Group ADS43-D

CORONAVIRUS AND AIR POLLUTION

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Introduction

One of the biggest problems in Italy[1] is air pollution and as per the air quality report of 2018[2], the air quality had a red alert for Italy. The increasing air pollution in Italy was the cause of a total of 9% of deaths of Italians over the age of 30 years. That is why through our project we aim to find the impact of COVID-19 on the environment of Italy and hopefully find a decline in deaths due to air pollution. We, through this project, will also try to visualize the contrast between deaths due to coronavirus and possible lives that were saved due to better environmental situations in Italy during and post coronavirus.

[1] Bressa, R. (2005, 2 December). Air pollution. Italy is Europe's most polluted country. From https://www.lifegate.com/people/news/air-pollution-europe-eea

[2] IQAir AirVisual. (2018). 2018 WORLD AIR QUALITY REPORT. consulted from https://www.iqair.com/world-most-polluted-cities/world-air-quality-report-2018- en.pdf

Main Research Question

- Did Corona end up saving more lives than it took?

Sub Questions

- What is coronavirus?
- How did the coronavirus come about?
- What is air pollution?
- How did the overall air quality change during the impact of the coronavirus?
- How did covid-19 affect countries overall?
- What is the number of deaths due to air pollution before the coronavirus?
- Is there a decline in deaths due to air pollution after the coronavirus?

What is Covid-19?

1. Short description

The virus first occurred in Wuhan, China. Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) is the name given to the 2019 coronavirus variant. COVID-19 is the name given to the disease associated with the virus. SARS-CoV-2 is a new strain of coronavirus that has not been previously identified in humans. Coronaviruses are a family of RNA (ribonucleic acid) viruses. These viruses are called Corona viruses because the virus particle exhibits a characteristic corona (the latin word for a crown) of spike proteins around its lipid envelope.

2.Transference

It spreads through air and liquid, this mostly happens with sneezing and or coughing, but also when talking loudly or when breathing heavily. The virus particles that are airborne can be inhaled through both mouth and nose, and once this happens the virus particles meet the cells lining the throat and larynx. Those cells have many receptors on their surfaces, which play a big role in passing chemicals into cells and in triggering signals between cells.

Once inside the body, the RNA inserts itself into the cell's own replication segment, which causes the cells to create more copies of the virus. After a certain threshold is reached and the cell can not hold more, since the cell is bloated, it will burst. This results in releasing the virus further throughout the body.

3.Symptoms

The symptoms of COVID-19 vary a lot in severity from having no symptoms at all (being asymptomatic) to having:

- Fever
- Coughing
- Having a sore throat
- General weakness
- Fatigue

- Muscular pain

Whilst in the most severe cases the symptoms could be:

- Severe pneumonia
- Acute respiratory distress syndrome
- Sepsis
- Septic shock

All these severe symptoms could all lead to potential death. Recently the loss of the sense of smell and/or taste (anosmia/hyposmia) have been reported as symptoms of the COVID-19 infection. This could happen while the other symptoms are absent[3].

[3] Microdroplets might explain the rapid spread of COVID-19. (2020, 14 april) https://www.weforum.org/agenda/2020/04/coronavirus-microdroplets-talking-breathing- spread-covid-19/

