LANCET COUNTDOWN: TRACKING PROGRESS ON HEALTH AND CLIMATE CHANGE

SIGHT. SWEDISH INSTITUTE FOR GLOBAL HEALTH TRANSFORMATION

UMEÅ UNIVERSITY

Lancet Countdown 2017 Report:

Briefing for Swedish Policymakers

21st November, 2017

Introduction

Each year the Lancet Countdown: Tracking Progress on Health and Climate Change will publish an article, preceding the United Nations Framework Convention on Climate Change's Conference of the Parties, reporting on a number of health and climate change indicators and providing evidence regarding their progress up until 2030. To complement the annual publication and to engage more directly with policymakers, the Lancet Countdown will publish a suite of national policy briefs, of which Sweden is one of the countries.

The 2017 Lancet Countdown paper arrives at three central conclusions:

1. The human symptoms of climate change are unequivocal and potentially irreversible – affecting the health of populations around the world, today.
2. The delayed response to climate change over the past 25 years has jeopardised human life and livelihoods.
3. Whilst progress has historically been slow, the last five years have seen an accelerated response, and the transition to low-carbon electricity generation now appears inevitable, suggesting the beginning of a broader transformation.

This policy brief looks at some of the Lancet Countdown's indicators in the context of Sweden – a high-income country with well-established infrastructure and equal access to health care for all. Sweden has, in general, a cold temperate climate and is sparsely populated in the northern parts. The population is growing and the urban growth rate is high. Three indictors have been chosen for Sweden. The first addresses the combination of an ageing population, increases in urban populations, and impacts of heatwaves on health in different parts of the country. The second indicator focuses on changes in summer sea water temperatures, and the emergence of *Vibrio* infections transmitted through recreational waters. The third indicator addresses Swedish mitigation policies for the transport sector that will have several local health co-benefits. The country case study focuses on changes in seasonal climate and impacts on the geographical distribution and remarkable northward spread of disease-transmitting ticks that have been observed during the last three decades.

Acknowledgements

The concept of this brief was developed by the Lancet Countdown on Health and Climate Change. The brief was written by Elisabet Lindgren's (Stockholm University), Joacim Rocklöv (Umeå University), and Maria Nilsson (Umeå University). Critical review and edits were provided by Nicola Wheeler (Lancet Countdown).

Strategic Partners

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About the Lancet Countdown

The Lancet Countdown: Tracking Progress on Health and Climate Change is a global, interdisciplinary research collaboration between 24 academic institutions and inter-governmental organisations. It monitors progress on the relationships between health and climate, and their implications for national governments, reporting annually. It was launched following the 2015 Lancet Commission on Health and Climate Change, which concluded that, left unmitigated, climate change will undermine 50 years of public health gains, whilst responding to it could represent "the greatest global health opportunity of the 21st century".

The 2017 report presents data on the indicators selected following a consultation process in 2016. These span 5 domains, from impacts and adaptation to mitigation, and the economics and politics of climate action.

About Umeå University

The Swedish partner of Lancet Countdown is unit of Epidemiology and Global Health at Umeå University. The unit is a multidisciplinary research and teaching environment located within Umeå University's Faculty of Medicine. The research, research training and masters education focuses on health problems and possible solutions in settings throughout the world. The units' engagement with society aims to contribute to the development and implementation of evidence-informed health policy and practice.

About the Swedish Institute for Global Health Transformation (SIGHT)

The Swedish co-partner of this policy brief is SIGHT, Swedish Institute for Global Health Transformation. SIGHT was established in January 2017, at the Royal Swedish Academy of Sciences. SIGHT's purpose is to promote an interdisciplinary approach, to strengthen and bridge Swedish research and education, and to provide a scientific basis for national and transnational collaborative policy work, in the field of global health.

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Recommendation 1

Information and education about new and changing health risks posed by climate change should target not only the health sector and specific risk groups, but society at large.

Recommendation 2

Cross-sectoral work is often necessary to sustainably reduce health risks caused by climate change.

Recommendation 3

Health co-benefits should be considered when choosing mitigation and adaptation policies and actions.

Recommendation 4

Interdisciplinary research should be facilitated through increased funding possibilities and through education at different academic levels.

Health and Climate Change in a global perspective

The health impacts of climate change globally are experienced through both direct and indirect pathways. Extreme events may take the form of an increase in the frequency or severity of extreme weather events such as heatwaves, floods, droughts, and storms. These directly impact human health, resulting in heat-related mortality, injury, and loss of livelihoods. Indirectly, climate change may interact with other environmental systems, for example, altering the burden and pattern of distribution of vector-, water-, or food-borne infectious diseases. Increasingly, the effects of climate change interact with already vulnerable social systems, for example by threatening the availability of adequate nutrition or safe drinking water.

These challenges interact with many of the social and environmental determinants of health, presenting an unprecedented threat to human health which, left un-mitigated, could work to reverse the last half-century of gains made in public health globally.

Conversely, the response to climate change presents the potential for enormous health co-benefits. For example, efforts to phase-out coal-fired power globally not only reduce greenhouse gas emissions, but also reduce local air pollution, thus improving the cardiopulmonary health of local populations.

It is vital to understand a) the impacts that climate change is having on human health and b) the health consequences of the global response to climate change. This is the role of the Lancet Countdown: Tracking Progress on Health and Climate Change, an international, interdisciplinary research collaboration, comprised of 24 academic institutions and United Nations agencies.

