

GREENHOUSE GASES AND MEANS OF PREVENTION

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The greenhouse effect can be defined as the consequence of increased heating of the Earth's surface, as well as the lower atmosphere by carbon dioxide, water vapor, and other trace amounts gases. It is well-known that human industrial activities have released large amounts of greenhouse gases in the atmosphere, about 900 billion tons of carbon dioxide, and it is estimated that up to 450 billion are still in the atmosphere. In comparison to greenhouse gases water vapor is one of the greatest contributors to the greenhouse effect on Earth. Many projects, as does the PURGE project, have tendencies to build on the already conducted research and to quantify the positive and negative impacts on health and wellbeing of the population with greenhouse gas reduction strategies that are currently being implemented and should be increasingly applied in various sectors and urban areas, having offices in Europe, China and India. *Acta Medica Medianae* 2013;52(3):49-54.

Key words: *greenhouse effect, greenhouse gases, air pollution, global warming, prevention means*

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Introduction

The greenhouse effect can be defined as increased heating of the Earth's surface, as well as the lower atmosphere by carbon dioxide, water vapor, and other trace amounts gases. Sun heats the the Earth's surface via visible light. Some energy is radiated back into the atmosphere as infrared radiation. A large quantity is then absorbed by carbon dioxide molecules and water vapor which are found in the atmosphere and the energy is then radiated back towards the surface as more intense heat. Infrared radiation which is then absorbed heats more intensively the Earth's surface and lower atmosphere, thus making the Earth's surface livable. However, due to large amounts of greenhouse gases, which include gases made by human activities (production, transportation, etc.) such as chlorofluorocarbons, nitrous oxide and methane elevated levels of radiation remain even more trapped in the atmosphere. This artificial phenomenon is known as the improved greenhouse effect (1,2).

It is well-known that human industrial activities released large amounts of greenhouse gases in the atmosphere, about 900 billion tons of carbon dioxide, and it is estimated that up to 450 billion are still in the atmosphere. Naturally,

carbon dioxide can be generated by fermentation done by microbes, respiration of living aerobic organisms, burning of organic matter, and volcanic eruptions. Industrialization causes close to 80% of carbon dioxide emission and the rest is caused by land use, for example deforestation. It is estimated that from the start of the industrial revolution fossil fuel burning has increased the global temperature by 0.75°C, and during the twentieth century increased the sea level by 22 cm. International Panel on Climate Change (IPCC, the main body associated with climate change, where over 2500 international scientists take part) estimates that by 2100, global temperatures may increase from 1.1 to 6.4°C and sea level from 28 to 79 cm (3).

Gases which lead to the greenhouse effect

Vegetation and plankton eliminate carbon dioxide by breaking it down into oxygen and water during the process of photosynthesis. Plankton loss and deforestation due to the depletion of ozone prevent absorbing elevated amounts of generated carbon dioxide, therefore, the vegetation can currently absorb only a third of emitted carbon dioxide. Furthermore, trees have large deposits of carbon dioxide that are released into the atmosphere after their cutting down. Consequently, it has been observed that many countries emit greater quantities of carbon dioxide by the process of deforestation than they have by burning fossil fuels. For example, Brazil yearly emits 336 tons of carbon dioxide. This amount compared to the emission by burning fossil fuels is six times larger (4). The total emission of carbon dioxide which had been

recorded in London in 2006 was around 44.3 million tons and it was 8% of Great Britain's total carbon dioxide emission. By the year 2025, it is anticipated that the emission increase will be close to 15% as a consequence of population increase and economic development (5).

Although carbon dioxide plays an important role, the dominant role in the greenhouse effect in the Earth's atmosphere is actually played by water vapor. Water vapor is responsible for more greenhouse effects in comparison to all the other gases. Almost 95% of water vapor is created by ocean evaporation. Water in both gaseous and liquid forms contributes roughly from 66% to 85% to the greenhouse effect (6).

In the last two decades, gases such as chlorofluorocarbons have been added to the atmosphere. Even though they are present in very small quantities if their molecular structure is taken into consideration, they are several times more efficient in holding heat radiation than carbon dioxide (7).

