



This project is co-funded by the European Union
and the Republic of Turkey.

Climate Change Training Module Series 14



CLIMATE CHANGE IMPACTS ON HUMAN HEALTH



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CLIMATE CHANGE IMPACTS ON HUMAN HEALTH

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2019, Ankara

The original content of this publication has been prepared in Turkish.
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CLIMATE CHANGE IMPACTS ON HUMAN HEALTH

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ABBREVIATIONS

EU	European Union
USA	United States of America
APHA	American Public Health Association
AR2	IPCC Second Assessment Report
LRTI	Acute Lower Respiratory Tract Infections
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change
CDC	Centers for Disease Control and Prevention
CH ₄	Methane
CO ₂	Carbon Dioxide
COP	Conference of Parties
DALE	Disability Adjusted Life Expectancy
DALY	Disability Adjusted Life Years
DFLY	Disability Free Life Expectancy
WMO	World Meteorology Organization
WHO	World Health Organization
USEPA	United States Environmental Protection Agency
HALE	Healthy Life Expectancy
HeALY	Healthy Life Year
HFC	Hydrofluorocarbon
AQI	Air Quality Index
IPCC	Intergovernmental Panel on Climate Change
IHD	Ischemic Heart Disease
COPD	Chronic Obstructive Pulmonary Disease
N ₂ O	Dinitrogen Monoxide
NO _x	Nitrogen Monoxide
O ₃	Ozone
PFC	Perfluorocarbon
PM	Particulate Matter
PWWS	Philadelphia Hot Weather Warning System

QALY	Quality Adjusted Life Years
SF ₆	Sulphur Hexafluoride
SO ₂	Sulphur Dioxide
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
ICNIRP	International Commission for Non-Ionizing Radiation Protection
UK	United Kingdom
IARC	International Agency for Research on Cancer
UV	Ultraviolet Rays
UVI	UV Index
UVR	Ultraviolet Radiation
WASH	Water, Sanitation, Hygiene
WHO	World Health Organization
WMO	World Meteorological Organization

EXECUTIVE SUMMARY

Support Training Module titled “Effects of Climate Change on Human Health” has been prepared within the scope of “Enhancing Required Joint Efforts on Climate Action Project” financed by European Union/IPA II Fund. This module has been prepared under the measurable evidences by examining the theoretical essays, past data and experiences as well as future projections.

In the data provided by NASA, it has been stated that the global temperature increased 1°C since 1880, according to 136 years of records 17 of the hottest 18 years were experienced since 2001, north pole glaciers decreases 13.2% every ten years, sea level rose 3.2 millimeters every year and CO₂ level in the air reached its highest level in the period of 650 thousand years (NASA, 2019).

Climate structure is changing naturally and with the human hand. Change does not remain limited to a single city, region or country; it causes consequences that cross boundaries and affect all sectors. Generally, affected sectors are classified as agriculture, livestock, environment, energy, transportation and health. Even though the effects of climate change on human health module appear to be written to address the health sector, it will be seen in the following sections that there are interactions between the sectors.

Global risks and economic assessments have determined the issue of the future as “climate change”. When the studies made in the field of health are examined, the issues of the future are “genetic structure” of human being and everything outside human being, that is, environmental health. Environmental health field, which works with the pollutants coming from the environment and the health problems caused by them, focuses on climate change and health issue, which trigger each other and got entangled in a vicious circle. Health

problems threatening the whole world such as pollutants beyond boundaries and health, travellers' health and global health are now included under the title of “health problems caused by climate change”.

There are many confusing factors in the studies conducted in the field of environmental health. It has never been easy to say that a single factor leads to a single outcome. In climate change, also, it is difficult to match measurable values such as temperature, glaciers, sea level CO₂ level with health problems one to one. This difficulty leads to the scarcity of research conducted in the field of climate change and health. In policy documents drawn up in relation with climate change, the following points are made; to speed up the studies that deal with health effects among the expectations from future, to study more vigorously the relation between the health indicators and climatic parameters, to increase scientific and social awareness, to establish early warning systems and to develop emergency response and adaptation processes.

“Effects of Climate Change on Human Health” module is a document that contains basic information. The module includes the matters that must be known with priority from among the health problems that are caused and/or that may be caused by climate change. Third section of the module contains the climate, health and economic relation. It is explained in this section that in addition to the global economic burden caused by the changing profile of the climate, health burden are also generated. In other sections, the effects of international and national policies on the climate and health relation and the importance of national works' contribution to the future are emphasized. As of the date the module is published and reached its readers, up to date information may be accessed through the links given in the references section to get information about the new developments.



1. CLIMATE AND HEALTH

All countries are under similar risks against the negative health effects of climate change. Climate change affects the social and environmental determinants of health such as clean air, clean drinking water, sufficient food and safe shelter.

According to conventional sources, climate change may act on health **directly or indirectly**.

Its direct effects are the health problems caused by hot and cold air waves and extreme weather events.

Frequency and intensity of extreme weather events are increasing as a result of climate change. Diseases and deaths occur directly proportional to the intensity of extreme weather conditions such as tornados, floods, whirlwinds, snow and wind storms. In the period between years 2000-2011 in Europe 3.4 million people were affected from floods and 1000 people lost their lives (Ciscar et al., 2011). According to scenarios, if the climate change adaptation activities are not given the required acceleration, number of people affected by floods in 2080 is estimated to be between 775 thousand - 5.5 million (EEA, 2016a).

Extreme weather events may cause injuries, epidemic diseases after disaster, problems such as malnourishment and adverse effects on mental health. Especially among elderly people, temperature rise increases cardiovascular diseases, stroke, hypertension, kidney and respiratory system failures and death risk related with metabolic disorders. If climate change adaptation mechanisms are not developed, it is expected that death rates related with temperature to increase especially in Southern Europe (Ebi et al., 2005).

Its indirect effects are somewhat more complicated.

Environmental consequences of climate change includes temperature rise, extreme precipitation at some locations, drought at some locations, extreme weather events and rising sea levels (Haines et al., 2006). For this reason air, soil, water and food quality and safety are endangered.

As a result of climate change it may be possible that vector diseases, diseases that spread through water, food and animals may change; their areas of incidence and situation of repetition may also change (ibid).

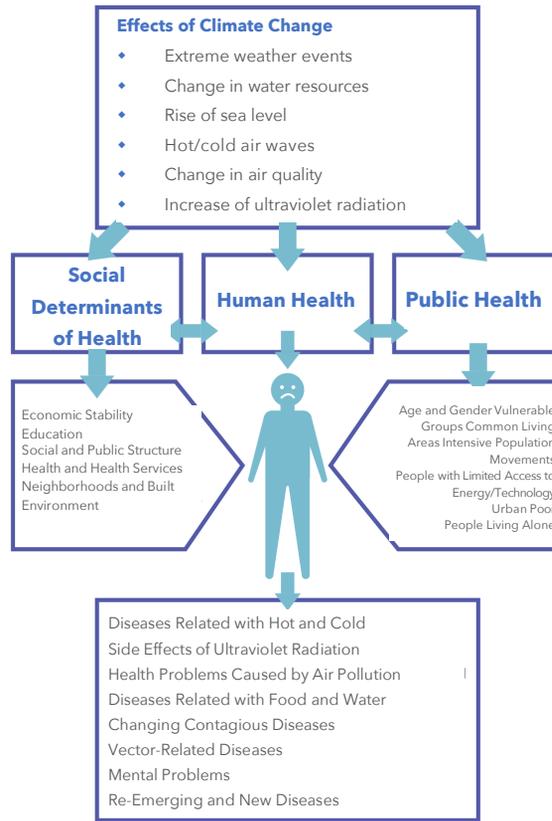
While air pollution causes climate change, it is also affected from climate change. Especially the gases that are emitted as a result of burning fossil fuels are among the basic harmful substances with their atmospheric effects in climate change; they also cause damage to human health directly (Hassan et al., 2016).

According to World Health Organization (WHO), if no measure is taken, food production and food safety will be at risk in Southeastern Europe and Central Asia. Crop productivity is expected to decrease around 30% in Central Asia in the middle of 21st century. This may, in turn, cause insufficient food and, consequently, nourishment disorders (Jakubicka et al., 2010).

Due to changing climate conditions, rising or falling temperatures, insufficient or increasingly polluted water resources and soils losing their fertility, the location displacements began as innocent tourism movements may turn into permanent immigration (IOM, 2019; MEU, 2012). Immigration carries the endemic diseases in the country it starts and the health threatening factors encountered in the immigration route to the country of destination. The endemic diseases in the destination country are also a threat.

It is deemed useful to examine the effects of climate change of health to assist interventions to mitigate these effects.

Figure 1: General Overview of Climate Change Effects on Human Health (Evci Kiraz, 2018)



Effects of climate change regarding its relation to health can be grouped under six headings:

- 1- Extreme weather events
- 2- Change in water resources
- 3- Rise of sea level
- 4- Hot/cold air waves
- 5- Change in air quality
- 6- Increase of ultraviolet radiation

Reflection of these effects are seen primarily on social determinants of health (economic stability, education, social and public structure, health and health services, neighborhoods and built-up environment) then on human and public health. Health problems associated with climate change are as follows:

- 1- Diseases related with hot and cold
- 2- Side effects of ultraviolet radiation
- 3- Health problems caused by air pollution
- 4- Diseases related with food and water
- 5- Changing contagious diseases
- 6- Vector-related diseases
- 7- Mental problems
- 8- Re-emerging and new diseases

The structure of the society affects the frequency and process of the problems listed above. Similarly, public health may change because of these eight problems. Climate change threatens the vulnerable groups present in the society given under seven headings below and their areas.

- 1- Age and gender
- 2- Vulnerable groups
- 3- Common living areas
- 4- Intensive population movements
- 5- People with limited access to energy/technology
- 6- Urban poor
- 7- People living alone

All explanations made about the relation between climate change and health are based on theoretical basis. The strength of evidence pool is still weak. There is a need to generate new data by using research methods, separating-combining disciplines sectors and disciplines at first, second and third stage health organizations, and, enriching with short and long term studies and projections. Analyzing and reporting the data according to evidence level will provide guidance for policy makers.

In addition to scientific production, efforts must be made to increase the awareness of the individuals and the society and to raise their level of knowledge. Especially, performing trainer training activities supported with social communication networks and using methods such as peer training will help to generalize the emerging evidences and training materials. "Development of Monitoring, Prevention, Control and Early Warning Systems on the Effects of Climate Change of Human Health" program must be started with political determination as soon as possible. Combination of theoretically known information and the evidences show that the process now progresses very rapidly and the early warning systems must be developed not for the world but at regional and especially local level (at city, neighborhood, housing compound and house level).

1.1 Diseases Related with Hot and Cold

Number of extremely hot days is increasing and number of cold days is decreasing (US EPA, 2017b; Erlat & Yavaşlı, 2009). Human body that gets used to the summer heat by time cannot make adaptation to sudden temperature changes from physiological aspect. According to urban heat island studies, the most risky living spaces are cities (Erlat & Yavaşlı, 2009; Luber & Michael Mcgeehin, 2008). It is observed that with the increase of hot air waves in cities, death rates also increase (Guo et al., 2012; Semenza et al., 1996).

While 514 people lost their lives in 1995 in Chicago state of United States of America (USA) because of hot air wave; in a study conducted in France in individuals of 65 years of age or older the risk of death during hot air wave was found to be higher in bedbound people, people with cardiovascular diseases or mental diseases, people living in uninsulated old buildings and people whose bedroom is directly under the roof (Guo et al., 2012; Vandentorren et al., 2003).

Similarly, in Catalonia region of Spain, the relation between hot days between the years 1983-2006 and 503,389 deaths in the same period was investigated, it was seen that some external factors such as cardiovascular and respiratory diseases, mental and nerve system disorders, infection and digestion system diseases, diabetes and suicide increased the relation (Basagana et al., 2011). Long term interaction with hot air wave may cause respiratory system disorders (Li et al., 2016). Hot air waves can cause adverse effects on newborns and children, who are physically less resistant than adults (Haines et al., 2006; Basagana et al., 2011).

It has been found that 28 deaths of 1 million deaths occurring in Eastern Europe between the years of 1991-2015 were caused by extreme cold (WHO, 2018a). WHO published a warning for cold air waves

on 28 February 2018 (ibid). In the text of this warning, it was stated that the poor and vulnerable groups are at risk and it explained the health problems that may be caused by cold weather together with the measures that can be taken by health and social services, individuals and the community. In a study conducted in 13 countries by London Hygiene and Tropical Medicine School it has been emphasized with 74 million death data between the years 1985-2012 collected from 384 settlement areas that the number of deaths occurring in moderately cold weathers is higher than the number of deaths occurring in moderately warm weathers (Gasparrini et al., 2015).

When the studies are evaluated in general; it is seen that the cause of death from diseases related with hot and cold are cardiovascular diseases, brain-artery diseases, respiratory system diseases, hypothermia and trauma, diseases associated with cold weather are listed as injuries due to falling, accidents, hypothermia, cardiovascular, respiratory problems, mental health problems such as depression and others (WHO, 2018a; WHO & WMO, 2012).

