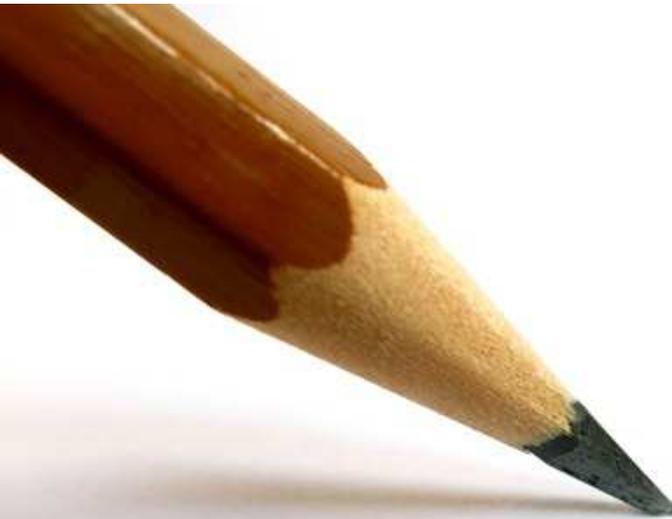


Impact of climate change on human health



CHARACTERISTICS AND INTENSITY OF IMPACTS

Humans are sensitive to an extraordinary environmental and climate change, which can lead to a general deterioration of state of health and well-being –

Stress

Trauma

Diseases

Psychical
(mental) disorder

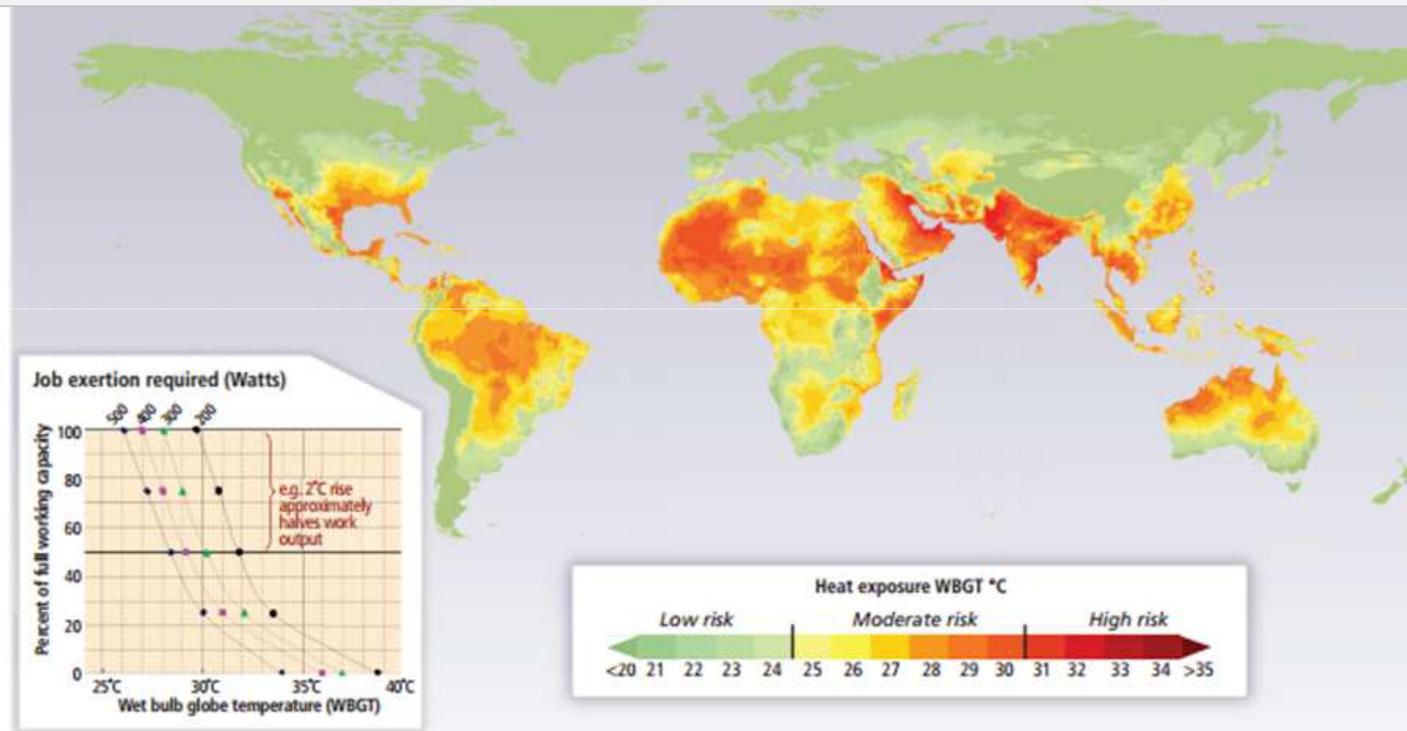
Decrease of
working capacity

Social
disorder

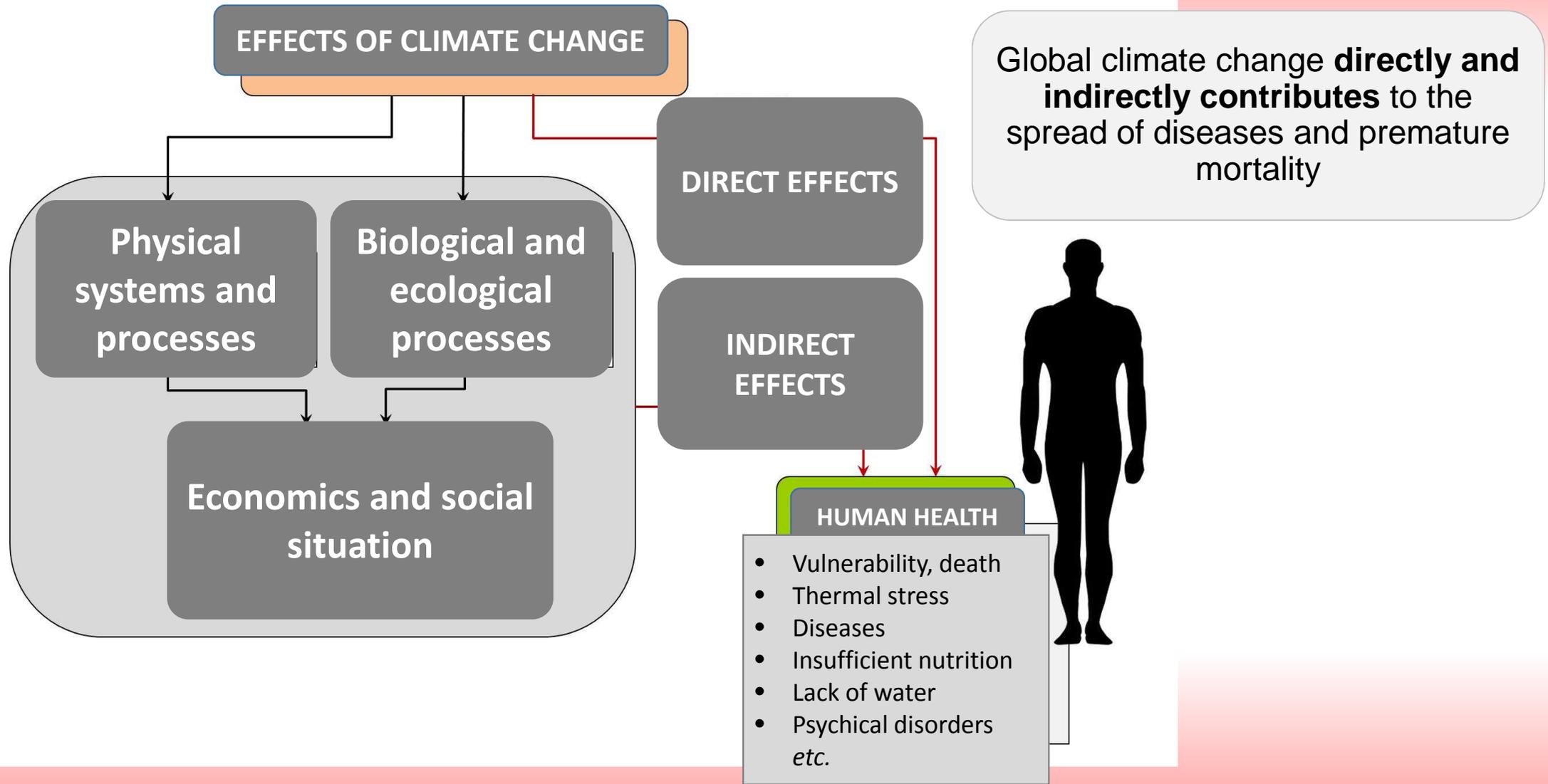
Death



Current risk of health exhaustion (izsīkums) will increase with global warming, exacerbating (saasinājums) diseases and illness and reducing work capacity



IPCC AR5 WG2 Figure 11-5 | The 1980–2009 average of the hottest months globally, measured in web bulb globe temperature (WBGT), which combines temperature, humidity, and other factors into a single index of the impact on work capacity and threat of heat exhaustion Note that some parts of the world already exceed the level for safe work activity during the hottest month. In general, with climate change, for every 1° C that Tmax goes up, the WBGT goes up by about 0.9° C, leading to more parts of the world being restricted for more of the year, with consequent impacts on productivity, heat exhaustion.



EFFECTS OF CLIMATE CHANGE

Physical systems and processes

Biological and ecological processes

Economics and social situation

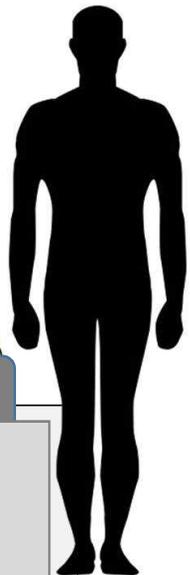
DIRECT EFFECTS

INDIRECT EFFECTS

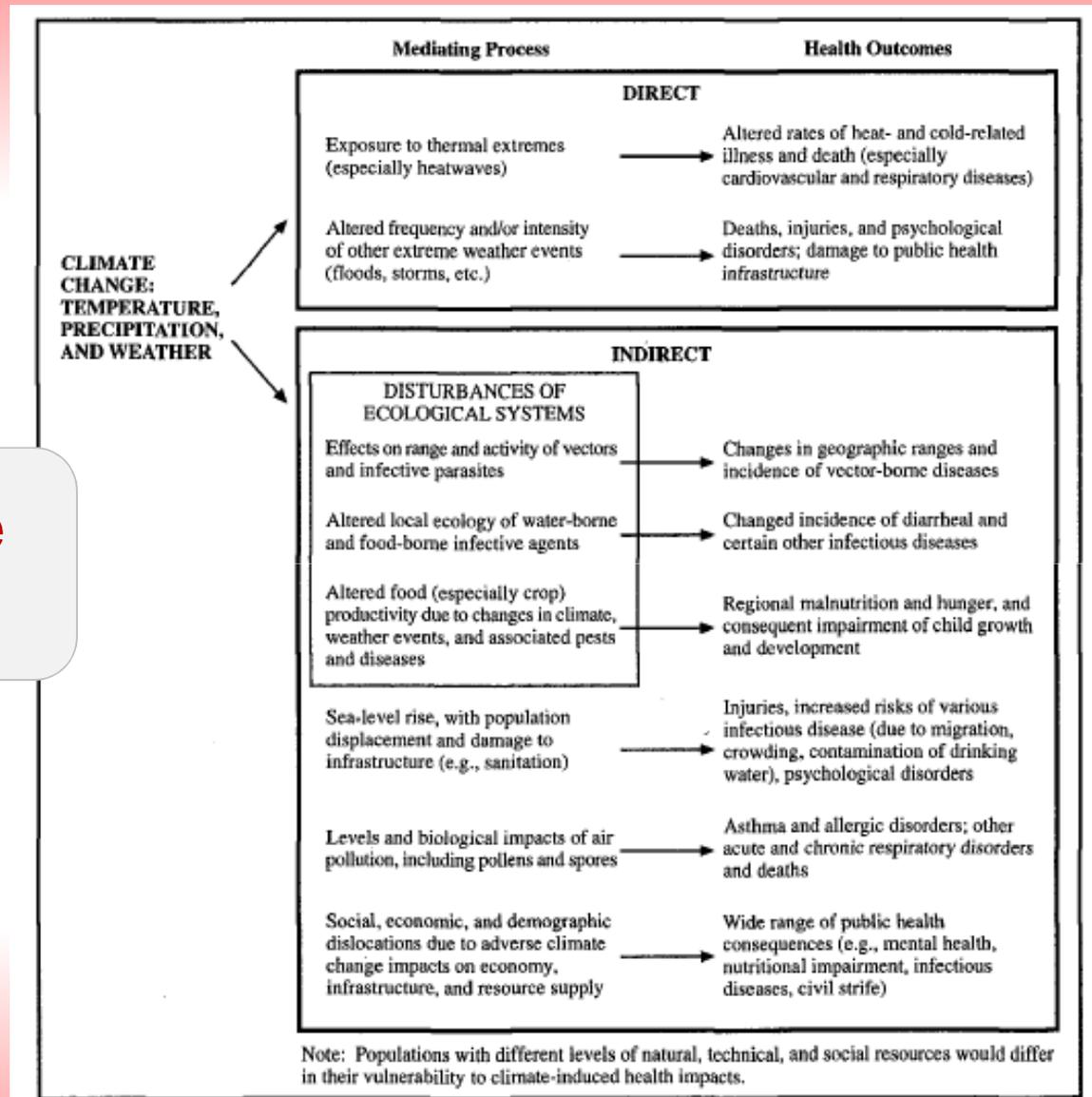
HUMAN HEALTH

- Vulnerability, death
- Thermal stress
- Diseases
- Insufficient nutrition
- Lack of water
- Psychological disorders
- etc.