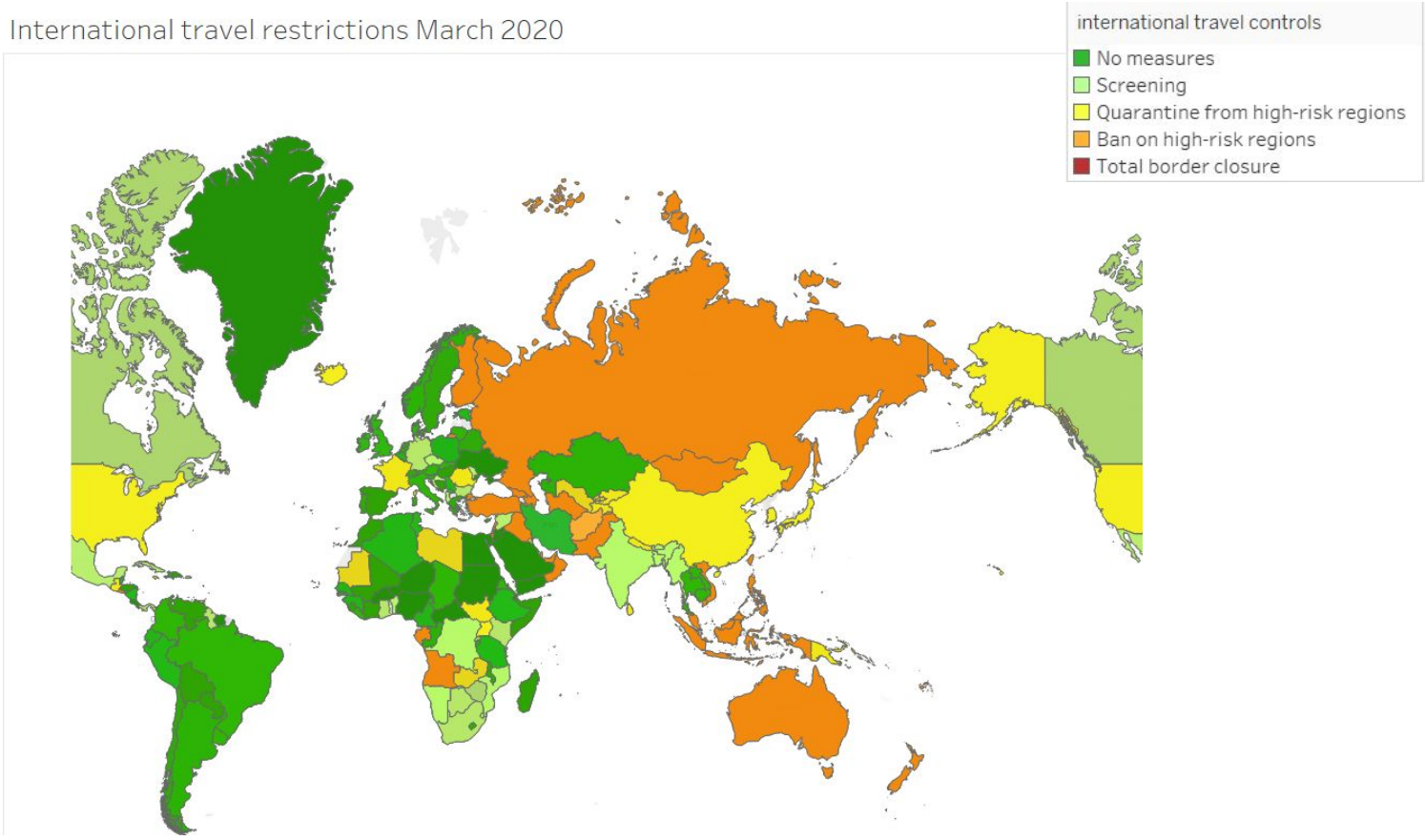
How did COVID-19 come about?