Climate changes related with hot and cold and resulting health effects are compared in Table 1 (Luber & Michael Mcgeehin, 2008; WHO, 2018a; WHO & WMO, 2012). Risk groups are given in Figure 1 under public health and in Table 1.

Table 1: Hot and Cold Weather, Risks, Health Effects, Risk Groups (Evci Kiraz, 2018)

Risks of Hot and Cold Weather	Health Effects	Risk Groups that Early Warning Must Reach with Priority
<p>1- Number of hot days and nights increases</p> <p>2- Frequency and intensity of hot waves increase</p> <p>3- Fire risk increases with the decrease of precipitation</p>	<ul style="list-style-type: none"> ▪ Increase in deaths related with temperature ▪ Increase in heat stroke and sun stroke ▪ More intense circulatory, cardiovascular, respiratory and kidney diseases especially in workers working outdoors, athletes and elderly people ▪ Increase in premature deaths due to ozone ▪ Injury because of fires especially that broke out during hot air waves, disease due to air pollution, increase in death rates ▪ Respiratory diseases due to increase in PM10 level 	<p>Elderly people</p> <p>Elderly people living alone</p> <p>Bedbound people</p> <p>People with cardiovascular, lung, kidney diseases</p> <p>People whose accommodation conditions, socio-economic conditions are not sufficient</p>
<p>4- Number of cold days and nights decreases</p>	<ul style="list-style-type: none"> ▪ Decrease in deaths due to cold ▪ Decrease in cardiovascular and respiratory diseases in elderly people especially in cold and moderate climates 	<p>Addicts</p> <p>Children</p>
<p>5- Temperature and humidity increase</p> <p>6- Tendency of change and increase in evaporation</p> <p>7- Temperature increases at sea surface and fresh waters</p>	<ul style="list-style-type: none"> ▪ Pathogens' capability to reproduce, resist, spread and cause disease to increase/speed up ▪ Change in geographic and seasonal distribution of cholera, schistosomiasis, harmful sea algae types ▪ Water shortage and personal/social hygiene problems ▪ Increase in water pollution as a result of water caused by floods and infrastructure damage and emerging of risk of diseases transmitted with water 	<p>People with diabetes</p> <p>Pregnant women</p> <p>People with disability and function loss</p>
<p>5- Temperature and humidity increase</p>	<ul style="list-style-type: none"> ▪ Increase in parasites and their power to cause harm ▪ Prolonged seasonal transition periods ▪ Re-emergence of old diseases ▪ Changing distribution and frequency of disease factors 	<p>People working Outdoors</p>

Risks of Hot and Cold Weather	Health Effects	Risk Groups that Early Warning Must Reach with Priority
6- Tendency of change and increase in evaporation	<ul style="list-style-type: none"> ▪ Increased risk of diseases transmitted with vector 	Sportsmen Overweights Street children, homeless people
8- Temperature increases and evaporation changes	<ul style="list-style-type: none"> ▪ Decrease in food production in tropical regions ▪ Difficulty to access food due to decreased supply and increased prices ▪ Combined effect of insufficient nutrition and infections ▪ Short and weak children 	Elderly people Elderly people living alone
9- Temperature and humidity increase	<ul style="list-style-type: none"> ▪ Health problems in people working outdoors and without protection ▪ Decrease in productivity and production 	Bedbound people People with cardiovascular, lung, kidney diseases
10- Extreme and long term heat	<ul style="list-style-type: none"> ▪ Heat cramps ▪ Syncopes due to heat ▪ Heat fatigue ▪ Heat stroke 	People whose accommodation conditions, socio-economic conditions are not sufficient
11- Temperature increases irregularly and extremely	<ul style="list-style-type: none"> ▪ Increase in deaths ▪ Increase in diseases 	Addicts
12- Night temperatures rise	<ul style="list-style-type: none"> ▪ Increase in air pollution and related health risks ▪ Increase in deaths 	Children
13- CO ₂ and temperature increase	<ul style="list-style-type: none"> ▪ Increase in pollen production and related health risks 	People with diabetes
14- Temperatures rise and precipitation distribution becomes irregular	<ul style="list-style-type: none"> ▪ Change in the hazard that causes disease ▪ Increase in the following diseases: <ol style="list-style-type: none"> 1- Avian flue 2- Diseases caused by tick 3- Cholera 4- Ebola 5- Parasites 6- Plague 7- Lyme 8- Harmful sea algae 9- Red fever, malaria 10- Sleeping sickness 11- Tuberculosis 12- Yellow fever 13- Malaria 14- West Nile Virus 15- Chikungunya 16- Dengue Fever 	Pregnant women People with disability and function loss people working outdoors Sportsmen Overweights Street children, homeless people
15- Being threatened by cold weather	<ul style="list-style-type: none"> ▪ Rise in hypothermia risk ▪ Injuries ▪ Increase in deaths ▪ Increase in diseases 	

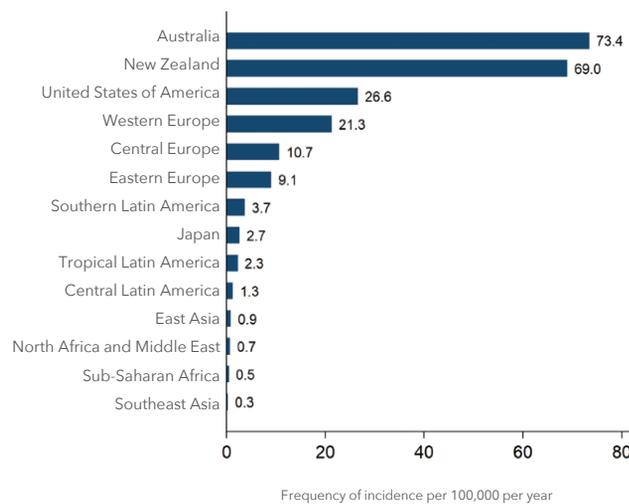
1.2 Side Effects of Ultraviolet Radiation

Ultraviolet radiation (UVR) comes from the sun and helps the body to produce vitamin D. As in everything, too much of it is harmful.

It has side effects changing from aging of the skin to cancer, according to the wavelength.

Malign melanoma is one of the skin cancers which is increasing in the world due to UVR (Figure-2) (WHO & WMO, 2012; Basis et al., 2017). Based on United Nations Environment Program (UNEP) predictions, WHO states that a 10% decrease in stratospheric ozone quantity will cause an additional 300,000 non-melanoma and 4,500 melanoma skin cancer cases over the world every year (Basis et al., 2017).

Figure 2: Global Disease Burden Study-Regional Cutaneous Malign Melanoma Estimated Incidences Taken From 2016 (Basis et al., 2017)



UVR causes cornea, lens and retina damage in the eye. In long time exposure causes photokeratitis; lifelong cumulative exposure causes cataract and other eye damages. A reduction of 10% in total stratospheric ozone quantity causes an additional 1.7 million cataract cases over the world (Basis et al., 2017).

In addition to skin and eye effects, evidences are increasing related with its affecting the immune system, thus increasing tendency to infection diseases and increasing the limitation under the influence of immunization (WHO & WMO, 2012; Cramp & Franklin, 2018).

Unprotected exposure to sun especially in infancy and childhood increases the risk of the above mentioned effects through the whole life.

International Agency for Research on Cancer (IARC) stated in 2009 that 100-400 nm wavelengths of UVR are carcinogenic for humans (Goettsch et al., 1998).



As long as the stratosphere is intact, problems decrease concerning human health. UVR risk also decrease when public awareness is increased.

Ozone is produced over the equator belt in the stratosphere layer. Ozone moves towards the poles with air movements. Total ozone reaches the highest level at these regions. Even though thinning of the ozone layer at Antarctica is explained with the weather conditions specific to this region; industrial halogens are also harmful substances that cause climate change (Republic of Turkey, Ministry of Forestry and Water Works General Directorate of Meteorology, 2016).

For the purpose of UVR risk awareness in the field of public health and to facilitate detection of diseases caused by UVR the UV Index (UVI) was developed WHO, World Meteorology Organization (WMO), UNEP and International Commission for Non-ionizing Radiation Protection (ICNIRP). UVI was introduced in 1995 and published in 2002 in its initially arranged form (US EPA, 2016; Republic of Turkey, Ministry of Agriculture and Forestry, General Directorate of Meteorology, 2019).

The classification in Table 2 is helpful to read UVI (US EPA, 2016; Republic of Turkey, Ministry of Agriculture and Forestry, General Directorate of Meteorology, 2019).

Table 2: UV Index Value, Scale and Health Effects

UV Index Value	Ultraviolet Index Scale	Health Effects
<2	Low	Lowest. Persons except for white, red-headed and very light skinned people can stay under the sun without being burned for one hour between 10.00-16.00 hours when sun is at extreme values.
3-5	Moderate	Low risk. People may stay 20 minutes under the sun without being harmed. However, it is recommended to wear hats with wide visors and sunglasses.
6-7	High	Medium strength ultraviolet radiation. Persons with normal skin can stay under the sun for 15 minutes. They must definitely use hats and sunglasses. Also, persons who will stay in the sun must protect their noses and ears and protective creams must be applied on the lips.
8-10	Very High	High ultraviolet radiation. Persons must not stay under the sun longer than 10 minutes. Hats and sunglasses must be used; people who need to go outside must make use of shadows; pants and long sleeved garments must be preferred. All kinds of outdoors sports must be avoided.
11+	Extreme	Values in this range show the highest risks of ultraviolet radiation on living organisms. Time to stay under sun is limited to 5 minutes. People must not go outside if possible. In case where it is unavoidable to go outside, protection must be taken from sun and measures must be taken for this purpose.
SHADOW RULE	The simplest way to read UVI is to look at your shadow.	If your shadow is taller than yourself (early hours of the morning or late hours of the afternoon) your UVR exposure is low . If your shadow is shorter than yourself (midday) your UVR exposure high .

1.3 Health Problems Caused by Air Pollution

Use of fossil fuels, which are one of the basic sources of climate change, causes air pollution and changing climate also affects the existing air pollution. Protective effect of the atmosphere (warming and insulating) is called "greenhouse effect". Natural and man-made interventions increase the greenhouse effects and average temperature of the earth rises. United Nations Framework Convention on Climate Change (UNFCCC) aims to limit the temperature increase under 2°C with respect to the pre-industrialization value (IPCC, 2015). The main goal is to decrease the source of the natural and man-made interventions, their number, power, intensity, frequency and the conditions that increase them. It has been accepted with Paris Agreement in December 2015 that a global effort is needed for this and more measures must be taken than all the measures taken before with definite and continuous political determination (UNFCCC, 2015).

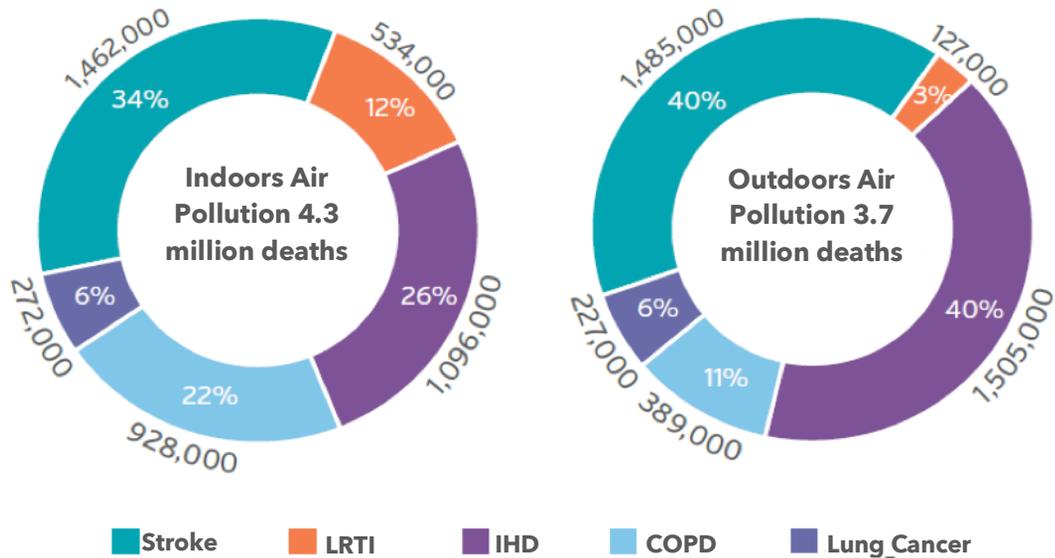
In the air pollution-climate change relation, focus is placed especially on people's transportation, food and energy use preferences. Pollutants that are produced in the use of transportation, food and energy are considered under the heading of greenhouse gas emissions. In the Regulation Concerning Monitoring of Greenhouse Gases, greenhouse gases are listed under six items according to the plants and activities (Official Gazette, 2014):

1. Carbon Dioxide (CO₂)
2. Methane (CH₄)
3. Dinitrogen oxide (N₂O)
4. Hydrofluorocarbons (HFC's)
5. Perfluorocarbons (PFC's)
6. Sulphur Hexafluoride (SF₆)

O₃ (Ozone), water vapor and other gas like atmosphere components are defined as greenhouses gases (Irmak et al., 2015; T.R. Ministry of Forestry and Water Works General Directorate of Meteorology). Sulphur dioxide (SO₂) and particulate matter (PM) are main air pollutants (Tayanç, 2013). PM is being considered more in recent studies (Breath Life, Climate and Clean Air Coalition and WHO).

