2026). Especially younger people (under 25 years old) report that climate anxiety worries them and has an impact on their functioning (Hickman, et al., 2021) ⁽³⁶⁾.

³⁴ For a more detailed overview of all kinds of health-related impacts, see e.g. SCOR (2022b) or Zhao et al. (2024).

³⁵ These are not unique for heatwaves and heat stress, but also part of the health impacts from a wide range of climate- and environment-related chronic and acute events (flooding, drought, sea-level rise, (air) pollution ...).

³⁶ In Hickman et al. (2021), Finland, France and Portugal were EU Member States included in a global study. Of these people between 16 and 25 years, the group mentioning to be extremely worried or very worried about climate change was 44% in Finland, 58% in France and 65% in Portugal while respectively 31, 35 and 37% said their feelings about climate change have a negative affects their daily

A contributing factor to mental health conditions is the helplessness an individual may experience when understanding that the danger of climate (and environmental) change is imminent while there aren't mitigation actions that can be taken to directly reduce the risk (CRO Forum, 2021). A study for health insurer Allianz estimates that the rising prevalence of heatwaves alone can increase the health costs per capita on average by 4.9% in Europe by 2035 (Allianz, 2024), e.g. because of a positive correlation between heat and emergency department visits (SCOR, 2024).

The danger of heatwaves for human health goes beyond the maximum temperatures recorded. The health risk is caused by:

1. High temperature extremes and their duration - Sustained high temperatures increase mortality more than short heat spikes as:
 - a) Prolonged exposure prevents physiological recovery;
 - b) Cardiovascular strain accumulates over successive days;
 - c) Night-time cooling is critical;
2. Tropical nights (with a temperature above 20 °C) and the lack of nocturnal cooling are a key driver of excess mortality (Roye, et al., 2025); as they
 - a) Prevent the body from cooling and recovering;
 - b) Increase sleep disturbance;
 - c) Elevate stress hormones and cardiovascular load;
3. High humidity and reduced evaporative cooling strongly amplify heat stress because:
 - a) Sweat evaporation becomes ineffective;
 - b) Core body temperature rises faster;
 - c) Risk of heat exhaustion and heat stroke increases;

The use of “apparent temperature” or “wet-bulb temperature” instead of just air temperature makes it possible to recognise the importance of the humidity factor as a critical amplifier ⁽³⁷⁾.

functioning The all countries average in the study for being extremely worried and very worried, and negative impact on functioning were 59 and 45% respectively. Poorer, heavily impacted countries like the Philippines, India, Nigeria or Brazil have a higher proportion of younger people reporting a negative impact on functioning (all between 50 and 74%), while Australia, the UK and the USA are the only non-EU countries scoring below 40%.

³⁷ In 2026, the Dutch KNMI introduced the Heat Force (hittekracht) index, a 0-10 scale derived from the Wet Bulb Globe Temperature (WBGT). The index combines air temperature, humidity, wind speed and solar radiation into a single measure of heat stress, providing citizens with a better indication of how heat is experienced than air temperature alone.

In addition to these factors, there is the urban heat island effect, and the role of air pollution and compound exposure (e.g. the coincidence of heatwaves and elevated ozone levels) impacting human health during heatwaves.

ANNEX I B – VULNERABILITY FACTORS

As measures to adapt and increase resilience have an impact the health impacts of climate change, it makes sense to assume a bias in the insured population versus the total population. Those who are able to take additional insurance are in general more affluent and more able to afford the costs of the necessary prevention measures. Heat-related mortality in Europe is strongly uneven and driven by socio-economic vulnerability, not just temperature.

This is not only in between countries (see for example Hickman et al. (2021)), but also within a country: the frequency and severity of mental health impacts due to climate change might be lower in the insured population compared to the total population. However, the data basis for these statements is in general lacking and the estimated impact on life and health insurance is difficult to quantify. Monitoring on an ongoing basis – next to the awareness of the potential of an increase - would be necessary to know how claim incidence and duration evolve and if this can or cannot be linked to climate change (SCOR, 2024).

A key vulnerability factor is the pre-existing health and psychological condition, where especially people with chronic conditions - like cardiovascular diseases, respiratory diseases, diabetes or mental health disorders - are consistently identified as highly vulnerable. There are also some widely prescribed groups of medication that reduce heat tolerance. National public health institutes and the WHO flag medication-related vulnerability as a major but often overlooked risk factor during heatwaves (EEA, 2024b).

Another main vulnerability factor is age and the exposure to heatwaves of vulnerable populations, e.g. infants and persons over 65 years old. This is commonly expressed as heatwave-person days experienced, referring to the cumulative number of days of heatwave these people were collectively exposed ⁽³⁸⁾. For the WHO Europe region (Romanello, et al., 2025), the results for 2021-2024 can be found in Table 10.