1. Origins

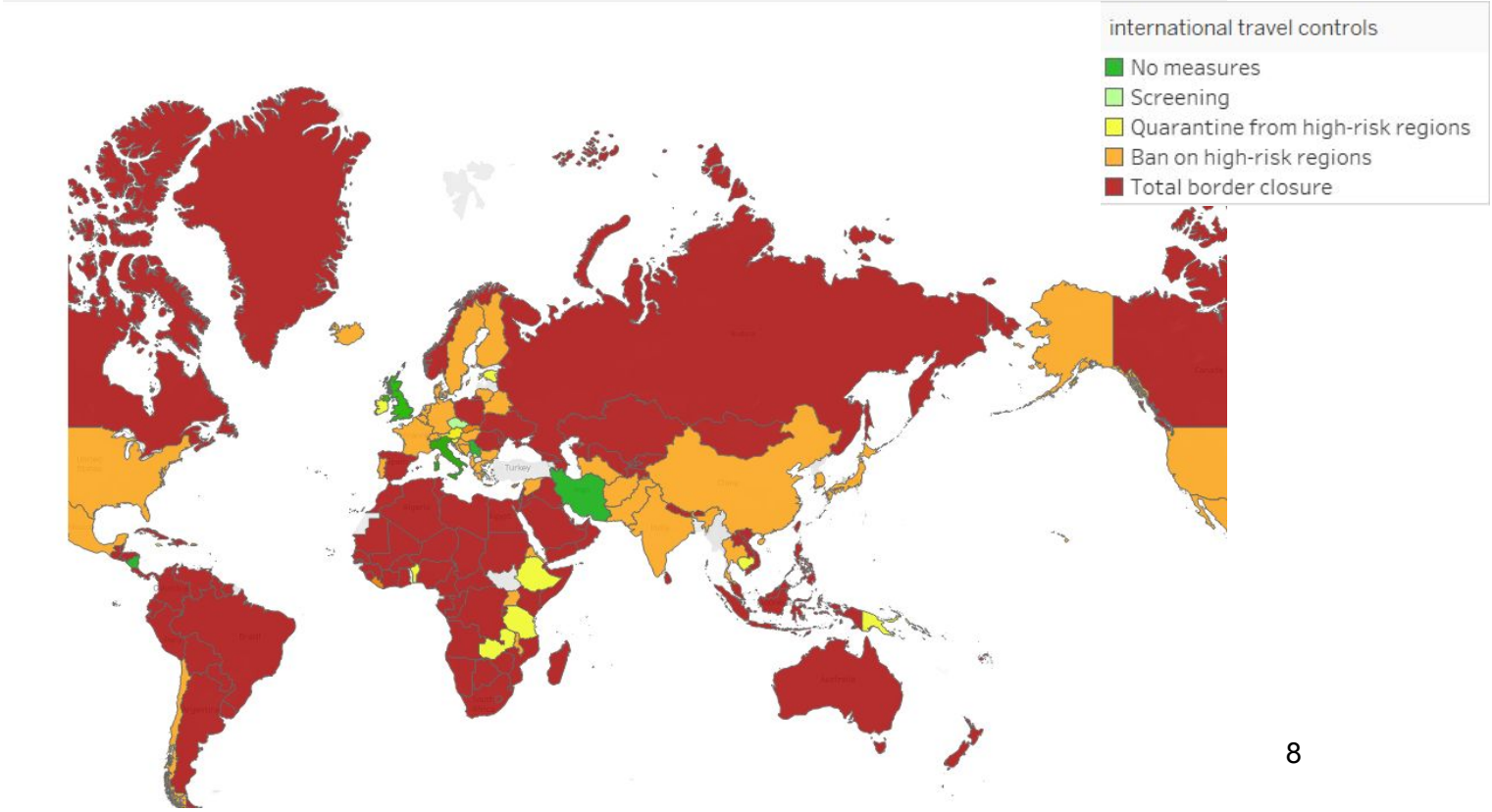
Covid-19 was first found and diagnosed in Wuhan, China. There are confirmations that the first patients got the virus from the market in Wuhan, after buying and eating a bat which also had a type of the COVID-19 virus. In December 2019, human cases of pneumonia of unknown origin were reported in Wuhan City, Hubei Province in China. A new Covid was identified as the causative agent by the Chinese government. Since then the virus has spread and human cases have been reported by almost every nation around the world and the COVID-19 has been declared as a pandemic by the World Health Organization (WHO). The CoV which causes COVID-19 has been named as SARS-Cov-2 bij the International Committee on Taxonomy of Viruses (ICTV); that is its scientific name. The virus is also referred to as COVID-19, the COVID-19 virus or the virus that is responsible for COVID-19. COVID-19 refers to the disease caused by the virus. Current research suggests that the SARS-CoV-2 emerged from an animal source. The genetic sequence data reveals that SARS-Cov-19 is a close relative of other CoV found in the horseshoe bat populations. However, to date, we still do not have enough scientific evidence to identify the source of the SARS-Cov-2 or how the original route of transmission to humans happened. There are speculations that the original transmission might have involved an intermediate host.

How did COVID-19 affect countries overall?