Global climate change **directly and indirectly contributes** to the spread of diseases and premature mortality



Ways in which climate change can affect human health



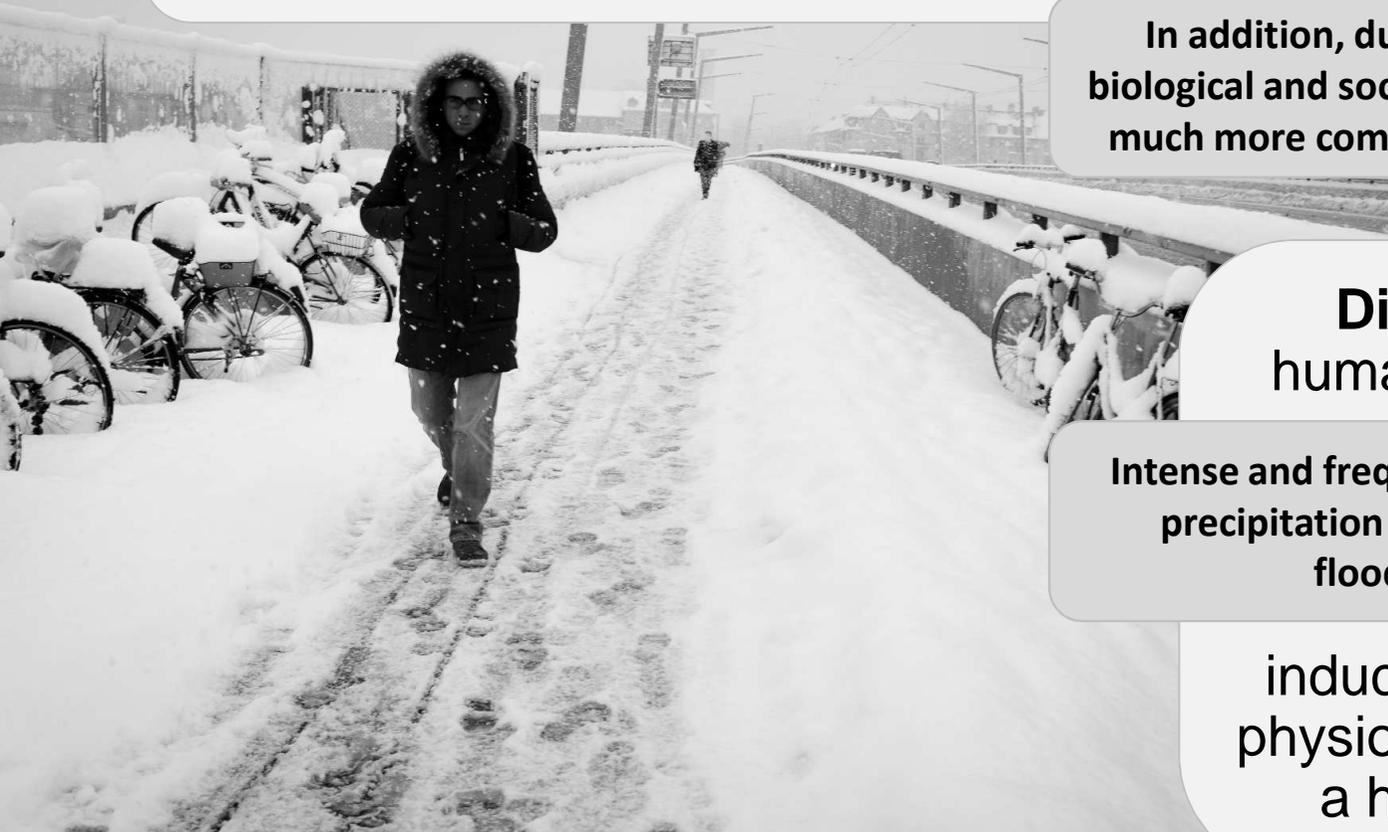
Three main groups of factors – **physical, biological and economic factors** – affect human well-being, health and ability to survive in any conditions, but climate change will escalate intensity of impact

In addition, due to the climate change human biological and social adaptation to new conditions is much more complex than in a stable environment

Direct impact on humans appears from:

Intense and frequent changes in temperature and precipitation (heat and drought, storms and floods, natural fires etc.) –

inducing functional and physiological disorders of a human organism



Indirect effects are linked to **environmental and ecological changes and its consequences** caused by climate change

Indirect impact on humans appears from:

Decrease of crop quality and food availability

Lack of drinking water

Invasion of disease vectors
(slimības pārnēsātājs)

as well as climate change provoked the **socio-economic responses of community** –

Migration of population due to droughts or flooding

Unemployment

Homelessness

Social violence



It is expected that **climate change will affect epidemiology of many diseases** (outbreak(uzliesmojums), spread and control of infection diseases), as well as physical and mental health and hygiene conditions of society and individuals



The nature and intensity of impact may vary, taking into account:

Climatic, regional and geographic conditions

Quality of health services

Activities of adaptation

Preparedness and operational capacity in emergency cases

Public awareness and ability to access emergency, prevention and treatment services

If climate change continues as it is forecasted, the human health risks will be statistically likely affected from moderate to a very high degree of confidence



Forecasted health risks of climate change	Degree of confidence
<ul style="list-style-type: none"> • Injury, illness and death risks from intense heatwaves and natural fires. • Risks of food and water borne diseases. 	<p>++++ Very high</p>
<ul style="list-style-type: none"> • Insufficient nutrition and water supply. • Consequences of health disorders – reduced working capacity and decline of productivity in vulnerable populations. 	<p>+++ High</p>
<ul style="list-style-type: none"> • Vector-borne diseases (malaria, Dengue fever etc.). • Geographical changes in food production. • Reduced capacity of disease vectors due to exceed thresholds of temperature. 	<p>++ Moderate</p>
<ul style="list-style-type: none"> • Moderate reduction of cold-related mortality and morbidity in some regions due to shortening of cold periods. 	<p>+ Low</p>

DENGUE FEVER

Dengue fever is a mosquito-borne tropical disease caused by the dengue virus. Symptoms typically begin three to fourteen days after infection. This may include a high fever, headache, vomiting, muscle and joint pains, and a characteristic skin rash. Recovery generally takes two to seven days. In a small proportion of cases, the disease develops into the life-threatening dengue fever, resulting in bleeding (*asiņošana*), and blood plasma leakage, or into dengue shock syndrome, where dangerous low blood pressure occurs.

Dengue is spread by several species of mosquito of the *Aedes* type. The virus has five different types; infection with one type usually gives lifelong immunity to that type, but only short-term immunity to the others. A number of tests are available to confirm the diagnosis including detecting antibodies.

A novel vaccine for dengue fever has been approved in countries, but it is not yet commercially available. Prevention is by reducing mosquito habitat and limiting exposure to bites. This may be done by getting rid of or covering standing water and wearing clothing that covers much of the body. Treatment of acute dengue is supportive and includes giving fluid either by mouth or intravenously for mild or moderate disease. For more severe cases blood transfusion may be required. About half a million people require admission to hospital a year. Non-steroidal anti-inflammatory (*pretiekaisuma*) drug such as ibuprofen should not be used.

Dengue has become a global problem since the WWII and is common in more than 110 countries. Each year between 50 and 528 million people are infected and approximately 10,000 to 20,000 die.

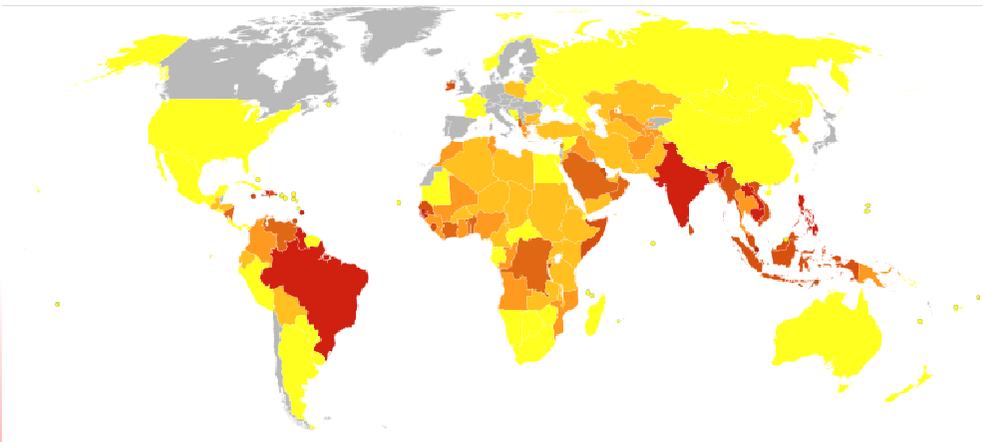
DENGUE FEVER



The mosquito *Aedes aegypti* feeding on a human host

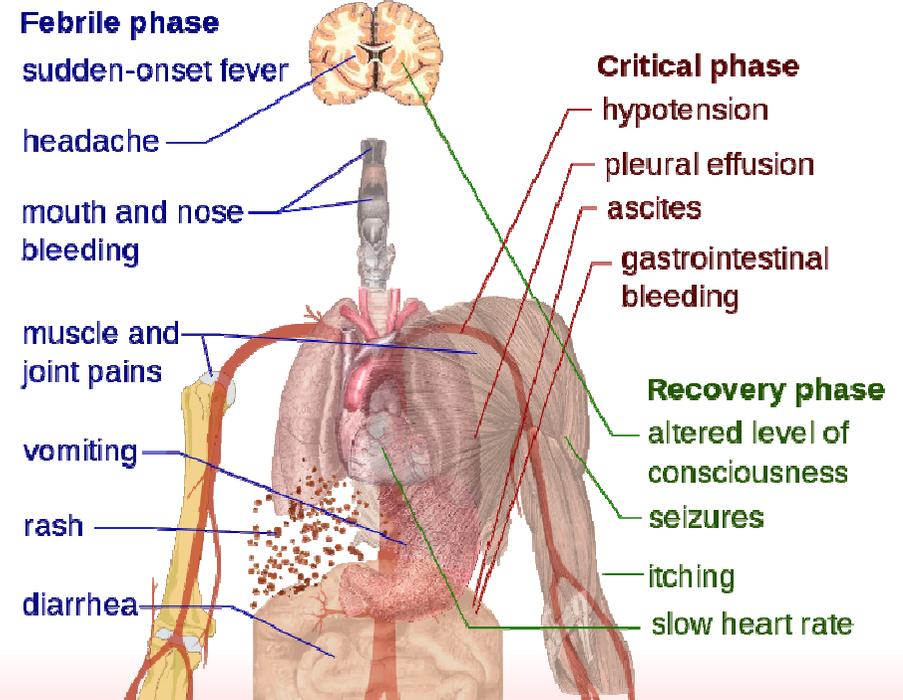


The typical rash seen in dengue fever



Dengue world map - deaths per million persons

Symptoms of Dengue fever



MALARIA

Malaria is a mosquito-borne tropical disease affecting humans and other animals caused by parasitic protozoans (a group of single-celled microorganisms) belonging to the *Plasmodium* type.

Malaria causes symptoms that typically include fever, fatigue (nogurums), vomiting, and headaches. In severe cases it can cause yellow skin, seizures (lėkme), coma, or death. Symptoms usually begin ten to fifteen days after being bitten. If not properly treated, people may have recurrences of the disease months later. In those who have recently survived an infection, reinfection usually causes milder symptoms. This partial resistance disappears over months to years if the person has no continuing exposure to malaria.

The disease is most commonly transmitted by an infected female *Anopheles* mosquito. The mosquito bite introduces the parasites from the mosquito's saliva (siekalas) into a person's blood. The parasites travel to the liver where they mature and reproduce. Five species of *Plasmodium* can infect and be spread by humans. Most deaths are caused by *P.falciparum* because *P.vivax*, *P.ovale*, and *P.malariae* generally cause a milder form of malaria. The species *P.knowlesi* rarely causes disease in humans.

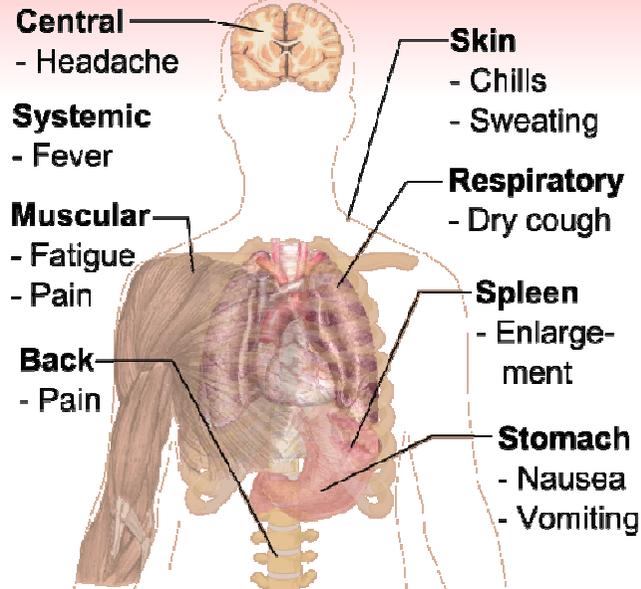
Malaria is typically diagnosed by the microscopic examination of blood using blood films, or with antigen based rapid diagnostic tests. The risk of disease can be reduced by preventing mosquito bites through the use of mosquito nets and insect repellents, or with mosquito-control measures such as spraying insecticides and draining standing water.

Several medications are available to prevent malaria in travellers to areas where the disease is common. Despite a need, no effective vaccine exists, although efforts to develop one are ongoing. The recommended treatment for malaria is a combination of antimalarian medications that includes an artemisinin.

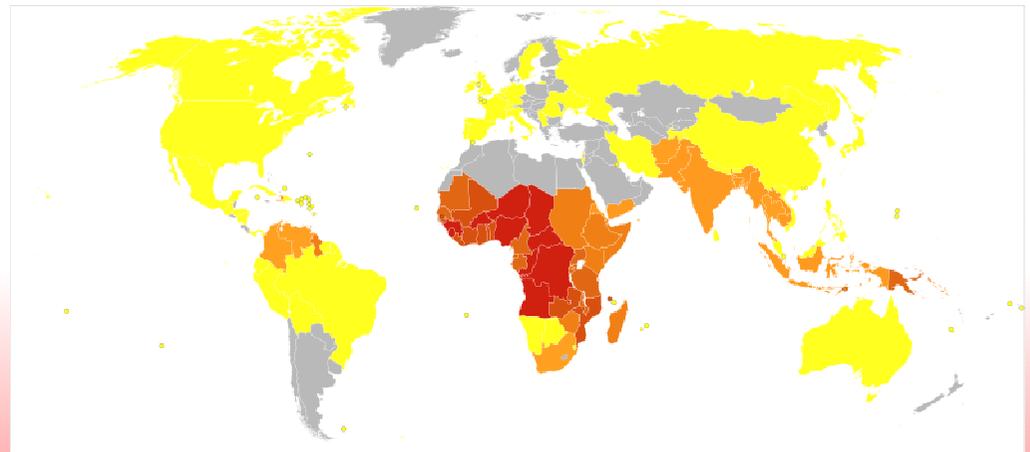
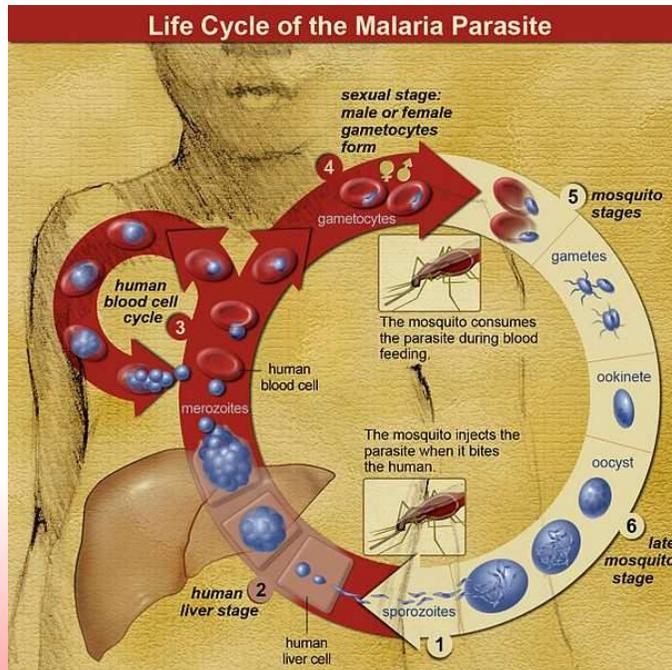


An *Anopheles stephensi* mosquito

Symptoms of Malaria



The WHO estimates that in 2010 there were 219 million cases of malaria resulting in 660,000 deaths. Others have estimated the number of cases at between 350 and 550 million for falciparum malaria and deaths in 2010 at 1.24 million up from 1.0 million deaths in 1990. The majority of cases (65 %) occur in children under 15 years old. About 125 million pregnant women are at risk of infection each year; in Sub-Saharan Africa, maternal malaria is associated with up to 200,000 estimated infant deaths yearly. There are about 10,000 malaria cases per year in Western Europe, and 1300–1500 in the United States. About 900 people died from the disease in Europe between 1993 and 2003.



