



INVITED REVIEW

Impact of weather conditions and global warming on COVID-19 outbreak

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Hava koşullarının ve küresel ısınmanın COVID-19 salgını üzerindeki etkisi

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Öz

Atmosferdeki sera gazının artışı ile birlikte, sıcaklık, hava olayları, aşırı yağış gibi iklim değişikliği tüm dünyada bölgesel ve küresel değişimlere yol açmaktadır. Sıcaklık artışı görülen küresel iklimde, özellikle gelişmiş iklim modelleri ile yapılan incelemelerde dünya genelinde 1990-2100 yıllarında yaklaşık 2-4,5 oC arasında bir sıcaklık artışı tahmin edilmektedir. Bu sıcaklık artışına bağlı birçok doğa felaketleri, salgın hastalıkların ve zararlı vektörlerin artışı beklenmektedir. Buna ilave olarak küresel iklim değişikliğinin tüm dünyada farklı hissedilmesi ile birlikte insanların ve ülkelerin etkilenme durumları farklı olacaktır. Bu etkilenmelerin sonucu olarak yıllık ortalama 1,2 milyon insan kentsel hava kirliliği sebebiyle ve doğal afetler sonucu 60 bin kişi hayatını kaybetmektedir. İklim değişikliği ile beraber hava kirliliği sonucunda en çok kronik hastalığı olan kişiler etkilenmektedir. Covid-19 pandemi sürecinde en çok etkilenen insan grubu kronik hastalardır. Coronavirus etkeninin yayılmasında havadaki partikül maddelerin taşıyıcı bir araç olarak görev alması hastalığın şiddetini artırması açısından önemlidir.

Anahtar kelimeler: Covid-19, iklim değişikliği, küresel ısınma, hava kirliliği, pandemi

Abstract

Together with the increase in greenhouse gas in the atmosphere, climate changes such as heat, weather conditions and heavy rains cause regional and global variations around the world. In global climate where a heat increase occurs, during the studies performed by especially improved climate models, an approximate heat increase by 2-4.5 oC is predicted between 1990-2100 in the world. Related with this increase, many natural disasters, epidemics and hazardous vectors are expected to increase. Additionally, the exposure state of humans and countries will be different together with feeling the global climate changes differently all over the world. As a result of these, an average of 1.2 million and 60.000 humans lose their lives annually due to urban air pollution and natural disasters respectively. Together with climate changes, those with chronic diseases are mostly affected as a result of air pollution. The most affected group of people during COVID-19 pandemic period have been the chronic patients. During COVID-19 pandemic period, the fact that particle substances in the air act as a carrier tool in transmission of Coronavirus agent is highly crucial in terms of increasing the severity of the disease.

Keywords: Covid-19, climate change, global warming, air pollution, pandemi





Introduction

As a result of global climate changes, we especially expect a decrease in water resources, bush fires, erosion, changes in agricultural production, drought and related ecological deteriorations, deaths because of hot air waves, increases in vector based diseases and related increases in diseases and deaths and an increase in chronic respiratory system diseases due to urban air pollution. The possibility to get health risks caused by climate changes is higher in low-income countries and in countries where health services are inadequate (Şeker et al 2020).

Global warming is expected to increase throughout 21st century. Together with the increase in extreme and abnormal weather conditions, human borne greenhouse gas concentrations (especially by using fossil fuels) are mainly believed to cause this increase. These changes will surely affect the usability of fresh water resources, natural ecosystems, agriculture and forestry, coastal ecosystems and fishery, settlement areas, industry and societies, energy and human health (Confalonieri et al 2007).

Natural climate variability includes fluctuations in the luminous energy of the sun and circular changes happening in the clearness of the atmosphere (sand storms, caused by volcanic dust and other particles) and in the orbit of the earth around the sun. The complex interaction between the atmosphere, hydrosphere, cryosphere and biosphere causes a constant change in the climate. In general, as can be understood from geographical distribution, when everything is considered, the heat increase in area surface heat and more northern latitudes is predicted to be nearly two times higher than the assumed average global heat increase while it is thought to be less in the oceans in the southern hemisphere and North Atlantic. It is also believed to affect the mechanisms regulating energy circulation between oceans and the atmosphere and to have an effect on ocean currents and shore winds (Trenberth et al 2007).

