Covid-19 effect on air quality

Whether we it has effect and reason of effect

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ABSTRACT

For the research paper, we are going to do research on whether Covid-19 lock down affects air quality. There are many assumptions for now, newspapers are all talking about the improvement of air quality. And for this paper, we want to find out whether the assumption is correct. If it is correct, what is the reason for the improvement of air quality? Is it because of the reduction of usage of vehicles? Is it because of lock down of the factories? Is it because people are quarantined at home and no longer go to restaurants or shopping malls? These are all the assumptions; we will give readers a final result in this paper.

KEYWORDS

Covid-19, Pandemic, Air quality, Pollution, Vehicle, Factory, Spring Festival, PM 2.5, AQI, IAQI

1 Introduction

After Covid-19 pandemic happened, people from all over the world have been through a long period of quarantine. There start to be some questions like "What has this Covid-19 pandemic changed our life". Our lifestyle and flow have totally changed after the pandemic happened. Restaurants have been shut down and people reduce the frequency of using vehicles. And news is telling people that air pollution has been reduced due to the Covid-19 quarantine. Is this true or is it a paper trying to get audiences' attention? In this article, we will be doing some research on whether this news is true or not. We will first have a thought on whether the air quality changed only because of the lock down or there is another factor that we should be considering. For example, in China, Spring Festive can be a reason why air quality is changing. In the next section, we will discuss the effect on air quality on China.

2 Relation between lockdown and air quality

With the Covid-19 lockdown happening worldwide, our society starts to have a more isolated way to manage daily life. People start to follow social distancing rules and reduce large gatherings. And like the butterfly effect, people reduce the use of vehicles and factories start to shut down. This all means that there will not be as much air pollution being released during this pandemic. In NASA's website, it states that "These particles and gases can come from car and truck exhaust, factories, dust, pollen, mold spores, volcanoes and wildfires (2020)." This means that with the reduction of the vehicle and factor there should be an improvement for air quality. But for now, this is just an assumption, there needs to be clear evidence said that there is a reduction of using vehicles.

Thus, we find an image in the Statista website, and it is easy to see from the figure that with the pandemic happening, the usage of vehicles has been reduced worldwide. And for China, they have stricter lockdown than any other place. This means that the Vehicle reduction in China will only be larger. Government stops bus and subway service and most of the citizens only go out for groceries. All those measures lead to a reduction of vehicle usage. However, vehicles can't be the only reason for influencing air quality. As we also know, there are strict lock down on many other factories. As we have mentioned before, people in all the factories start to quarantine at home so that factories can't work as it is before the pandemic.

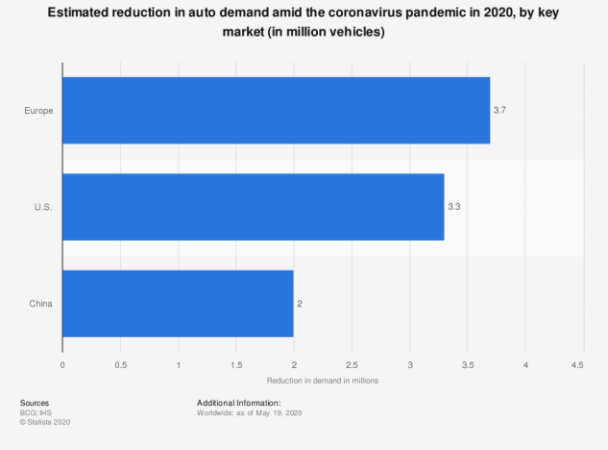

Figure 1: Vehicle reduction in pandemic

2.1 Whether lock down effect air quality

First, whether the air quality is changing and how it is changing is a question to solve. In the article "The short-term impacts of COVID-19 lockdown on urban air pollution in China", the authors

state that "We find that lockdown improved air quality substantially: it reduced AQI by 26.18 points (19.84 points from the first DiD and 6.34 points from the second DiD), which corresponds to a 22% reduction; PM2.5 was brought down by 21.12 μg m−3 (14.07 μg m−3 from the first DiD and 7.05 μg m−3 from the second DiD), which corresponds to a 24% reduction"(He,Pan,Tanaka, 2020). In this citation, there are several professional nouns such as AQI and PH2.5. AQI is the short name of Air Quality Index which is an index that can describe the quality of air. To calculate AQI, we need to introduce about IAQI which is Individual Air Quality Index. Using concentration of many kinds of pollution, we can get IAQI. And AQI is the largest IAQI in one word. After introducing those concepts, we can see that from the perspective of AQI and PM2.5, the quality of air is improving. This means that lock down does have an effect on air quality, moreover, it has a positive effect on air quality.