Heat stress can also reduce labour productivity and be harmful to the livelihoods of workers (and their dependents). Heat leads to lost hours of labour in different sectors, including agriculture, construction, manufacturing and services ⁽³⁹⁾. For the WHO Europe region (Romanello, et al., 2025),

³⁸ This can also positively affect insurers, since people insured in products with “mortality risk” (i.e. whole life, linked to mortgage amortization) are on average younger than people exposed to longevity risk (i.e. annuities). If excess mortality is disproportionately higher amongst older, more vulnerable people, climate change might even have a positive impact on insurers’ own funds (reduction of liabilities) and solvency risk.

³⁹ MunichRe recently warned it was difficult to quantify the financial impact of heatwaves but said damage was mainly caused by falling productivity and production standstills (next to damage to assets and agriculture) (Sagar, 2026).

the results for 2021-2024 can be found in Table 11 ⁽⁴⁰⁾. Less outspoken than on the global level, but also for the Europe region is agriculture responsible for the highest potential hours of labour lost (~ half of the total). It is difficult to make technical adaptations to these types of labour activities (especially to agriculture and construction, as these take largely place outside) to reduce the heat-related health stress.

Table 10 - Exposure of vulnerable populations to heatwaves

	2021	2022	2023	2024
Infants	169.8	155.4	188.3	195.2
Over 65 years old	2237.5	2439.6	2738.9	3187.4
Total	2407.3	2595.0	2927.2	3382.6

Note: for WHO Europe region, in million person-days.
Source: Romanello et al. (2025)

Table 11 - Potential hours of labour lost due to exposure to heat

	2021	2022	2023	2024	Trend since 1990
Agriculture	1317.0	1138.4	1283.0	1463.5	Stable
Construction	707.0	721.0	802.7	974.4	Increase
Manufacturing	238.4	229.0	285.6	354.3	Increase
Service	283.9	269.8	370.1	435.5	Strong increase
Total	2546.3	2358.2	2741.4	3227.7	

Note: for the WHO Europe region, in millions
Source: Romanello et al. (2025)

EEA (2022, 2024b) briefings stress that housing characteristics are among the strongest determinants of heat-related morbidity and mortality, especially during prolonged heatwaves and tropical nights. In addition, summer energy poverty can be considered a growing heat-health

⁴⁰ In Europe, absences due to “sick leave” are mostly covered by the public sector and the private companies employing this people, rather than by private insurers.

vulnerability in Europe, particularly in southern and central/eastern European Member States (EEA, 2022).

Limited access to green and blue spaces is particularly an issue for cities, exacerbating the urban heat island effect. European city-scale studies show substantially higher heat-related mortality in urban areas, even after controlling for age and income (Huang , et al., 2023). There is an unequal distribution of green infrastructure around schools, hospitals and low-income neighbourhoods, increasing vulnerability (EEA, 2025c).

Finally, there is the element of social and behavioural vulnerability where social isolation and living alone are factors repeatedly highlighted in European heat-health action plan evaluations as a key driver of excess mortality (EEA, 2023). Contrary to communal housing, like elderly homes or kindergartens, people living alone or with little social contacts are more vulnerable because heat-related illnesses may go unnoticed, informal care and warnings are reaching the people less or there's reduced assistance with hydration and cooling. Lower economic status is correlated with poorer housing, energy poverty and access to understandable information (EEA, 2023).

Future heat impacts are highly sensitive to socio-economic pathways, implying that investments in healthcare access, housing quality, urban planning, and early warning systems can substantially reduce mortality burden (Paniello-Castillo, et al., 2026).

ANNEX I C – ADAPTATION MEASURES

Climate change and adaptation measures can however bend the curve. Even when heatwaves in recent years exceeded the intensity of the 2003 European heatwaves, mortality rates in many western European countries decreased. The Lancet Countdown (Romanello, et al., 2025) suggests a 3-level cooling framework for protection against heat:

- ▶ Landscape-level actions to cool the environment;
- ▶ Building-level adaptations to protect indoors; and
- ▶ Personal-level behaviours.

At the landscape level, cooling is achieved by shaping the outdoor environment—especially through urban green and blue infrastructure (trees, parks, water bodies), which reduce ambient temperatures, limit urban heat-island effects, and deliver co-benefits for air quality, flood risk and mental health. This is highly relevant for Europe, where many cities are densely built and only a minority currently have sufficient urban greenness.

At the building level, cooling should focus on passive and efficient design—including insulation against overheating, shading, ventilation, reflective materials and nature-based solutions—reducing indoor heat exposure, particularly during tropical nights, which are a major driver of excess mortality in Europe.

At the personal level, cooling relies on behavioural and individual measures such as hydration, use of shade, airflow, appropriate clothing and risk awareness, supported by heat-health warning systems. These personal measures are essential but insufficient on their own.