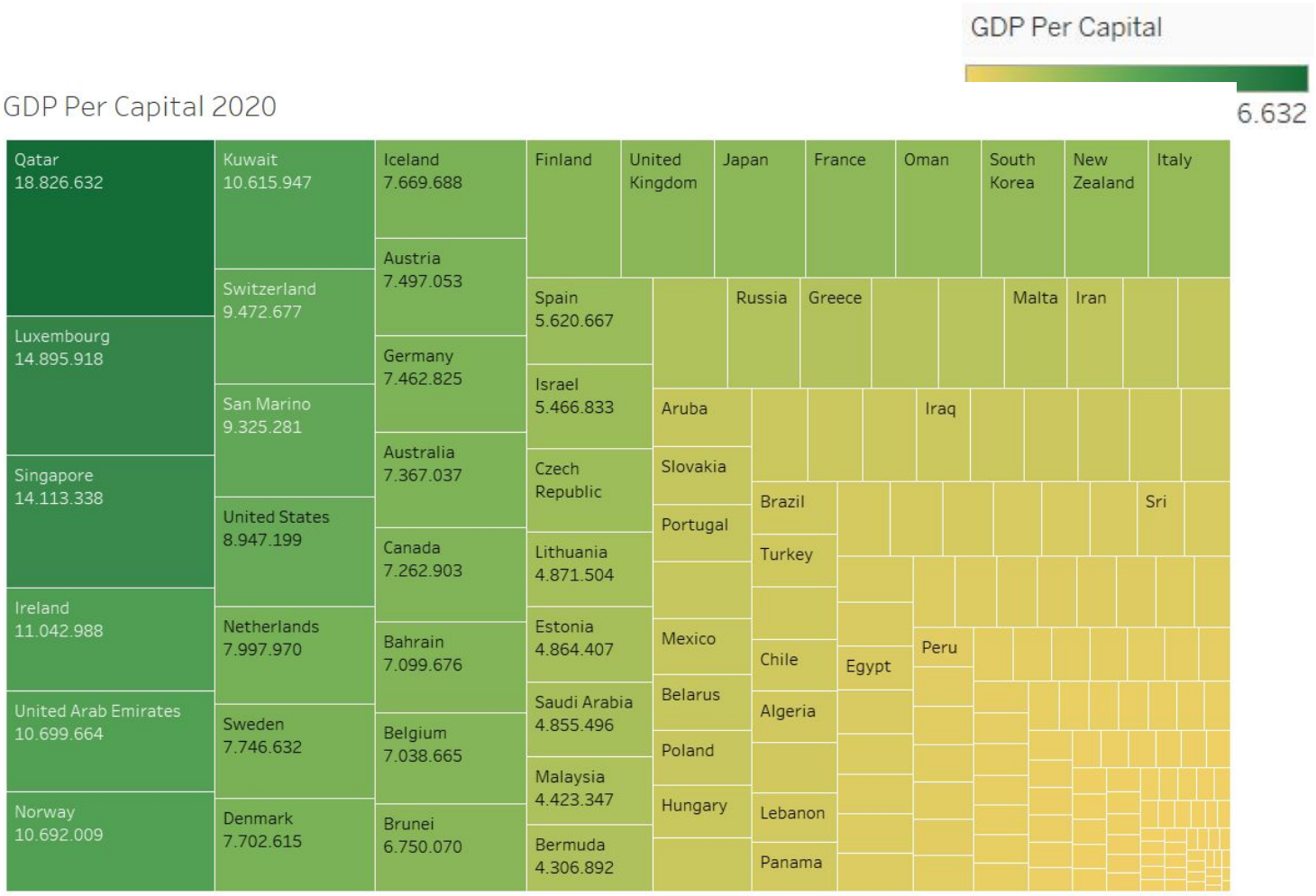
International travel restrictions March 2020