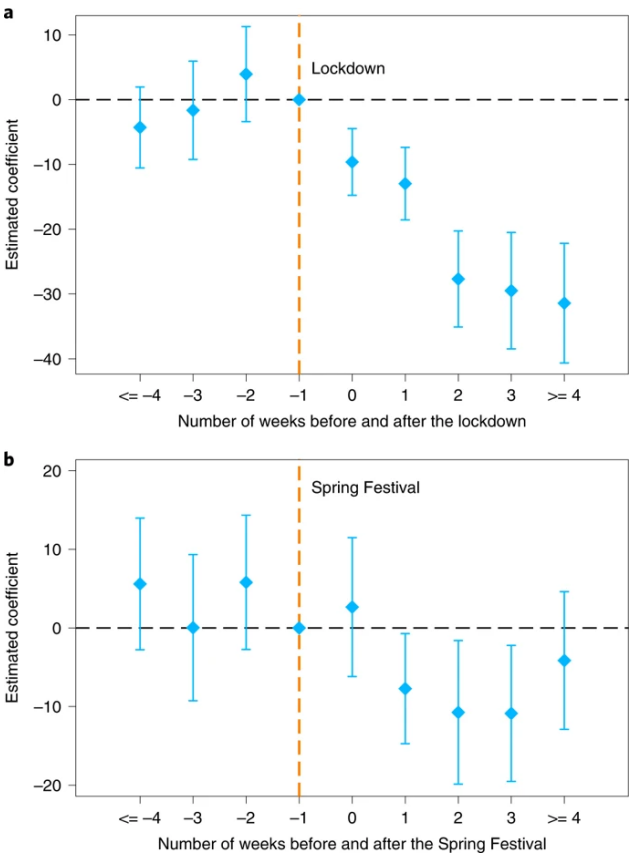

Figure 2: Compare with spring festival test group

In order to exclude other factors, we need to think about what could influence the air conditioner at that time. With Spring Festive going on at the same time with lock down happening, it needs to be thought about whether it is a factor to affect air quality too. We can see from the figure that, with the Spring Festival in China, there is also an improvement in air quality. However, since the lockdown happened on Spring Festival, they compared lockdown with Spring Festive in the past. This figure shows that, when the air quality deteriorated after Spring Festive in the past year, the lockdown test group still shows that air quality is improving. This means that the air quality being improved is not only because of the Spring Festival.

2.2 Another sound

However, there is always another sound for all the argument. In article "AMBIGUOUS POLLUTION RESPONSE TO COVID-19 IN CHINA", author states that in Hubei which has the most population of Covid-19 patient and the strictest lockdown, the air quality does not have a noticeably clear improvement. Then they analyze the data from Hubei, it's neighborhood province and its non-neighborhood province. They find out that in Hubei there doesn't seem to have a clear and huge growth in air quality improvement. This ambiguous is a remain question for us.

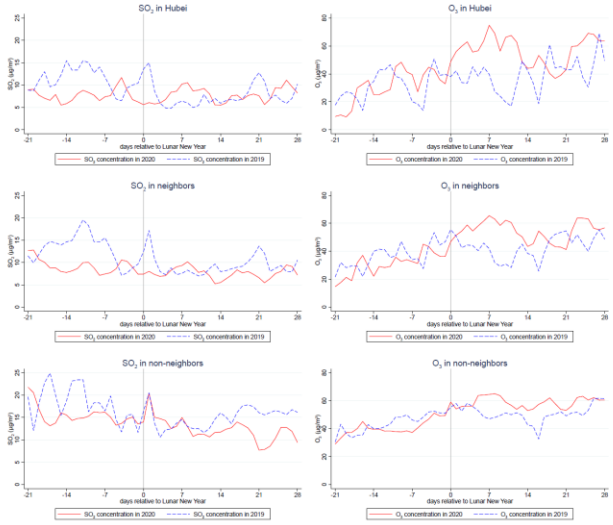

Figure 3: Air quality in Hubei, it's neighborhood province and it's non-neighborhood province

3 Changes of air quality in special Cities

The following part will put the perspective on specific cities and analyze whether the lockdown will have an effect on air quality through specific cities. The first part discusses New Delhi, Kolkata, Mumbai, Hyderabad, and Chennai, five major cities in India. The second part discusses the 50 most polluted capital cities in the world. The third part discusses the air quality changes of New York City during the lockdown period.