Adaptation measures typically suggested in plans and implemented are for example early warning systems, public health interventions and the increased access to (indoor) cooling (EEA, 2025a; Walkowiak, et al., 2025; Crugnola-Humbert, et al., 2026). For example,

- ▶ France introduced (and updates) a national heatwave plan with the establishment of a heat-health warning system and local safeguard plans for vulnerable populations, besides urban cooling investments and workplace heat protection guidelines and many more (MTE/MATD/MT/MVL, 2024; MSFAH, 2026; UNDRR, 2025).
- ▶ Spain updated laws making it mandatory for employers to take measures for outdoor workers during extreme temperatures, based on an occupational risk assessment. Examples are banning certain tasks during the warmest hours of the day, or modifying or reducing the working hours when weather warnings of a certain level are announced by the authorities (Garrigues, 2023).

- ▶ Austria relaunched the national heat-health action plan in 2024 to strengthen coordination across all governance levels. Federal states will have to update their regional plans, while national exchange of information has been supported through a new forum on heat and health and through the country's first national heat action day in June 2025 (WHO, 2026b).
- ▶ The Netherlands evaluated the effects of national heat-health plan. Comparing data from 2000 - 2009 with those from 2010 - 2019 showed that excess mortality during heatwaves has decreased, particularly amongst people above 75 years old, woman and residents of low-income areas. The collaboration between national meteorological and public-health services ensures warnings are timely activated and communication is widely distributed (WHO, 2026b).

Heat prevention plans (HPPs) are considered one of the main adaptation measures to reduce heat-related mortality in Europe with excess mortality during hot periods declining markedly after their implementation. A recent study (Urban, et al., 2025) quantified the effect of HPPs through a “factual–counterfactual comparison”, where observed mortality under existing HPPs is contrasted with a modelled scenario without such plans. They conclude that the results are broadly consistent across countries although in general with more limited gains in southern Europe. Overall, around one quarter of heat-related deaths can be avoided by implementing HPPs. The results also reveal limited evidence that the more developed HPPs result in a stronger protective effect. That might be caused by the large uncertainties associated with the HPP data collection, making it unable to compare the HPPs at regional and local level and to verify if the nationally defined actions were fully implemented in each location (Urban, et al., 2025).

Despite some ongoing initiatives and by being explicitly being recognised by UNEP and the WHO as a key solution, the role of nature-based solutions ⁽⁴¹⁾ remains undervalued when looking to reduce the heat stress, e.g. by urban heat island mitigation (Crugnola-Humbert, et al., 2026; WHO, 2025b; UNEP, 2023).

Adaptation and socio-economic development can significantly reduce heat-related mortality, even under similar climatic conditions. However, climate change is increasing exposure faster than adaptation alone can offset in some regions, meaning that without further intervention, disparities in heat-related mortality may widen. Regions currently less vulnerable could also face growing risks as extreme heat intensifies (Paniello-Castillo, et al., 2026).

⁴¹ Nature-based solutions used here in a broad sense, covering all related concepts, including ecosystem-based adaptation or Eco disaster risk reduction (Eco-DRR) (EEA, 2021c).

ANNEX II – HEATWAVE EFFECTS IN EUROPE – CASE STUDY

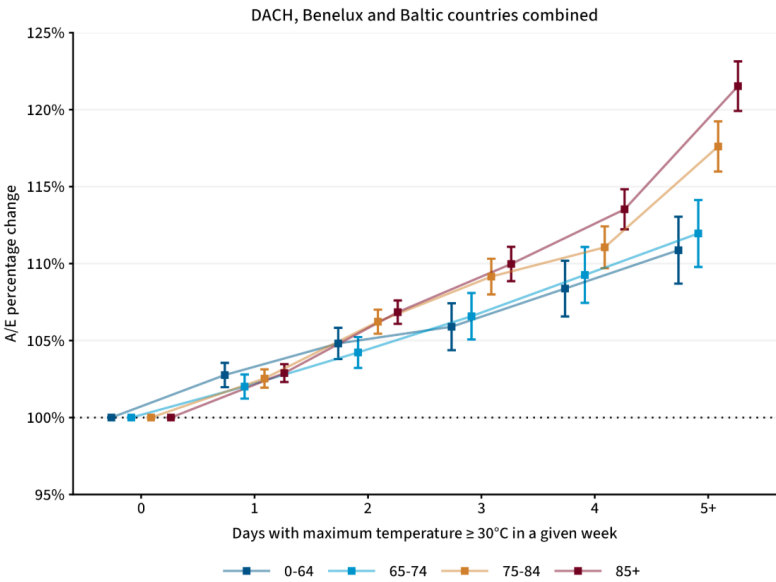
Without a common definition for a heatwave (temperature thresholds, duration, etc.), comparing European countries might be difficult. One approach is to define a heatwave as a period of several days in which maximum temperatures exceed a specified threshold—either a fixed level or a location-specific percentile—and models its impact with actual-over-expected (A/E) mortality rates, including lag effects to capture delayed deaths. Based on historic data for the period 2000-2019, this is done for 3 groups of European countries: a) Germany, Austria and Switzerland (DACH); b) Belgium, the Netherlands and Luxembourg (Benelux), and c) Estonia, Latvia and Lithuania (Baltic). The results show a clear and consistent pattern in all 3 regions: heatwaves increase mortality ($A/E > 1$), with stronger effects as the duration of extreme heat rises and with additional increases observed in the following one to two weeks (Hermanns, et al., 2024).