The Lancet Countdown will do this from now until 2030 by reporting annually on indicators arranged into five thematic groups:

1. Climate Change Impacts, Exposures and Vulnerability
2. Adaptation Planning and Resilience for Health
3. Mitigation Actions and Health Co-Benefits
4. Economics and Finance
5. Public and Political Engagement

Health and Climate Change in Sweden

Climate change will create new health risks in Sweden (e.g. impacts of heatwaves; establishment of new disease vectors within the country's borders and emergence of new diseases), enhance pre-existing risk conditions (e.g. increases in the concentrations of *Vibrio* bacteria in sea waters; impacts on health due to more intense flooding), change seasonal risk patterns (e.g. pollen concentrations and allergy seasons; risk seasons for vector-borne diseases), and change the geographical distribution of different diseases (e.g. tick-borne diseases such as Lyme borreliosis). These challenges may be addressed both through adaptation and mitigation policies and measures. The cost for society and the individual may be decreased by selecting evidence-based adaptation and mitigation solutions that not only decrease a specific health risk or reduce future climate change, but also have additional benefits on health – so-called health co-benefits.

Swedish Indicators

Sweden is a high-income country and a Member State of the European Union, with well-established infrastructure and welfare systems. Health care in Sweden is largely tax-funded and ensures equal access to health care services for all. The country's population is growing (10,081,396 in August 2017) due to an ageing population, immigration, and recent increases in birth rate. Most people live in the southern and central parts and the larger cities, in particular Stockholm, are rapidly growing. The first Swedish Lancet Countdown indicator addresses the combination of an ageing population, increases in urban populations, and impacts of heatwaves on health.

Sweden has a cold temperate climate with snowy winters and coniferous forests, except for a warm temperate climate with deciduous forests in the southern coastal parts, and polar tundra climate in the most northern mountains. The climate in Sweden has become milder and wetter during the last 30 years. The temperatures have increased year round with the highest increases during winter in the northern parts (Swedish Meteorological and Hydrological Institute, SMHI). There are several indications in nature that changes in climate are occurring in Sweden; for instance, the tree line in the northern mountains is climbing to higher altitudes, glaciers are melting, and the geographical distribution of several indigenous flora and fauna species are changing. The second Swedish Lancet Countdown indicator and the country case study focus on changes in seasonal climate and impacts on emerging and endemic climate-sensitive communicable diseases. Sweden has adopted far-reaching climate and energy mitigation policies. The third Swedish Lancet Countdown indicator addresses Swedish mitigation policies for the transport sector, and health co-benefits.

Heatwaves and Mortality

Climate change will increase the frequency and intensity of episodes of prolonged summer heat with increased night temperatures in Sweden, especially in the southern parts of the country (Kotlarski et al, 2014). People at risk during heat waves in temperate climates consist of the elderly, people with cardiovascular and respiratory diseases, neonates, and people that have difficulties caring for themselves during severe conditions, such as mentally and physically disabled.

Studies of Sweden have shown an 8% increase in relative risk of dying when ≥ 65 years for each degree increase above a threshold of 21°C (Rocklöv and Forsberg, 2010). Hospitalization increased in all ages with 3% above a 22°C threshold; and with 8% in age group 65-74 (Michelozzi et al, 2009). Highest mortality risks were shown in Stockholm for individuals with psychiatric disorders, including dementia, a history of myocardial infarctions, and to a lesser extent diabetes and chronic obstructive pulmonary disorders when maximum temperatures increased above 26°C in Stockholm (Åström et al, 2015).

Intense heatwaves in Russia in the summer of 2010 and severe droughts and wildfires led to high excess mortality in Moscow (Shaposhnikov et al, 2014). South and central Sweden also experienced heatwaves during 2010, as shown in Figure 1. A heatwave is here defined to occur when temperature exceeded the 99th percentile of the locality for at least 3 consecutive days.