3.1 Changes of air quality in India

Due to the severe impact of COVID-19, the Government of India announced a complete nationwide lockdown, from 24 March 2020 for 21 days. In the article "Impact of lockdown on air quality in India during COVID-19 pandemic", the authors mentioned that during this period, train and vehicle transportation were almost stopped.（Ramesh P. Singh，2020） In other words, the use of vehicles has been greatly reduced in India. The US Embassy's test results of the air quality in **New Delhi** the city have heavily polluted and densely populated show that in the lockdown, New

Delhi's air pollutants are clearly decline. At the same time, PM2.5 levels in the other four developed Indian cities: **Kolkata, Mumbai, Hyderabad** was be tested gradually decreased as Lockdown progressed. Only have one city **Chennai** the PM2.5 level in increased. It is not difficult to find that with the lockdown, the traffic flow is reduced, and the air pollution in most big cities in India is reduced in just 21 days. We can say that the reduction of vehicles is a major reason for lockdown to reduce air pollution.

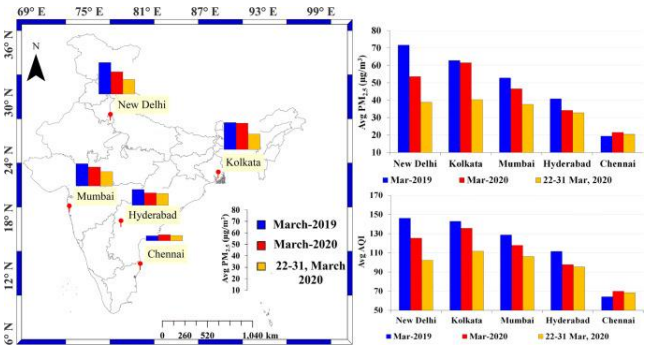

Figure 4: Changes in average PM2.5 during lockdown in New Delhi, Kolkata, Mumbai, Hyderabad, and Chennai

3.1 Changes of air quality in 50 most polluted capital cities

This paragraph will discuss the air quality during the lockdown of the 50 most polluted capitals. The analysis method mentioned in article "Air quality during the COVID-19: PM2.5 analysis in the 50 most polluted capital cities in the world" is 1. Identify the 50 most polluted capital cities. 2. Review the quarantine information. 3. Data collection of population and weather stations. 4. PM2.5 data extraction. 5. Graphics and analysis. This is a noticeably clear method of data analysis. The author mentions the decrease, increase or constant level of PM 2.5 in these countries. Attributable to the level of confinement in each country, the level of confinement at the beginning of quarantine, or to increase the amount of power generation based on the power generation technology used. It can be seen from Figure 4 that during lockdown, the PM2.5 content of most capital cities is lower than before lockdown. **Bogotá** (Colombia) has an amazing decrease of 57%, while **New Delhi** (India) mentioned in the previous paragraph shows a decrease of PM2.5 by 40%. Bogotá's pollution reduction is staggering, probably because the city has one of the largest traffic flows in the world. After restricting vehicles, air pollution has been rapidly reduced. This reason is similar to the Indian capital New Delhi. Restricted travel for the same vehicles has also caused huge traffic flow. After the restrictions, air pollution has also been greatly reduced. In summary, we can draw a conclusion: PM2.5 made by vehicles is a big cause of air pollution. However, there are some capital cities where PM2.5 changes are not obvious. In some European capital cities, such as Paris (France) and London (United Kingdom), air quality has been maintained at a good level, because European population density is not large and technology is developed, it can be speculated that the traffic volume is not particularly large, and vehicle technology may be more environmentally friendly. In summary, it can be concluded that the decrease in traffic during Covid-19 lockdown is one of the main reasons.