Across Europe, the relationship between heat and mortality is broadly similar, highlighting a robust positive link between heatwave duration and excess mortality. However, there are notable differences in magnitude. DACH and Benelux countries exhibit more pronounced and statistically significant increases in mortality, while Baltic countries show weaker or less consistent effects, likely reflecting differences in climate, adaptation, and population vulnerability (Hermanns, et al., 2024).

The analysis - for all countries studied combined - shows that heatwave-related mortality increases disproportionately with age, with older populations—especially those above 75 years olds—experiencing the strongest and most persistent excess mortality effects (Figure 9). These impacts are not only immediate but also amplified through lag effects, as elevated mortality continues in the one to two weeks following extreme heat, reflecting delayed health deterioration. In contrast, younger age groups exhibit much weaker and often statistically insignificant responses, with limited evidence of sustained lagged impacts (Hermanns, et al., 2024).

In a global study (Zhao, et al., 2024), Europe - and in particular southern and eastern Europe - had the largest heatwave-related excess death ratio and deaths per 10 million residents, making it the most affected region by heatwaves worldwide. This high impact region for heatwave fatalities still existed after removing the population ageing factor (Zhao, et al., 2024), as Europe is typically having a higher average age and larger share of elderly compared to the global average. The authors identify long-term heat acclimatisation, population structure, climate and socioeconomic conditions as relevant factors, while noting that other characteristics—including urbanicity, greenspace and community-level factors—may also influence the heat–mortality relationship.

Figure 9 - Effects of extreme heat duration by age group



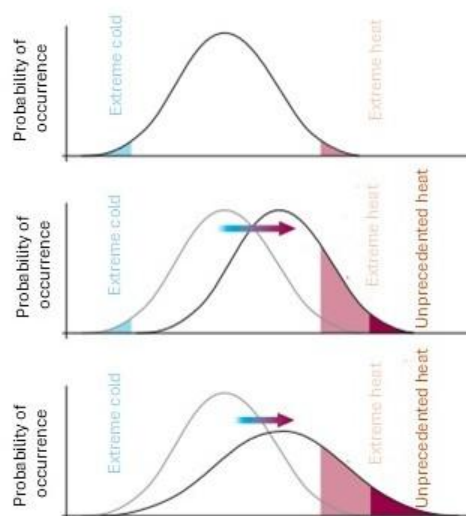
Not: for all countries combined.

Source: Hermanns et al. (2024).

ANNEX III – HEAT STRESS AND COLD WAVES: IMPACTS IN OPPOSITE DIRECTIONS?

While the focus of this scoping study is on heatwaves and the impact these can have on life and health insurance, there might also be a more positive impact on life and health impacts during winter and cold periods. Climate change not only causes differences in the temperature distribution. A simple shift would mean more extreme heat and unprecedented heat while extreme cold is virtually no longer existing (Figure 10, middle part). As the beginning of 2026 has learned (WMO, 2026), climate change does not make a simple shift in the temperature distribution towards higher values, it increases variability and the width of the whole distribution (Figure 10, lower part).

Figure 10 - Temperature distributions under different assumptions

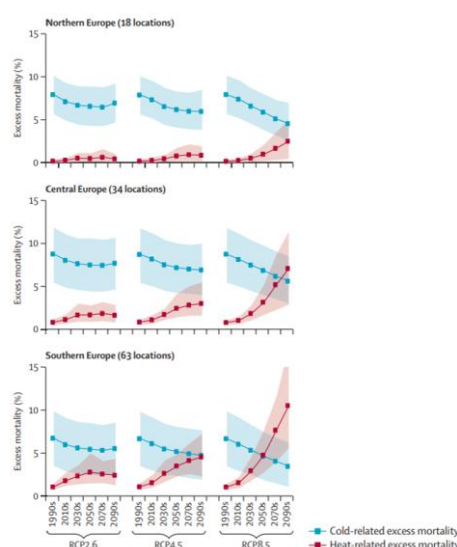


Source: redrawn from SCOR (2022a).