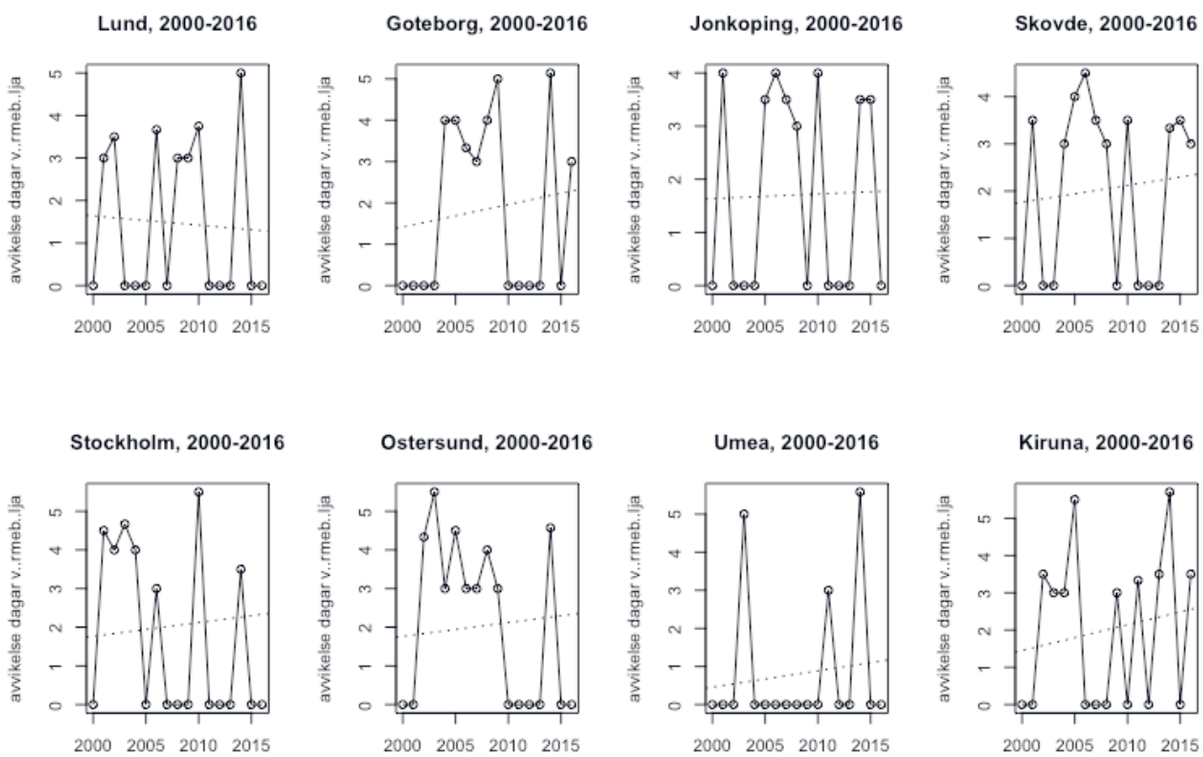


Figure 1. Average length of heatwave´s per annum for eight Swedish cities for each year 2000-2016 compared with average for 1986-2008. The upper row show cities in southern (Lund, Göteborg) and southcentral Sweden. The lower row shows two coastal cities (Stockholm in central and Umeå in northern Sweden) and two inland northern cities with Kiruna located north of the Arctic Circle.

In Sweden, indoor temperatures will be of particular interest since many private and commercial buildings are built to withstand a cold winter climate and often lack adequate cooling during heatwaves. The elderly are particularly at risk. Many live in small apartments or rooms with no sufficient ventilation, which further increase both day and night time temperatures indoors.

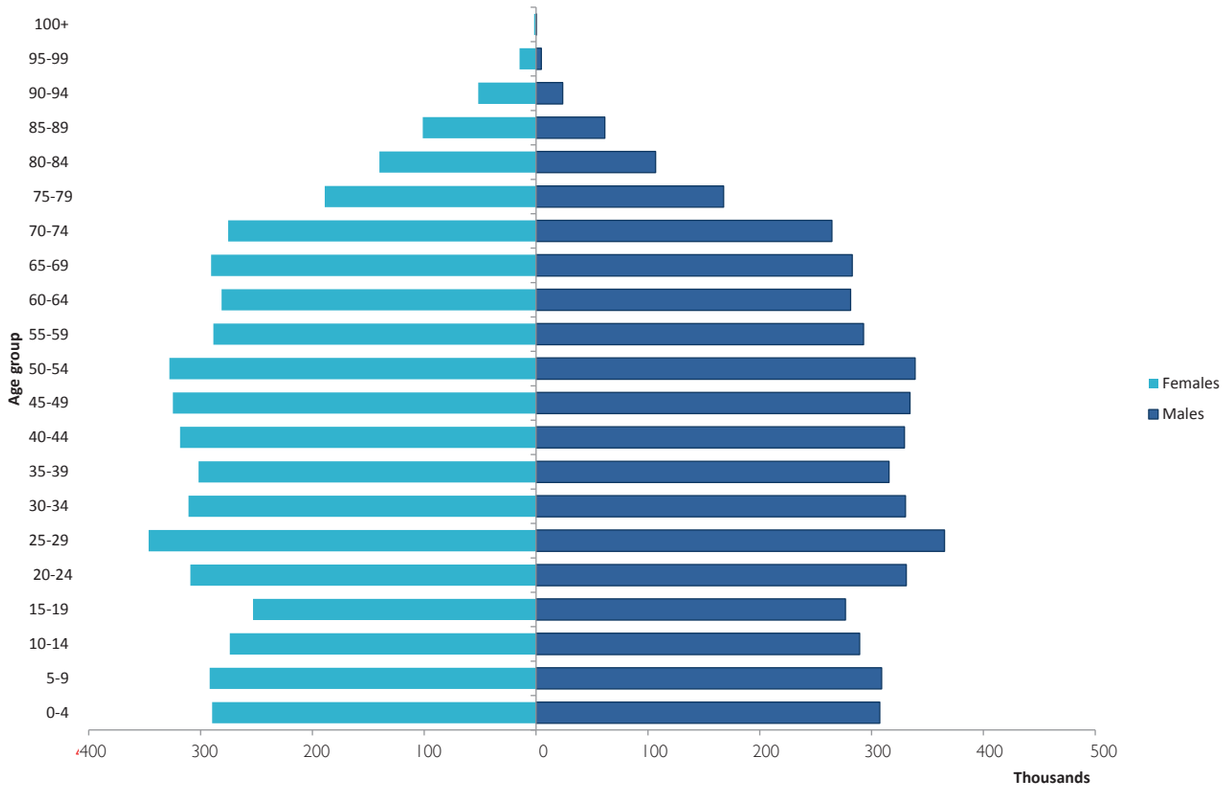


Figure 2. Population pyramid Sweden 2016. Females to the left, males to the right. X-axis shows numbers in thousands, y-axis shows age 0-100 years (Source: Statistics Sweden)

National warning systems for heatwaves have been implemented in some countries worldwide, such as France and Italy, and some of these have shown to reduce mortality risks (e.g. Fouillet et al, 2008). A study showed differences between Stockholm and Rome in terms of mortality in different risk groups during increased temperature events that might be explained by differences in awareness and adaptive measures (Åström et al, 2015). In 2013, the Swedish meteorological authority (SMHI) introduced heat waves into their weather warning system, but so far these warnings are not linked to general policies or preventive actions for the health care sector. Messages are posted when there is a risk of maximum temperatures of ≥ 26°C for 3 consecutive days. A Class 1-warning is issued when maximum temperatures are ≥ 30°C for 3 days, and a Class 2-warning when maximum temperatures reach ≥ 33°C for 3 days or ≥ 30°C for at least 5 days.