Air pollution is being held responsible for 7 million deaths per year; 4.3 million of this is due to indoors air pollution and 3.7 million due to outdoors air pollution (Breath Life, Climate and Clean Air Coalition and WHO). Causes of death are listed as stroke, ischemic heart disease, chronic obstructive pulmonary disease (COPD), acute lower respiratory track diseases and lung cancers, as shown in Figure 3 (WHO & UNFCCC, 2015).

Figure 3: Distribution of Causes of Death Due to Indoors and Outdoors Air Pollution, 2012 (WHO)



Indoors Air Pollution 4.3 million deaths
 Outdoors Air Pollution 3.7 million deaths
 Stroke, acute lower respiratory tract infection (LRTI), ischemic heart disease (IHD), chronic obstructive pulmonary disease (COPD), lung cancer

Interaction between the pollutants is one of the most important subjects that must be focused on in the climate and air pollution relation. For more than expected deaths and diseases due to air pollution generally PM_{2.5} connection is held responsible, which is emitted from diesel vehicles and from burning of biomass, coal, kerosene and garbage (Breath Life, Climate and Clean Air Coalition and WHO). Nitrogen oxides (NO_x) emitted from diesel vehicles give ozone and water vapor reaction in the atmosphere (ibid). Ozone is the pollutant which is the cause of serious respiratory track diseases including asthma (Hagenbjörk et al., 2017; Amann et al., 2008). Like ozone, which is called short term climate pollutants, black carbon also stays in the atmosphere for a short time (Breath Life, Climate and Clean Air Coalition and WHO). Black carbon is the basic component of PM_{2.5}, which is harmful for health.

Air Quality Index (AQI) is the classification system to classify the air quality according to the amount of pollutants in the air as good, medium, sensitive, unhealthy, bad and hazardous. AQI decision makers help to explain how healthy the air is for the community and vulnerable groups (US EPA, 2014). When calculating AQI, EPA makes calculation for four major air pollutants: O₃, PM, CO, SO₂. Table 3 gives AQI explanations (ibid).

Air pollution also has effects on airborne allergens. Especially exhaust gases emitted as a result of use of diesel fuel make it easy for pollens to be moved and changes occur in pollenization times because of climate change. Also, high CO₂ and temperature increases pollen production of the plants (Irmak et al., 2015; Bartra et al., 2007).



Table 3: Air Quality Index (AQI) Explanations

AQI	Health Relation	Warning Colors	Meaning
0 - 50	Good	Green	Air quality is considered satisfactory, and air pollution poses little or no risk.
51 - 100	Moderate	Yellow	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
101 - 150	Sensitive	Orange	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
151 - 200	Unhealthy	Red	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
201 - 300	Bad	Purple	Health alert: everyone may experience more serious health effects.
301 - 500	Hazardous	Brown	Health warnings of emergency conditions. The entire population is more likely to be affected.

Even though some cultural and social habits in rural areas are also held responsible, the places where all relations from air pollution and climate change listed above are cities.

The persons who are affected from air pollution the most are children under the age of five-six, chronic patients (asthma, bronchitis, COPD, cardiovascular diseases patients, diabetes patients, etc.) and elderly people. Factors such as low social status (such as homeless persons) lack of access to medical institution (e.g. disaster situations) cigarette/alcohol

addiction, malnutrition increases the effect on these groups even more.

In the studies conducted with housewives, it has been seen that ranges, kitchen stoves, ovens used for cooking purposes, fireplaces used in wells and in activities conducted with the household and in modern houses, fossil fuels burnt in stoves negatively affect human health, in addition to the damages they make on climate (Chafe et al., 2015; WHO, 2014).

1.4 Diseases Related with Food and Water, Changing Contagious Disease Factors

Climate change affects “safe drinking water, sufficient food and safe shelter” conditions that are some the social and environmental determinants of health. While evaluations directed at the past is difficult, 250,000 additional deaths are expected every year between 2030-2050 due to malnutrition, malaria and hot stress caused by climate change (WHO, 2018; EEA, 2016b).

Rising acidity of water in the oceans (26% increase in hydrogen ion concentration, 0.1 change in 150 years) is associated with the accumulation of human produced CO₂ in planktons. When planktons die, they sink down to the bottom of the ocean and make CO₂ permanent for millions of year in the oceans. It must be stated that tropical and poisonous lion fish of Pacific origin began to cross the Red Sea and establish population in Mediterranean ecosystem; they were seen Turkish waters also, and that they will cause damage in Mediterranean ecosystem due to the invasive character of this species. In this context, it is stated that poison of the lion fish cause extreme pain in humans, vomiting, fever, difficulty in breathing, head ache, diarrhea and similar ischemic symptoms; its poison is lethal for allergic people and heart disorders and death incidents were witnessed, though seldom (Akkir, 2017).

High air and water temperatures may cause interruption in the supply of drinking, resting and irrigation water and water cleaning means in intensive precipitation periods and in cases of flood. Climate change may threaten food safety by affecting food chain. In this case, food and water related diseases may be seen at the scale to affect a continent depending on water treatment systems, food sanitation processes, human-society behaviors and other conditions.

Drought is another problem. In the future, in addition to diseases caused by food and water, transmitted with food and water, it will be necessary to deal with health problems caused by scarcity of water. Water shortage starts the cycle such as pollution in water resources like small water resources, canals, lakes and dams, salinization in agricultural fields, diminishing of clean water resources, decrease/differentiation in foods, malnutrition, people’s movement towards food and water resources, rapid population growth, impoverishment, infrastructure problems, diarrhea and other contagious diseases, respiratory system diseases caused by sand storms and all these factors causing problems in provision of health services, spread/epidemics and increase of death rates. The said cycle may be broken or managed with the public health measures conducted by related local units.

Health problems related with hot and cold weather are given in Table 1. Information is summarized in this table about diseases related with food and water and changing contagious disease causes. Information compiled about profile and causes of changing contagious diseases are given below (EEA, 2016b; Ayres et al., 2009):

- Diseases caused by vibrio species increase especially in Baltic Sea region since 1980’s (EEA & JRC, 2016). Sea surface temperature is annually 0.063-0.078^oC between years 1982-2010. This situation creates environmental conditions that favor reproduction of vibrio species in sea waters. An unprecedented Baltic region hot air waves and vibrio infections broke out in 2014
- Rising temperatures increases the salmonella risk. It is an infection of food origin. It is easy to control when food safety and public health principles are followed.

- In regions where extreme precipitation and floods are seen, the risk of Campylobacter and Cryptosporidium may increase.
- It is indicated that there is a relation between high ambient temperature and relatively low humidity and Campylobacter. In regions where precipitations decrease, efforts to make use of rain waters increase. However, the possibility of increase in infections caused by Campylobacter must not be forgotten in rain waters provided for use without cleaning.
- Norovirus causes diseases of viral food origin. Increase is seen in diarrhea cases as a result of increase in precipitation, viral contamination of sea environment and water. As climate studies emphasize increase in precipitation, it is predicted that this factor and the frequency of the diseases it causes will increase.
- Polluted water increases dermatitis, conjunctivitis, lower and upper respiratory tract infections and stimulates the infections of other existing infections and wounds.
- Desert dusts help to carry over 10000 bacteria and fungi over long distances.
- The relation between agents causing respiratory tract diseases such as influenza and rhinovirus and high temperatures is known.
- As a result of human movements that increase as a result of food and water shortage, immigrations caused by climate change, poverty, unplanned and irregular urbanisation, unhealthy common living areas, employment problems, housing problems, weakness of individual health responsibility, as a result of low literacy rate it is indicated that there is increase in tuberculosis and respiratory syncytial virus infections and it will continue to increase.
- Hot and cold air waves, air pollution, precipitation changes, increase in humidity (indoors and outdoors), floods, forest fires, dust storms, etc. change the seasons of pollen and duration, frequency and effects of allergies increase
- Frequency of asthma, rhino sinusitis, COPD and respiratory tract infections vary according to sensitive groups in the community. Hot seasons may reduce the frequency of respiratory system diseases; this is a positive effect.
- With the climate change, it is expected that the diseases whose boundaries are known for the present to go beyond these boundaries. Chikungunya virus infection is supposed to be confined to tropical regions. But, that it was seen in Europe is evidence that its boundaries have changed.
- With the climate change, not only the human movements but also the mobility of the natural life and its direction of motion will change. Changes experienced in the migration of birds and the changes in the cycle of avian influenza viruses can be given as examples to this. As the sea water level rises, environmental reservoirs of enteric pathogens will be affected.

1.5 Diseases Related with Vectors

When the changes in climatic conditions exhibit their effects on ecology and biodiversity, they also change the following:

- Disease pattern
- Disease origin
- Variety, structure, quantity, strength of disease agents
- Means of carrying of agents
- Carriers
- Living and non-living creatures that the agents live on
- Properties of the environment they are found in

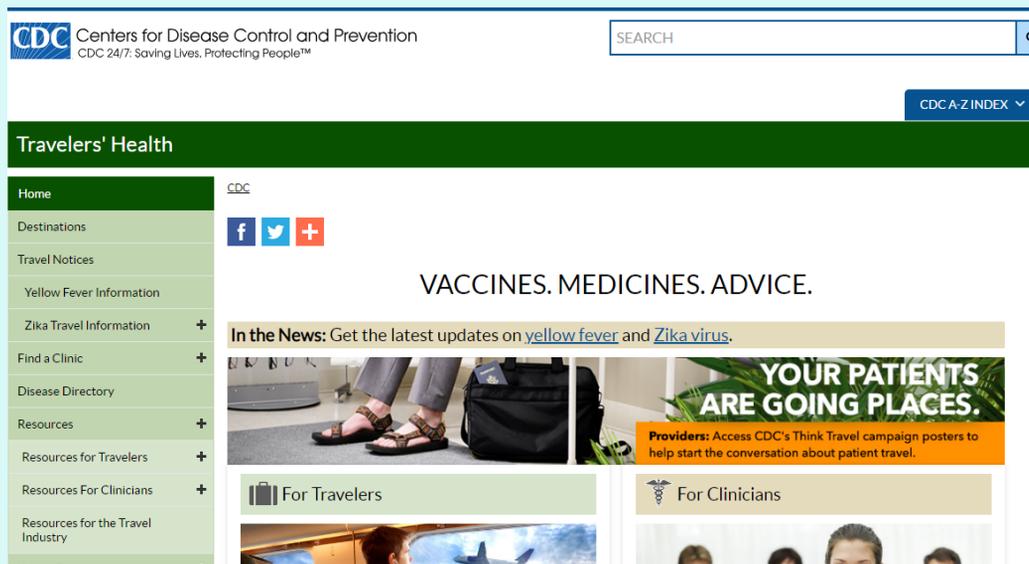
The carriers that are functional in transmitting diseases to humans and animals are called vectors. As seen in Table 1, temperature and humidity changes, extreme precipitation, changes experienced in winter temperatures, urbanisation, increase, decrease and structural changes in vegetation cover cause the vectors to be seen in places other than they are expected and to be present or to multiply more than the foreseen at places where they are expected.