All the other greenhouse gases which can be found in the atmosphere contribute to the greenhouse effect almost equally as the effect of carbon dioxide does (8-10). Measurements which have been performed in the period between 1970 and 1980 confirmed that the combined warming effect of chlorofluorocarbons, methane, and nitrogen dioxide was from 50% to 100% of the effect caused by elevated levels of carbon dioxide during this time. These greenhouse gases combined warming was higher than the natural global temperature variability in the year 1980, which led to an increase in mean global temperature and consequently it increased over the predicted maximum value (11).

An increase in atmospheric levels of nitrogen dioxide can be caused by burning of fossil fuels and extensive use of chemical fertilizers and it may disrupt the nitrogen cycle. Moreover, many harmful processes can increase the amount of ammonia and methane in the atmosphere (12).

Methane has a significant impact in the greenhouse effect and it remains in the atmosphere between 9 and 15 years. It was shown over a 100-year period that methane is over 20 times more effective in trapping heat in the atmosphere in comparison to carbon dioxide. This gas is emitted from various sources which can be either natural or humanly influenced. Humanly influenced sources are natural gas and petroleum, landfill systems, wastewater disposal, coal mining, agriculture, as well as certain industrial processes.

Methane as the primary constituent of natural gas is an important energy source. Taking this into consideration, preventing or taking advantage of methane emissions can lead to significant environmental, energetic and economic benefits. For example, the United States has numerous companies which are voluntarily reducing

methane emission by applying low cost management methods and technology (13).