Vibrio Infections:

Climate-Sensitive Waterborne Diseases

A large part of Sweden is surrounded by waters that are extensions of the Atlantic Ocean: The Baltic Sea to the east and the North Sea to the west. Naturally occurring here are pathogenic bacteria of the *Vibrio* species that prefer nutritious waters with low or moderate salinity, such as estuarine coastal waters and the brackish waters of the Baltic Sea. Increased growth rate of *Vibrio* spp. is associated with increases in water temperatures and chlorophyll concentrations (Escobar et al, 2015). Bacteria concentrations can be measured in filter-feeding molluscs, such as oysters, clams and mussels.

Vibrio cholera that may cause severe diarrhoeal infections is notifiable in all EU Member States. In addition, all infections caused by nontoxigenic *Vibrio* cholera and the non O1/O139 serotypes are also notifiable in Sweden since 2004, including *Vibrio* vulnificus, V. parahaemolyticus, and V. alginolyticus. The majority of the reported Swedish cases in the younger age groups are ear infections after bathing in contaminated waters. Only a few cases of gastro-intestinal infections are reported. Underlying medical conditions that suppress the immune system increase the risk of developing severe symptoms, in particular if bathing with open wounds (Daniels, 2011). Necrotizing ulcers, septicaemia, and death are mostly found in the older age groups.

The annual number of reported *Vibrio* (nontoxigenic; non 01 and non O139) cases in Sweden since 2006 is shown in Figure 3. Most cases occur in southern and middle parts of the country. The peak in reported *Vibrio* spp. (except O1 and O139) cases in 2014 coincided with an unusually warm summer with high water temperatures also in the very northern parts of the Baltic Sea, with several cases reported from the northern coastal counties. A study from Sweden has shown statistically significant relationships between water temperatures above 16°C and risk of *Vibrio* infections (otitis, ulcers, septicaemia) after bathing in Swedish sea waters (Semenza et al, 2017).

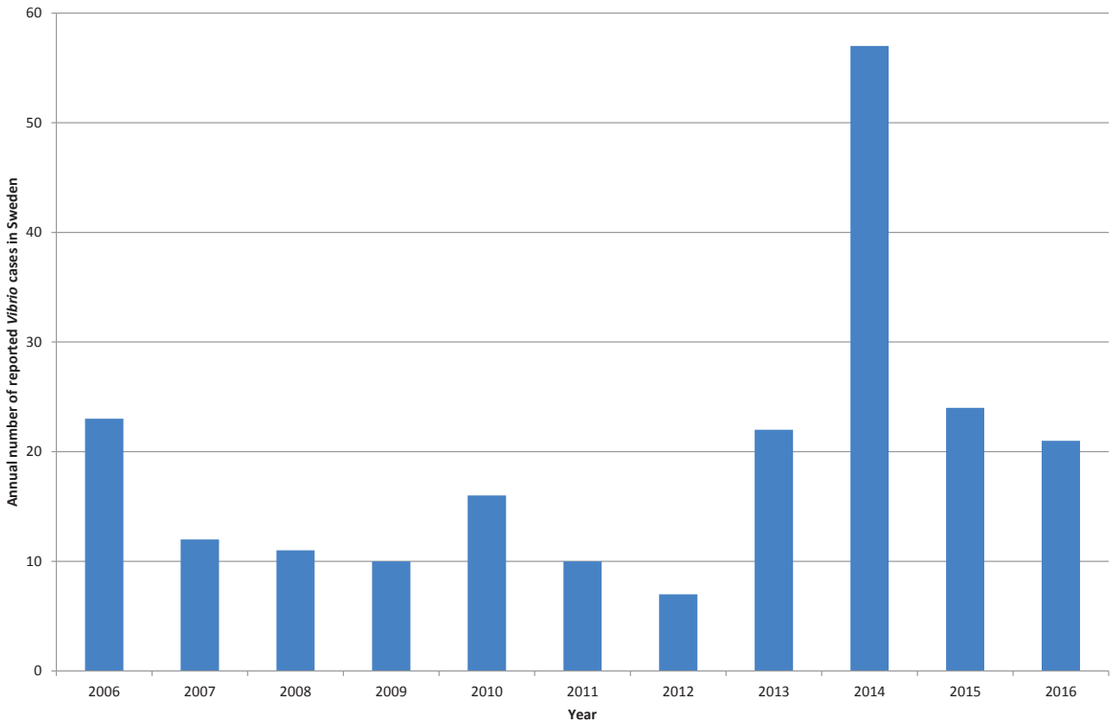


Figure 3. The annual number of reported *Vibrio* (nontoxigenic; non 01 and non O139) cases in Sweden since 2006. (Data source: The Swedish Public Health Agency).