As in contagious diseases, combating vectors can be managed with public health measures by all related

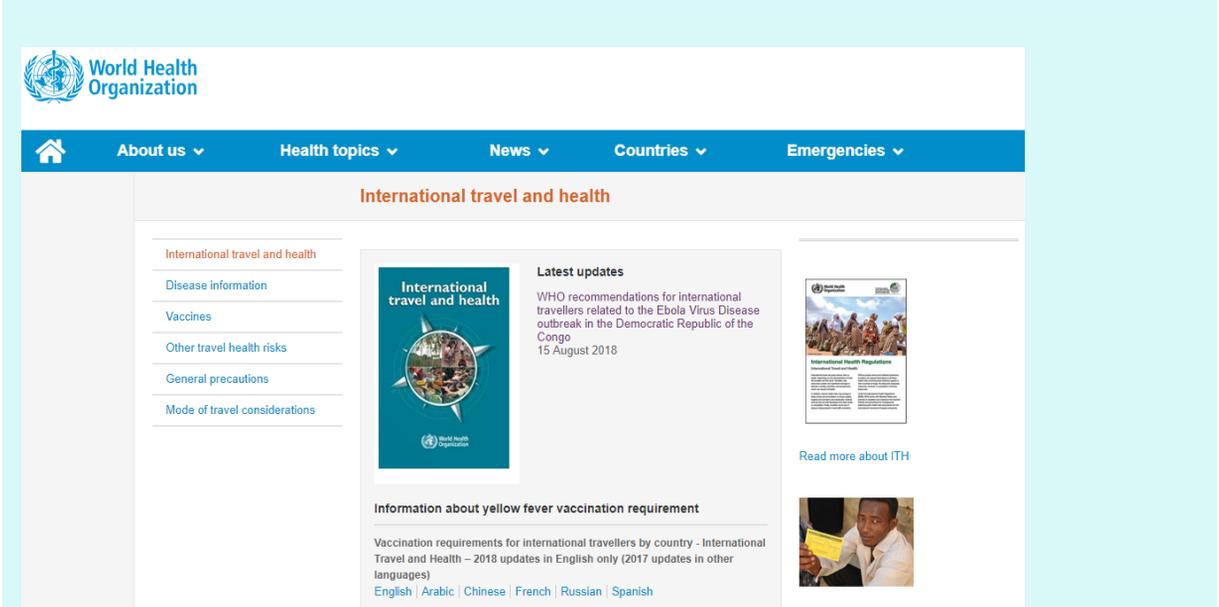
units locally. However, participation of public is also important. They must make contribution to individual vector combating, protection methods and public vector combating in their cities of residence. It is especially useful for the travellers to be knowledgeable about the vectors they will encounter in the countries they travel to and they will bring with them on their return. An integrated and cooperative approach is required for combating vectors. Vectors cause diseases that cross beyond borders.

Information Box-1

Sources of information related with travellers' health:



<https://wwwnc.cdc.gov/travel>



<http://www.who.int/ith/en/>



<http://www.seyahatsagligi.gov.tr/>

For this reason, international standards must be adhered to in the fighting methods. Fighting methods that are used improperly, too much or too little in any region of the world and/or in a house may cause the vector to acquire resistance and require different efforts to reduce their effects. Diseases of vector origin is a field with developed evidence pool and rich in scientific publications. However, there is a need to collect the existing information under the title of "diseases of vector origin related with climate change".

WHO draws attention to the diseases that are transmitted with insects, snails and other cold-blooded animals together with climate change. Schistosomiasis caused by fresh water snails being widespread in China due to climate change can be given as an example (WHO, 2018b). Another example is malaria cases caused by anopheles species mosquitos. It is reported that more than 400,000 deaths occur every year due to malaria spread by anopheles species mosquitos (ibid).

Dengue fever is concentrated in tropical and subtropical regions. Its agent is dengue virus from flavirus family and it is carried and transmitted by aedes species mosquitos (T.R. Ministry of Health Turkey Borders and Coasts Health General Directorate, 2015). The interesting thing about it is that aedes species mosquitos like clean waters, for this reasons it is easy for them to abound in cities. They settle in water collection vessels made by humans (barrels, drums, jars, buckets, vases, bottles, cans, tires, ice holders, etc.) (T.R. Ministry of Health Turkey Borders and Coasts Health General Directorate, 2015; WHO Regional Office for South-East Asia, 2019). In the information booklet published by United States of America Centers for Disease Control and Prevention (CDC) on vector-borne diseases related with climate change, the dangerous vectors constituting the number one health risk for vector-borne diseases are listed as ticks, animal hosts for ticks (such as deers), bacteria

causing Lyme disease and West Nile virus (Centers for Disease Control and Prevention).

Agent of Lyme disease is *Borrelia bourdorferia* bacteria and it is transmitted with biting of *Ixodes ricinus* species ticks that carry the virus. West Nile fever occurs as a result of biting of mosquitos carrying West Nile virus.

Asian Tiger mosquito (*Aedes albopictus*), seen in many cases in Europe, transmits Zika, Dengue and Chikungunya diseases (T.R. Ministry of Health Turkey Borders and Coasts Health General Directorate, 2015). Leishmaniasis must not be forgotten, which is listed by WHO among neglected diseases but began to be seen with climate change; 1 million cutaneous type of which was reported between years 2012-2017 (Çavuş et al., (2017). It is a diseases transmitted to humans by phlebotomus species female sand flies. Crimean-Congo haemorrhagic fever transmitted by *hyalomma* species ticks and tick-borne encephalitis transmitted by *Ixodes* species ticks are also viral diseases.

Extreme precipitations and floods make the rodents move from their habitats and carry the disease agent on them to different regions. Especially rodents forgotten in cities refresh the memories with the effects of climate change again (Irmak, et al., 2015). The relation between rats and leptospirosis (Weil disease) is one of these. Hantavirus, on the other hand, is a virus that does not need vectors, is seen in limited areas and affected much from climate. Its source in nature is rats and similar rodents. Virus released into the environment with body fluids enters the digestive tract with foods or respiratory tract with dusts. Hantaviruses cause "haemorrhagic fever" and "Hantavirus lung syndrome" in humans.

People travelling to tropic regions of Africa and South America are required to have yellow fever vaccination. It is a disease known to be peculiar to these regions, but it is forcing its borders. It is

transmitted with mosquitos of *Aedes* or *Haemagogus* species. According to 2018 data of CDC a total of 10 cases were reported between years 1970-2015 from USA and Europe to West Africa (5), and South America (5) who travelled without vaccination (Gershman & Staples, 2018). 8 of these 10 cases died. Even though yellow fever is a mandatory vaccine and there are works in place to eradicate it, it still maintains its existence.

The regions where the above mentioned diseases are seen as well as the re-emerging/newly emerging diseases that area transmitted with vectors must be mapped, the dimension of being affected from climate change must be investigated, climate changes must be marked on these maps using mapping methods such as geographical information systems in cooperation with related bodies and organizations and they must be put under seasonal and annual follow up.

The basic health measuring method in public health is epidemiology and health indicators. In climate change and health relation, very disciplined and sectored measurement methods and tools are used in addition to epidemiology. Multifaceted analyses must be made; especially short and long term projections must be visualized and monitoring-assessment-reporting process must be speeded up. Climate change is gaining a speed that will challenge the human speed.

1.6 Mental Problems

Mental problems associated with climate change are the most neglected subject in the field of climate change and health. Information obtained from two compilations published in June 2018 supports this view (Hayes et al., 2018; Berry et al., 2018).

It is known that there are many research results aimed at mental disorders associated with disasters such as cold and hot stress, flood, landslide, forest

fires, storm, whirlwind and tornado; post-traumatic stress disorders experienced after war, immigration, accidents, etc.; and mental problems after bad experiences. However, studies that deal with the mental problems that will be/are experienced before these experiences, in the process of preparation for these experiences are much less. And, the field of mental problems caused by climate change is empty.

Since 2007, the importance that media attaches to the issue of climate change and health has increased; it is stated that the rate of discussion of this subject in media reports has gone up to 78% (Hayes et al., 2018). In scientific publications, this increase has become three times (ibid). It is observed that especially extreme weather events and mental problem subjects are dealt with. In the article published by Berry H.L. et al. in April 2018, it has been stated that in 9,672 publications produced between the years 2007-2016 the search "climate change and mental health" terms yielded matches in 208 publications (Berry et al., 2018). Scientists recommend that researches in this field be increased urgently.

There is a complicated relation between mental health and social determinants of health. It looks very difficult to make study in this area. While climate change is affected from social determinants of health, it may also turn the determinants upside down instantaneously or permanently. The difference between climate change and mental health and disasters, etc. is that it deals with issues such as;

- To be prepared for an expected event,
- To meet the event by taking all necessary precautions,
- To be ready with humanitarian feelings for the events that are too big to take precautions,
- To determine one's role/direction in a global common problem that he can never be ready

for but it is evident that it exists/it will come. Studies must be made to warn people ahead of time, to raise awareness, train and make them prepared. Arrangements are needed where policy makers and bodies and individuals that provide mental health services speak the same language in cooperation.

1.7 Re-emerging and New Diseases

All our information is new, within the framework of that can be accessed when writing this section of the report. There may be re-emerging and/or newly emerging health problems associated with climate change as of the date that you read this report.



2. MUTUAL ASSESSMENT OF CLIMATE AND HEALTH ECONOMY

2.1 Research Resources Related with Climate and Health Relationship

Number of theories, scientific records, publications, scientists, organization structures and evidences that explain the climate change is very high; the fund resources that support these works are ever increasing. However, it is difficult to say the same thing for climate change and health relation. The process that was experience in the transition from traditional health to clinical period and from clinical period to public health point of view is being experienced in a similar manner on the subject of climate and health. While climate events and experienced changes look as if they are not the subjects of health sector, WHO began to encourage the health sector to get involved in the issue and to provide support.

European Commission and European Union (EU) allocate support resources for interdisciplinary and intersectoral works. However, while the health specialists are focused on disease-agent-diagnosis-therapy-protection, they preferred to leave the subjects of climate and climate change to their experts. Public health specialists, on the other hand, have drawn the theoretical framework, determined the risks and left the risk management and practical implementation to policy makers and decision makers. Works at the scale of research, evidence collection are being conducted according to individual, regional discipline as much as fund resources suffice, without an organizational context.

Patz and Thomson (2018) included the sentence "new movement in health discourse, risks caused by climate change" in their article titled "Climate Change and Health: Transition from Theoretical to Practical" in 2018. They gave some examples of activities that deal with climate change and health

- American Public Health Association (APHA), 2017 conference with the theme "Climate Changes Health"
- Global Climate and Health Partnership
- Medical Community Consortium on Climate and Health
- Global Green and Healthy Hospital
- Our Planet, Our Health Program
- Belmont Forum

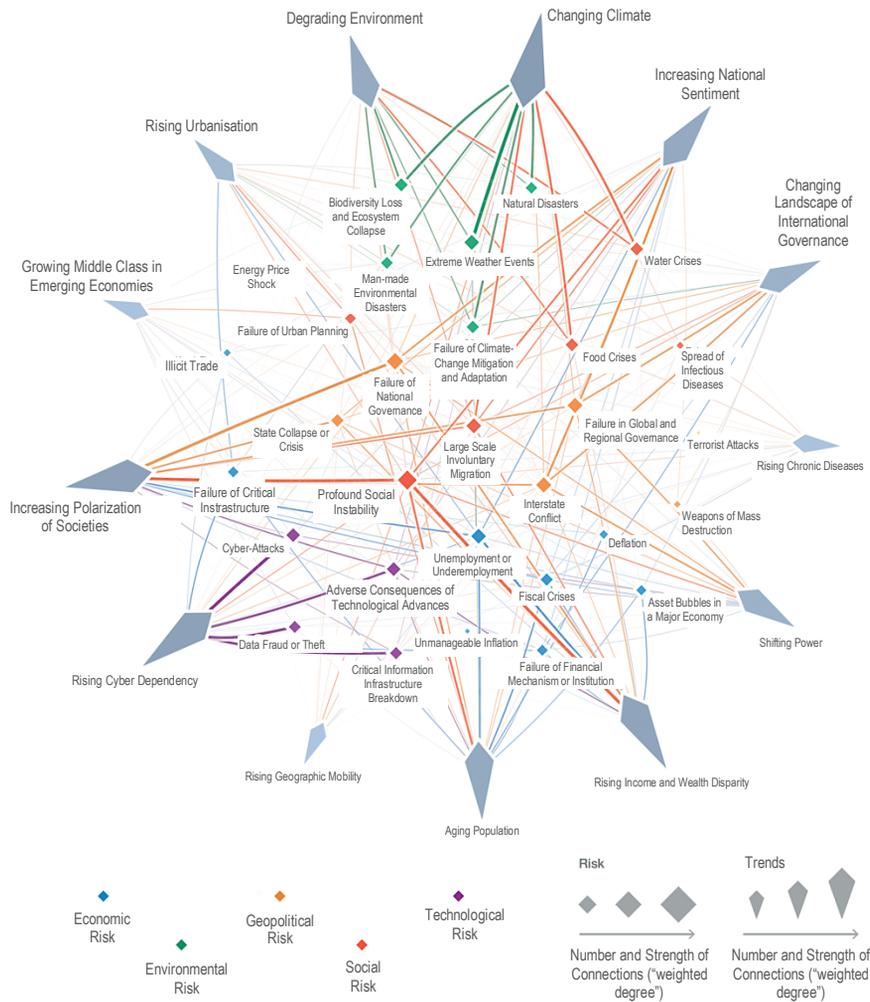
It has been emphasized that applications are being made now to some fund resources on the subjects of climate change and health.

It is quite costly to train researchers, support them and make them professionals for climate and health researches whose network of relations is multi-functional and complicated. There are presently many training programs, specialists and working environments on the subject of climate variables. However, climate and health relationship is limited with the teams that came together for the purpose of health effects of climate change and training programs and working environments special to them.