Fewer days with very low temperatures reduce physiological stress on the cardiovascular and respiratory systems and lower the incidence of hypothermia and cold-related aggravated diseases. Cold-related mortality in Europe has historically disproportionately affected older adults, people with cardiovascular and respiratory conditions, and those living in poorly insulated or energy-poor housing, with deaths often occurring at moderately cold—not extreme—temperatures over longer periods. Notwithstanding the fact that extreme cold can happen, an overall decrease of cold-related excess mortality is expected for all European regions, especially for the RCP4.5 and 8.5 scenarios

(Figure 11) ⁽⁴²⁾. Historically, cold-related excess mortality was larger in absolute numbers than heat-related excess mortality in all European regions. However, the correlation between temperature and mortality appears much weaker in winter (cold) than it does in summer (heat). As a result, the impact from climate change on increased heatwave mortality is much larger than the impact of less cold spells in winter ⁽⁴³⁾ (Hogekamp, 2024; García-León, et al., 2024). Recent climate change has already led to declining cold-related mortality in many European countries, although this benefit is increasingly outweighed by rising heat-related deaths ⁽⁴⁴⁾ (Copernicus, 2026b; Dimitriadou, et al., 2022). In an RCP8.5 scenario, heat-related excess mortality is expected to become bigger in central and southern Europe in absolute values by the end of the century.

Figure 11 - Trends in cold- and heat-related excess mortality by region and climate scenario



Notes: Estimates are reported as general circulation model (GCM)-ensemble average decadal fractions. The shaded areas represent 95% empirical confidence intervals.

Source: Gasparrini et al. (2017).

⁴² RCPs stand for representative concentration pathways and are greenhouse gas concentration trajectories used for climate modelling. When linking them to relative end of century temperature increase compared to pre-industrial levels, an RCP2.6 scenario is ambitious mitigation scenario that would likely keep us on a warming trajectory of less than 2 °C (as agreed in the Paris agreement, UNFCCC (2015)). An RCP4.5 scenario brings us between 2 and 3 °C temperature increase, while and RCP8.5 scenario will result in an increase of more than 4 °C by the end of the century. These are global averages, while keeping in mind that Europe is the fastest warming continent (EEA, 2024a). For the RCP2.6, the effect on both cold- and heat-related excess mortality is more limited, without big changes in the 2nd half of this century.

⁴³ This is also known as the “influenza influence”. In fact, we must distinguish between cold mortality and mortality during the cold season. One major contributor to mortality during the cold season in Europe is influenza. While there is a correlation to cold temperature, it is not exclusive, and many additional factors ultimately determine the number of influenza cases: factors such as seasonal variations in host immune response, changes in influenza strains and environmental factors such as humidity and UV radiation also influence influenza activity and, indirectly, influenza mortality. So even if the winters did become milder with climate change, influenza activity (and cold season mortality) might still be significant (Hogekamp, 2024).

⁴⁴ This trend is not only expected but already taking place. For the WHO European region, heat-related mortality has increased around 20% over the last 20 years (Copernicus, 2026b).

ANNEX IV – SOLVENCY II LINES OF BUSINESS IMPACTED BY CLIMATE CHANGE

Table 12 - Solvency II lines of business (Life) impacted by climate change

Solvency II LoB	% of Life GWP ^a	Potential negative impacts (mechanism)	Main risk drivers	Expected relevance ^b
Health insurance (SLT)	12	Higher frequency/severity of climate-related illnesses (incl. heat stress, respiratory and cardiovascular disease, vector-borne disease, mental health conditions).	Primary: morbidity Secondary: mortality (if death benefits or riders exist); lapses (linked with economic stress and affordability issues)	High , benefits are directly linked to health incidence, severity and duration.
Insurance with profit participation	39	Changes in mortality/longevity affect guaranteed benefits; morbidity affects riders; investment and economic effects (physical/transition) after surplus and bonus distribution influencing policyholder behaviour.	Primary: mortality Secondary: morbidity (if riders), lapse (changes in bonuses and economic conditions affect policyholder behaviour)	Medium , management actions and profit participation mitigate part of the impact.
Index-linked and unit-linked insurance	39	Indirectly, through economic and market effects driven by climate risks and influencing policy values and lapses; mortality/longevity impact where guarantees/riders exist.	Primary: lapse, market risk Secondary: mortality/longevity/morbidity (via guarantees, riders or embedded options)	Low, depending on the scale of guarantees and riders' coverage.
Other life insurance (non-participating)	10	Sensitivity to changes in mortality (protection); morbidity impact riders; limited availability to smooth via bonuses.	Primary: mortality (for protection products, higher mortality leads to higher and earlier claim payments) Secondary: morbidity (riders and supplementary benefits), lapse (economic stress affects persistence and surrenders)	Medium-high , especially for guaranteed long-term products.
Annuities stemming from non-life contracts relating to health	0	Climate-related morbidity and medical needs affect duration and cost of long-term health-related annuity payments (e.g. worker's compensation/medical care annuities).	Primary: morbidity Secondary: mortality (opposite effect: higher mortality shortens annuity duration)	Medium-high , due to direct linkage to health and care needs.
Annuities stemming from non-life contracts relating to obligations other than health	0	N/A, as typically no health costs are covered.	Primary: mortality (often reducing liabilities) Secondary: --	Low, often asymmetric (reduced liabilities).