Malaria world map - deaths per million persons

Not all impacts on human health related to climate change are unfavourable

In temperate climate zone warmer winters could appear more frequently –

it will reduce the number of freezing-related deaths, as well as it will be easier to maintain comfortable indoor climate conditions

Outdoor employers will be less affected by cold caused accidents during the winter, which in turn will improve work productivity

Longer warm seasons and vegetation periods, unless they will be adversely affected by extraordinary heat and drought, will promote production of agriculture and food, as well as private gardening and outdoor activities

However, the positive effects of climate change, such as cold-related mortality reduction will be drastically overestimated if compared to the increase, extent and severity of negative effects induced by climate change



IMPACT

Negative

Positive

Very high confidence

- Malaria: contraction and expansion, changes in transmission season



High confidence

- Increase in malnutrition
- Increase in the number of people suffering from deaths, disease and injuries from extreme weather events
- Increase in the frequency of cardio-respiratory diseases from changes in air quality
- Change in the range of infectious diseases vectors
- Reduction of cold-related deaths



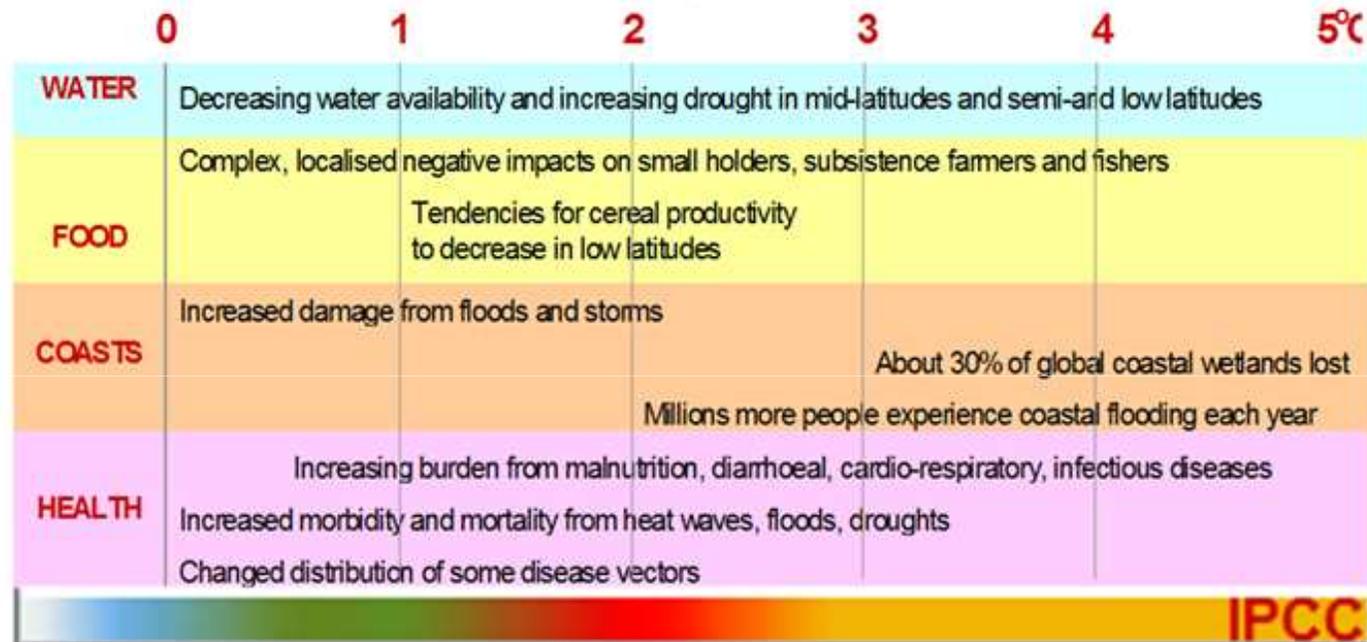
Medium confidence

- Increase in the burden of diarrhoeal diseases



Direction and magnitude of change of selected health impacts of climate change
(confidence levels are assigned based in the IPCC guidelines on uncertainty)

Examples of impacts associated with projected global average surface warming relative to preindustrial epoch



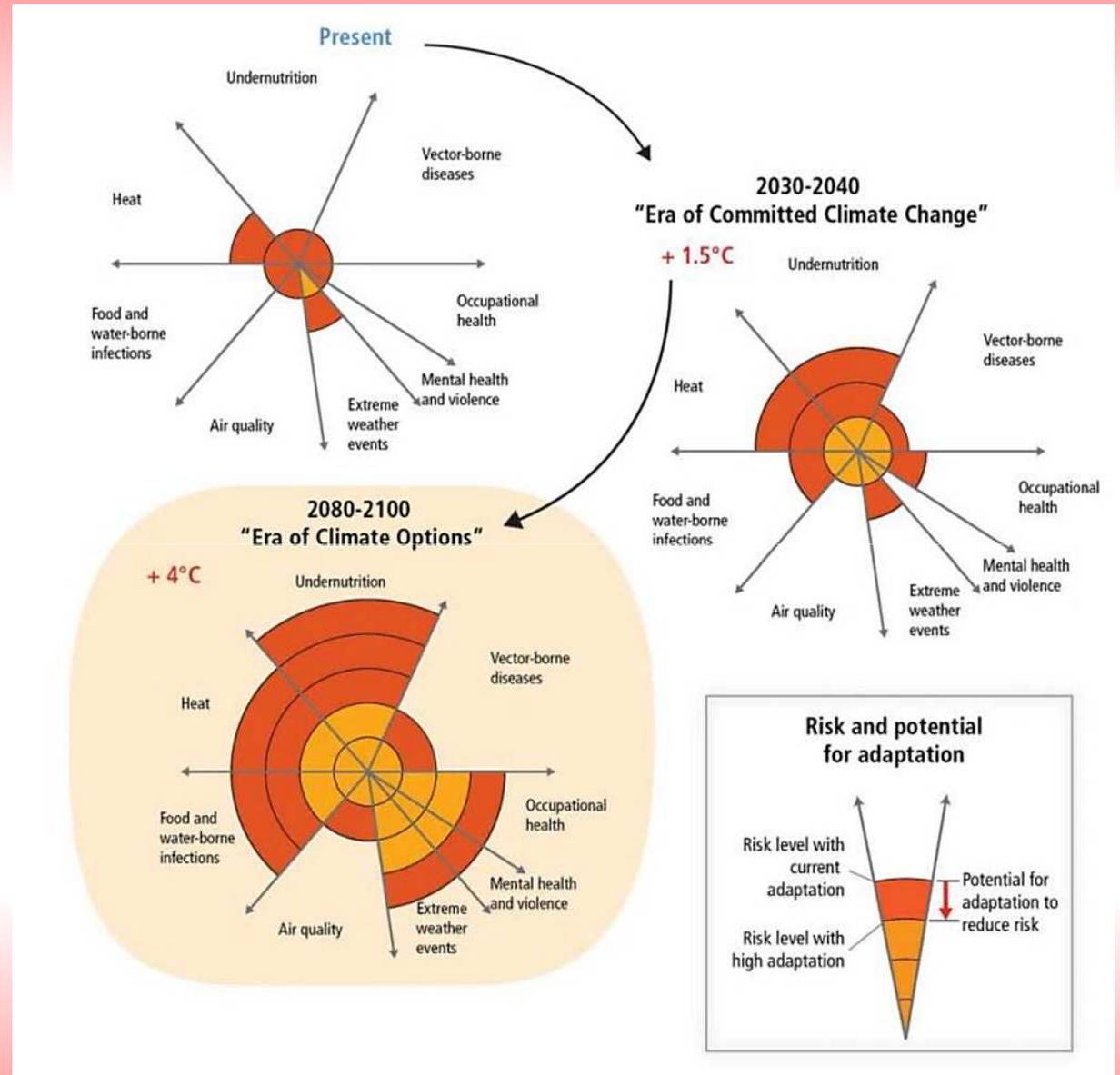
From a presentation by IPCC Chairman R. K. Pachauri of the IPCC 4th assessment

Impacts start where text begins

Source IPCC website

- edited to show only adverse impacts on population health .
- Note: this omits extreme weather events that have started to increase (IPCC AR4) and powerful Arctic amplifying feedbacks that are all operant.
- Food is projected by climate crop models that do not capture a large number of large impacts

Increase of average temperature and intensity of climate change impacts on human health at present and in the future, evaluating adaptive capacity



Climate change effects on human health can be divided into **primary, secondary and tertiary**

Primary:

Heat waves, fewer, cold waves, injuries, floods, fires

Secondary:

Infectious diseases, especially vector-borne, allergies, air pollution

Tertiary:

Famine, conflicts, population displacement, refugees



Certain professionals who are working outdoors, such as construction workers, farmers *etc.* may be exposed to greater risk of climate change impacts on health



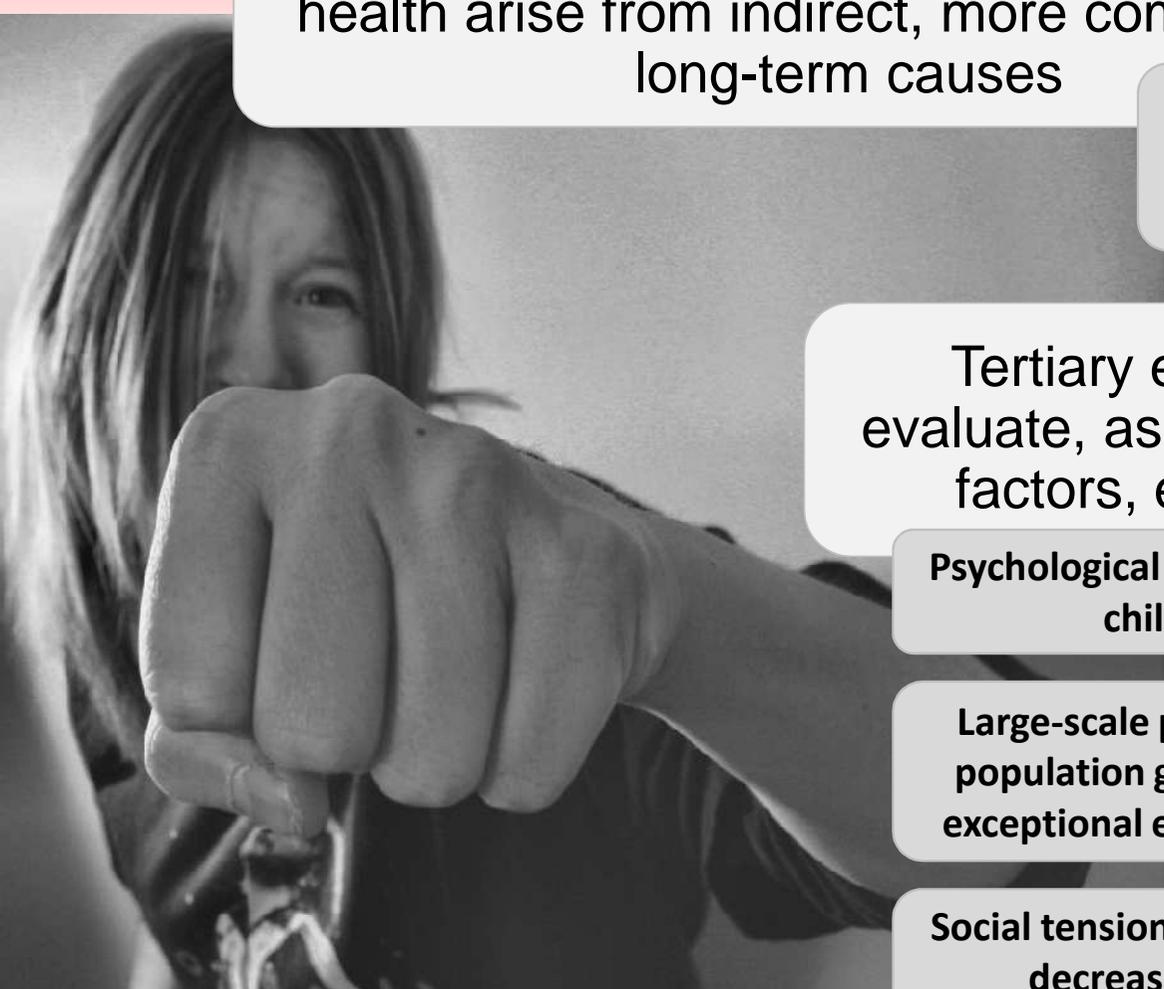
Secondary effects of climate change on human health arise as a mediator between the environment and ecological consequences

Secondary effects include range and intensity of infectious diseases and changes in seasonality

Secondary effects include also decline of agricultural productivity, impact on nutrition and drinking water security, hygiene conditions

Health effects induced by environmental mediators include elevated appearance of aero-allergens (pollen, spores, dust) raising asthma, hay fever and other allergic reactions





Climate change **tertiary effects** on human health arise from indirect, more complex and long-term causes

Consequences appear slowly, affecting fundamentals of social relations and institutions as well as human health, well-being and survival ability

Tertiary effects are difficult to investigate and evaluate, as it usually takes the form of a number of factors, exposure to cumulative effects, e.g.:

Psychological stress, emotional anxiety and behavioral disorders in children and adults, worrying about the future

Large-scale public health consequences and forced migration of population groups may occur due to the population growth and exceptional environmental conditions or environmental disasters

Social tension and a threat of conflicts related to the availability of decreasing natural resources (arable land, fresh water), availability of home place etc.