2.2 Global Economic Risks

Climate change brings global risks with it (Figure 4) (WEF, 2019). Among the important but not definite situations that may affect a large number of countries and sectors in the coming decade, the significance of climate change is increasing steadily. According to "Global Risks 2019" the first five global risks according to the probability of occurrence are extreme weather events, failure in mitigation of climate change and adaptation to it, natural disasters, data fraud and theft and cyber assault. The first five risks according the effects of the risk are weapons of mass destruction, failure in mitigation of climate change and adaptation to it, extreme weather events, water crisis and natural disasters (ibid).

Figure 4: Map of Risks-Tendencies Relations 2019 (World Economic Forum)



The climate change which began to take its place among the environmental risks will begin to be placed among social risks and economic risks with its sub-headings regarding disciplines/sectors that affect/are affected.

2.3 Disease Burden

Health indicators are used to present the public health numerically and to compare it. Disease burden is one of the health indicators. The criteria

used to measure the disease burden are Disability Free Life Expectancy (DFLY), Healthy Life Expectancy (HALE) Disability (DALY), Healthy Life Year (HeALY), Disability Adjusted Life Expectancy (DALE) and Quality Adjusted Life Years; (QALY). While climate changes the health, it also makes contribution to disease burden. Even though this sentence is grammatically positive, the health burden is a negative definition.

Health burden covers individual/social disease cost, individual burden of medical personnel, burden of health services and disease burden. The direct damage cost of climate change on health is estimated to be 2-4 billion dollars until 2030 (WHO, 2018b). This calculation does not include the contribution of sectors that affect health/that determine health.

Disease burden studies do not contain a section such as “climate change and health”. In Global Disease Burden report of WHO global climate change was indicated as an environmental risk in the table of five environmental risks according to regions in 2004 and deaths attributed to the combination of these risks and DALY distribution table (WHO, 2009).

Figure 5: Five Environmental Risks According to Region and Deaths Attributed to Combination of These Five Risks and DALY, 2004 (WHO)

World Health Organization

Figure 5: Deaths and Dalys Attributable to Five Environmental Risks, and All Five Risks Combined by Region, 2004

Risk	World	Low and Medium Income	High Income
Death rate			
Indoors smoke environment caused by solid fuels	3.3	3.9	0.0
Unsafe water, sanitation, hygiene	3.2	3.8	0.1
Outdoors air pollution in cities	2.0	1.9	2.5
Global climate change	0.2	0.3	0.0
Lead poisoning	0.2	0.3	0.0
Total of 5 risks	8.7	9.6	2.6
DALY rate			
Indoors smoke environment caused by solid fuels	2.7	2.9	0.0
Unsafe water, sanitation, hygiene	4.2	4.6	0.3
Outdoors air pollution in cities	0.6	0.6	0.8
Global climate change	0.4	0.4	0.0
Lead poisoning	0.6	0.6	0.1
Total of 5 risks	8.0	8.6	1.2

In the assessment of Global Disease Burden 2016, due to the reason that “global policies focus on the effects of climate change on health”, it is indicated that in the burden studies to be conducted from now on, temperatures and precipitations will also be added as risk factors (GBD 2016 Risk Factors Collaborators, 2017).

As an example of some potential effects of climate change that can be converted to numerical data; it is given that 3% of the deaths in the world in 2004 were from diarrhea, 3% from malaria and 3.8% from dengue fever (WHO, 2009).

Raising the awareness of the public on UVR and the training programs for protection from sun are considered important regarding skin cancer. In a study of WHO conducted in Australia, it was stated that regular use of sun cream of 15 or higher factor since the age of 18 reduces the skin cancer more than 70%.

It was seen that 0.08 dollar expense was made per person per year in this campaign; the cost of skin cancer treatment was 5.70 dollars. It is evident that effective training programs may reduce the health system costs (WHO, 2019b).

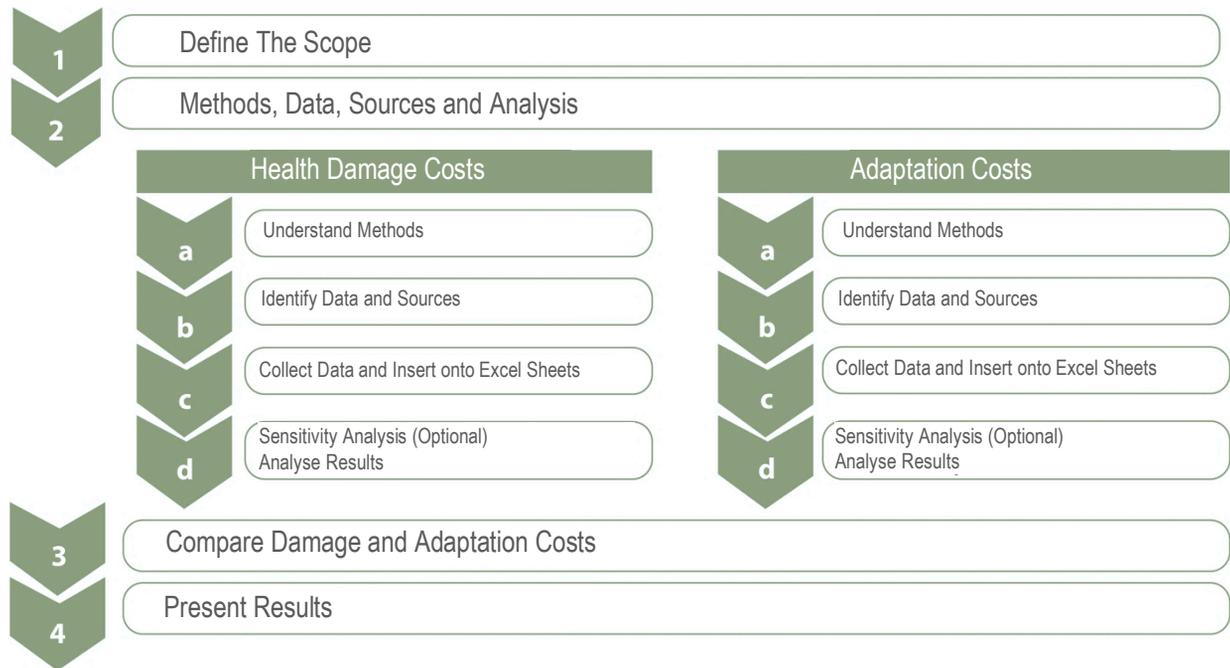


2.4 Adaptation Options to Mitigate Health Effects of Climate Change

WHO published in 2013 "Climate Change and Health: A Tool for Prediction of Health and

Adaptation Costs (WHO, 2013). It is of a nature that will be a guidance for decision makers. It is considered that the relation between climate change and health can be assessed with standard economic data and comparisons between countries/regions may be made more easily.

Figure 6: Climate Change and Health: A Tool to Understand Health and Adaptation Costs –Assessment Steps (WHO)



3. INTERNATIONAL STUDIES ON EFFECTS OF CLIMATE CHANGE ON HUMAN HEALTH

Even though climate change was mentioned at dates that are known as life forming periods, its relation with humans was felt in 900's with the air currents coming from North Atlantic. Swedish scientist Svante Arrhenius claimed in 1890 that fossil fuel consumption may affect the whole world (Arrhenius, 1896). However, it is understood that nobody believed him. In the First World Climate Conference held in 1970 under the leadership of World Meteorology Organization (WMO), it was decided to make a call to governments for determining the climate change caused by human effect and for preventing it (WMO, 1979). In the conference book on page 745 under the heading of "The Interaction of Climate and Society" there is this sentence "Climate effects may change human activities in various aspects". The change aspects given in items are as follows:

- 1- Human health and working capacity
- 2- Residence and settlement
- 3- All types of agriculture
- 4- Development and management of water resources
- 5- Forest resources
- 6- Fishing and sea resources
- 7- Energy generation and consumption
- 8- Industry and trade
- 9- Transportation and communication
- 10- Large number of public services

In 1988 Intergovernmental Panel on Climate Change (IPCC) was founded under the leadership of United Nations to conduct scientific analyses and various researches on global climate change. In 1990, in its First Assessment Report (FAR/AR1), IPCC stated that the temperature of the world

increased 0.5°C in the last century. It gave the warning that if measures are not taken, it will not be possible to prevent global warming. In 1992 in Rio de Janeiro (Brazil) the United Nations Framework Convention on Climate Change has taken its place in the history, which is the first international agreement on the subject. It was decided that the industrialized nations will reduce their greenhouse gas emissions to the level of greenhouse gas emissions of 1990's. A much more active climate policy was intended with 1997 Kyoto Protocol.

While the climate change was being discussed with all its modelings and economic-social consequences, the year 2003 became the third hottest year recorded in the world. The hottest summer of 500 years was experienced in Europe and as a consequence 30,000 people lost their lives. However, there is no climate and health emphasis in Kyoto Protocol. In 2007, IPCC made warning about "sudden and irreversible climate change in its Fourth Assessment Report for Global Warming. In the Durban/South Africa Conference of Parties (countries that are parties to United Nations Framework Convention on Climate Change) held in 2011, emphasis was made on loss of the Amazons, oxygen reduction and mass deaths.

In year 2018, it is seen that there is no deviation from the points of view set forth in the First World Climate Conference in 1979. However, even though human health was at the first place in this conference, it is seen that it slipped from the first place to the lower places.

In 1990's "climate change and health relationship" began to be placed on agenda in the assessments of IPCC and WHO. It was defined as an area which has the potential to develop and which must be focused on. When 1990-1992 assessments of IPCC are examined it is seen under the heading "Human Health" that there is the sentence "human being's capacity to adapt to climatic conditions is very high

(IPCC, 1992). Five articles coming after that are summarized below:

- 1- Hot air waves may increase the death risk at unexpected levels
- 2- With the increase in UVB risk, rise is expected in incidences of skin cancer, cataract and snow blindness
- 3- It is possible for the parasites and viral diseases to increase and for the countries to be re-subjected to these diseases
- 4- Water quality and accessibility will affect the human health.
- 5- In countries where meals are cooked with biomass, malnutrition may be seen more due to the reasons such as famine, insufficient access to healthy water because of desertification.

At the end of the 1990's, an increase was observed in the subject in some scientific disciplines. Some people used the expression "Scientific Nostradamus" in articles concerning the relation between climate and health (Reiter, 2008). In IPCC Second Assessment Report (AR2) of 1996 it was reported that there were limited number of scientific publications on health effects of climate change (IPCC). It was seen that the existing publications were related with natural events such as El Nino and extreme weather events.

2000's began to become the scene of studies that enrich the evidence pool of the relation between climate and health. World Health Report emphasized in 2002 that there was a need for modelings that would yield numerical data to present the climate change and health effects. Climate change was included in the report in the table of environmental risks that affect health (WHO, 2019c).

In 2008 when WHO was celebrating its 60th year, it designated the theme of the World Health Day as

"Let Us Protect Our Health Against Climate Change". Thus, the subject was taken into consideration for one year at the level of countries. This year may be considered as a step whereby climate change and health relation was placed in future plans so that it will not be a neglected issue. The same year, WHO announced the new climate change and health decision in the World Health Assembly (WHO, 2008). According to this;

- Health sector must direct its attention at the highest level to protection of human health against climate change
- Solutions must be produced covering global health risks including climate change for attaining the thousand year goals and for equality in health
- Awareness of all parties must be raised, cooperation must be improved, capacity must be increased
- National health sector must be mobilized, numerical data must be collected, monitoring and adaptation works must be conducted
- Public health leaders must be prepared to provide fast, comprehensive responses
- Interdisciplinary and intersectoral works must be speeded up.

In 2010, WHO promoted the first global project for public health adaptation to climate change together with United Nations Development Program (UNDP) (WHO, 2019d). It was considered the beginning of a series of projects to increase the adaptation capacities of organizations in national health systems, to include the health workers in the field and to strengthen them to counter the climate-sensitive health risks. They were conducted in Barbados, Bhutan, China, Fiji, Kenya, Jordan and Uzbekistan by ministries of health and other related bodies and organizations.

They covered activities such as early warning systems, determining the roles of national parties,

interventions to decrease the health risks and sharing of documents and experiences. Each country focused on different subjects according to its requirements. For example, China conducted works to strengthen the early warning system in hot weathers in cities, Jordan worked on control of diseases with diarrhea while using safe waste water recycling for fighting against water shortage, Bhutan and Kenya, both of which are at high altitudes, and Barbados and Fiji, both of which are island nations, conducted studies on changes experienced in vector-borne diseases.

In 2011, the first Global Climate and Health Summit convened. The summit, that convened in Durban, South Africa, became the founding place of Global Climate and Health Alliance.

Three projects of European Commission Joint Research Center were prepared in 2011 to produce predictions for the period 2011-2100. With PESETA II project, effects of climate on multiple sectors in Europe are being assessed (Paci, 2014). It is intended to obtain numerical data with modelings including health sector between years 2011-2100. Effects of hot and hit air waves on death and disease are prioritized. ClimateCost is a FP7 research project started the same with a similar method.

