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Effect of Covid-19 Outbreak on Particulate Matter Pollution in Istanbul City Centre

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Abstract

Istanbul is a big, crowded, megacity. Air quality decreases as cities get crowded so air pollution is more important issue in a crowded city like Istanbul. Due to Covid-19 all human's habits have changed. For instance, people mostly stayed at home and used less vehicle during the period when many precautions are taken against the disease. Istanbul’s air quality is affected more by this habit changes of people because over 15 million people live in Istanbul. This change has led to the reduction of humanmade air pollutants. In this study, 2 and a half years of PM2.5 and PM10 data was examined to understand the change in air pollution. Particulate matter amounts were examined in 3 periods as before, during and after lockdown. Istanbul's air quality has improved thanks to the precautions taken by people against coronavirus.

**Keywords:** Particulate matter, Coronavirus, air pollution, lockdown, Istanbul.

Covid-19 Salgınının İstanbul Şehir Merkezindeki Partikül Madde Kirliliğine Etkisi

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Özet

İstanbul büyük, kalabalık bir megakent. Şehirler kalabalıklaştıkça hava kalitesi düşer, bu nedenle İstanbul gibi kalabalık bir şehirde hava kirliliği daha önemli bir konudur. Covid-19 nedeniyle tüm insanların alışkanlıkları değişti. Örneğin, hastalığa karşı birçok önlemin alındığı bu dönemde insanlar çoğunlukla evde kaldı ve daha az araç kullandı. İstanbul'un hava kalitesi, insanların bu alışkanlık değişikliklerinden daha fazla etkileniyor çünkü İstanbul'da 15 milyondan fazla insan yaşıyor. Bu değişim insan kaynaklı hava kirleticilerinin azalmasına yol açmıştır. Bu çalışmada, hava kirliliğindeki değişimi anlamak için 2 buçuk yıllık PM2.5 ve PM10 verileri incelenmiştir. Partikül madde miktarları karantina öncesi, sırası ve sonrası olmak üzere 3 dönemde incelenmiştir. Koronavirüse karşı alınan önlemler sayesinde İstanbul'un hava kalitesi iyileşti.

**Anahtar Kelimeler:** Parçacık madde, Koronavirüs, hava kirliliği, karantina, İstanbul.

1. Introduction

Air pollution is a significant issue in human beings’ life since the Industrial Revolution. Air pollution has been recognized for decades. All creatures suffer from pollutants that occurs by people. Air pollution occurs from mostly human activities but there are some natural activities such as volcanic eruptions are unrelated with people. High amount of air pollution has terrible impacts on human health and earth ecosystem. For last 3 decades air pollution’s adverse impacts on human health has become a remarkable subject (Schwartz, 2004). Air pollution affects every people and may cause health problems even leads to death. People are more aware of the bad effects of the air pollution that increase every day on human health such as air pollution increases the rate of respiratory and cardiovascular diseases (Mannucci et al., 2015). Air pollution does not only affect people’s health but also affects plants and ecosystems. Particulate matters do not distribute homogeneously, covering plants with this heterogeneous dust may cause erosion and radiation heating, this event may damage plants (Grantz et al., 2003). Especially, particulate matter can damage crops. Air pollutants can be examined in two types as particulate and gases (Vallero,2014). “The composition of PM varies, as they can absorb and transfer a multitude of pollutants” (Kampa & Castanas, 2008). PM means particulate matter and PM is very small dust or other things and may include tiny liquid particle. PM10 is a type of an air pollutant. PM10 means that a particle’s size is smaller than 10 μg. PM2.5 is another type of an air pollutant. PM2.5 means that a particle’s size is smaller than 2.5 μg. Meteorological parameters and physical features of an area can affect presence of particulate matter, the amount of particulate matter is affected by natural sources and human activities (Unal et al., 2011). Industrial activities, construction activities, transportation, fossil fuel consumption creates particulate matters. Especially in big cities these type of activities as construction and transportation are more than small cities or towns. A disease because of coronavirus first appeared in Wuhan city in China, then World Health Organization named this disease as Covid-19, the disease spread in a very short time to all China and to whole world (Hou et al., 2020). This disease spreads all the world in a short time then it became a pandemic disease. There are lockdowns because of the Coronavirus disease and this disease has many impacts on people’s life and natural life on earth. Covid-19 pandemic has been affected people in many different ways. By examining the change in the air pollution levels during the coronavirus prevention can help to improve air quality (Berman & Ebisu, 2020). Due to Covid-19 People's behavior had to change. This big change in human behavior has affected air pollution because human behavior is a big part of air pollution. Main purpose of this study is to understand whether the precautions applied to protect people from coronavirus pandemic have an impact on air pollution.