Many people regard weather conditions in an area as climate. In fact, climate has quite a complex structure in which more than one factor are included, that is these are short term fluctuations, climate oscillation (an air mass that is constantly the same character shows a different feature), sudden stops and various long term changes affecting the different geographies of the world. This variability is related with energy distribution mechanisms between the ocean and the soil surface and the atmosphere (Trenberth et al 2007). Changes in this area affect the energy distribution as a result of the increase in the greenhouse gas in the atmosphere. Seasonal changes and geographical borders affecting climate and flora have been revealed to have been effective in breakouts of vector based important contagious diseases (NRC 2001). Associative with heat changes again, specific epidemics have

been thought to appear since the synchronization of life cycles between the agent and the vector might be broken (Slenning 2010).

Climate changes are able to affect severity, distribution and seasonal variability of contagious diseases theoretically. Apart from climate, both biophysical (flora changes, settlement and vector density, wildlife) and sociopolitical changes directly related with humans and factors such as public health, nutrition and other human behavior are believed to regulate the contact rate between pathogens, vectors and reservoirs by changing the behavior of the disease. In recent years, the prevalence of various diseases such as yellow fever, Trypanosomosis, Leishmaniosis, Lyme disease, tick borne encephalitis, blue tongue and coronavirus (SARS, MERS, COVID-19) depending on climate change has increased specifically and/or the prevalence of disease has shown changes. Although the relation between the climate and the disease is obvious, it is still difficult to say that the climate creates these effects singly. The climate change has frequently been blamed as tropical pathogens and vectors invade free areas while it is regarded as a helpful factor of the mobility breaking the traditional physical obstacles preventing vectors and pathogens from spreading in the past and humans, animals and properties on our day. Besides, the fact that some generations came to an end depending on climate changes is thought to increase the risk of zoonotic infections both in wildlife and for humans (Mills et al 2010, Wu et al 2020)

As a result of quarantine measures applied as part of fighting the COVID-19 epidemic recently in Turkey, the quality of air has been improved significantly with factors like people could not go out and traffic congestions relented, and the amount of particle substances (PM10) has decreased by 32% (TMMOB, 2020).

Particle substances and nitric oxide due to the increase in the number of vehicles in urban areas are generally accepted as the biggest contaminative factors affecting human health. Long term exposure to these factors at high levels might cause various effects ranging from negatively affected respiratory systems to early death (EAA 2020).

Symptoms of bronchitis grow in children with asthma who were exposed to long term NO₂. NO₂ is the main source of nitrate aerosols consisting an important fraction of PM_{2.5}. NO₂ will be a pioneer for ozone to form in the atmosphere in the event of presence of sunlight. Particulate substance (PM₁₀ and PM_{2.5}) is one of the worst air pollutants affecting human health. Small particles that might be inhaled down to the deepest parts by lungs are named as PM₁₀ and PM_{2.5}. PM_{2.5} is the most dangerous one and could be inhaled to the deepest parts of peripheral areas of bronchioles and might



affect gas changes within lungs. Chronic exposure to particles might carry the risk of diseases in cardiovascular and respiratory tracts and could have the risk of lung cancer additionally (TMMOB 2020).

During the pandemic period, another topic being searched has been the effect of particle substances as a carrier tool on the speed of velocity in contagion periods of viral infections. Various scientific data has been stated on that there is a connection between the pollutants in the air and COVID-19. In a study carried out in Martin Luther University Halle-Wittenberg (MLU), concrete data was released for the first time showing that high nitrogen dioxide levels in the air might be related with numerous deaths from COVID-19 (Ogen 2020). In another study carried out in Harvard University, the increase by $1 \mu\text{g}/\text{m}^3$ in $\text{PM}_{2.5}$ was related with the increase by 8% in the death rate from COVID-19 (Wu et al 2020).