Three health consequences of climate change were studied in this project: decreasing work productivity, deaths associated with temperature, Salmonellosis. Health economy aspect was also added to the study. In PHEWE project, events experienced in 15 European countries were studied for the purpose of assessing and preventing sudden health effects of weather events. The relation between weather, death and hospital applications was studied with the time series approach and special and pooled analyses for the cities. Threshold values, latent period and accumulated influences were determined.

Seven Nations Initiative was founded to protect human health from climate change; its first report was announced in 2010 and other results in 2013. Activities focused on adaptation to climate change, strengthening health system and structuring organizational capacity were conducted by WHO Europe Regional Office, German Federal Environment Ministry, Nature Protection and Nuclear Safety in Albania, Kazakhstan, Kirgizstan, Russian Federation, Tajikistan, Macedonia and Uzbekistan. It is an important project for implementation, monitoring and assessment of WHO climate change and health action plan at local level.

In the section related with climate change and health effects prepared by Smith et al. (2014) it is possible to find the results of long term observations in Africa and Asia, intervention work for the purpose of controlling Dengue fever, assessment of health and economic effects that are not dependent on climate, of CO₂ and other pollutants disturbing the climate, results of a large number of compilations and researches. The relation between climate and health was classified by making use of the results of the study, which was published between years 2007-2013.

In December 2015, in Paris at the UN Framework Convention on Climate Change 21st Conference of Parties (COP21) Paris Agreement was adopted. Participants of COP23, convened in Bonn, Germany in 2017, witnessed a high level intersectoral event titled "Health Movement for the Implementation of Paris Agreement. Global Climate and Health Summit, convened on 11 November 2017, emphasized that global response capacity should be increased for effects of climate change on human health.

An example of country implementation is "Building adaptation to climate change in health in least developed countries through resilient water,

sanitation and hygiene (WASH)" project, which is supported by United Kingdom (UK) International Development Unit. This project is an adaptation project implemented in Bangladesh, Nepal and Tanzania in the period 2013-2018 (WHO, 2019d). It is a project in the series of adaptation projects started in 2010.

The other adaptation projects are;

- Building resilience of health systems in Pacific Island LDCs to climate change
- The Global Framework for Climate Services (GFCS) Adaptation Programme in Africa
- Adaptation to climate change in the health sector: Improving engagement, evidence and action in sub-Saharan African countries

- Norway - WHO collaboration on "Building sustainable health systems: Focus on climate resilience", it is explained in detail on web page <http://www.who.int/globalchange/projects/en> under the title of Cooperation with WHO (ibid).

In WHO 71st World Health Assembly, convened in Geneva in May 2018; WHO, United Nations Environment Program (UNEP) and WMO founded the health, environment and climate change global coalition (WHO, 2018). This movement focuses on decreasing 12.6 million deaths per year caused by environmental risks, especially air pollution, and on establishing cooperation in its true sense; what this movement will bring is the next most important climate change and health agenda item (ibid).

Information Box-2

Adaptation Options to Mitigate Health Effects of Climate Change (IPCC Assessment Report [WHO, 2013])

Health Effects	Legislation	Technical Information	Training Consultancy	Culture and Behavior
Thermal Stress	Development	Residence , Government Buildings, City Planning to Reduce Heat Islands, Acclimatization	Early Warning System	Clothing, Noon Sleep/Break
Extreme Weather Events	Planning Development Immigration Economic Incentives	City Planning Storm Shelters	Early Warning System	Using Storm Shelters
Air Quality	Emission Traffic	Public Transport, Catalytic Converter, Factory Chimneys	Pollution Alert	Car Sharing
Vector-Borne Diseases		Vector Control Immunization, Protective Covers Sustainable Surveillance, Protection and Control Programs	Health Education	Water Storage Practices
Water-Borne Diseases	Basin Protection Water Quality	Genetic/Molecular Monitoring of Pathogens Improvement of Water Treatment Improvement of Sanitation	Boiled Water Alert	Hand Washing and Other Hygiene Behaviors Use of Cesspool

4. TURKEY'S CLIMATE AND HEALTH POLICIES

Turkey has always been involved in every stage of international climate developments and has been trying to fulfill its national responsibilities. Turkey's recent policy documents related with climate change and health connection are "National Climate Change Strategy (2010-2020)", "T.R. Climate Change Action Plan (2011-2023)" and Turkey's Climate Change Adaptation Strategy and Action Plan (2011-2023). In these strategies and plans, there are goals and actions about the health aspect of climate change. In this context, all bodies and organizations are expected to prepare their own action plans.

In fact, when the decisions of "Environment and Health Ministers Meetings (since 1989) and initial outputs of "National Environment and Health Action Plan" (1999-2001), Healthy Cities Project (since 1993) are examined, it is seen that the issues mentioned in the relation of climate change and health are taken into consideration under different headings. For example; malaria-vector borne diseases, UVR-environmental health, CO₂-air pollution, healthy city planning- opening air corridors in city planning, etc.

Ministry of Health has been making contributions to climate change activities since the beginning and it is also in the position of manager of the activities in the field of health. Ministry of Health has started preparations for an action plan to mitigate the health effects of climate change as support to climate change action plan.

The starting point of Turkey's climate and health policies should be taken as 2010. In the process started in 2010, two meetings were held in Ankara in 2011 and 2013 with the financial support of WHO. WHO and stakeholder organizations (Republic of Turkey, Ministry of Environment and Urbanisation, Ministry of National Education, Ministry of Agriculture and Forestry, AFAD, Ministry of Energy and Natural Resources, universities and other related government bodies and organizations) made contribution to the activity.

All stakeholders were brought together in the workshop organized on 5-6 December 2013 in Ankara by Public Health Institute of Ministry of Health, Turkey and "National Program and Action Plan for Mitigating Adverse Effects of Climate Change on Health" work was started. Program and Action Plan was approved on 21 January 2015. On 10 April 2015 "National Program and Action Plan for Mitigating Adverse Effects of Climate Change on Health Opening Meeting" was held and National



Program and Action Plan presentation were made. On 12 January 2016 opinions of related bodies, and organizations as well as academicians were taken with the "National Program and Action Plan for Mitigating Adverse Effects of Climate Change on Health Conference of Parties" organized by Ministry of Health Turkey Public Health Authority and a working schedule was drawn up. Then, on 5-6 April 2016 commissions were formed for implementation with "National Program and Action Plan for Mitigating Adverse Effects of Climate Change on Health Workshop".

The contribution of National Program and Action Plan on climate change and health area was expected to be under the following headings:

- A-** Mitigation of extreme weather events (extreme precipitation, extreme hot and cold weathers, air pollution) and natural disasters (flood, fire, etc.) as a consequence of these on human health and social life
- B-** Strengthening the institutional infrastructure for monitoring the diseases that are seen and/or that increased in our country as a result of climate change, increasing cooperation in the organization and between organizations
- C-** Ensuring water and food safety, combating diseases of water and food origin
- D-** Conducting necessary activities for sensitive groups not to be affected by adverse effects of climate change
- E-** Mitigating health instructions' negative contributions to climate change
- F-** Raising awareness of public for more effective protection from negative effects of climate change on health
- G-** Conducting monitoring and assessment activities.

In line with the works of the commissions goals were determined, strategies were established and activities were listed. In addition to technical, clerical

and scientific developments it was seen that the time has come to provide information, raise awareness and provide warning at national, regional, local, city, neighborhood scale and to generate general/special models to respond the warning rapidly.

The answer to the question "what can be done from now on" is given below:

- Maintain the commission activities
- Training programs
- Regional publicity meetings, workshops, field works, media, visibility materials, etc.
- Ensure integration of activities with other "city, environment, health" activities
- Complete activities on time
- Improve monitoring and assessment methodology (local, regional, national), ensure integration with other systems
- Convert indicators to evidence, publish in evidence pools
- National and international sharing.

On 19 April 2016, "National Program and Action Plan for Mitigating Adverse Effects of Climate Change on Health Training Meeting" was held in Bursa and the first step was taken for local functionality of the action plan. Health sector workers selected from provinces received the first trainer training on health effects in Ankara on 13-14 September 2017 and they were asked to convey the information they acquired in this training to other health personnel in their provinces.

"International Water and Health Congress", started in 2015, and "International City, Environment and Health Congress", started in 2016, are two important events that consider the effect of climate change on health in a multi-dimensional way. They have taken their places in climate and health history of Turkey with their activities of bringing together a large number of disciplines and sectors and guiding

national and international scientific and practical parties to negotiation for taking real steps.

It would be expected to have scientific works, projects, theses and similar titles in this section that deal with climate and health relation in Turkey. However, a compilation at a level to meet such a requirement has not been made yet. When the subject headings are examined that are on the agenda it is seen that such subjects are being discussed as climate effects caused by use of energy resources and their possible health effects, health problems, that are not dependent on climate, caused by risk factors that disturb the climate, diseases related with traveling, increase in diseases that existed before but not seen for a long time, vector borne diseases and increase in cancer cases.

“Climate Risk Case Study, Pilot Climate Change Adaptation Market Study: Turkey” drawn up by Baglee et al. (2013) was published in 2013. In this study, health was considered as one of the risk categories in the adaptation of private sector to the climate change.

The thesis titled “Early Warning Model Aimed at Air Variables in Primary Protection (Researcher: Dr. Burcu Diliüz Doğan, Consultant: Prof. Dr. E. Didem Evcı Kiraz)”, which was implemented by Aydın Adnan Menderes University in June 2014 - August 2016 is the most recent climate and health study (Diliüz Doğan & Evcı Kiraz, 2016).

This study was planned for developing “local early warning system model” to protect, raise awareness and prepare the society on air variables. It was foreseen to raise the awareness of the participants in the intervention group and increase their behavior by sending warning and information messages with sms and e-mails about air variables.

The study is an intervention study to determine the awareness levels experienced at intervention and

control groups selected in Aydın Province Central Efeler Township before and after the intervention on extreme hot weather, high UV index and extreme air pollution issues. The study was conducted between June 2014 and August 2016. G-Power was used to determine the study sample. Sample size was taken as 1000 persons by taking $d=0.2$ $power=0.80$ and 20% contingency. Within the scope of intervention, 1- Message series, 2- Web page were prepared. In this context, the awareness and behaviors of the intervention and control groups were determined with the applied survey.

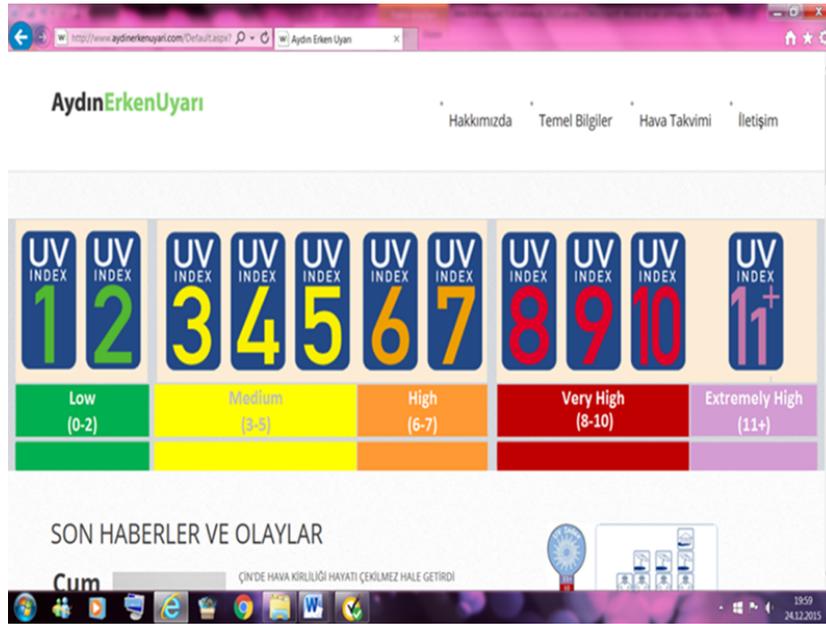
Using the prepared computer program warning and information messages were sent with sms and e-mail for a period of one year to the intervention group when the threshold values specified for air temperature, UV index and air quality index (air temperature: 27°C, UV index: 6 and air quality index: 101) were exceeded. Information was provided to the public with the web site www.aydinerkenuyari.com. The web page started to broadcast on 26.06.2015. This web site was open to both the participants and the general public; it broadcast daily weather report, UV index values, humidity ratio and AQI values. Information was compiled from literature and shared on the web page under the headings of climate change, latest news on extreme weather events, basic information on subjects such as health effects of extreme hot weathers, what the UV index is and harmful effects of too much sun rays, skin cancers, air pollution and its effects on human health and AQI.



In-service training program was organized on 28.12.2015 for hospital personnel in Adnan Menderes University Hospital with the senior class Faculty of Medicine students who were given training on climate change and health effects. A public panel was held in Adnan Menderes University

Ataturk Culture Center Miletos Hall on 30 March 2016 on "Climate Change and Health" with the participation of Aydın Public Health Directorate, Aydın Provincial Environment and Urbanisation Directorate, Aydın Meteorology Directorate and academicians from the University as speakers.