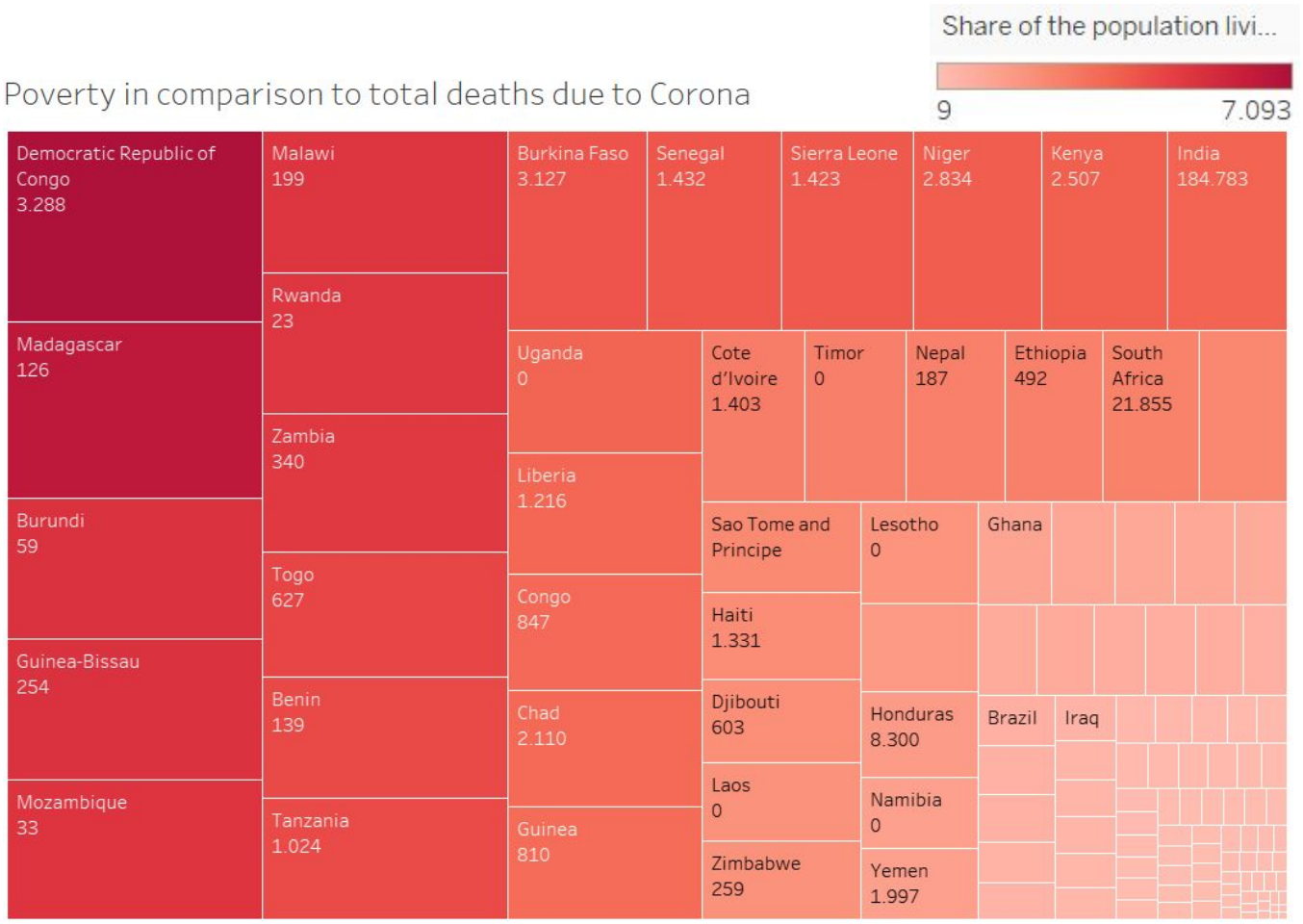
International travel restrictions June 2020



The two graphs above show the international travel restrictions which each country took on the first of March and the first of June. We can see that from the second graph, that about 80% of the countries are in total border closure. Not only did the border lockdown have a big impact on the distribution of food and the export & import but also hit the tourism industry very hard. Resulting in a plummet in the GDP of countries whose main revenue was tourism.
A lower GDP does not only affect the economy of the country but a lower GDP leads to more death; malnutrition, less sanitation, bad medical facilities, etc.