Notes: see Table 13.

Table 13 - Solvency II lines of business (non-life) impacted by climate change

Solvency II LoB	% of Non-Life GWP ^a	Potential negative impacts (mechanism)	Main risk drivers	Expected relevance ^b
Medical expense insurance	24	Higher frequency and/or severity of climate-related illnesses (heat stress, respiratory and cardiovascular diseases, vector-borne diseases, mental health conditions).	Primary: morbidity Secondary: mortality (if death benefits or riders exist); lapses (linked with economic stress and affordability issues)	High , benefits are directly linked to health incidence, severity and duration.
Income protection insurance	6	Increased incidence of heat-related sickness, workplace disease, mental-health conditions which can raise long-term disability claims.	Primary: morbidity (higher incidence and longer durations of sickness/disability) Secondary: --	Medium-high , temporary incapacity may become more frequent.
Worker's compensation insurance	1	Increased frequency of heat stress, outdoor worker exposure and occupational diseases (with increased claims and longer recovery); might also cause more workplace disruptions due to floods, fire, etc. Long-term claims and medical annuities may be significant. Workplace fatality spikes due to extreme weather events.	Primary: morbidity Secondary: mortality	Medium-high.
General liability insurance	9	Higher frequency/severity of extreme events might increase third-party bodily injury claims (depending on policy conditions and/or exclusions on NatCat) and create new liability exposures (failure to adapt, environmental liability) and reputational/transition litigation.	Primary: morbidity/mortality Secondary: --	Low.
Assistance	2	Increased frequency	Primary: morbidity/mortality Secondary: --	Medium.
Fire, (other) motor, MAT, credit and suretyship, miscellaneous financial loss, legal expense insurance	--	N/A because no direct biometric exposure.	N/A	N/A

Notes:

Abbreviations used: LoB: Line of Business, GWP: gross written premium, MAT: marine, aviation and transport;

^a Based on the 2024 year end annual solo data, rounded;

^b Based on expert judgement. The expected relevance is also used in 3.1.2 (Modelling climate change risks for Life and Health – key building blocks) as part of the exposure estimates in the exploratory study on heatwaves.

ANNEX V – HEATWAVES AND EXCESS MORTALITY

HAZARD

The case study in Chapter 3 describes a methodological approach to estimate changes in risk between the current situation and a scenario for the future climate. The hazard is described as changes in the number of heatwave days, while insurers and occupational pension funds ultimately want to know the changes in excess mortality or longevity. There is no universal set of equations describing the relation between both.

The hazard in this case study is not described as a single European threshold temperature – as this would hide major climatological differences between north and south Europe – but based on the (changing) number of days above the 99th percentile summer temperature during summer months. Heatwave days, rather than temperatures reached is used as a proxy for excess mortality due to the link between excess mortality and apparent minimum mortality temperature (Box 10). For heat, there is a more immediate impact and less delay than for cold-related mortality, hence the number of heatwave days being a good indicator to use as a proxy for excess mortality (Dimitriadou, et al., 2022; D'Ippoliti, et al., 2010).

DATA ISSUES

While number of heatwave days can be used as a proxy for excess mortality, some important data issues related to this choice for the hazard component of the risk should be taken into account. These include:

- ▶ The use of national-level data instead of regional (city)-level information: the apparent minimum mortality temperature differs across cities in the same country. This variation is not reflected in the chosen methodology.
- ▶ The use of a single climate model and a single climate scenario instead of an ensemble of climate models, for different shared socio-economic pathways (SSP) ⁽⁴⁵⁾.
- ▶ The effect of the length of heatwaves is not taken into account: longer heatwaves have a higher impact on excess mortality than the same number of heatwave days interrupted by days with lower maximum of mean daily temperatures (D'Ippoliti, et al., 2010).

⁴⁵ SSPs or SSP-RCPs are used instead of RCPs in the IPCC 6th Assessment Report describing the combined socio-economic world scenario and the radiative forcing. E.g. SSP3-7.0 a regional rivalry scenario combined with a higher emissions pathway.

- ▶ There is no parameter to describe when the heatwave days fall during summer season, while there are indications that over time (years) there is increased adaptation/resilience and during a single summer increased acclimatisation ⁽⁴⁶⁾. Early season heatwaves (as a few took place during the last years) have a higher impact compared to end of summer similar apparent temperatures (Dimitriadou, et al., 2022; D'Ippoliti, et al., 2010; Baccini, et al., 2008).
- ▶ The effect of certain thresholds is not taken into account, e.g. when apparent temperatures are above 37° C, or the combined effect of daily maximum and minimum apparent temperatures (the effect of tropical nights) (D'Ippoliti, et al., 2010).