1. ***Material and Methods***
	1. Research area

Istanbul is in the Marmara Region and located in Turkey’s north-west. Istanbul has a history approximately 300 thousand years. Istanbul is the most crowded city in Turkey and its population increasing every year, today over 15 million people live in Istanbul. As we can see in Figure 1, Istanbul is like a bridge that combines Asia and Europe continents. The latitude of Istanbul is 28 E 58 and the longitude is 41 N 01 and the surface area is 5.343km².

Istanbul locates in between Sea of Marmara and Black Sea. Istanbul’s climate type is Csa as known as Hot-summer Mediterranean climate (URL-1). Istanbul’s climate affected from both Mediterranean and Black Sea climate. In this province average annual temperature is 14.5°C, average number of rainy days is 106.9, the average amount of precipitation is 677.2mm and the sum of annual sunshine duration is 75.3 hours (URL-2). Istanbul’s flora is like Mediterranean Region’s flora, evergreen shrubs and small trees. Istanbul is Turkey’s economic and tourism center, there are lots of industrial facilities. Until 2020, each year over 10 million tourist visited Istanbul. There are over 4 million traffic vehicles in Istanbul (URL-3).



**Figure 1.** Map of Istanbul (URL-4)

Fig. 2. shows the average temperature values of Istanbul. According to Fig. 2 Istanbul's air temperatures change periodically. Mean temperature values generally range between 0°C and 30°C.

**Figure 2.** Temperature values of Istanbul

In a study about particulate matter episode in winter in Istanbul made by Im et al., (2010) shows there are more emission measured in European side of Istanbul because there are more vehicle traffic and industrial area are than Anatolian side.

* 1. Data

Daily meteorological parameter as temperature and concentrations of two pollutants as PM10 and PM2.5 were included in this study.

Daily data of PM10 in 2018, 2019 and 6 months of 2020 and daily data of PM2.5 in 2019 and 6 months if 2020 were analyzed. Hourly data of PM10 and PM2.5 in between March 15th and April 15th belong to 2018, 2019 and 2020 were analyzed. Air pollution data taken from the website of Ministry of Environment and Urbanism of Turkey. Temperature data were also analyzed to understand whether the change in air pollution was related with precautions. Temperature data taken from Turkish State Meteorological Service.

* 1. Method

To determine the changes in air pollution levels, data analyzed with Excel calculations, graphed and tabulated with Excel. Data were analyzed daily and hourly. The relationship between temperature change and air pollution was examined.

1. ***Results and Discussion***

Out of transport and industrial activities, those months are winter so people use fuels for heating. In the middle of March 2020 Turkey announced lockdown. During the lockdown period due to coronavirus people used transportation vehicles less because students started studying online and some people started working from home. But at the beginning of the coronavirus period PM10 did not decrease suddenly because people continued to use fuel for heating. As can be seen in the Daily PM10 values graph, there is a downtrend in PM10 levels over the years.

Figure 3 shows that the PM10 concentrations averaged daily values of Istanbul province for time range from 01.01.2018 to 30.06.2020. Averaged daily PM10 values of Istanbul from first day of the 2018 to middle of June 2020 are generally between 15 μg/$m^{3}$and 130 μg/$m^{3}$. Blue line means the daily PM10 values of Istanbul and the red line means five-day average of the daily PM10 values of Istanbul. In Figure 3, as we can see the amount of PM10 is high in the last few months of 2019 and in the first 2 months of 2020.

**Figure 3**. Daily PM10 values of Istanbul between 01.01.2018 and 30.06.2020

Fig. 4 shows that the PM10 concentrations averaged hourly values of Istanbul province for time range between March 15th and April 15th in 2018, 2019 and 2020. As can be seen in the graph the amount of PM10 of the year 2020 is lower than the year of 2018 in the all hours. At 7 a.m. and 5 p.m. amounts of 2020 have higher values than the amount of 2019. From 8 a.m. to 16 a.m. the amounts of 2020 are lower than 2019. In the other hours, values are very close to each other.