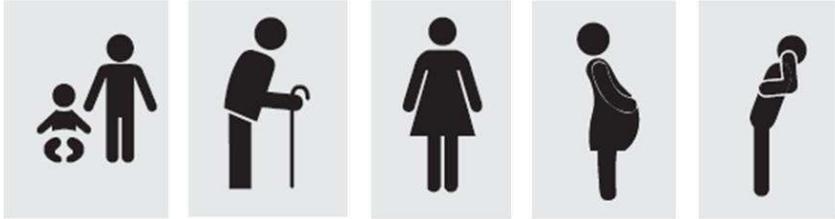
Vulnerable population groups

Climate change on a global scale affect health and welfare of all society, but some population groups are more exposed to the impact of risk

Factors such as age, sex, health, ethnicity, social status and economic security creates different groups of the population

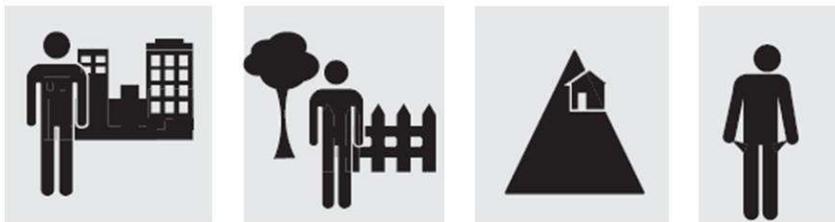


Vulnerable groups of the population affected by climate change



Particularly sensitive groups of the population

Children, elderly, women, pregnant, people with chronic illnesses



Socially and economically distinct groups of the population

Workers outdoor, inhabitants of cities / remote regions, low-income people



Regionally distinct groups of the population

Inhabitants of tropics / subtropics, small islands, mountain, Arctic regions

Scientists point out that due to various aspects an individual of today's society is biologically more sensitive to climate change-related health risks than in the past

For example, risk of public health vulnerability increases due:

- The aging of the population – longer life is expected, resulting in higher organism's susceptibility to infectious diseases, heat and other environmental emergency events
- Significant spread of non-infectious diseases such as cardiovascular diseases, respiratory diseases, metabolic disorders, that increases the organism's susceptibility to heat and other pressures by increasing risk of strokes, heart attacks, respiratory failures etc.
- High temperature, both, outdoors and indoors (at home or at work), that increases susceptibility to heat, dehydration and risk of kidney damage



- **Effect of urban heat island: increased impact of heat and reduced the body's defenses**

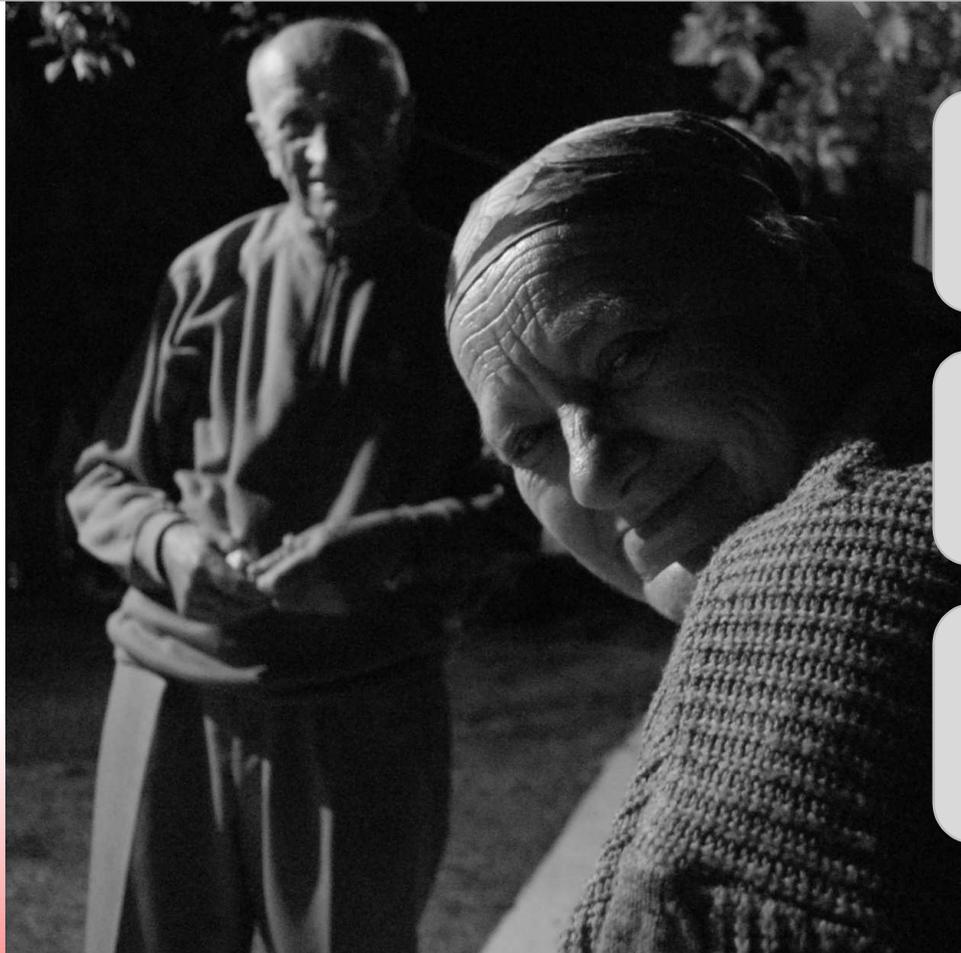
- **Higher susceptibility to allergies, which is also induced by exaggerated hygiene of children, resulting in distortions of the immune system - increase in hay fever and risk of asthma due to the increase of aero-allergen concentration**

- **Increased risk of infectious diseases due to more frequent and wider spread of pathogenic micro-organisms and the impact on the overall immune system weakness of the population**

- **Population employment in industry, agriculture or other sectors where during the working hours are is provided adequate ventilation and air conditioning, as well as if there is not possible regular access to drinking water**



At present, the projected global climate change keeps in step with the growth rate of the world's population, the uneven distribution of population density in the world and the growing demographic aging



Until 2050 average age of an European citizen will increase from 77.7 years to 80.6 years (according to data of 2003)

At the end of the 21st century, the ratio of population over the age of 60 years will increase from currently estimated 10 % to about 32 % of the global population

In many regions of the world, including in Europe, a large part of society will be elderly people, more affected by risk and less able to adapt to climate change

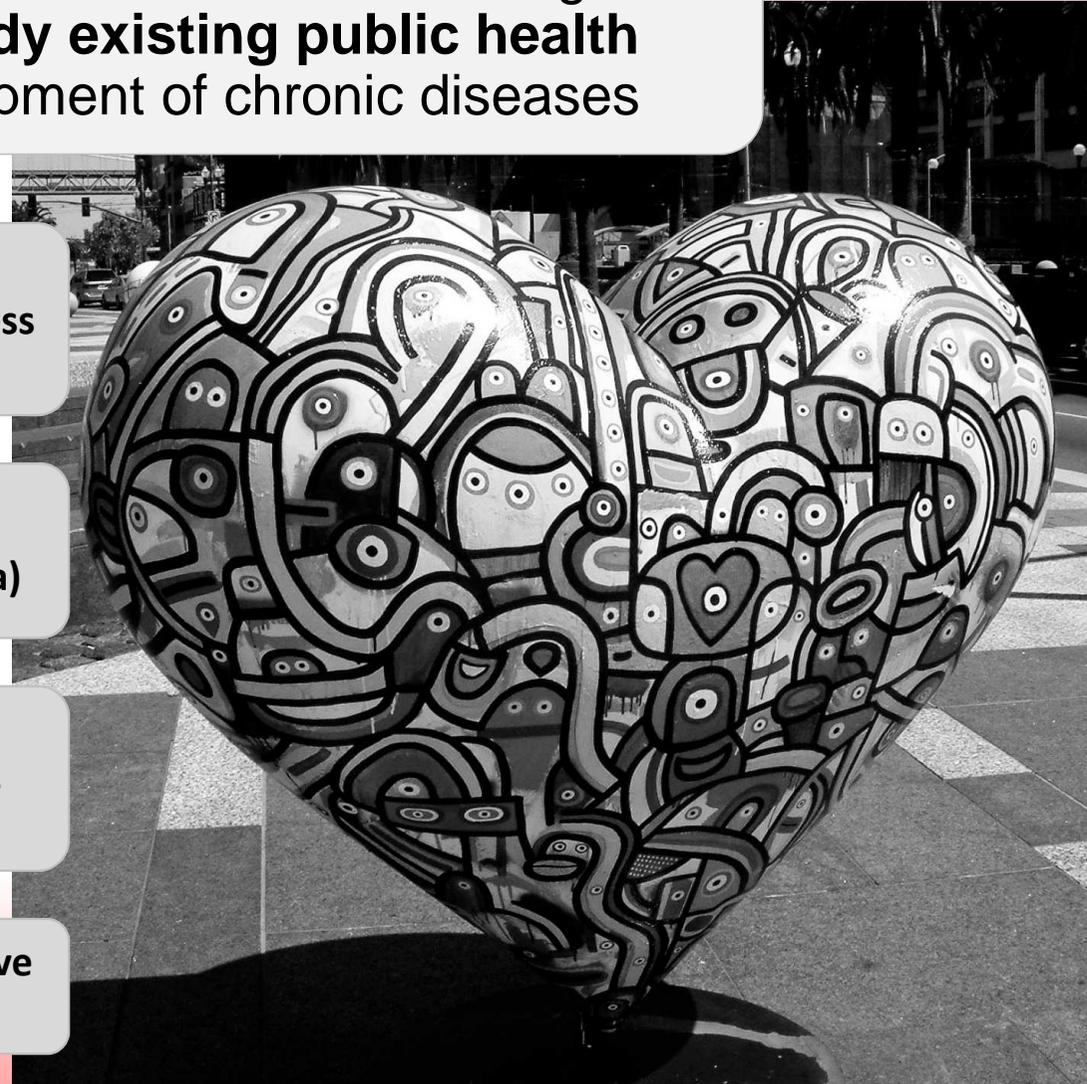
Until middle of the 21st century, effects of climate change will manifest **escalate the already existing public health problems** promoting development of chronic diseases

Chronic diseases (diabetes, cardiovascular disease, obesity (tuklums) and overweight etc.) will increase the risk serious illness or risk of mortality caused by climate change

Cardiovascular disease is currently the major cause of death worldwide, causing 31 % of all deaths (according to 2012 data)

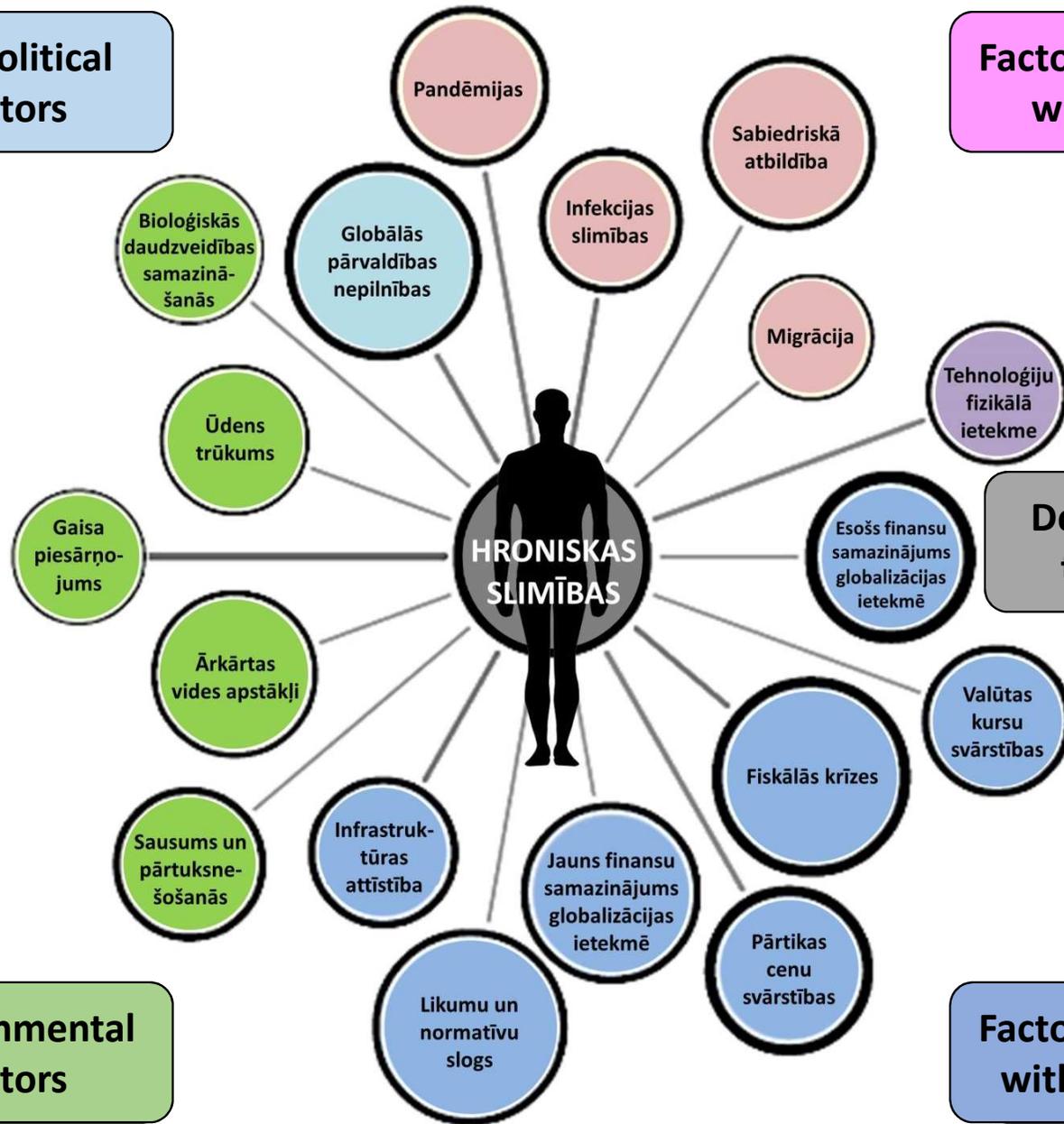
By contrast, rates of world's population suffering from overweight and obesity since 1980 doubled and in 2014 was affecting 39 % of the world's population

People who suffer from these diseases are particularly sensitive to exceptional heatwaves



Geopolitical factors

Factors associated with society



Development of technologies

Factors that influence the occurrence of chronic diseases and their development

Environmental factors

Factors associated with economics

Climate change may lead to new circumstances and existing diseases (such as food- and water-borne infections, vector-borne diseases) can expand to the areas which until now have not been affected



It is expected that health damage due to malnutrition caused by climate change will seriously affect such regions –

Where there is overpopulation, military conflicts, low levels of economic security and food and drinking water shortage is already a problem

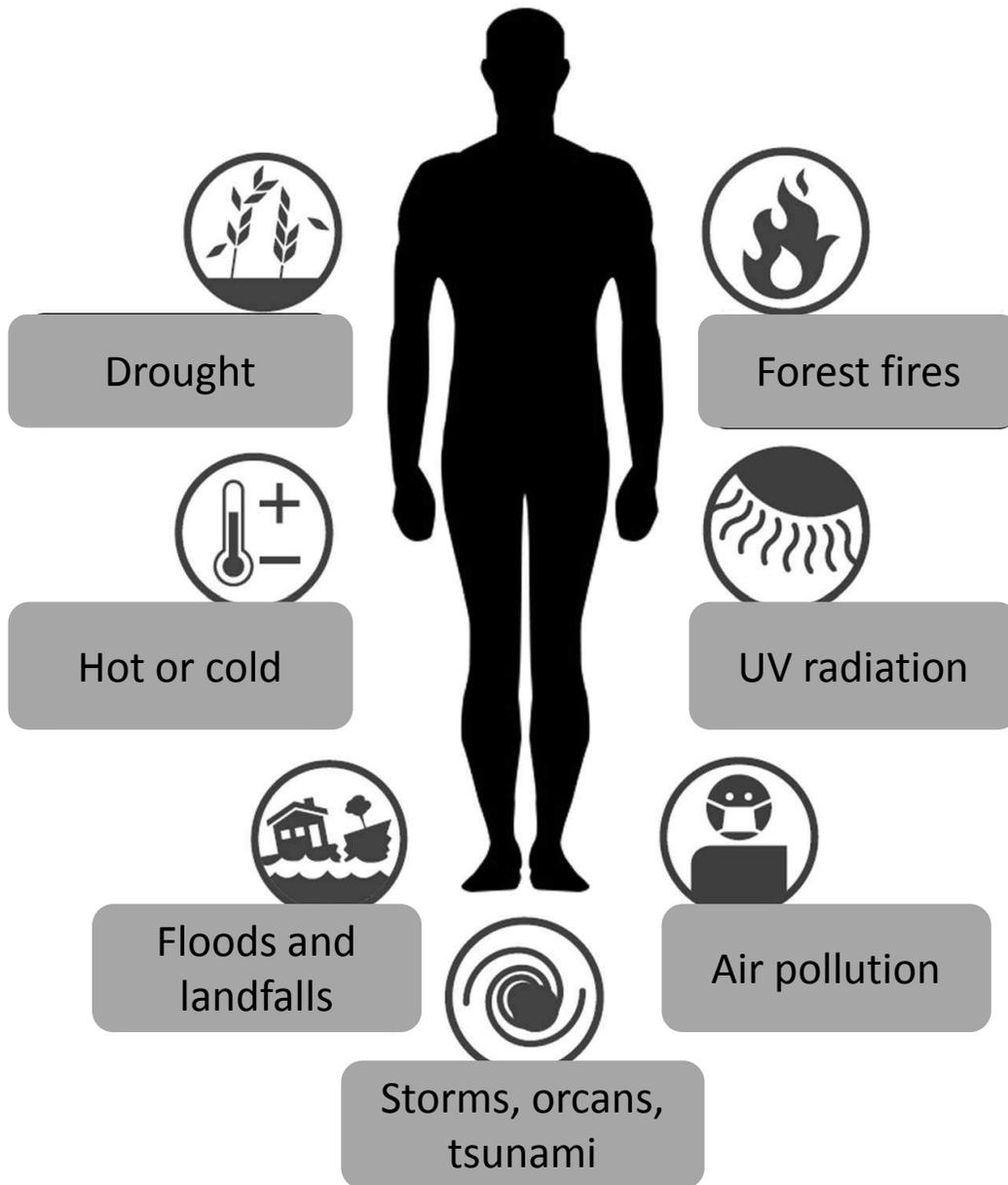
Climate change can affect changes in inequality between different public socio-economic groups, such as failing to ensure equal health care for people with low income and vulnerable groups