BOX 10 - EXCESS MORTALITY AND APPARENT TEMPERATURE

For almost all European cities, the relationship between daily temperature and excess mortality is U, V or J-shaped. It means there is an (apparent) minimum mortality temperature and higher and lower temperatures have a higher mortality than this minimum. Studies are hard to compare due to different parameters used (e.g. daily mean versus daily maximum apparent temperature), the baseline period (from almost half a century of data to less than a decade), confounding parameters (e.g. urbanisation and population changes during the study period), etc.

Baccini et al. (2008) (Table 14), and Masselot et al. (2023) and García-León et al. (2024)(Figure 12) describe this for a series of Mediterranean cities and cities in the rest of Europe.

Table 14 - Change in mortality per 1°C apparent temperature

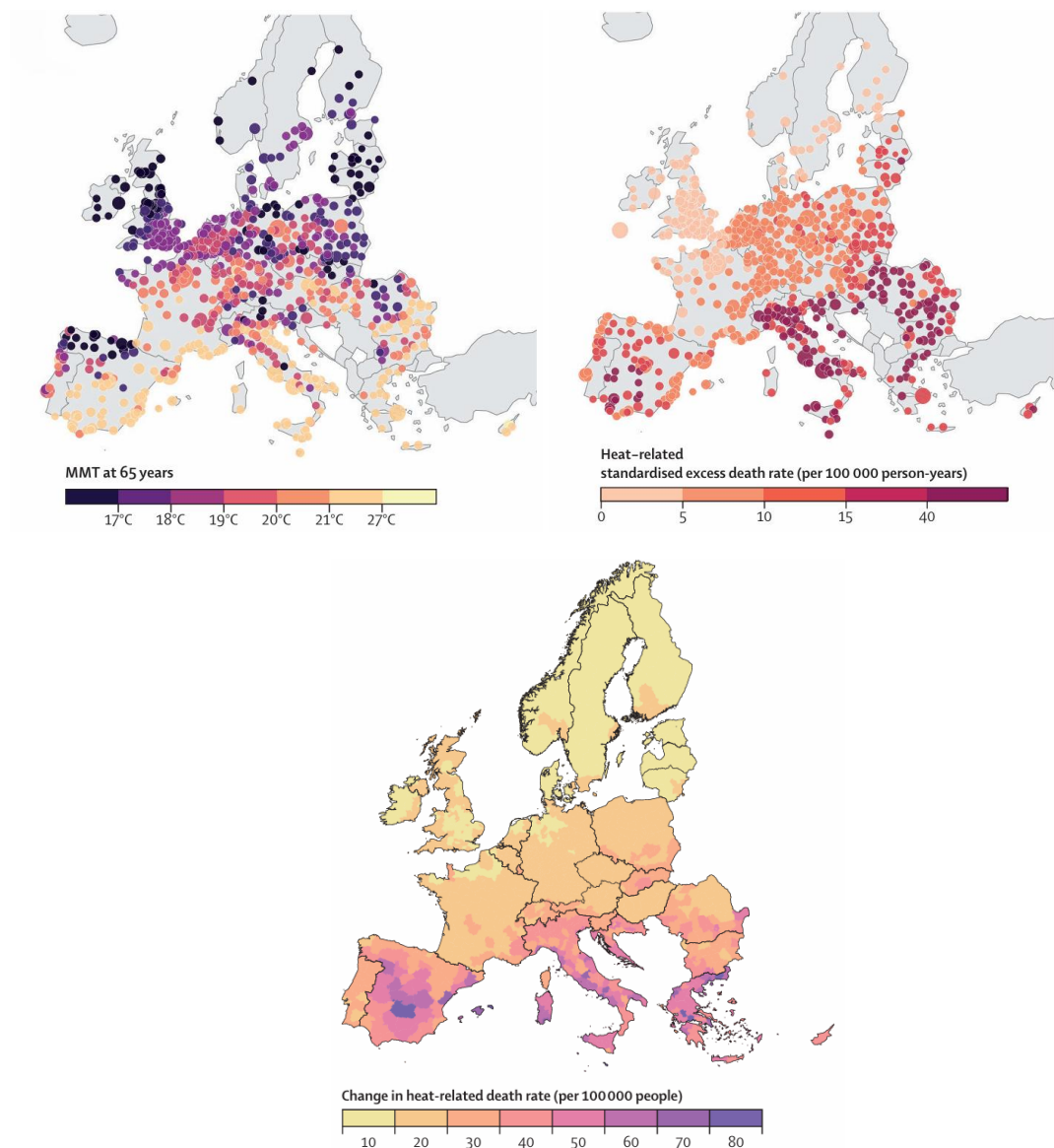
	Threshold apparent temperature	Change in mortality per 1°C apparent temperature (all)	Change in mortality per 1°C apparent temperature (15-64 years)
Mediterranean region	29.4°C	3.12 %	0.92 %
Rest of Europe	23.3°C	1.84 %	1.31 %