Transmission of viruses might be affected by many factors such as climate conditions (heat and humidity etc.), medical care quality and population density (Wang et al 2020). Thus, understanding the relation between geographical features of a country and infection of COVID-19 is a crucial step to control and stop the pandemic. In other words, geographical changes play an important role in fighting SARS-CoV-2 virus causing coronavirus (COVID-19) (Ahmadi et al 2020).

Apart from COVID-19, people of the world witnessed at least five epidemics in 21st century, firstly H1N1 in 2009, then poliomyelitis and EBOLA in 2014 and 2019, Zika virus in 2016 respectively. Later, COVID-19 pandemic was declared as the sixth public health emergency case with international importance on January 30th, 2020 by World Health Organization. These worldwide epidemics triggered numerous mortalities and morbidities and caused billions of dollars (Fan et al 2019). When compared to other illnesses and their burdens, COVID-19 will probably affect more people than other contagious diseases do around the world. Also, other environmental changes such as soil erosion, thinning of ozone layer, air pollution and urban sprawl constitute an indisputable threat for changing world order and human health. High CO_2 oscillation and industrial development is among the reasons of global warming. Together with industrial revolution, greenhouse effect appeared in the atmosphere. When these negative conditions improved, COVID-19 pandemic could be regarded as an indirect result of global/environmental changes. The new coronavirus disease (COVID-19) has caused a prominent decline in economies of not only China, India and the USA but also around the world besides its sad effects on human life (Chakraborty and Maity 2020).

Industrialization and urbanization is on the increase due to population growth. This growth has been proved to be hazardous on global environment. Besides, climate change, water pollution and air pollution, global warming, thinning

of ozone layer, decline in the level of subsurface water, biological variation, ecosystem change, arsenic pollution and many others are among environmental problems (Bremer et al 2019). Climate change is the result of growing greenhouse gas concentration (CO_2 , CH_4 , N_2O etc.). Societies began to destroy nature because of their desire to use it for their own needs. It has become a vital matter of our day as an inevitable conclusion (Chakraborty and Maity 2020).

However, due to COVID-19 pandemic, in all cities in affected countries such as China, the USA, Brazil, Italy, Spain, France, Taiwan, Turkey, Germany, Iran, South Korea, England, Australia and India, a full quarantine was applied partly during periods ranging from several weeks to several months. All local and central managements around the world fully prohibited their citizens to get out of their houses freely in order to prevent human mobility. Activities such as pilgrimage, sportive facilities, indoor and social organizations, olympics etc. were cancelled. Almost all factories do not operate or run in half capacity and all kinds of travel have been cancelled. In the meantime, efforts to restrain the infection of SARS-CoV-2 has caused an extraordinary environmental effect by restraining human mobility. Since factories do not run, industrial waste emissions have decreased largely. Vehicles could not travel on roads and released nearly zero greenhouse gas and zero toxic small particles to the environment. Because factories demanded less energy, usage of fossil fuels or traditional energy sources decreased to a great extent. Ecosystems have been enhanced largely. The level of pollution in touristic places such as beaches, forests, hill areas etc. has also declined largely. Ozone layer has freshened to some extent (Chakraborty and Maity 2020).

Conclusion

The capacity of industry to operate has decreased during the pandemic, but on the other hand air pollution will be seen once again when sources causing a decrease in emissions become active again together with normalization following the air pollution that decreased with quarantine applications. Since greenhouse gases like CO_2 continue to increase in the atmosphere, struggle with climate change should be in longer term and solid steps. Many creatures are affected negatively by the new conditions following climate change while viruses are so unique to adapt to this change. Climate change and the increase in viral infections is expected to cause to form a basis for new epidemics. Structures of some viruses are suitable for mutation, therefore the present situation might be more dangerous than those in previous years.

The size of the destruction by developed countries has been revealed during the global epidemic. The fact that people stayed at homes, production decreased and transportation went down to minimum level due to COVID-19 global pandemic has caused environmental based problems to decline se-





riously. This condition is a striking indicator of human effect on natural destruction. All partners and countries must work together for a more habitable world and retainable source management.

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