With high reliability it can be stated that the impact of climate change on health will be less explicit (*skaidri izteikts*), but it will not be completely prevented at society groups that will benefit from the rapid social and economic development, especially among the poorest and less healthier population groups

Climate change is an obstacle (*šķērslis*) to long-term health improvements in many areas of the world

If the country's economic growth will not improve the economic situation of the population, the impact of climate change on human health will worsen





IMPACT OF EXCEPTIONAL ENVIRONMENTAL CONDITIONS ON HEALTH

There are enough evidences on the impact of environmental conditions and climate on human health –

And it is expected that due to climate change, the negative impact can be exacerbated by the effects on each other

The main climate change-related cause of concern for the health of the population in Europe is attributed to **heat-induced** health problems and increased mortality



Increase of average temperature by 1 degree and more due to frequent exceptional heatwaves will increase mortality by 1-4 %, which by 2080 could reach 50,000 to 110,000 deaths a year

Although the number of deaths is closely related to number of population, the major changes of mortality rate could be observed in regions where there is a trend for warming up

Consequently, in Europe, heatwave impact on health of the population will be regionally uneven – more people will be affected in countries of southern and central Europe

If the body temperature exceeds 38 °C
it may cause heat stress –

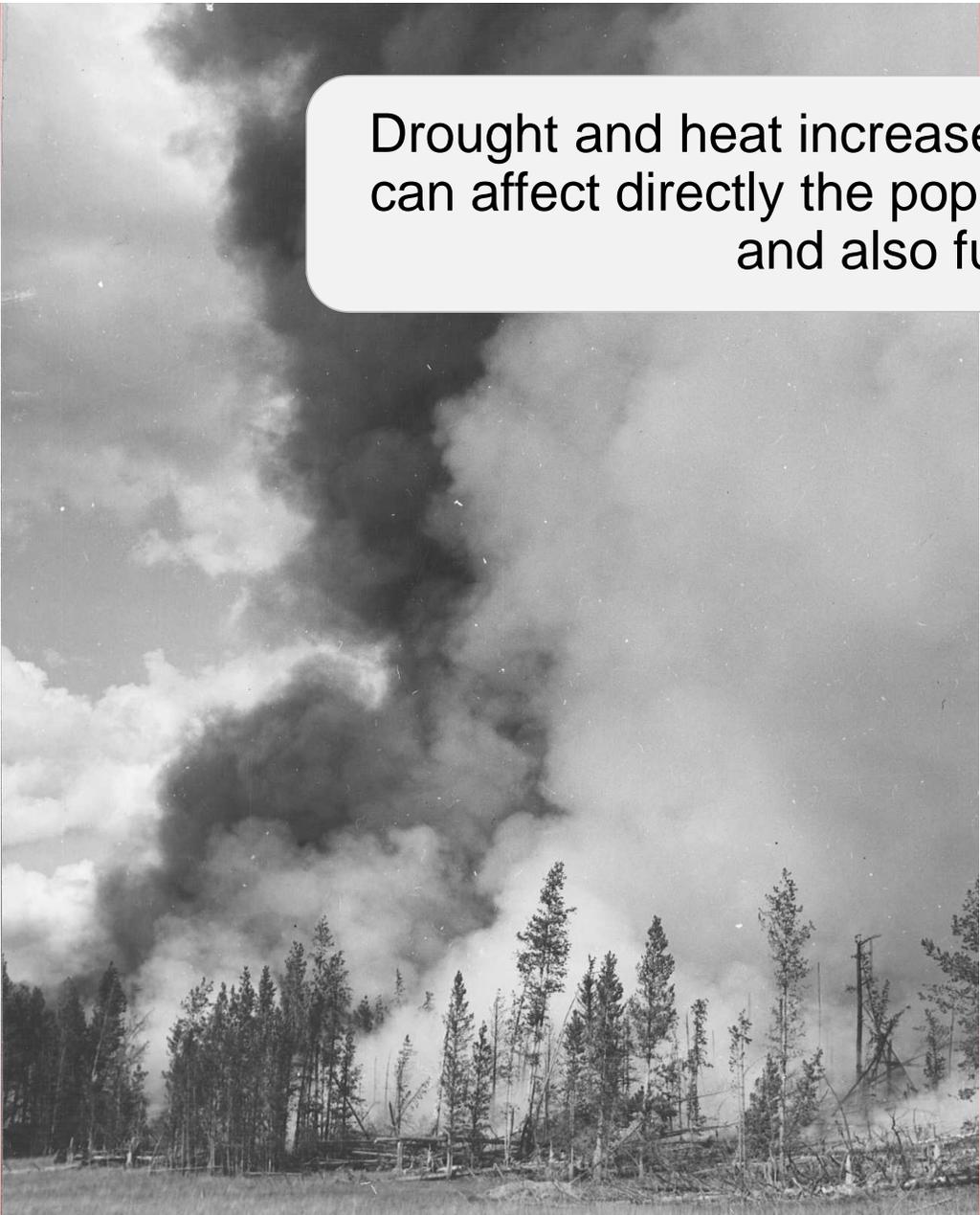
person becomes tired, lethargic, come in sight such symptoms as
dizziness, headache, irritability, confusion, nausea, vomiting,
diarrhea, and so-called heat rash, also physical and cognitive
function weakens

If the body temperatures rise above
40.6 °C occurs heat stroke -

this can cause internal organ damage risk, loss of consciousness
and death risk is increasing rapidly, especially in the population
risk group

High temperatures promote blood flow to the body surface,
which can cause circulatory collapse or sudden
cardiovascular weakness





Drought and heat increases the risk of natural fires – it can affect directly the population living in areas of fires and also further around

In Latvia there are distributed such natural fire as forest and bog fires, and previous year's grass burning, mainly, during dry spring and summer seasons

Smoke, heat and flame caused by natural fires may seriously affect human health, well-being and life – the risk of burns, injuries, poisoning with smoke, as well as losing a home will increase

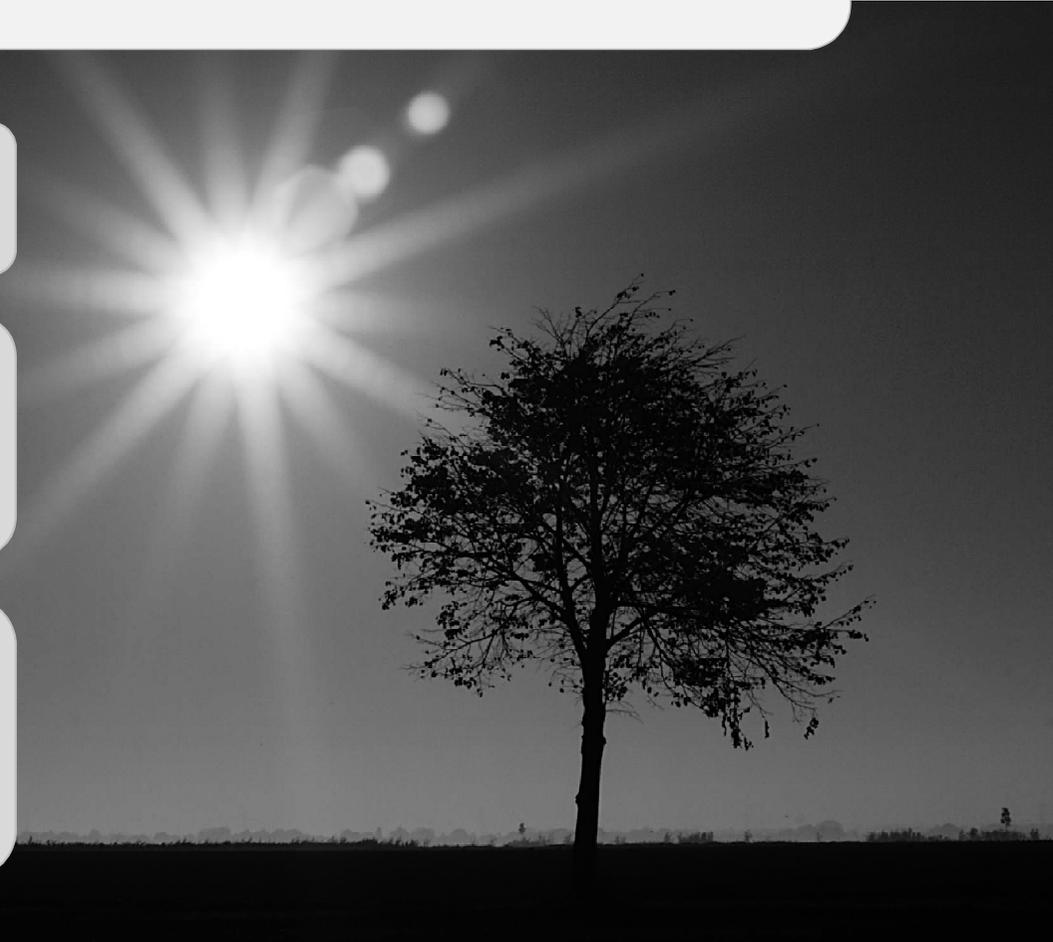
Effect of smoke on health may induce eye irritation (burning eyes, watery eyes), throat irritation, cough, shortness of breath, chest pain, headache, runny nose

Due to climate change, increase of maximum daily temperature during the summer season, will also increase the level of **ultraviolet (UV) radiation**, which can cause skin cancer and eye diseases such as cataract

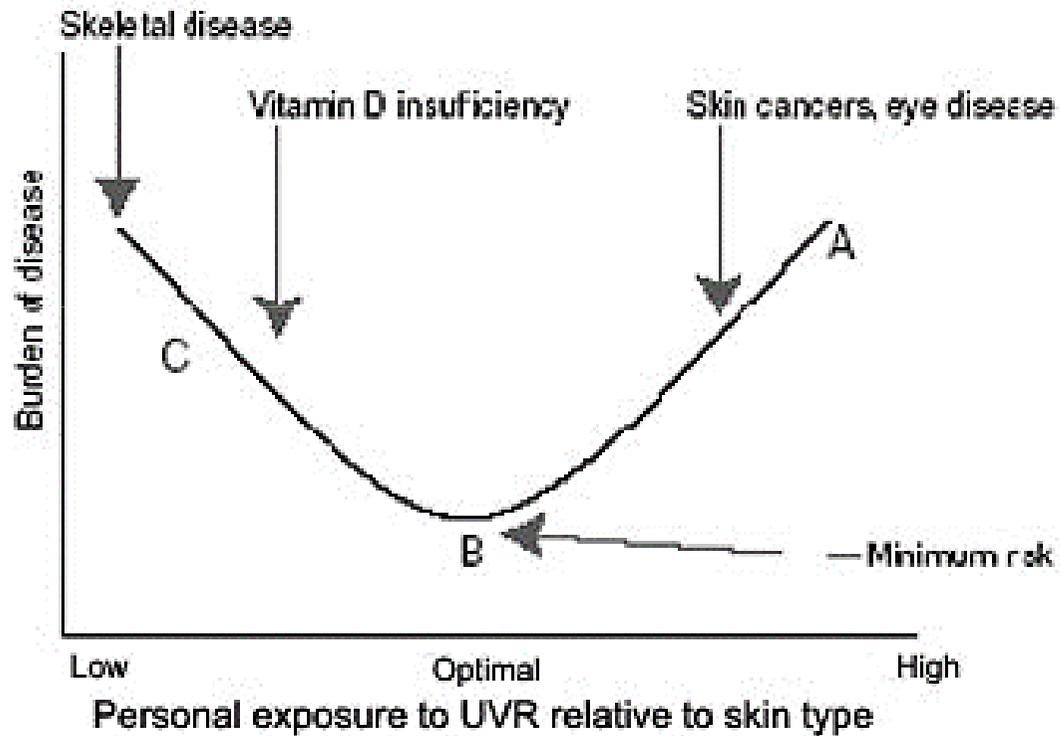
Studies have shown that an increase in daily average temperature by 1 °C, carcinoma cases may rise by 2-6 %

Studies of stratospheric ozone recovery and climate change suggest that the level of UV radiation at the Earth's surface has a tendency to decrease, and until middle of the 21st century in some areas it will reach a level as it was before 1980

However, in temperate climate zone, by increase of daily average temperature and number of sunny days, will increase the time that people spend outdoors, which can lead to elevated impact of UV radiation especially for people with fair and sensitive skin



Effects of ultraviolet radiation on human health



Sunlight has a beneficial effect on synthesis of vitamin D in the human body, which has a positive effect on health

Thus gains and losses of UV radiation levels increased impact are varying depending on -

Region, radiation intensity and duration as well as other factors, such as dietary character that affect the level of vitamin D in the body

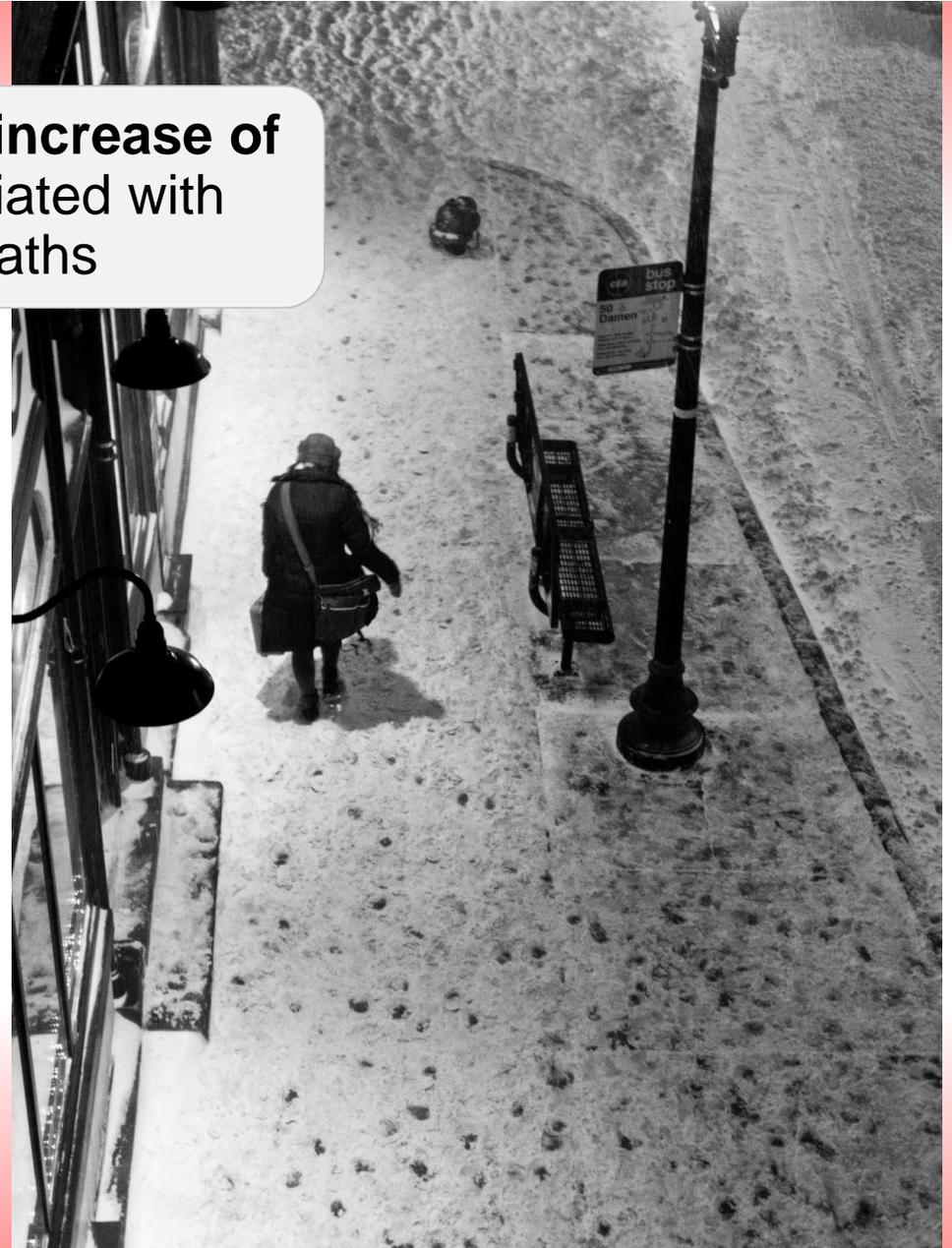
Climate change induced expected **increase of minimum temperature** is associated with reduction of cold-related deaths