For the Mediterranean region, the increase per degree Celsius is larger overall but smaller for the population most at interest in an insurance study (15-64 years) (D'Ippoliti, et al., 2010). In addition, the variability between the Mediterranean cities is larger than between the cities in the rest of Europe, but also the lag effects (i.e. the time increased temperatures have an impact

⁴⁶ In general, it is accepted that the same temperature may be less harmful in “hotter” regions compared to “colder” regions, and explained this as long-term acclimatisation to heat. However, this theory might not fully explain the largest increment of heatwave mortality burden in areas with a continental climate, as found in a long-term (over 30 years) global study (Zhao, et al., 2024).

on excess mortality) are larger in the Mediterranean. All temperature thresholds for Mediterranean cities were found to be statistically significant for all causes of mortality (cardiological, respiratory, cardiorespiratory) (Baccini, et al., 2008; Dimitriadou, et al., 2022).

Figure 12 - Maps of annual impacts of heat and projected changes by 2100 on mortality across European cities



Notes: MMT = minimum mortality temperature. Change in heat-related death rate for a 3° C increase in global warming scenario and projected population in 2100.

Source: upper panels left and right: Masselot et al. (2023), lower panel: .Garcia-León et al. (2024).

EXPOSURE

The exposure is based on the TP in each LoB. In reality, there are products within a LoB that are impacted differently: products with exposure to mortality risk, products with exposure to longevity risk and products with non-material biometric risk (like financial products).

DATA ISSUES

- ▶ Using the Solvency II QRT data, no analysis can be made beyond the LoBs as defined and reported, as no specific data request was created for this study. The second part of the exposure data includes an impact scoring per LoB, made together with NCAs to reflect on the different types of products within a LoB. This cannot describe the details of an individual portfolio and more detailed data should be collected (at solo, group, national or European level) to make a more detailed assessment.
- ▶ There are no changes in TP between the current and future mid-century scenario. In reality, a portfolio will react on changes in hazard and vulnerability.

VULNERABILITY

As for the hazard, the vulnerability data are per country and kept constant over time. When rescaling the vulnerability between 0-5, Liechtenstein got 0 (and is not further taken into account)⁽⁴⁷⁾. As a result, all other countries are scored between 2.97 (Ireland) and 5.00 (Greece).

So far, we discussed excess mortality, because this is much simpler than excess morbidity. The changes in excess mortality are then used as a proxy for excess morbidity (Dimitriadou, et al., 2022). Mortality can be measured “binary”, while for morbidity a degree should be estimated.

DATA ISSUES

- ▶ Vulnerability indicators only reflect sub-aspects of the vulnerability and assigning overall weights to the different sub-indicators is subject to uncertainty. In addition, these scores are kept constant and might not reflect demographic and resulting socio-economic evolutions. Adaptation plans ⁽⁴⁸⁾ already changed the impact from temperature on mortality, but the effect they will have on future vulnerability is too uncertain to quantify accurately (Dimitriadou, et al., 2022).

⁴⁷ Otherwise, Liechtenstein would be excluded as aggregated information is only published if it comprises data from at least three reporting entities, to make sure individual financial institutions cannot be identified.

⁴⁸ In particular early warning systems.

- ▶ Vulnerability indicators are defined per country and do not reflect regional differences. As the excess mortality is impacted by the local apparent temperature, vulnerability differences between cities are not captured by this indicator.
- ▶ At the other hand, keeping the vulnerability indicators constant does not reflect the risk of a “collapse” of public health systems in case of major events.

ANNEX VI - ORGANISATIONS WHICH ARE MEMBERS OF THE TECHNICAL EXPERT NETWORK ON CATASTROPHE RISKS

Please see below the list of organisations with whom the members of the Technical Expert Network on Catastrophe Risks are affiliated. The inputs provided in the discussion paper is based on each individual members' expertise and contribution.

Allianz	Hannover Re
Achmea	HDI
AON	Impact Forecasting
AVIVA	JBA Risk Management
CMCC (Euro-Mediterranean Centre on Climate Change)	Liberty Mutual
Consorcio de Compensacion de Seguros	Moody's RMS
Cotality	MSK Meyerthole Siems Kohlruss
Deloitte	Munich Re
EEA (European Environment Agency)	ORTEC
Gallagher Re	PERILS
Generali	Siriuspoint
Guy Carpenter	SwissRe
	Verisk

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