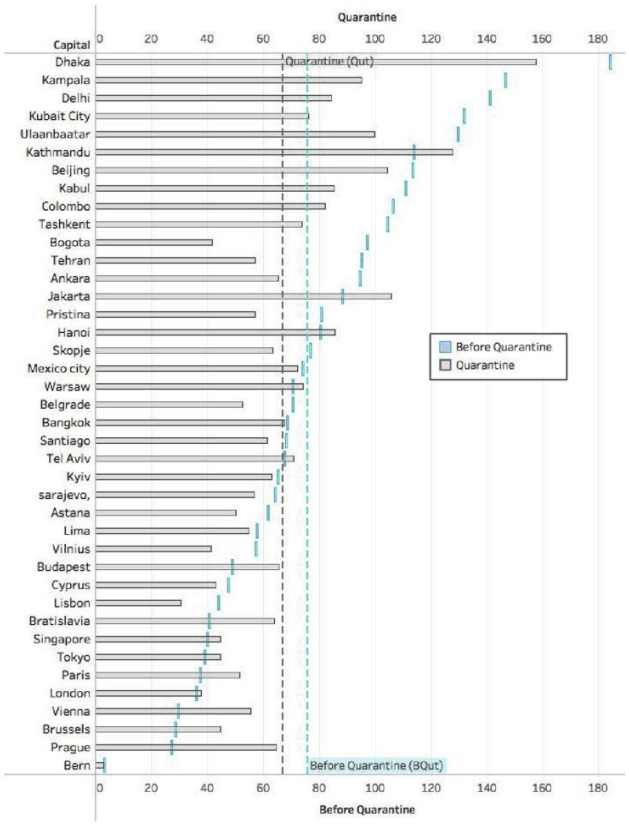

Figure 5: Air quality comparison of the 50 most polluted capitals with and without lockdown

3.2 Changes of air quality in New York City

In the previous paragraph, we can know that the content of PM2.5 in the air during the blockade in Paris, France, and London, UK did not change much. This part will focus on the PM2.5 content in **New York City**, USA. New York City is the most populous city in the United States, with a very dense population. There may be two results before seeing the conclusion. One is that the air quality of some Asian cities is obviously improved, and the other is that the air quality of European cities is not changed much. Author Shelby Zangari et al. analyzed the air quality in New York in the article "Air quality changes in New York City during the COVID-19 pandemic". They used 15 test points to conduct air tests on different areas of New York. In addition, they tested for PM2.5 by year using a time-lagged linear regression model.

$$y = \beta_0 + \beta_1 X + \beta_n Z_n + XZ_n + t_n + \varepsilon$$

After the data analysis, compare the test data in 2020 with the test data in 2015, 2016, 2017, 2018, and 2019. The results are shown in Figure 5, it can be intuitively found that the air quality has not changed significantly in 2020 compared with other years. It can be concluded from the data that although the lockdown measures have led to reduced traffic in New York City, this has not caused a sufficient impact on the air quality of New York.

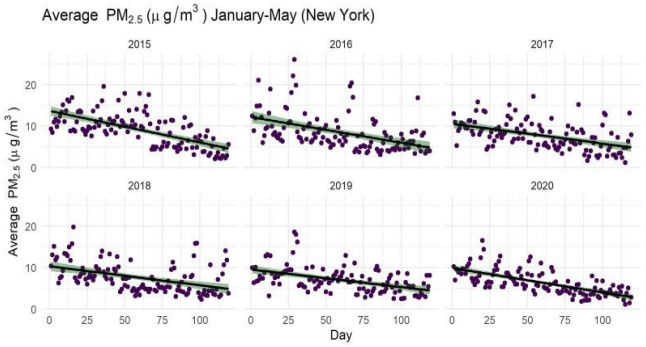

Figure 6: New York City PM2.5 changes in the air from 2016 to 2020

4 Conclusion

In summary, due to the prevalence of covid-19 worldwide, most cities have chosen lockdown measures, and these measures are effective in reducing air pollution for some cities. For China, the government has implemented a strict lockdown, the traffic volume has been greatly reduced, most factories are no longer open, and the air quality can be significantly improved. Similar to China, the city of India and Colombia also have big reduction in vehicle, and That is the main reason for reducing the PM2.5 in the air. However, in some large cities in Europe and America, air quality has not decreased significantly. Perhaps it is because the lockdown policy is not as strict as that in Asian countries, it may be because the traffic volume is not as large as that in Asian countries, or it may be because the environmental protection of the car is better. In short, after analyzing multiple papers, it can be concluded that air pollution will be affected by many aspects, such as holidays and season changes. But for some countries, the air pollution caused by cars will ignore these effects, and intuitively show how much traffic has imposed on air quality. For some countries, adopting more environmentally friendly travel methods or making changes to vehicle policies can improve the air environment. This is also an analysis of the impact of Covid-19, which is more positive.

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