Since the increase of mortality that is associated with the summer temperature increase is consistently projected by research on climate change, then –

It at least partly is compensated by cold-induced mortality in the winter seasons

However, it is unlikely that relatively milder winters due to climate change, will compensate negative heat-induced health effects –

Because the negative health effects of more frequent exceptional heatwaves greatly surpasses the benefits of reduced cold days



Most of the climate change scenarios foresee significant **increase in frequency, intensity and volume of rainfall**, but the intense precipitation will cause or worsen risk of floods



Globally it is forecasted that the areas affected by the monsoon influence in the 21st century will enlarge, and intensity of monsoon precipitation will increase

Already now flooding is an exceptional environmental conditions that most often affects health and well-being in many regions of the world

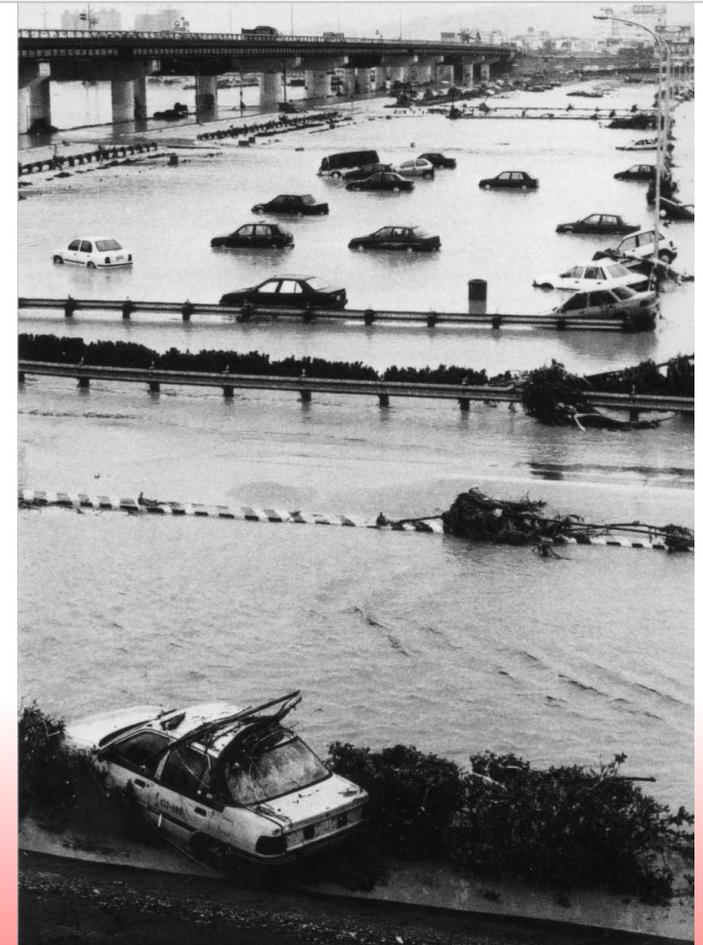
In 2011, 6 of 10 the world's major natural disasters were floods as by number of victims population - 112 million people were affected, as by number of deaths - more than 3100 people died

Climate change particularly affects **the rising river flood frequency worldwide**, but **also sea level rise** is expected causing economic losses and impacts on public health, as well as by destructing properties and infrastructure in the flood areas

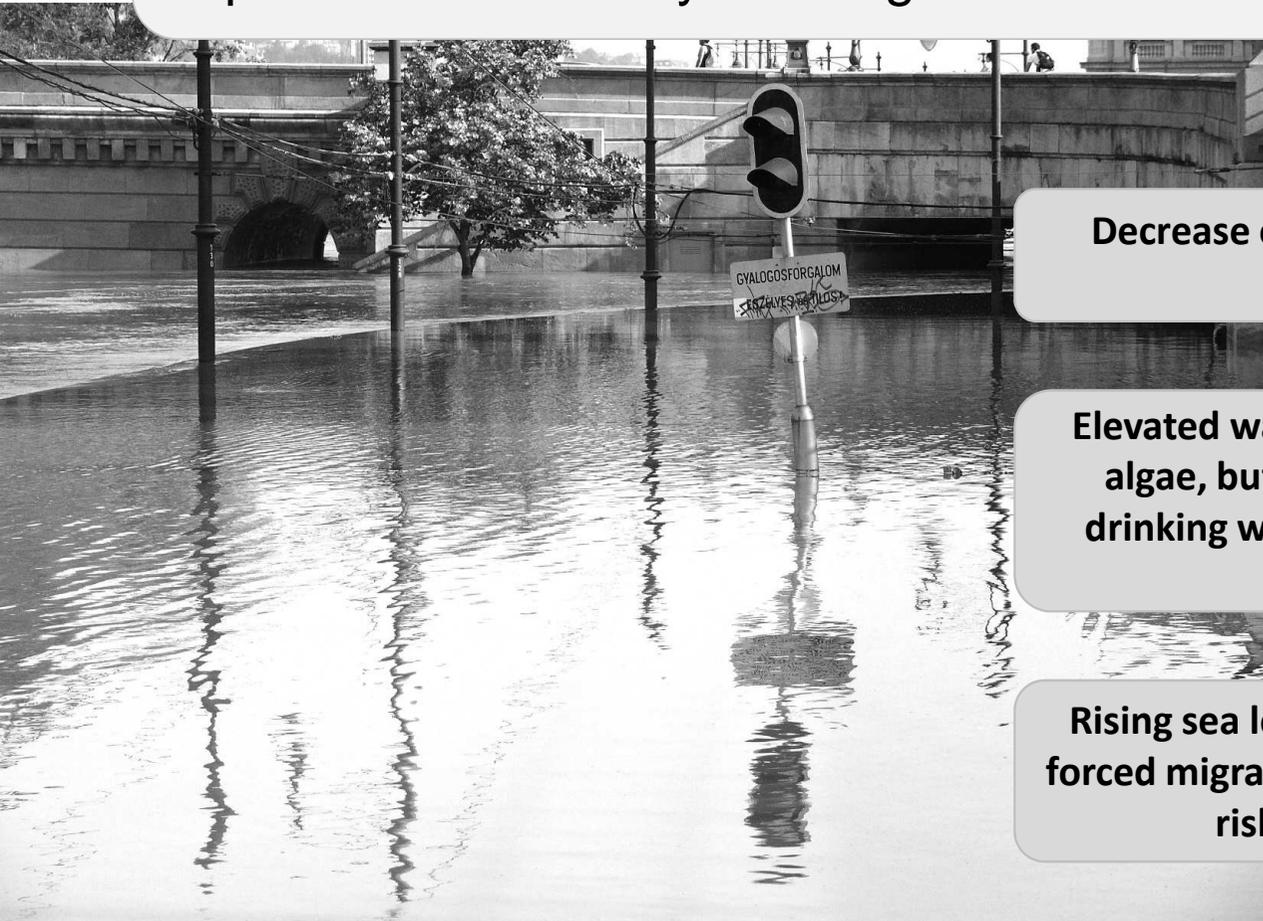
Flooding leads to a higher risk of drowning, injuries, suffering from hypothermia, infectious diseases (such as diarrhea, leptospirosis, cholera) and induces forced migration or evacuation of people is need

Symptoms of mental disorders such as psychological distress, anxiety and depression prevalence is 2-5 times higher for individuals who are faced with the impact of floods, than for undisturbed population

In rivers of Latvia, amount of spring waters creates serious threats affected by ice and sludge congestion, but rain and wind surges waves sometimes can also cause flooding



Effects of floods, storms and strong precipitation are associated with several outbreaks of water-borne diseases, pathogens or exceptional mobilization of pollution caused by flooding of waste water pipe and/or sewage systems



Decrease of water streams in summers can increase risk of bacterial and chemical pollution

Elevated water temperature can promote the spread of toxic algae, but fecal contamination risk could affect quality of drinking water resources and areas where water is used for recreation and agriculture

Rising sea levels may cause impact on the population such as forced migration, loss of livelihood and residence, and a greater risk to suffer from coastal storms and floods

Climate change may promote **air pollution** – every year from air pollution, caused by fossil fuel combustion products, 7 million people die

Although air pollution in Europe has decreased sharply in the recent decades, air its health risks still remain significant, mainly due to increased concentrations of particulate matter and ozone that affect the respiratory system, induces diseases and associated mortality

The most significant effects of climate change is likely to be related to ozone, which is a major pollutant in many areas of Europe

Climate change has contributed to increased ozone concentration in central and south-eastern part of Europe, and climate-induced increase in ozone levels may obstruct currently applied measures of ozone reduction



Changes in food and water availability due to climate change



The main sectors most closely linked to the possible human health risks of climate change affects are:

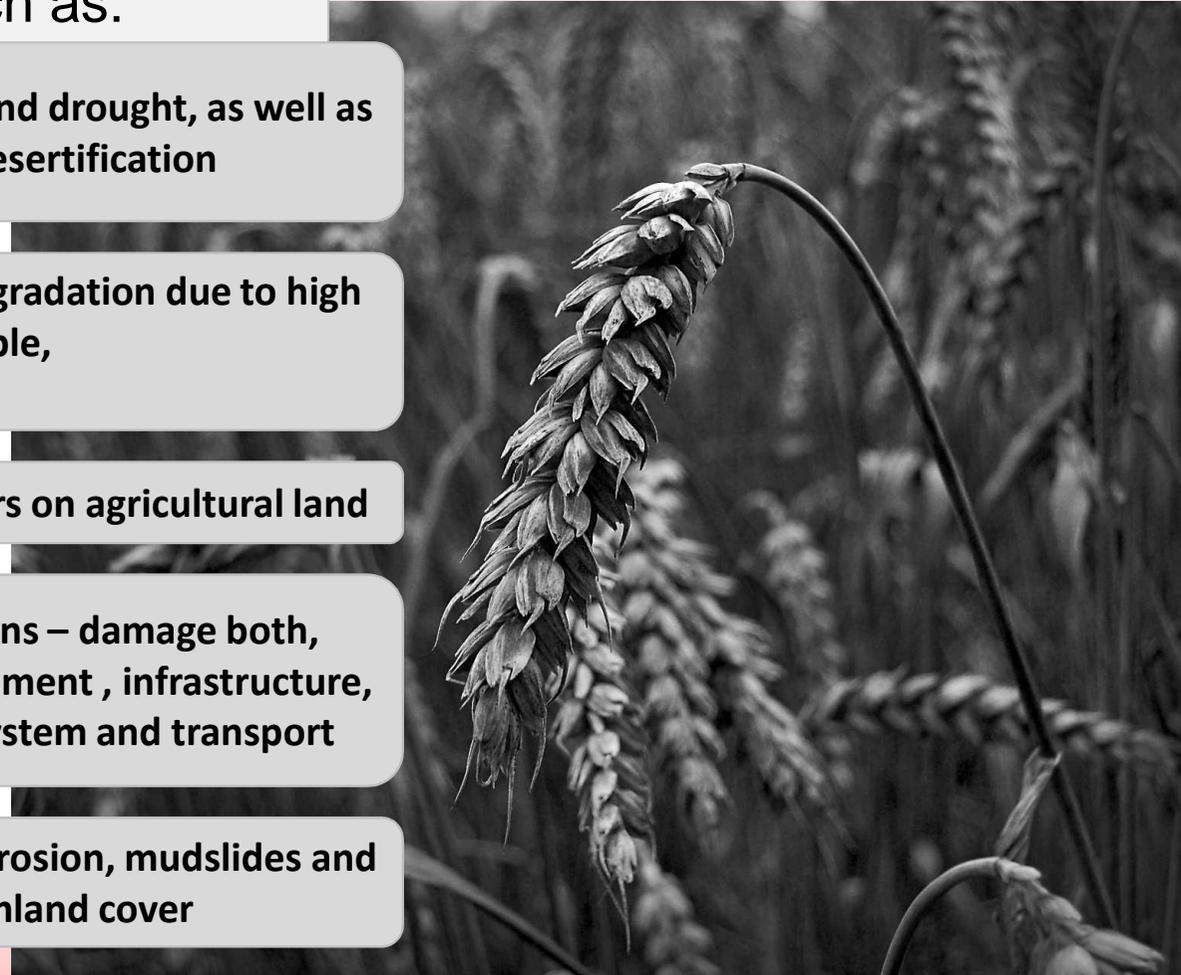
Agriculture – relating to the risk of food inventory, productivity, quality and accessibility –

The impact on food security of the population, as the consequences poor, polluted food, malnutrition and hunger can be mentioned