**Figure 4.** Hourly PM10values of Istanbul between March 15th and April 15th in 2018, 2019 and 2020

Table 1 prepared to understand to see if there is a change in the amount of PM10 before, during and after period of lockdown precautions. Lockdown period started in the middle of March so the second period is which people take precautions. When compared with the values of 2018 and 2019, the amount of PM10 in 2020 decreased by 28% during the lockdown period.

**Table 1.** Changing PM10 values over the years

|  |  |
| --- | --- |
| PM10 (µg/m3) |  |
| Periods | 2018 | 2019 | 2020 | Change (%) 2020/ (2018;2019) |
| Jan 1 – Mar 15 | 43 | 40 | 42 | 0 |
| Mar 16 – May 31 | 53 | 42 | 34 | -28 |
| Jun 1 – Jun 30 | 34 | 38 | 36 | 0 |

Figure 5 shows that the PM2.5 concentrations averaged daily values of Istanbul province for time range from 02.01.2019 to 30.06.2020. Averaged daily PM2.5 values of Istanbul generally between 5 μg/$m^{3}$and 65 μg/$m^{3}$. Blue line means the daily PM2.5 values of Istanbul and the red line means five-day average of the daily PM2.5 values of Istanbul.

Figure 6 shows that the PM2.5 concentrations averaged hourly values of Istanbul province for time range between March 15th and April 15th in 2018, 2019 and 2020. As can be seen in the graph the amount of PM2.5 of the year 2018 and the year 2019 are very close to each other. The amount of PM2.5 of the year 2020 is lower than the values in both 2018 and 2019 in all hours. There is a significant decrease in PM2.5 values in Istanbul in a month period compared to previous years.

**Figure** 5. PM2.5 values of Istanbul between 01.01.2018 and 30.06.2020

**Figure 6.** Hourly PM2.5values of Istanbul between March 15th and April 15th in 2018, 2019 and 2020

Table 2 prepared to understand to see if there is a change in the amount of PM2.5 in the period of lockdown. When compared with the values of 2019, the amount of PM2.5 in 2020 decreased by 27% during the lockdown period. All the values of 2020 are lower than the values of 2019, but there has been a greater decrease in lockdown period.

**Table 2.** Changing PM2.5 values over the years

|  |  |
| --- | --- |
| PM2.5 (µg/m3) |  |
| Period | 2019 | 2020 | Change (%) 2020/2019 |
| Jan 1 – Mar 15 | 25 | 22 | -11 |
| Mar 16 – May 31 | 23 | 17 | -27 |
| Jun 1 – Jun 30 | 17 | 15 | -15 |

According to a study conducted in China, the highest concentration of PM10 occurred in the cold winter season and PM10 concentration was measured lower during periods of higher air temperature (Zhang, et al., 2015). Fig. 2 has mean temperature values of Istanbul. We can divide the time of 2 and a half years into 3 periods as before, during and after lockdown. If we look at the all the periods, we can see increases and decreases from time to time. These increases and decreases might cause by meteorological events such as temperature changes. There is uptrend in temperatures in Istanbul. There is no sudden change in temperature values corresponding to the coronavirus period.

Conclusion and Recommendations

The main cause of the amount of particulate matter before the lockdown period is heating. People who live in Istanbul needs heating in winter season because of the weather conditions of Istanbul. Heating types create particulate matter pollution in air. After the winter season so in the spring, the weather gets warmer and the need for warming is reduced. Thus, particulate matter pollution is also reduced. However, in 2020, the amount of particulate matter has decreased more in the spring season than in previous years thanks to the lockdown precautions.

Because of the coronavirus related lockdowns air pollution decreases almost %44 in the whole world (Arora et al., 2020). There are so many cars and they cause traffic and traffic is a huge problem in Istanbul because most vehicles use fossil fuel. While lockdowns in some Turkish people stayed at home mostly, some factories did not work, all students took their lessons online so they stayed at home and do not use transportation. That’s why between March 16th and May 31th pollutants created by people are reduced.

All people have tasks to do in order to reduce air pollution. In coronavirus quarantine precautions, we have seen that many people can do their jobs over the internet. Employers should consider this issue in order to reduce air pollution. In lockdown period, the precautions taken by humans have helped reduce air pollution. People should continue these precautions, both as a avoid catching the coronavirus disease and to reduce air pollution.

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