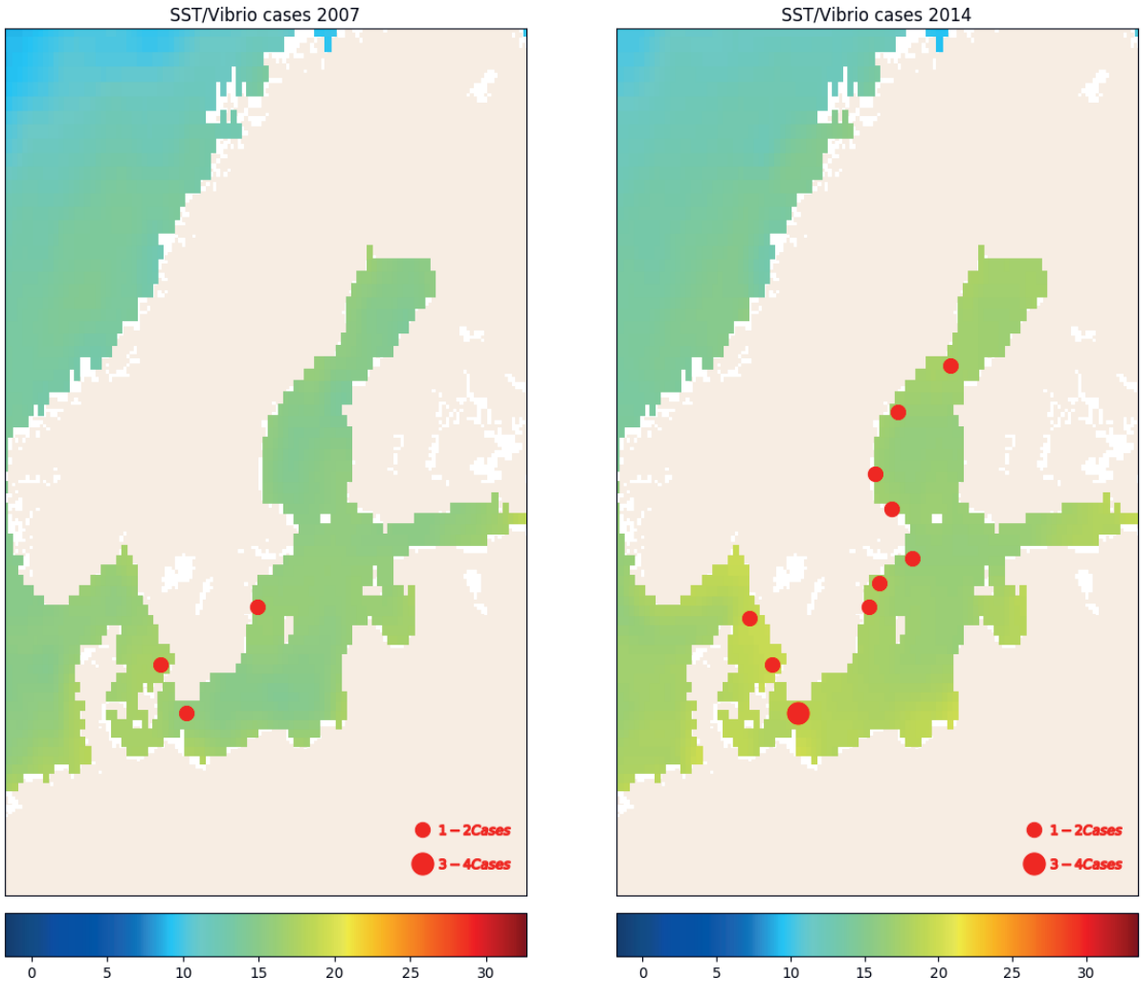


Figure 4. Mean July water temperatures in 2007 (left map) and 2014 (right map). Red dots show locations (county level) of reported *Vibrio* spp cases (only those with a history of recreational bathing are included). Small dots represent 1-2 cases; large dots 3-4 cases.

The Baltic Sea, with its extensive archipelago and coastline, and the south-western coast are popular recreational areas. The number of private-owned boats and summer cottages has increased markedly over the last decades in these areas. With climate change, the bathing season will be prolonged and more people will be bathing as the sea water temperatures increases, which in combination with increasing concentrations of *Vibrio* spp. further increase the risk of *Vibrio* infections.

Clean Fuel Use for the Transport System

The transport sector contributes to both greenhouse gas emissions and local air pollution. Climate change mitigation policies that focus on substituting fossil fuels with renewable fuels for road traffic, in particular towards the use of electric vehicles, will both reduce climate change related health risks in the future as well as have more direct local health co-benefits. Several studies have found that air pollution further increases mortality and morbidity during heat waves (see Indicator I).The risk of air pollution-related respiratory and cardio-vascular diseases will decrease with increased air quality (e.g., IARC 2013, Landrigan et al, 2017).

Sweden has adopted several comprehensive objectives to reduce greenhouse gas emissions, with the long-term vision that the country shall have no net emissions of greenhouse gases to the atmosphere by 2050. Today the transport sector accounts for one fourth of Sweden's energy use, mostly in form of fossil fuels. By 2030, Sweden is expected to have a vehicle fleet independent of fossil fuels. The planned switch towards renewable energy within the transport sector will therefore play an important role in achieving Sweden's climate and energy goals, as well as having positive public health effects at the local level.

Table 1. Energy use in Swedish transport sector 2016 (Data source: Swedish Energy Agency)

Domestic transports	% of total transport energy use 2016	Main energy source	Comment
Road traffc	93.6%	Petrol and diesel	Renewable fuels are increasing
Railway	3.5%	Electricity	
Shipping	0.6%	Fossil fuel oils	
Aviation	2.3%	Fossil jet fuel	

The use of renewable fuels in the traffic sector is increasing, in particular for buses and trucks. The most common renewable fuels in Sweden include biodiesel (currently mostly biodiesel mixed in fossil diesel fuel, but pure biodiesel is rapidly gaining ground), biogas, ethanol, and electricity. Ethanol has been commonly used in public transport, but since 2011 used less as fuel for private vehicles. Electric cars and buses are expected to take a larger share, with a focus on renewable electricity. Several cities have electric trams and more cities are planning to build light rail transit systems.