See. www.aydinerkenuyari.com



Sample Messages

Messages Related with High Temperature and UV Index

- Some of the rays coming from sun are called ultraviolet rays (UV).
- Classification of the amount of UV radiation between 0-15 when sun is at the summit which is expected to reach earth that can be harmful for human health is called UV Index.
- UV index lower than 2 is LOW, between 3-5 is MEDIUM, between 6-7 is HIGH, between 8-10 is VERY HIGH, 11 and higher is EXTREMELY HIGH. High UV index is harmful for humans.
- Hello, the highest temperature expected in Aydın today is and ultraviolet level of sun is
- isDo not forget to drink water. Do not go to the sun if not necessary.
- Hello, the highest temperature expected in Aydın today is and ultraviolet level of sun isDo not forget to use hat and sunglasses and apply sun cream
- The highest expected temperature is and ultraviolet level of sun is Please wear light colored, lightweight, loose fitting dresses made of close-woven cotton fabric.
- Hello, the highest temperature expected in Aydın today is and ultraviolet level of sun is Protect the elderly, sick and children.

Messages Related with Air Pollution and Air Quality Index

- Air pollution is the presence of pollutants such as dust, smoke, gas and water vapor in the air at a level that will cause harm to humans and other living organisms. Air pollution has important effects on human health.
- Health effects of air pollution vary from coughing to bronchitis, heart disease and lung cancer.
- Risk groups for air pollution are elderly people, babies and children in growing age, pregnant and suckling women, people with respiratory and circulatory system diseases and cigarette smokers
- You can obtain detailed information on prevention of air pollution at the web address <http://www.aydinerkenuyari.com>.
- Air Quality Index (AQI) is an index that classifies the air quality as good, medium, sensitive, unhealthy, bad and dangerous.
- AQI between 0-50 is GOOD, between 51-100 is MEDIUM, between 101-150 SENSITIVE, between 151-200 is UNHEALTHY, between 201-300 is BAD, between 301-500 is DANGEROUS.
- Hello, air quality index in Aydın at the moment is(class). Do not go outside unless necessary.
- Hello, air quality index in Aydın at the moment is(class). Do not open the doors and windows of the place you are in, unless necessary.
- Hello, air quality index in Aydın at the moment is(class). If you have to go outside cover your nose and mouth with scarf, muffler or mask.

Changes in awareness and behaviors were assessed at the end of one year by conducting another survey. A total of 882 persons were contacted; 440 of these were from intervention group and 442 from control

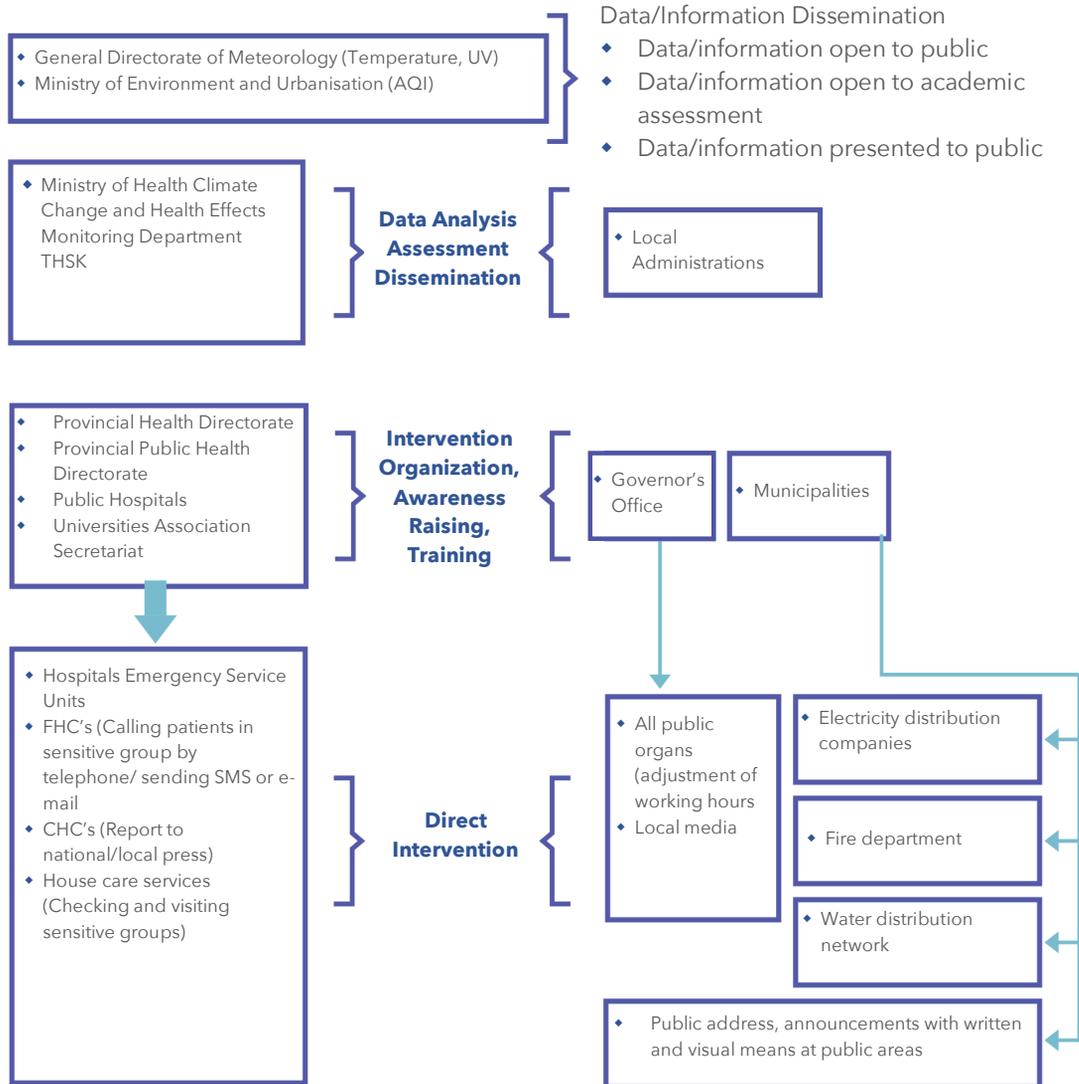
group. Participants' average age was calculated as $41,26 \pm 14,64$. Regarding gender, 55,9% of the participants (n=493) were women, 44,1% (n=389) were men. It was seen that 60.0% of 882 participants (n= 529) were included in at least one of the sensitive groups, and 40.0% (n=353) were not in any sensitive group. It was found that 31.9% (n=281) of the participants were in sensitive groups themselves, 48.3% (n=426) has individuals living in their houses. Before the intervention, the situation of hearing "Extreme Hot Weather", "UV Index" and "Extreme Air Pollution" terms were questioned. After the intervention, the situation of hearing "UV Index" and "Extreme Air Pollution" terms were increased significantly. When the intervention group's temperature points, UV points and air pollution points before and after the intervention were assessed, a significant increase was observed. It was also found that the intervention group's behavior points for protection from extreme air temperature, sun and extreme air pollution before and after the intervention increased statistically significantly. The temperature points, UV points and air pollution points and behavior points protection from extreme air temperature, sun and extreme air pollution of the persons in a sensitive group the intervention group before and after the intervention also increased statistically significantly.

At the end of the study it was observed that monitoring the threshold values of air variables and alerting the society with sms, e-mail, etc. digital media in cases where threshold values are exceeded raised awareness in the participants and changed their behavior positively. Starting from the obtained results, a local early warning system recommendation was made (Figure 7). According to this; the process will begin with sharing of the related data and information in government, public and academic data bases and it will continue with assessment, dissemination, intervention organization, awareness raising, training and it will be concluded with direct intervention.

The organizations and units foreseen to be included in the process are presented in Figure 7. The last training session was organized by the Ministry of Health on 28 November 2018 for

provincial health directorates' environmental health employees for one day to give them information.

Figure 7: Early Warning System Recommendation Schematic (Diliuz Doğan & Evcı Kiraz, 2016)



5. TURKEY'S FUTURE PERCEPTION INTEGRATING CLIMATE CHANGE POLICIES AND HEALTH POLICIES

Turkey is trying to take the necessary steps in line with international arrangements on international arrangements related with climate change. In the light of the information given in Section 5 and new developments, the integrating points of climate and health policies in Turkey are the following:

- The goal, targets and actions included in human health section of Turkey's Climate

Change Adaptation Strategy and Action Plan (2011-2023) are given in Table 4.

- The basic goal of National Program and Action Plan for Mitigating Adverse Effects of Climate Change on Health is protection against adverse health effects to be caused by the climate change and taking necessary health precautions for disaster situations. Targets are listed under seven headings. For each target; strategies, activities, responsible organizations, duration, monitoring assessment and indicators are indicated (Table 4).

Table 4: Framework Policy Documents for the Assessment of Climate and Health Relation in Turkey

Climate Change Adaptation Strategy and Action Plan (2011-2023)	National Program and Action Plan for Mitigating Adverse Effects of Climate Change on Health (2015-2019)	24. Conference of Parties (COP24) WHO Special Report- Health and Climate Change (2018)
Goal 1: Determining the present and future effects and risks of climate change on human health	Goal: Protection against adverse health effects to be caused by the climate change and taking necessary health precautions for disaster situations	Goal: Increasing the power of Paris Agreement, which is the strongest public health agreement of the century
Target 1. Investigating the effects of extreme weather events on human health	Target 1. Mitigation of extreme weather events (extreme precipitation, extreme hot and cold weathers, air pollution) and natural disasters (flood, fire, etc.) as a consequence of these on human health	Recommendation 1. Determining the activities to reduce air pollution in line with Paris Agreement taking into consideration special obligations for carbon emissions short term climate pollutants and encouraging them
Target 2. Investigating the connection between the climate change and contagious diseases and health risks, monitoring it and taking necessary precautions	Target 2. Strengthening the institutional infrastructure for monitoring the diseases that are seen and/or that increased in our country as a result of climate change, increasing cooperation in the organization and between organizations.	Recommendation 2. Including all adaptation criteria related with health into economic and financial policies
Goal 2: Increasing the capacity in the national health system to combat	Target 3. Ensuring water and food safety, combating diseases of water and food origin.	Recommendation 3. Taking health under guarantee

risks caused by climate change		
Target 1. Drawing up emergency action plans in risk regions and provision of necessary infrastructure	Target 4. Conducting necessary activities for sensitive groups not to be affected by adverse effects of climate change.	Recommendation 4. Removing previously existing investment obstacles in adaptation to climate change in the field of health
Target 2. Strengthening the capacities of health sector organizations against health risks caused by climate change	Target 5. Mitigating health instructions' negative contributions to climate change.	Recommendation 5. Increasing the advocacy of health sector in climate change activities
	Target 6. Raising awareness of public for more effective protection from negative effects of climate change on health.	Recommendation 6. Local governments and related sectors having priority in climate change approaches
	Target 7. Conducting monitoring and assessment activities.	Recommendation 7. Establishing a system to regularly monitor and report the health results in the process of adaptation to climate change

- The decision taken by in WHO, of which Turkey is a member, in 71st World Health Assembly, in Geneva in May 2018 is "to decrease annual 12.6 million deaths caused by environmental risks and especially air pollution". A call was made in the Assembly to implement the Paris Agreement urgently (WHO, 2018c).
- 24th Conference of Parties 24 (COP24) convened on 2-14 December 2018 in Poland's Katowice city. It was decided to transform the requirements of Paris Agreement into action (COP 24, 2018). When the discussions are examined, it is seen that Katowice decisions are important for the days when future generations will call their ancestors to account.
- In line with the request in COP 23, WHO prepared a comprehensive "Health and Climate Change Report" for the first time. The report was presented in December 2018 in COP 24 (WHO, 2018d). There are seven recommendations in the report for health

changes brought about by climate change (Table 4).

- "WHO Health and Climate Change Report - 2018" is the first in presenting an integrating future vision for all countries and it is a very important framework policy document. Countries were warned with a strong language to act urgently and rapidly. Turkey has presented its political determination with its policy documents, designated its stakeholders and is ready for implementation.

It must review its preparations for implementation and complete them rapidly. According to WHO report, implementation must focus on the process of adaptation to climate change. However, there are some steps Turkey must take before the process of adaptation.



1- The trainings being held since 2015 National Program and Action Plan for Mitigating the Adverse Effects of Climate Change on Health must be speeded up. **Trained human force capacity** must be increases in the field of climate change and health. It must not be limited to health sector, the other stakeholders must be included in the training and a common language must be formed on the effects of climate change on human health.

2- It is known that the persons in the community considered as **sensitive from health point of view** are affected more rapidly and severely from climate change. In a study conducted in USA, the potential effects of climate change and variation on health were investigated. The group consisting of academicians, government employees and private sector representatives came to the conclusion that it is required to be cautious against climate conditions and to improve the public health policies to mitigate the effects on sensitive groups (Patz et al., 2000).