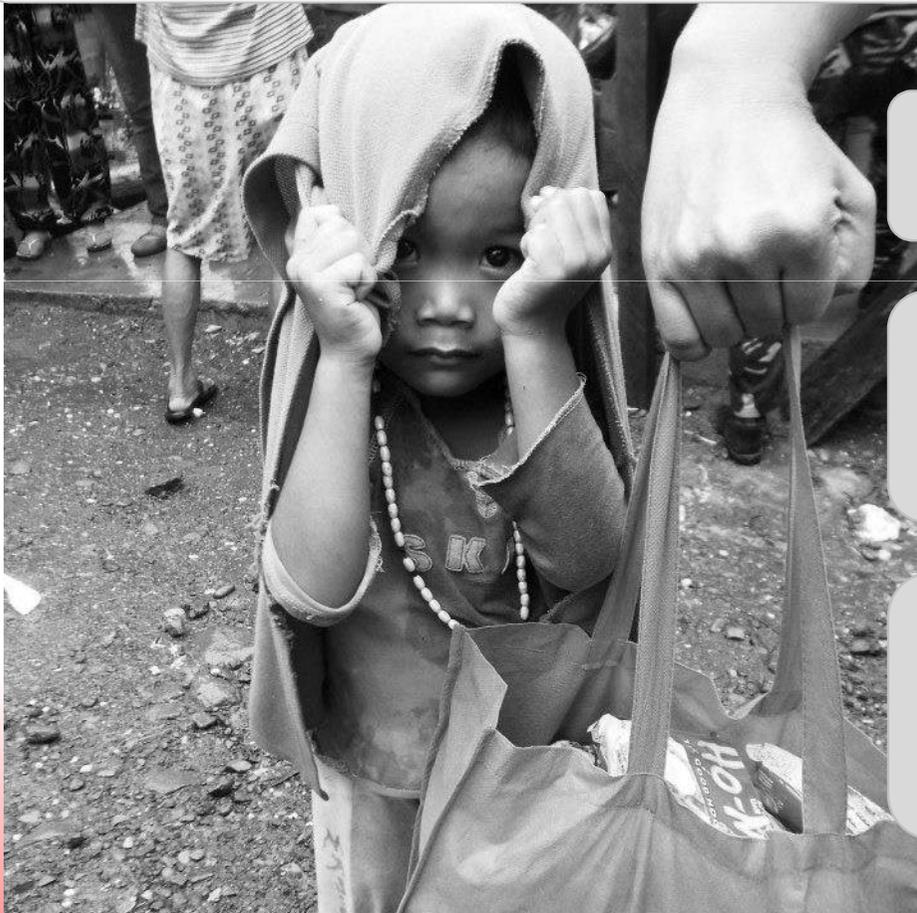
Water management – water management - the risks affecting the security of the population supply with drinking water and water required for personal hygiene, as well as spread of water- and food-borne diseases

Changes in food production can be affected by several environmental factors such as:

- **Temperature – crop yield reduction due to heat and drought, as well as decrease of areas of farmlands due to desertification**
- **Amount and intensity of rainfalls – crop yield degradation due to high humidity, leading to, for example, grain rot, mold etc.**
- **CO₂ level – in connection with the use of fertilizers on agricultural land**
- **Exceptional periods of environmental conditions – damage both, agricultural and food industries, damage of equipment , infrastructure, power supply, disruptions of communication system and transport**
- **Rising sea level – agricultural soil salination and erosion, mudslides and landslides, which will cause loss of farmland cover**



Drinking water and food insecurity, as well as poor diet and water-induced acute intestinal infections account for a significant part of the current global disease burden, especially with regard to children and women, and it is likely that the situation will get worse by impacts of climate change becoming more intensive



About half of the women and children in the world suffer from reduced body weight, which is a consequence of malnutrition

Poor availability of water and the lack of water for hygiene cause increase of infectious diseases, especially the risk of an outbreak of acute intestinal infections which promotes increased mortality

In regions with low economic security, where food supplies are already limited, such as in sub-Saharan Africa and South Asia in the future due to climate change the largest risk of food and drinking water supply reduction is expected

Climate change may also affect the yield of cultivable and wild-growing edible vegetable due to unforeseen diseases, pests or spread of invasive species

For example, in Latvia since 2007, fruit trees are affected by blight – a disease which is induced by the bacterium *Erwinia amylovora* – its reproduction and spread is affected by moist and warm climatic conditions during the flowering time of fruit trees

Trees affected by this disease perish or have to be disposed, particularly such fruit trees and shrubs as apple, pear, hawthorn, quinces, currants etc.

Blight affected fruit trees in Latvia have to be disposed by incineration





Globally, about 150 million people now are living in cities affected by chronic water shortages

Until 2050, water scarcity affected urban population will grow to one billion, if quickly and efficiently urban improvement solutions will not be found

Currently, about one-third (1.7 billion) of the world's population live in areas with an increased risk of water shortage, and this number will rise to 5 billion in 2025

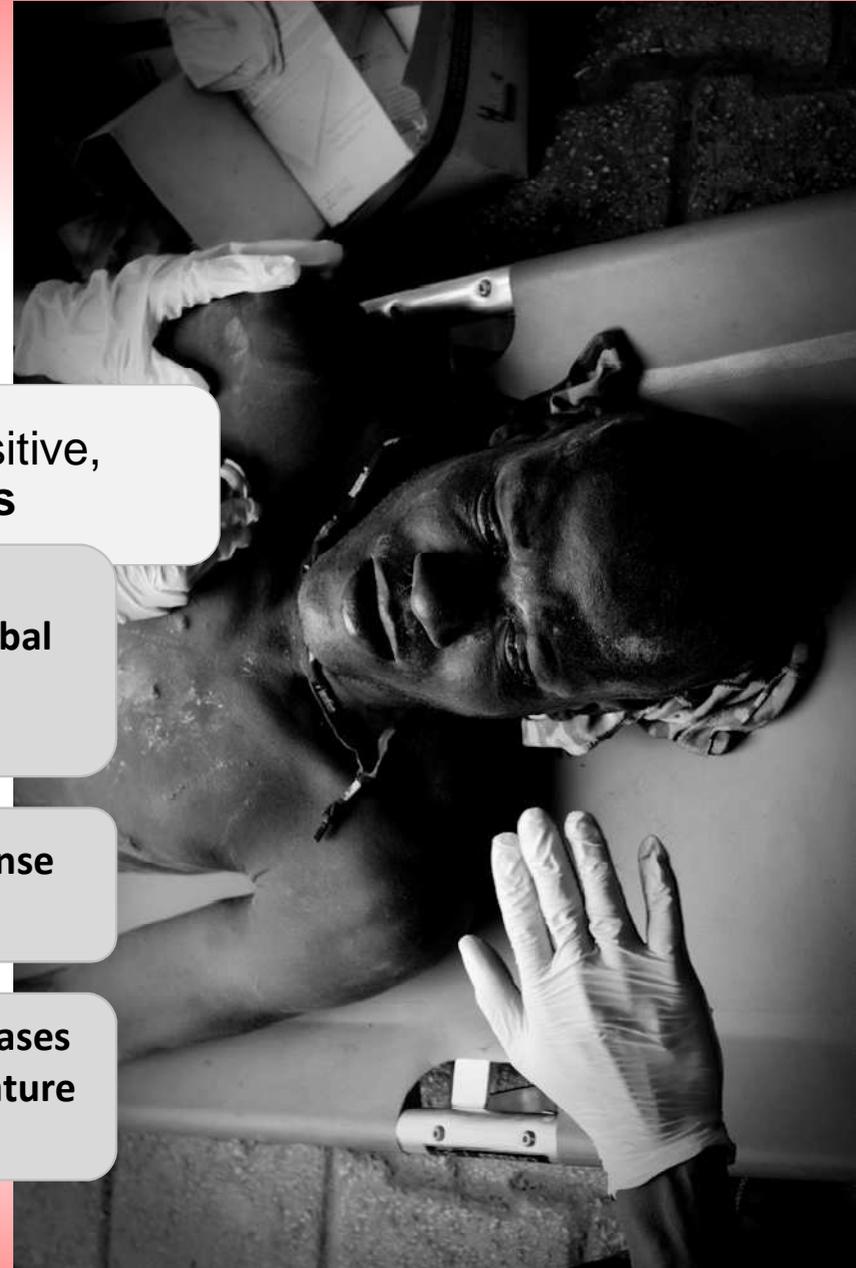
CLIMATE CHANGE PROMOTED ILLNESS

Due to climate change will increase risk to temperature sensitive, including **food- and water-related, infectious diseases**

Food-borne and water-borne diseases, usually diseases affecting gastrointestinal tract, which has a symptom of diarrhea remains a global health problem that particularly affects children in regions with a low level of economic development

Impacts of climate change such as exceptional drought, floods or intense rainfalls generally reduce the availability of safe water supply

Researches reveal that the incidence of acute intestinal infectious diseases will increase in step with the increase of temperature, i.e., if a temperature increase is 1 °C, the number of illness cases is increasing by 3-11 %



With food- and water-borne diseases a person can fall ill capturing pathogens:

Consuming contaminated drinking water, contaminated or uncooked food, accidentally swallowing water during swimming or with water that comes in direct contact with the eyes, ears, mucous membranes or open wounds

Pathogens in water can be zoonoses that are concentrated, e.g., in bivalves (oysters, etc.) and be deposited during irrigation of food crops

Pathogens that cause risk of infections are in human and animal intestines existing organisms that are spread by fecal-oral route, and also bacteria and protozoa that naturally develops in the aquatic environment



Zoonoses are infectious diseases of animals that can naturally be transmitted to humans.

Climate factors can directly affect the growth, survival ability, persistence of pathogens, their portability and **virulence (degree of pathogenicity)**

Indirect climate factors include infection outbreaks in local ecosystems or species habitats that act as reservoirs for zoonoses

Pathogens in warm conditions may spread on surface of food crops (such as lettuce)

The amount and intensity of rainfall also is associated with spread risk of acute intestinal infections

Higher concentration of acute intestinal infectious agents, such as enteroviruses, is more common for drinking water and bathing water after heavy rainfalls

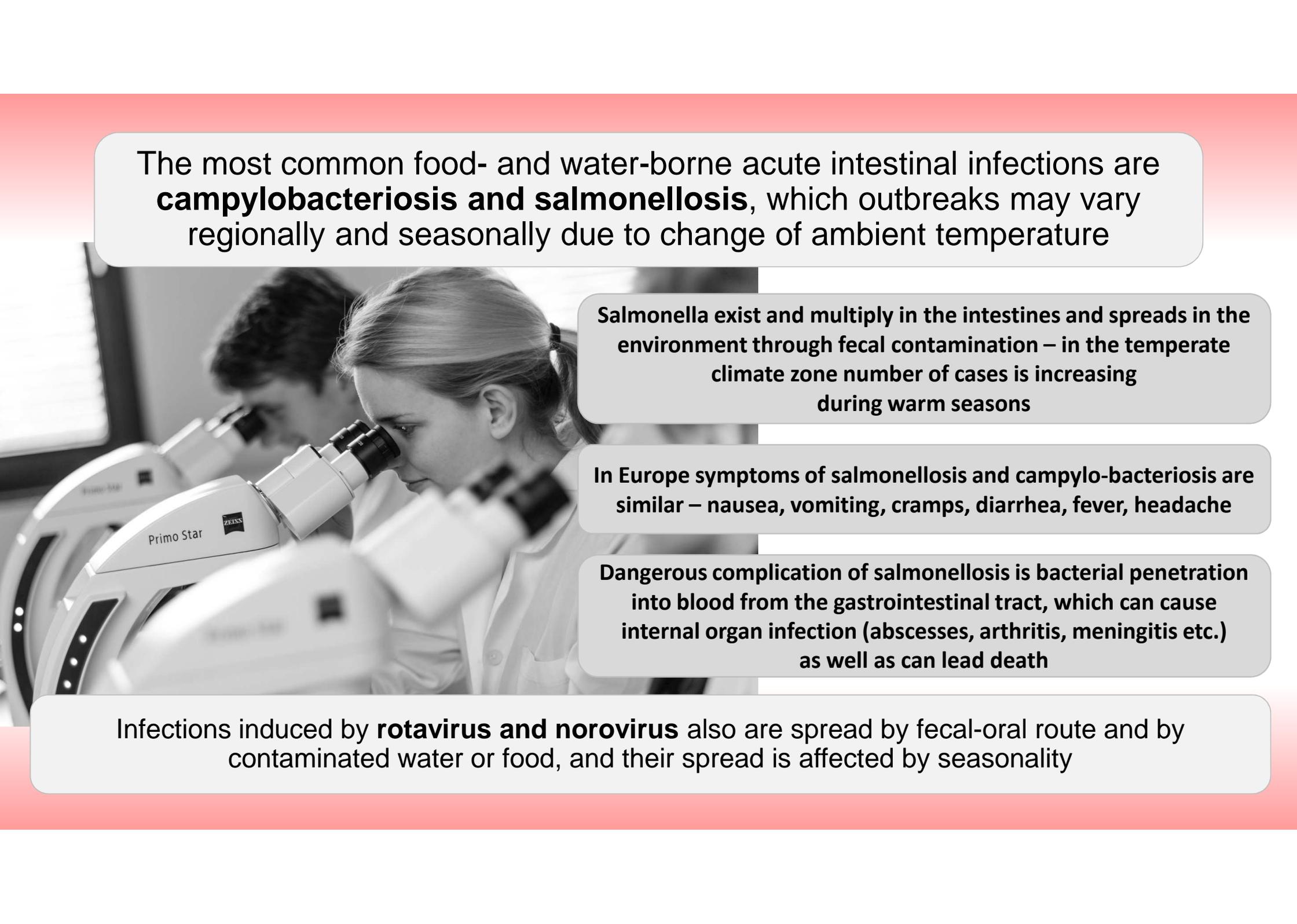


The diseases with the **faecal-oral mechanism** of transmission belong to the group of intestinal infections.

TYPES OF INTESTINAL INFECTIONS

VIRAL INFECTIONS
viral hepatitis A and E,
enterovirus diseases,
poliomyelitis,
rotavirus gastroenteritis

BACTERIAL INFECTIONS
Typhoid fever,
paratyphoids,
cholera,
shigellosis (dysentery),
salmonellosis,
yersiniosis,
esherihiosis,
campylobacter infections



The most common food- and water-borne acute intestinal infections are **campylobacteriosis and salmonellosis**, which outbreaks may vary regionally and seasonally due to change of ambient temperature

Salmonella exist and multiply in the intestines and spreads in the environment through fecal contamination – in the temperate climate zone number of cases is increasing during warm seasons

In Europe symptoms of salmonellosis and campylo-bacteriosis are similar – nausea, vomiting, cramps, diarrhea, fever, headache

Dangerous complication of salmonellosis is bacterial penetration into blood from the gastrointestinal tract, which can cause internal organ infection (abscesses, arthritis, meningitis etc.) as well as can lead death

Infections induced by **rotavirus and norovirus** also are spread by fecal-oral route and by contaminated water or food, and their spread is affected by seasonality

Climate change caused prolongation of warm seasons may promote **multiplying of algae in freshwater and saltwater bodies**, which can also lead to water-induced disease risk

Potentially dangerous algae such as *Dinoflagellata*, blue-green algae (*Cyanobacteria*), diatoms (*Diatomea*) due to rising temperature may multiply in a large scale and they excrete toxins that are harmful to human and animal health

During the activity of cyanobacteria toxins are emitted that can cause damage of nervous system, digestive organs, liver and skin, but diatoms emit domoic acid, a potent neurotoxin and it can bioaccumulate in fish

Cyanobacterial toxins can cause a range of health problems such as irritation of skin and mucous membrane, allergic reactions, seizures, nausea, vomiting, diarrhea, fever, headache, muscle and joint pain, liver damage





Climate change may have a significant impact on **vector-borne diseases** –

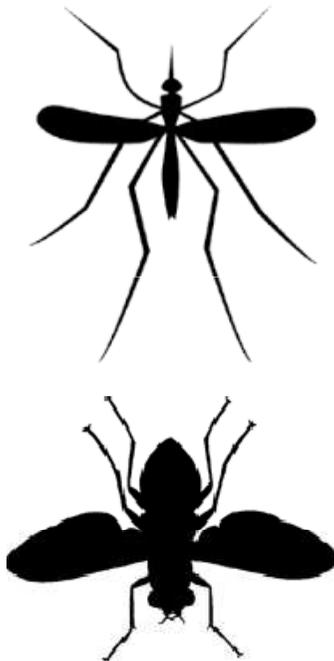
The spread of such infectious disease that are spread by mosquitoes, flies, ticks and other vectors (usually biting insects) will change through the geographical range, and thus the global rise in illness incidence will increase

Increase of vector-borne disease risk the most substantial is due to the effects of climate change, because the spread of these diseases is the most sensitive to influences of climate factors

Disease vectors and pathogens themselves are sensitive to environmental factors such as temperature, character of upper layer of water, air and soil humidity, precipitation, wind, vegetation characteristics, seasonality

Regionally spread of vector-borne diseases can be reduced by vaccination of the population, as well as by use of pesticides to eradicate vectors, however, there is an increased risk for development of pesticide persistent species and pathogens

Vector-borne diseases and intensity of their spread



Disease	Vector	Population at risk (million) ¹	Number of people currently infected or new cases per year	Present distribution	Likelihood of altered distribution
Malaria	Mosquito	2,400 ²	300-500 million	Tropics and Subtropics	Highly likely
Schistosomiasis	Water snail	600	200 million	Tropics and Subtropics	Very likely
Lymphatic Filariasis	Mosquito	1 094 ³	117 million	Tropics and Subtropics	Likely
African Trypanosomiasis (Sleeping sickness)	Tsetse fly	55 ⁴	250 000 to 300 000 cases per year	Tropical Africa	Likely
Dracunculiasis (Guinea worm)	Crustacean (Copepod)	100 ⁵	100 000 per year	South Asia, Arabian Peninsula, Central-West Africa	Unknown
Leishmaniasis	Phlebotomine sand fly	350	12 million infected, 500 000 new cases per year ⁶	Asia, Southern Europe, Africa, Americas	Likely
Onchocerciasis (River blindness)	Black fly	123	17.5 million	Africa, Latin America	Very likely
American Trypanosomiasis (Chagas disease)	Triatomine bug	100 ⁷	18 million	Central and South America	Likely
Dengue	Mosquito	1,800	10-30 million per year	All Tropical countries	Very likely
Yellow Fever	Mosquito	450	more than 5 000 cases per year	Tropical South America, Africa	Likely

1. Top three entries are population-pro-rated projections, based on 1989 estimates.

2. WHO, 1994.

3. Michael and Bundy, 1995.

4. WHO, 1994.

5. Ranque, personal communication.

6. Annual incidence of visceral leishmaniasis; annual incidence of cutaneous leishmaniasis is 1-1.5 million cases/yr (PAHO, 1994).