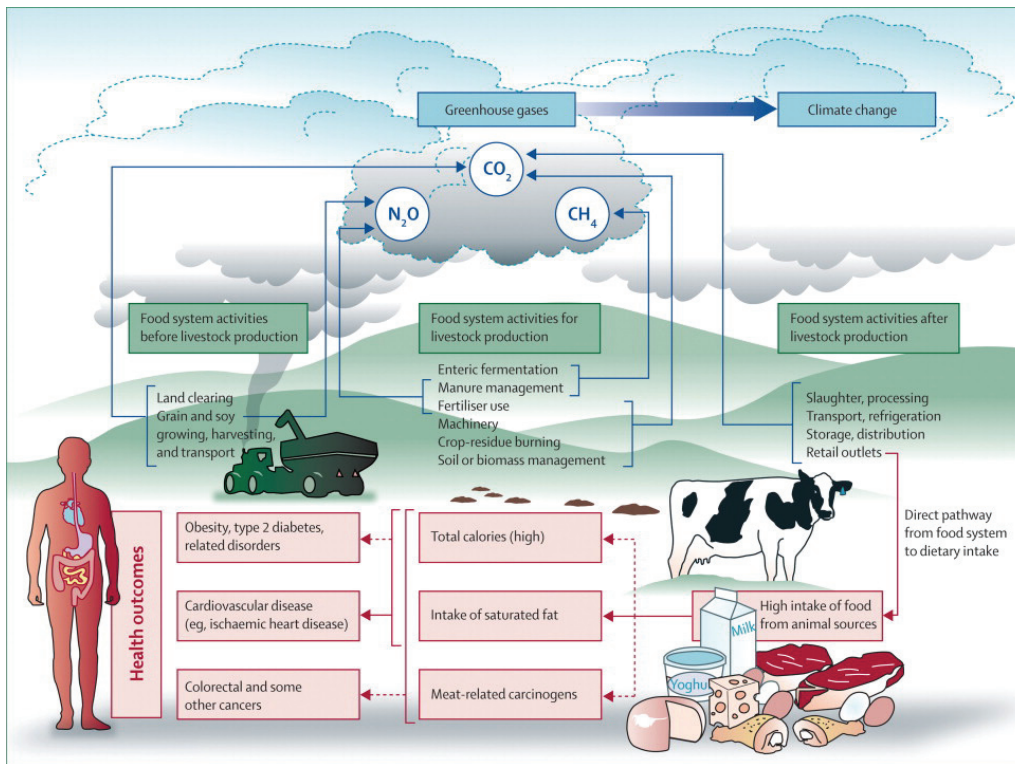
Negative health effect

The greenhouse effect has a different impact on health which is manifested in changes in morbidity and mortality rates, climate disasters and the availability of food and water. In developing countries due to an already present poor health care system, the epidemiological impact of climate change on the rate of diseases is more significant than in other countries (14,15). Temperature elevation leads to stress brought on by its increase, which consequently increases heat stroke short-term mortality. Rise in the global temperature has a direct health effect. For example, in the year 2003, the heat wave caused about 70.000 deaths in Europe, the dominant being of cardiovascular and respiratory origin (16). Moreover, experts predict that in developing countries there will be an increase in the urban population, from 2.3 billion in 2005 to 4 billion by 2030, which will thus lead to urban sprawl and poor housing. This change will consequently increase the heat stroke risk and other adverse health effects in cities due to air pollution. Surveys conducted in the Nišava district showed higher air pollution in Niš than in Niška Banja, and the cause being more intensive traffic in Niš. This affects vulnerable categories directly acting on the body and the genetic structure. Future research will probably closely show the effects of air pollution on the human body (17-19).

The increase in temperature will also affect the human health by increasing the spread and transmission of disease through vectors or rodents. Temperature is known to affect the rate of pathogen maturation and mosquito replication, the number of insects in a particular area and also increases the likelihood of infection.

Vector reproduction and parasite development generally increase with temperature rise. Therefore, malaria, encephalitis caused by ticks and various diseases will therefore become widespread. The mosquitoes which can transmit malaria will, due to increase in global temperature, reproduce more intensely and will consequently migrate to higher altitudes and places that they have not been found so far.

Climate change is also dangerous to human health because it leads to food insecurity and increased malnutrition. This is manifested through acute and chronic child malnutrition, low birth weight and lack of proper nursing, and following some estimations, they could cause 3.5 million deaths of young children and mothers yearly. Moreover, one out of three children that has been born in developing countries under the age of 5 suffers from some form of growth disorder due to chronic malnutrition (21).



Picture 1. Negative health effects of greenhouse gases (20)

It is predicted that there will be a significant reduction in the availability of fresh water due to intensive melting of glaciers. According to the recent studies more than a sixth of the world population is currently living in water basins which are supplied by melting of glaciers, and are very sensitive to climate change. The increase in global temperature can also lead to earlier melting of snow, causing water flow increase earlier in the year and the subsequent worsening of the dry season and water scarcity. This was observed in August of 2008 when the Kosi river changed its course and caused flooding in Bihar (India). Probably the increased river levels were due to the melting of glaciers. This flood has not only affected 4.4 million people but also destroyed 290.000 hectares of land (16). River flow decrease and increase in water temperatures will lead to a deterioration of the water quality; also, microbial activity increases when less oxygen is dissolved in water. These effects can most likely cause, especially during droughts, major health problems in vulnerable populations.

Climate change can also directly affect health in the form of natural disasters which are caused by extreme weather conditions, and it is estimated that they will increase with an ever increasing warming of the planet. When there is a general breakdown of infrastructure, health problems directly arise, especially when water and sanitation are hindered. It was recorded that in the period from 2004 to 2008, 40% of 1.062 disasters in this time were the result of floods and tropical cyclones, while 52% of the disasters in 2007 were caused by weather conditions (22).

The most vulnerable populations are those who live in developing countries in coastal tropical regions.

Prevention

Results from recent studies confirm that it is difficult to overcome the mayor problem of global warming by only taking preventive actions. Therefore, there are very strong arguments for implementing adaptive policies which are aggressive (23).

There are numerous guidelines for preventing greenhouse gas emission which range from passive adaptation prevention, developing counter-measures and the "law of the atmosphere." One of the approaches is not only to implement those policies that will reduce greenhouse gas emission but also that will in addition have social benefits (24).

It has been observed that in California a positive progress has been made, where in the year 2006 three acts were passed (Greenhouse Gas Emission Performance Standard, the Renewable Energy Act and California Global Warming Solutions Act) which were intended to limit all emission of greenhouse gases. Moreover, they require greenhouse gas levels to be reduced to the levels which were measured in 1990 by the year 2020. This presents from 25% to 30% less emission than it was estimated to have otherwise occurred (25).