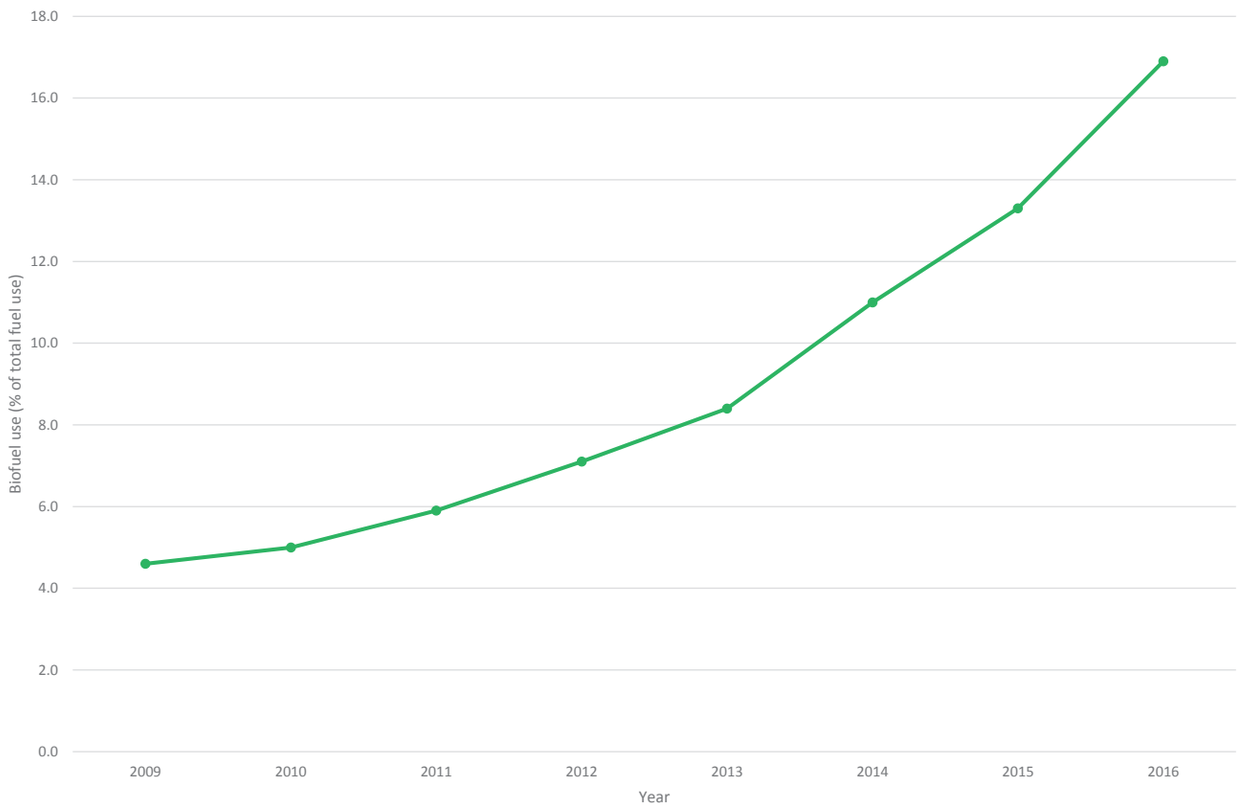


Figure 5. Biofuel use (% of total fuel use) in road traffic 2009-2016 (Data source: Swedish Energy Agency)

Table 2. Use of fossil fuels and biofuels (TWh) in the Swedish road transport sector 2009-2016. (Data: Swedish Energy Agency)

	2009	2010	2011	2012	2013	2014	2015	2016
Fossil fuels: Petrol, diesel, natural gas	81,9	82,9	81,3	79	77,6	76,2	75,2	72,3
Biofuels	4,6	5	5,9	7,1	8,4	11	13,3	16,9
Total TWh	87	88,5	87,8	86,4	86,2	86,9	89	89,7

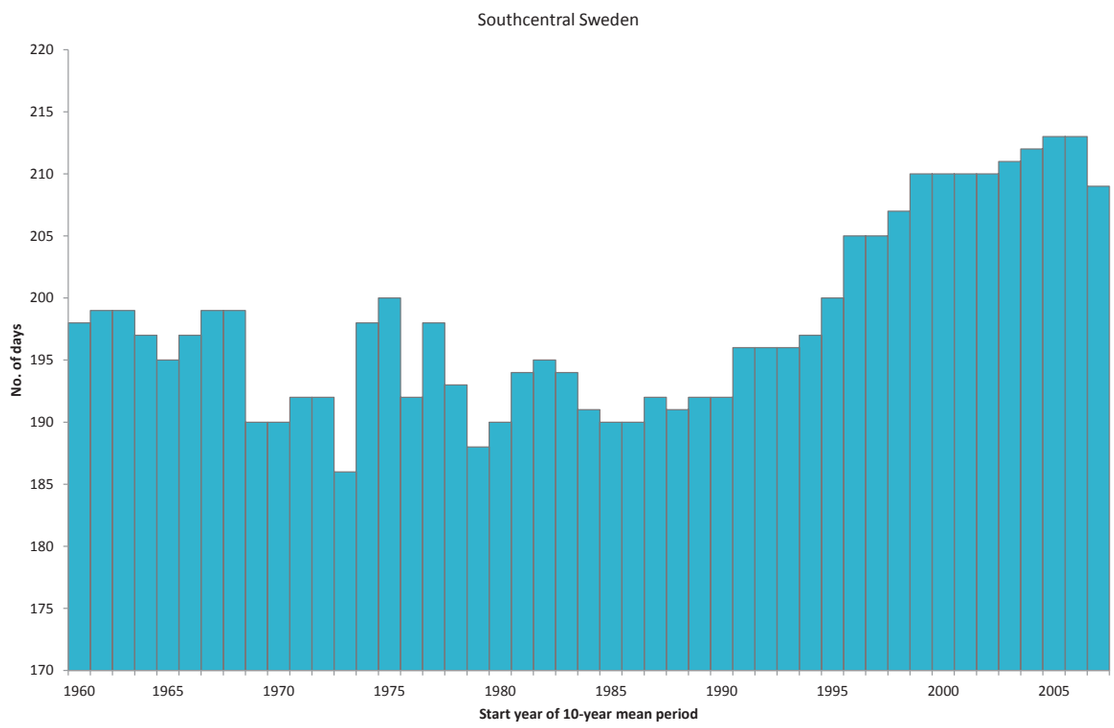
The public transport sector in Sweden is increasing its use of biofuels; from 40% in 2009 to 76% in 2015. However, the percentage biofuel of total energy use from 2009 to 2016 for public transport differ between the 21 different counties in Sweden, ranging from 99% in one of the southern counties to less than 20% in the sparsely populated northernmost counties (Swedish Association of Local Authorities and Regions, 2016). Stockholm County, for example, used ethanol as main renewal fuel for buses until 2007-8 when the number of biogas driven buses started increasing rapidly. Stockholm now produces biogas at local wastewater treatment plants and from food waste. The biogas is then transported through pipelines to bus depots where buses can refill.