In this context, integrated programs may be developed in Turkey to provide information to sensitive groups on frequently encountered events due to climate change, to arrange their places of living, alert sensitive groups, direct them to places where they can receive service and to receive service with priority because of events caused by climate change.

3- The role of **early warning systems** is great for minimizing the health effects in climate change. In Turkey, there is a "Health Effects Early Warning and Response Department" in the Ministry of Health under the General Directorate of Public Health. The Ministry of Health has the necessary infrastructure to determine the early warning components related with health effects of climate change and to start implementation. According to WHO report, necessary capacity must be reached to manage data collection, analysis, assessment, early warning and mobilize the stakeholders. It is recommended in USA

to make early warning systems, extreme temperature emergency plans, management plans for temperature related diseases, beyond the change of individual behavior (ibid). Aydın project in Turkey is an exemplary study in this regard (Diliüz Doğan & Evcı Kiraz, 2016). In a study conducted in 33 EU member countries, it was investigated whether they have early warning systems against hot air waves. It was found that there are have early warning systems against hot air waves in 12 EU countries. They were examined regarding action thresholds, notice giving strategies, message means, communication and dissemination strategies, prevention strategies and designated target groups. Even though there were similarities in many areas, it was seen that they had differences in their basic properties. Hot air wave action plans were generally arranged in phases related with "forecast", "monitoring", "warning" and "alarm". In the warning model in the study there are "forecast", "monitoring" and "warning" phases. While national and local response systems were detected in general, response systems at city level were detected in Former Yugoslav Republic of Macedonia, Holland and Italy. There are various parameters that the said countries use for hot air wave warning system. Threshold values of maximum temperature, minimum temperature, temperature index (combining air temperature and humidity) and some other combinations of temperature as well as continuity are used as basis. The use of temperature threshold is the simplest of the warning systems. Temperature can be used by itself or other meteorological data can be used for warning. Spain, France, United Kingdom and Portugal use maximum (Tmax) and minimum (Tmin) temperature. In USA and Canada temperature data is used together with humidity values (Miami Miller School of Medicine Department of Public Health Sciences, 2019).

It was observed that in general meteorological services gave warning to health or environment ministry when the threshold values are exceeded.

Threshold values may vary according to the countries, climatic conditions and adaptation situations of the communities. Some countries included air pollution in the warning system. Belgium, Germany, Hungary, Portugal and Switzerland takes ozone levels as the basis while United Kingdom and Macedonia take the threshold values of SO₂, NO₂, O₃ and CO as basis. The other factors monitored in hot air warning system were found to be emergency service use, drought, electric outage, UV radiation levels, fire and other local events (Lowe et al., 2011). Three parameters were used in the study, namely air temperature, UV index and AQI values; when the threshold values determined in line with literature of 27°C, 6 and 101, respectively, were exceeded messages were sent. Messages were sent the day the threshold values were exceeded. System was operated for one year, but sending times changes according to the seasons. Hot air wave and UV index forecasts and warnings continued from July 2015, which is the start date of the study, until the end of September 2015 and from April 2016 to July 2016, which is the end date of the study. AQI messages were sent between November 2015 and April 2016, which were considered winter months. AQI in Turkey is calculated for five basic pollutants consisting of PM₁₀, CO, SO₂, NO₂ and O₃.

It is reported that frequent and wrong warning messages may decrease the reliability of the system (ibid). Intervention stage lasted one year in the study and 151 messages were sent every day when the threshold values were exceeded. From the feedback received from the participants, it was seen that the message frequency was too high. It became necessary to work for producing solutions to decrease the message frequency. Another point considered for warning systems is in what period the warning system was started to be operated. It was found that in the examined countries they are operated in the period between early May and late September (ibid). The early warning system

established in Aydın was planned and implemented to operate for 12 months.

In order to be protected from health effects of hot air waves individuals/community must be made conscious of the issue. It is required to get to know hot stress, stroke, dehydration and other diseases and situations related with temperature. In France, warning brochures addressing different parts of the community in the hot air wave warning system. 11 of the 12 EU countries that have hot air wave warning system aim to reach their goals by passive communication. Passive communication techniques were media, brochure, web site, radio, newspaper and some other communication means. However, three countries aimed at using active communication. These active communication means would be sending the message to the person directly or conveying the message through a particular person such as family doctor, nurse or pharmacist. Direct communication means to the person were foreseen to be sms, e-mail, telephone call or similar methods (ibid). In the study, both passive and active communication means were used. Active communication method was in the form of sending sms and e-mail directly. As passive communication method, written media and designed web site were used to provide training and warnings. While 11 of the 12 EU countries that have hot air wave warning system give warning, nine of them published emergency persons list. Also, 12 of them provided primary protection and also 12 of them provided secondary protection (ibid). In the conducted study, persons were warned about the effects of extremely hot weather, high level of UV radiation and extreme air pollution on health, required actions and precautions to be taken were described. This way, harmful health effects of these air variables were tried to be prevented with primary protection.

In the action plans of EU countries that have hot air wave warning system priority was given to the

protection and alerting of elderly people, children and other sensitive groups. Recommendations and precautions were presented such as avoiding hot weather, limiting outdoors activities, wearing light colored clothes, drinking water, cooling the ambient air, receiving medical help, following temperature forecasts and indoors ambient temperature, using sun screening creams, traveling at night, shifting working hours to cooler times of the day (ibid).

EPA (USA Environmental Protection Agency) recommends that individuals be encouraged to understand and apply the steps for protection from sun:

Following UV index, remaining outside as short as possible in midday, trying to be in shade, wearing suitable clothes (clothes made of tightly woven fabrics, long sleeved shirts and long pants, etc.), wearing hats to cover eyes, face, neck and back of the neck, using sunglasses providing 100% UV protection and using sun screening creams (US EPA, 2019).

In Aydin project, when the temperature exceeded the threshold value of 27°C and UV exceeded the threshold value of 6, the sent messages made warnings so as not to go into sun between 10:00 and 16:00 hours unless necessary, to wear hat, use sun cream, wear light colored, lightweight, loose fitting clothes made of tightly woven fabric and drink water

When health effects of heat waves became apparent in 1993 and 1994 in Philadelphia city of USA, Philadelphia Hot Weather Warning System (PWWS) was founded in 1995 so that these effects would not be seen in the following years (Lebi et al., 2004). PWWS took the forecasts of National Meteorology Station (NHS). In general, they gave warning at temperatures exceeding 40,5°C. They rarely gave warning at temperatures below 38°C. Death rates of population above 65 years of age in the years before 1995 were compared with the mortality rates at

extreme hot weathers. It was established that mortality decreased with the early warning. While the researchers indicated that too much recommendation and warning would affect the society negatively for the subsequent warnings, it was determined with an intermediate assessment that warning frequencies were not high enough. Because, it was seen that deaths due to high temperature also occurred on days when warning was not given. Only mortality rates were compared in the study; morbidity rates were not examined. In PWWS, it was asked from TV's radios and newspapers to report the weather to reduce deaths related with heat. These media announcements included encouragement to warn friends, relatives and elderly people. They were asked to warn the persons in sensitive groups to take protection precautions at extreme hot weathers. A "Heatline" connection was formed and its telephone number was announced at the media and at a public square. Information was given for the elderly to avoid heat stress. Activities were planned and implemented when warning was given such as the public health house nurse contacting the persons, giving them information in case of high risk heat situations, protecting the dwellers of other facilities providing boarding service, alerting the electricity and water companies, increasing the number of personnel at fire brigades and emergency services, taking necessary precautions for homeless people and extending the operating hours of air conditioners (ibid). EPA recommends that community be prepared for hot air waves, telephone communication systems be established for use in hot air waves, volunteers be trained, and air conditioner systems be installed at public bodies and organizations (US EPA, 2017b). In many communities it found general acceptance to make announcements to public through written/visual media instruments, web sites, free telephone lines and similar means containing health effects of extremely hot weather and related precautions to reduce or prevent the health problems of the

community caused by hot weather (Miami Miller School of Medicine Department of Public Health Sciences, 2019). In Aydın project, a computer program was designed to send information messaged to the participants with sms/e-mail when the threshold values are exceeded and warning messages were sent directly to the participants. Warning messages also included recommendations and precautions to be taken. Air conditioners used on the days when hot air waves are seen for adaptation to hot weather increase fluorine greenhouse gas emission due to electricity consumption. Excessive use of air conditioners in hot weathers increases the heat island effect in cities. For this reason, messages encouraging the use of air conditioners were not sent (Çelik et al., 2008; Silkin, 2014). Effort was spent since the beginning of the study to make general public and decisions makers aware of this study with media news. Purpose of the study and information related with climate change and accompanying weather events were shared with the public, together with the precautions to be taken (Hürriyet, 2015). A panel was held on 30 March 2016 on "Climate Change and Public Health". Panel was announced to the public by various media organizations and their participation was expected (Barlas, 2016). Academicians from Ministry of Environment and Urbanisation, General Directorate of Meteorology, Aydın Public Health Directorate, and Adnan Menderes University Faculty of Medicine were invited as speakers.

United Kingdom's hot air wave warning system was published in 2004 in response to the hot air wave that made a devastating effect in Europe in 2003. It was revised in 2012. Levels were designated between 0-4. These levels vary from long term plans against hot air waves to the preparations that must be made throughout summer to plans to be made for emergency situations. A different action was prepared for each warning level. Level 1 indicates hot air wave and action plans for preparation for summer; level 2 warning and preparation/air wave

warning with 60% probability for 2-3 days; level 3 hot air wave warning action, the situation of threshold value being exceeded in one or more regions; level 4 central level alarm, a severe, hot air wave of long duration. The system is operated between 1 June and 15 September. There are warning distribution means such as e-mail, web site, sms, tv-radio (GOV.UK, 2018). In Macedonia a national warning system was developed in the Ministry of Health against hot air waves. It is operating since 2011 and it is renewed annually. Maximum temperature (T_{max}) is the indicator. The country has 13 regions and different threshold values were designated for each region for each season. Forecasts are made for 2 days and warnings are given on 24-hour basis. Data is provided by Macedonia Meteorology unit. Warnings are shared with related bodies and organizations, announced through media and web site, warning and recommendations are given similar to the ones sent in Aydın system to participants with sms and e-mail. Warnings are given on points such as not making physical activities between 10:00-17:00 hours, wearing light clothes, using hats and sunglasses, avoiding food containing fat, sugar and high calories, preferring shades if it is necessary to go out, taking cold showers, people with chronic diseases being more careful, checking and protecting children and the elderly (Climate ADAPT, 2017). Table 5 gives the comparison of Aydın early warning system and Macedonia (ibid) and United Kingdom (GOV.UK, 2018) hot air wave warning systems. Reporting time for threshold values changes according to country. While forecasts are transmitted once every two days, in United Kingdom forecast frequency varies according to the determined levels. Levels are between 0 and 5; forecasts for 2-3 days are sent at level 2. At level 3, the forecasts for the day when threshold is exceeded and the day after that are sent (GOV.UK, 2018; Climate ADAPT, 2017). In Aydın, warning messages were sent every day when threshold values are exceeded.

Table 5: Comparison of Aydın Early Warning System and Hot Weather Warning Systems in Some Countries (Diliüz Doğan & Evcı Kiraz, 2016)

	Countries		
	Macedonia	United Kingdom	Turkey (Aydın)
Organization	Ministry of Health	Department of Health	ADU Medical Faculty, Department of Public Health
Level	National	National	Local
Threshold value	Temperature values for each of the 13 regions for each month	level 0-4. level 2: daytime temperature > 30°C; night > 15°C; level 3: hot air wave situation. In one or more regions.	$T_{\max} \geq 27^{\circ}\text{C}$
Message frequency	Forecast for 2 days; 24 hours warning	level 2: 2-3 day; level 3: 1 day and next day and forecast for the day after.	Once a day when threshold is exceeded
Forecast center	Macedonia meteorology service	Meteorology office	www.wundergruond.com (paid service)
Means of message transmission	Transmission to related bodies and organizations; Transmission through media and web site	Transmission to NHS, government, public health system	Directly to persons (sms/e-mail)

4- Arrangements and activities at local level must be started urgently and awareness raising works must be prioritized. These activities must be at the level of decision makers, community and media.

5- Emergency response mechanism must be developed. Correct data and evidence are needed to perform the emergency response in time, properly and to reach the goal. Data base is needed in Turkey to present the relation between climate change and health. Priority is on harmonizing the data bases such as present disease coding systems ICD-10/11 and training the users. Climate change and health must be declared priority field for scientists and academicians.

In this context; projects, scientific publications, meetings, innovations R&D, investment supports

must be implemented. Collected data, information, results must be published in different portals which can be accessed by the public, academy and people; it must be encouraged to generate new information and reports from the published data.



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This publication was produced with the financial support of the European Union. Its contents are the sole responsibility of the consortium lead by WEglobal Consultancy Inc. and do not necessarily reflect the views of the European Union.



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