This is a positive step and it should also be followed by other countries, especially those that are in transition, because of the rapid growth of

their industry and consequent increase in greenhouse gas emission. Also, it is necessary to stop cutting down forests and to reduce fossil fuel burning by developing and using alternative energy sources such as, for example, hydro energy, solar energy and others.

However, we cannot ignore the impact each individual exerts on the greenhouse gas emission prevention. Some every day activities such as walking, cycling and avoiding car usage reduce emission of greenhouse gases. Every individual can also help to prevent harmful effects of greenhouse gases by using less energy, recycling and planting trees (26,27).

Experts responsible for climate change mitigation have found in a recent survey that some strategies which were intended to reduce greenhouse gas emission can either positively or negatively affect health (28). Examples include the measures which are intended to reduce the use of private vehicles in the United Kingdom, where there is a direct health benefit through the increase in physical activity by walking and cycling. However, this can consequently lead to traffic accident increase if there is no previous adaptation of traffic being made. Moreover, while implementing strategies that are aimed at improving health, other negative health effects can be detected, as in the case of United Kingdom where isolation of houses with the aim to increase their energy efficiency causes negative health effects to occur by a consequent increase in indoor pollutant exposure (29).

PURGE project as an important step in the 21st century in reducing the effect of greenhouse gases

"The European Environment & Health Action Plan 2004-2010" has been adopted by The European Commission, and under FP7 (Seventh Framework Programme) program is the PURGE (Public health impacts in urban environments of Greenhouse Gas Emissions Reduction Strategies) project. In order to realize this project, selection of cities has been made which will conduct a more detailed study. Some cities are in Europe:

London, Milton Keynes (England), Belgrade, Niš (Serbia), and a few in Asia: Beijing, Jinjiang (China), Delhi, Bhubaneswar (India). The cities were determined based on the principle of metropolis and the city in development in order to enable easier data collecting.

This project is significant because of its tendencies to build on the already conducted research and also to quantify the positive and negative health impacts on the population having greenhouse gas reduction strategies that are currently being implemented and should be applied even more in various urban areas and sectors. A team of internationally recognized experts in the fields of urban planning, consumption and energy demand in cities, environmental sciences and epidemiology, health risk assessment collaborating with many partners in the above mentioned locations will intend to develop and implement a methodological framework in order to reduce greenhouse gas emission and to evaluate the merits and risks to population health in three to four large urban centers and three smaller urban centers (30-32).

The focus will primarily be on the sectors of energy consumption and energy production in industry, transport, household energy sources, food and agriculture. The ultimate purpose of this project is manifested through specifying realistic goals which are in accordance with the needs of each of these urban areas in order to enable the mitigation of climate change, moreover, the years 2020, 2030, and 2050 represent the time when these strategies should be implemented (33).

Conclusion

Population health is threatened by climate change worldwide, especially in developing countries. These effects are very important reasons for a collective act with determination to reduce global emission of greenhouse gases.

Acknowledgements

The Ministry of Education and Science of Republic of Serbia supported this work (Projects No. 175092, 171007 and 31060).

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GASOVI STAKLENE BAŠTE I MERE PREVENCIJE

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Efekat staklene bašte se može definisati kao posledica zagrevanja Zemljine površine i niže atmosfere ugljen-dioksidom, vodenom parom i drugim gasovima koji se nalaze u tragovima u atmosferi. Opšte je poznato da je ljudska industrijska aktivnost oslobodila velike količine gasova staklene bašte, oko 900 biliona tona ugljen dioksida, od kojih je oko 450 biliona još uvek u atmosferi. U poređenju sa gasovima staklene bašte, na našoj planeti vodena para pospešuje u većoj meri ovaj efekat. Mnogi projekti, a posebno PURGE projekat, nastaviće istraživanja da bi kvantifikovali integrisane pozitivne i negativne uticaje na zdravlje i dobrobit ljudi, uz strategije redukcije gasova staklene bašte, koje se primenjuju i koje treba intenzivnije primenjivati u različitim sektorima i raznim urbanim sredinama, sa sedištima u Evropi, Kini i Indiji. *Acta Medica Medianae 2013;52(3):49-54.*

Ključne reči: efekat staklene bašte, gasovi staklene bašte, aeroxagađenje, globalno zagrevanje, mere prevencije