Biofuels reduce greenhouse gas emissions but emit certain air pollutants, in particular NOx. Improved technology may decrease such emissions. Electric and hybrid buses and cars are expected to become increasingly of interest in the near future.

Case Study: Changes in the northern distribution limit of disease-transmitting ticks

Sweden is located between latitudes 55 and 69 degrees north, but the close proximity to the Gulf Stream and North Atlantic winds result in rather mild winters for this latitude, with the exception of the northernmost parts of Sweden. Several northern geographical distribution limits of plant, insect and arthropod species are located within the borders of Sweden.

Tick-borne diseases, in particular Lyme borreliosis and tick-borne encephalitis are by far the most common vector-borne diseases in Sweden. The ectothermic tick vector, Ixodes ricinus, has a 3-year life-cycle and its geographical distribution is thus closely related to climatic conditions and land cover characteristics. Since built-up areas make up only 3% of the total land cover in Sweden and since ecosystems where ticks may flourish are abundant (forests account for 53%, wetlands 9%, and farmland 8%), land cover is not a major limiting factor for tick distribution within Sweden, thus making climatic and weather conditions important determinants (Statistics Sweden, 2008, Gray et al, 2009). Studies have shown that shorter and milder winters, and prolonged and humid vegetation seasons with temperatures that allow ticks to be active, feed and reproduce contribute to higher tick population densities and allow ticks to become established in new areas (Lindgren et al, 2000).



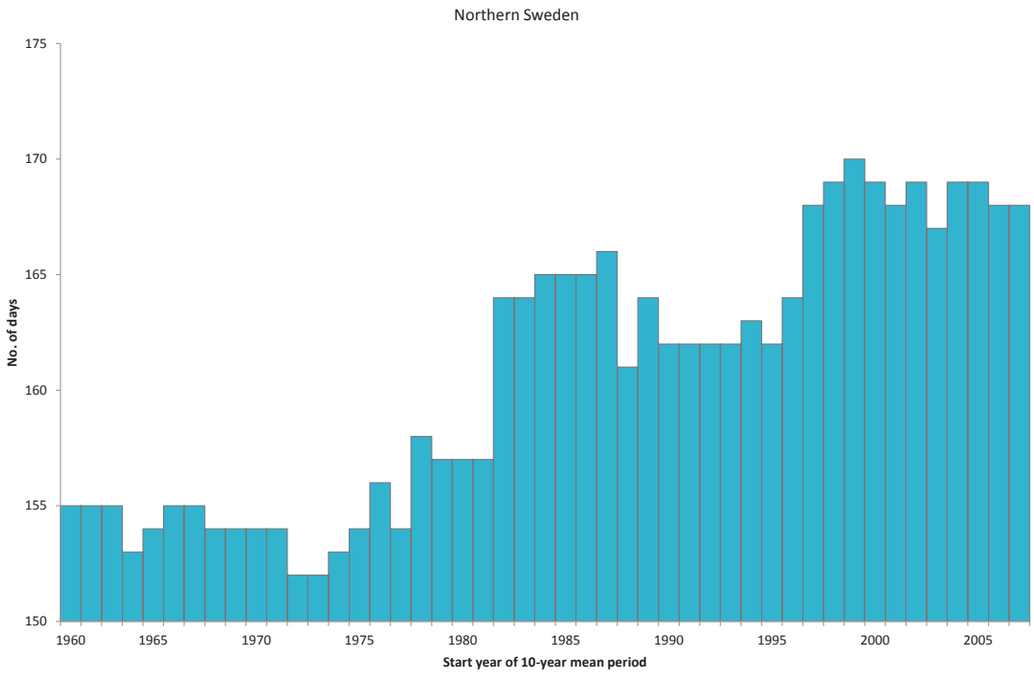


Figure 6. Running 10-year mean values of length of the vegetation season for southern and northern Sweden (SMHI). No of days are shown on the y-axis and 10-years periods on the x-axis. (Source: Swedish Meteorological and Hydrological Institute)

Figure 7. Observed tick distribution maps. The map to the left shows tick distribution in mid 1990s and the right map in 2010 (Jaenson et al, 2012). The yellow line indicates the old biological border that limited the northward expansion of many species.