7. WHO, 1995.

 Highly likely
  Very likely
  Likely
  Unknown



 GRID Arendal
 GRAPHIC DESIGN: PHILIPPE REVAZ/EMC2

Source: Climate change 1995, Impacts, adaptations and mitigation of climate change: scientific-technical analyses, contribution of working group 2 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge press university, 1996.

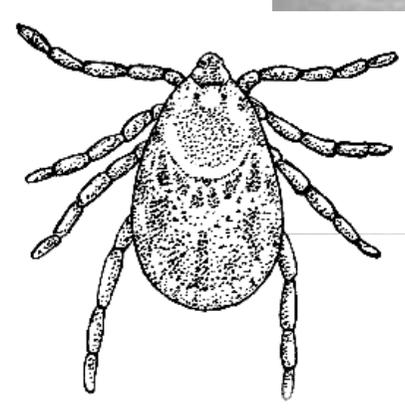
Climate change is likely to affect the **spread of ticks** – there is a trend of thick population in Europe to expand towards the north and up to the high-altitude regions

Due to climate change induced warmer winters tick population may increase and thus to a greater extent than in the past may threaten people with Lyme disease and tick-borne encephalitis

Ticks of *Ixodes* genus («hard ticks») which are common also in Latvia - can be transmitters of tick-borne encephalitis and Lyme disease

Dog tick in the territory of Latvia is the dominant species, while boreal forests' tick is more common in the eastern part of Latvia

Symptoms of encephalitis can be similar to flu (gripa), but due to possible complications such as inflammation of the lining of the brain, the illness can result in disability or even death



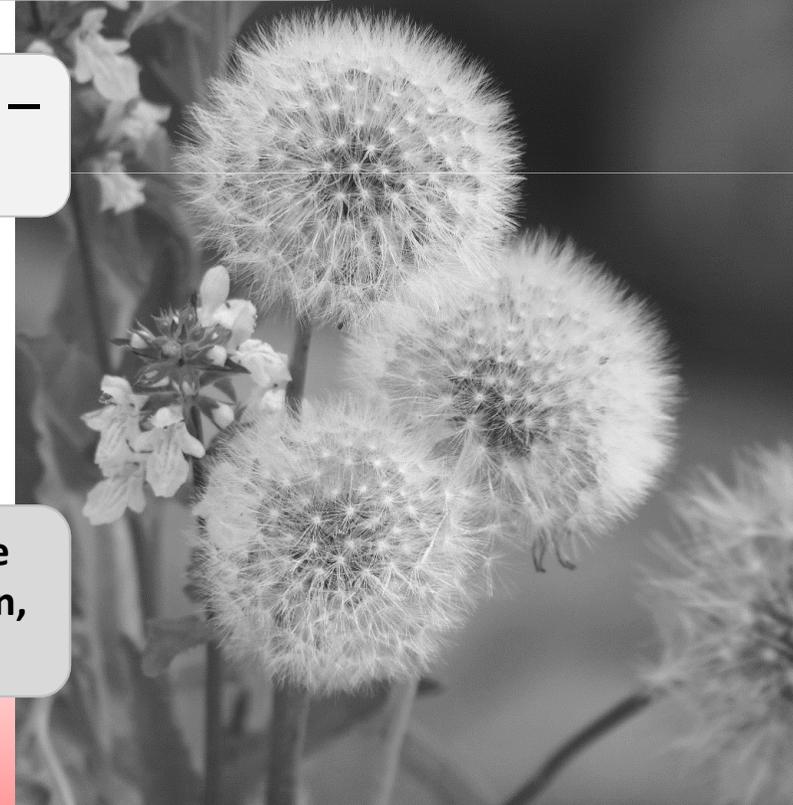
Climate change contributes to elevated concentration and distribution of **air-borne allergens (aero-allergens) in the environment**, due to rising CO₂ levels and changes in length and ratio of warm and cold seasons

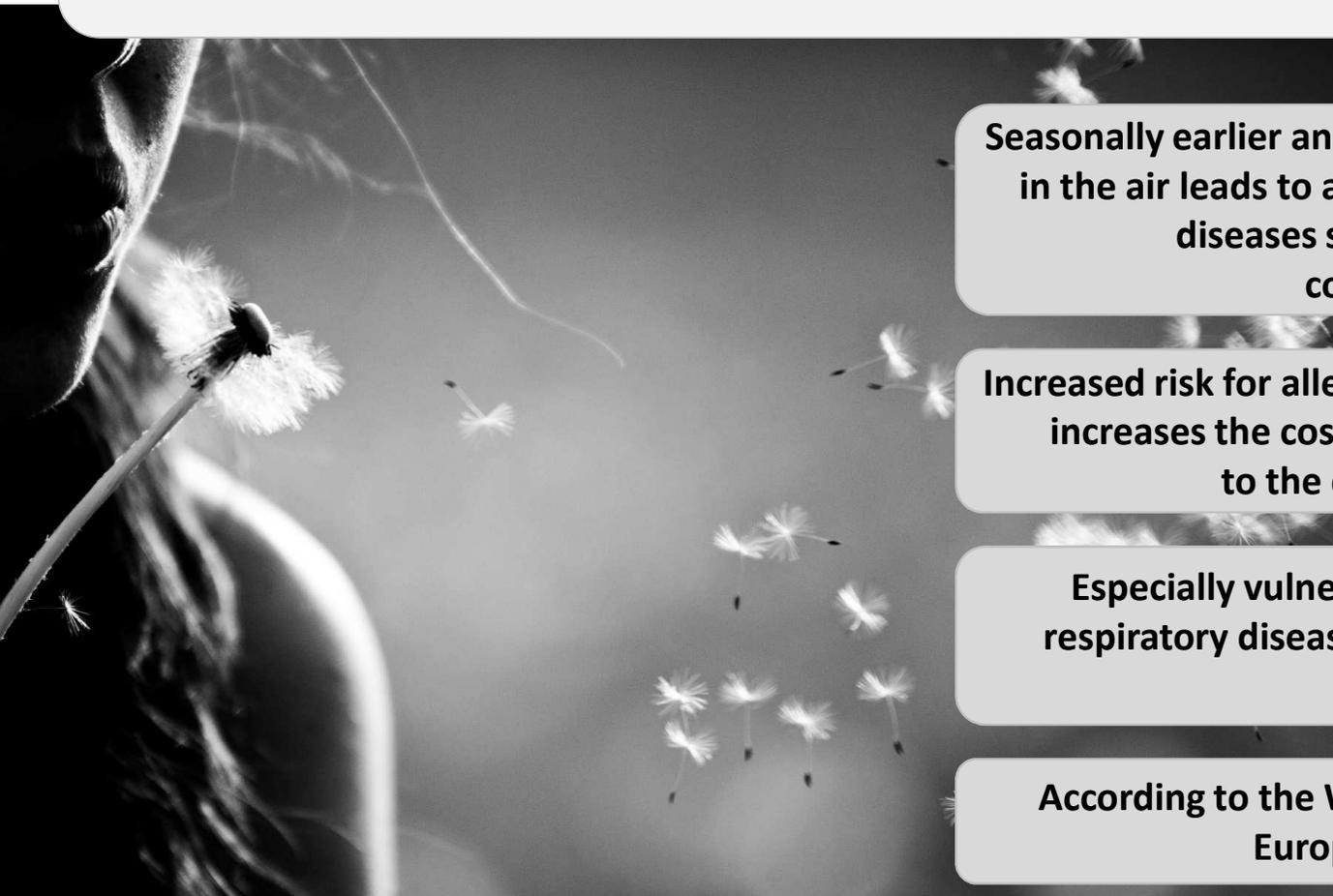
This, in its turn, can have a positive effect on the vegetation season, prolonging the flowering time, and also promoting distribution of atypical plant species in the region

Allergy is a hypersensitivity to the specific substances – allergens existing in body or in the environment

Drought and strong winds can cause dust and other atmospheric particles containing pollen and spores, and the air masses can be transfer these allergens to previously undisturbed areas

Due to climate change, changes in air quality outdoors and indoors may arise and increased air pollution and concentration of aero-allergens, such as pollen, dust or mold spores can be caused





Increase of pollen concentration elevates the organism's sensitivity to allergens and contributes to a more severe allergic reaction expression, as evidenced by the increase of asthma, allergic rhinitis and other allergic diseases

Seasonally earlier and more sustained presence of aero-allergens in the air leads to an increased risk of respiratory and allergic diseases such as allergic rhinitis, hay fever, conjunctivitis or dermatitis

Increased risk for allergies reduces human working capability and increases the costs of medical care, as well as contributes to the development of serious illness

Especially vulnerable are people suffering from chronic respiratory diseases such as asthma or chronic obstructive pulmonary disease

According to the World Health Organization, about 15 % of Europeans are sensitive to pollen

Due to the increasing prevalence of pollen allergy, in Latvia since 2003 the **aerobiological monitoring** is implemented; in Latvia most of allergies are caused by:

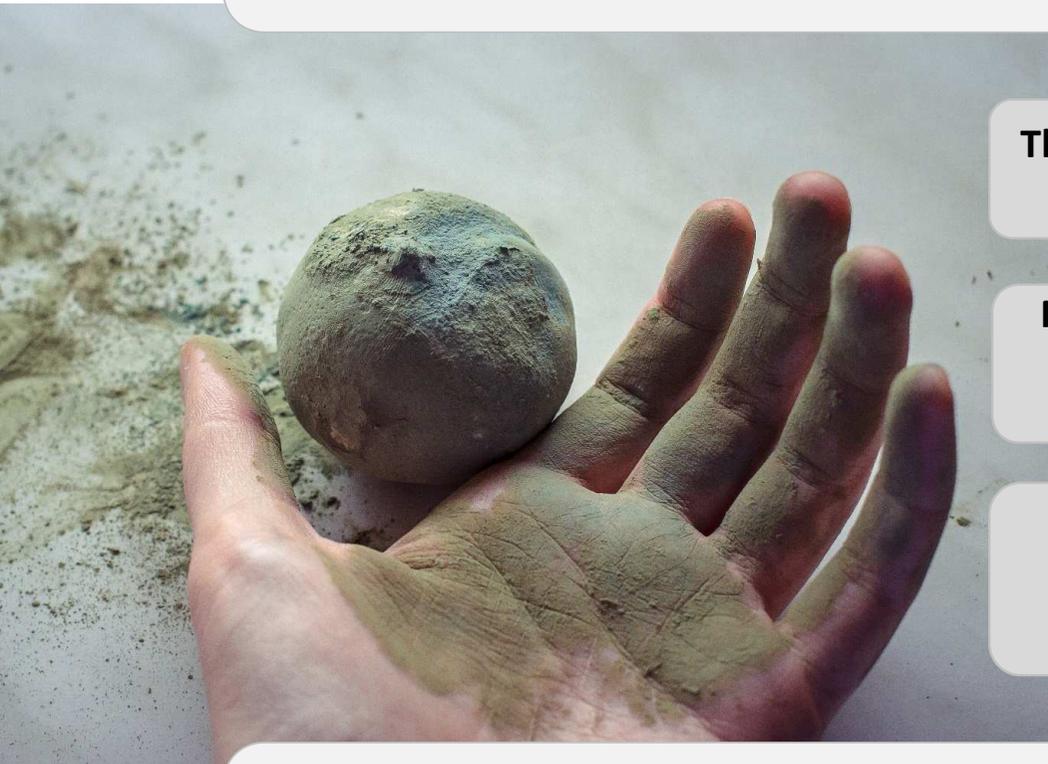
- Tree and shrub pollen – birch, alder, hazel, oak, maple, poplar, ash, elm etc.
- Grass pollen – timothy, fescue, bluegrass, wheat grass, rye, buckwheat, wheat etc.
- Wild plant pollen – mugwort, dandelion, hemp, nettle, wormwood, buttercup, psyllium etc.



In northern Europe **birch pollen** are considered to be more aggressive in causing allergic symptoms, while in central Mediterranean regions – **olive pollen**, but in southern Europe several species of **ambrosia pollen** are recognized as aggressive allergens

Furthermore, species of ambrosia are plants which range of spread rapidly enlarges due to global climate warming

Also **mold** (pelējums) **spores** can be a serious allergen, such as *alternaria* mold spores which are not only one of the most powerful aero-allergens in the world, but also are considered as a pathogenic agent of plant diseases



The most common indoor mold types are *Alternaria*, *Aspergillus*, *Cladosporium* and *Penicillium*

Mold spores can cause health effects ranging from light allergic reactions such as sneezing, nasal, eye, throat or lung irritation to serious asthmatic attacks

Allergy prevalence is closely linked to the environmental pollution - intensive air pollution or smog can cause breathing difficulties, cough, asthmatic attacks

The indoor airborne aero-allergens are dust consisting of mold spores, plant fibers, food particles, insect excrement, pet hair, human and animal skin (epidermis) particles

Health is a physical, emotional and social well-being – impact of climate change on human health may be associated with prevalence of various diseases, without the aforementioned, encouraging also **the emergence of mental disorders as well as cancer and other diseases** induced by specific factors

Natural disasters or exceptional environmental conditions and the resulting forced migration of population can affect a person's cognitive functioning (thinking), emotional and behavioral level, changing the mental state of many people, especially children - inducing stress, anxiety and panic attacks, depression etc.

To diminish consequences of climate change effects on human health or to prevent impacts, important role is attributed to support of the population, which can be delivered by governmental attitude towards the society, for instance –

Strengthening social support networks, improving environmental safety and access to health care by raising public awareness of the risks and emergency situations, reducing economic instability



Thank you
for the attention!