Before the 1980s, ticks, as well as some plant and insect species, were seldom found north of the so-called biological northern border (Limes Norlandicus). In the mid-1990s, with nearly two decades of mostly milder winters and slightly longer vegetation seasons, ticks had started to move further northwards along larger waterways where the climate is less harsh (Lindgren et al, 2000). A follow-up study 15 years later showed that ticks had become established markedly further north along the whole northern Baltic Sea coastline and along the river valleys in the northern inland region of Sweden (Jaenson et al, 2012).

Climate change will allow ticks to become established in new places at higher northern latitudes. In southern and central Sweden, ticks will become more abundant in many locations with climate change and the risk season will be prolonged. Risk areas for Lyme borreliosis in Sweden follow the distribution of Ixodes ricinus ticks.

Recommendations

Our key recommendations for Swedish policymakers are as follows:

Recommendation 1

Information and education about new and changing health risks posed by climate change should target not only the health sector and specific risk groups, but society at large.

Climate change will both create new health risks and enhance existing public health concerns in Sweden. Education, information and monitoring of changing and emerging local health risks are important diagnostic and preventive tools. Education of the health care sector is needed. Information should target local authorities as well as risk groups and the general public.

For example, in order to give the right diagnosis it is vital to know that severe ulcers (i.e. *Vibrio* infection), as well as for instance coronary symptoms associated with secondary borreliosis, can be found also in patients that have never been outside there communities located in the very northern coastal counties. Relatives and personnel working with the elderly and people with chronic cardio-vascular diseases need to be informed about the importance to reduce exposure time to high indoor temperatures during heatwaves, and provided with practical advice. It is also important to monitor and report emerging local threats as well as changes in risk areas and risk seasons. Several endemic climate-sensitive diseases are notifiable in Sweden. Monitoring at the European level is also important since, for example, some of the vectors species currently found in central and northern Europe may spread northwards with climate change into southern Sweden during this century (Lindgren et al, 2012).

Recommendation 2

Cross-sectoral work is often necessary to sustainably reduce health risks caused by climate change.

Cross-sectoral work should be stimulated and multi-sectoral partnerships built for sustainable climate-health adaptation actions. Sweden has long adapted the built environment and the indoor climate in buildings to a cold winter climate. With climate change, the risk of increased indoor temperatures during summer heatwaves is increasing. The capacity of buildings to keep cool during heatwaves needs to be included in new construction recommendations, and assessed for buildings used as hospitals, nursing and elderly homes, as well as other buildings with vulnerable people.

Recommendation 3

Health co-benefits should be considered when choosing mitigation and adaptation policies and actions.

Collaboration across governmental agencies and between governments and the private sector would promote clean energy production and use, and encourage sustainable innovations. In addition, climate mitigation policies and actions should acknowledge evidence-based solutions with health co-benefits. For example, shifting from fossil fuels to renewable fuels, in particular renewable electric energy, will both mitigate climate change and increase local air quality, thus contributing to better public health.

Recommendation 4

Interdisciplinary research should be facilitated through increased funding possibilities and through education at different academic levels.

Interdisciplinary research should be facilitated. Interdisciplinary projects, especially when health research is included, often have difficulties being funded since they fall between the program silos of funding agencies and institutions. Special funding programs for interdisciplinary health research projects should be promoted. Also, there is a need to educate academics at different levels of how to work interdisciplinary and find a common language.

Additional Information and Key Resources

Lancet Countdown Website: lancetcountdown.org

WHO UNFCCC Climate and Health Country Profiles

The WHO UNFCCC Climate and Health Country Profiles form the foundation of WHO's national level provision of information, and monitoring of progress in climate change and health. The climate and health country profiles, first published in 2015, are developed in collaboration with ministries of health and health determining sectors with the aim of empowering Ministers of Health to engage, advocate and act to protect health from climate change. The most recent and relevant scientific evidence from the health, environment and meteorological communities is presented to highlight country-specific climate hazards and the potential health impacts facing populations. National action on health adaptation and mitigation is reported in the profiles and opportunities to promote actions that improve health while reducing carbon emissions are presented. For more information on the WHO UNFCCC Climate and Health Country Profiles please visit the website and watch the introductory video.

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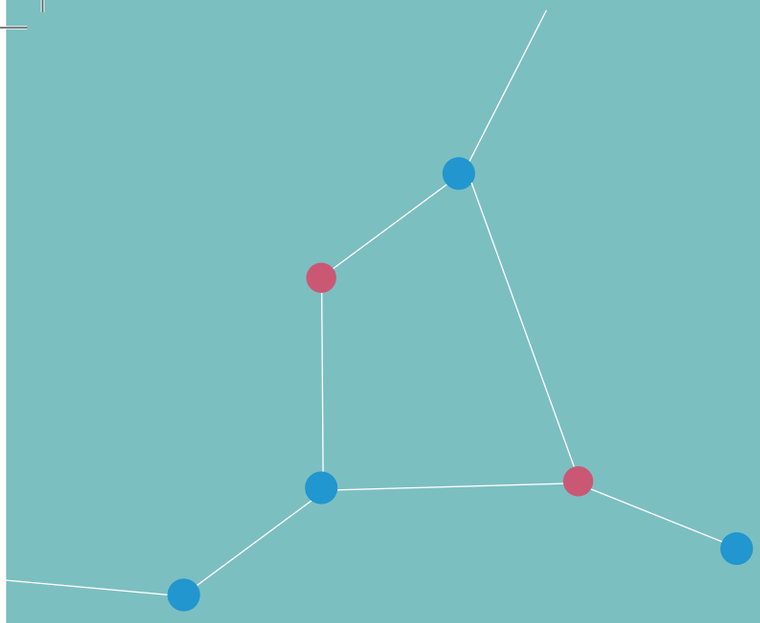

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