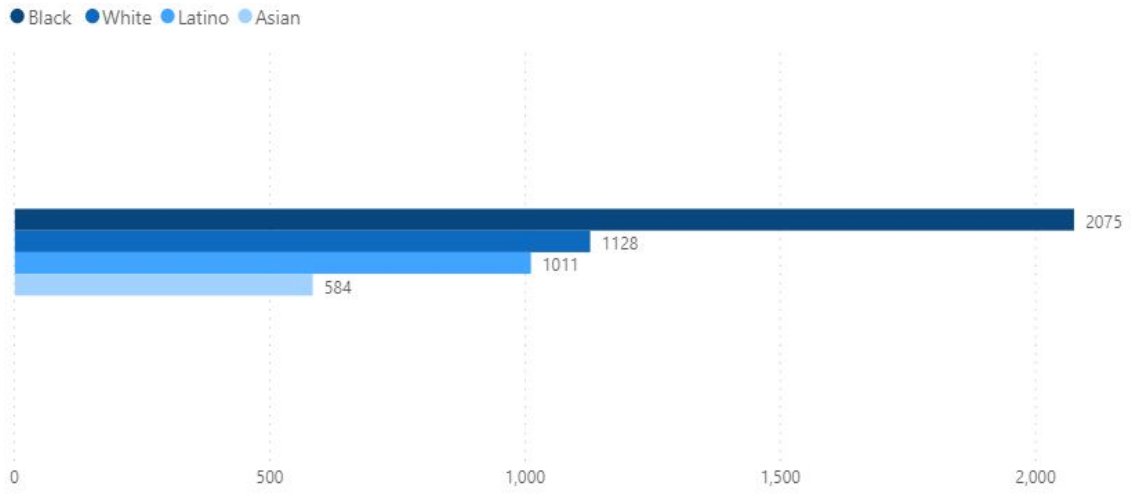


The graph above shows the total GDP per country ranking from highest to lowest.



The graph above shows the share of the population living in extreme poverty in percentage of the total population of that specific capital related to covid-19 deaths. How bigger the square, how more covid-19 deaths the country had, whereas the color represents the poverty of the country. We can clearly see that the poorest countries are all from Africa. Not only does covid-19 impact the population numbers but it also hurts the poorest countries the hardest.

Covid-19 deaths by race



The graph above shows the deaths per race, we can see a disproportionate number of black deaths, as Dr. Fauci, Director of the National Institute of Allergy and Infectious Diseases since 1984 said; *"Health disparities have always existed for the African American community… [coronavirus is] shining a bright light on how unacceptable that is because, yet again, when you have a situation like the coronavirus, they are suffering disproportionately. We will get over coronavirus, but there will still be health disparities which we really do need to address in the African American community*."

The higher death toll in the black communities is also rooted in institutional racism, after the slaves were freed from various farms, they didn't move very far away and established african american neighborhoods. These later became 'redlined neighborhoods' meaning they're seen as worse. Black people living in these neighborhoods were denied loans by banks and their property value was low because they couldn't afford houses. Educational institutes were funded by property tax, meaning that because these neighborhoods were poorer, the black people in them stayed poor and had poor education. Later on power plants and industry buildings were put close to these 'redlined neighborhoods' lowering the air quality and making the black people living there sick and resulting in them having worse immune systems. Covid-19 attacks lungs and airways and after decades of lower air quality black people died disproportionally much compared to white people. Combine that with african americans and other people of color being overrepresented as essential workers & as service workers, making them more exposed to the virus.

What is air pollution?

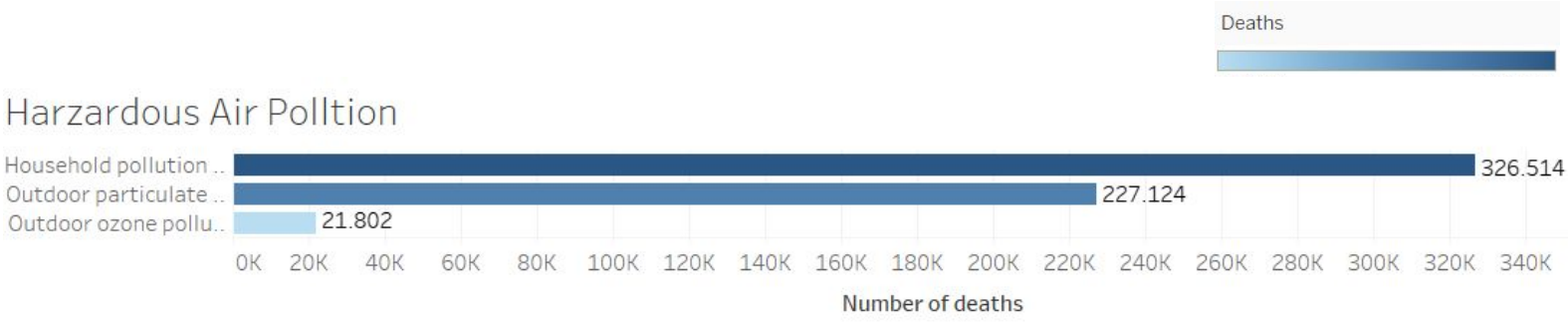
Air pollution refers to the release of pollutants into the air that are detrimental to human health and the planet as a whole.
Deaths due to air-pollution is in the headlines every now and then. The WHO has also categorized air pollution as the top reason for deaths related to environmental reasons. Around 7 million people die every year due to air pollution, and with countries striving for growth and development, especially in Asia and Africa; the number of deaths per year due to air pollution is expected to grow more.

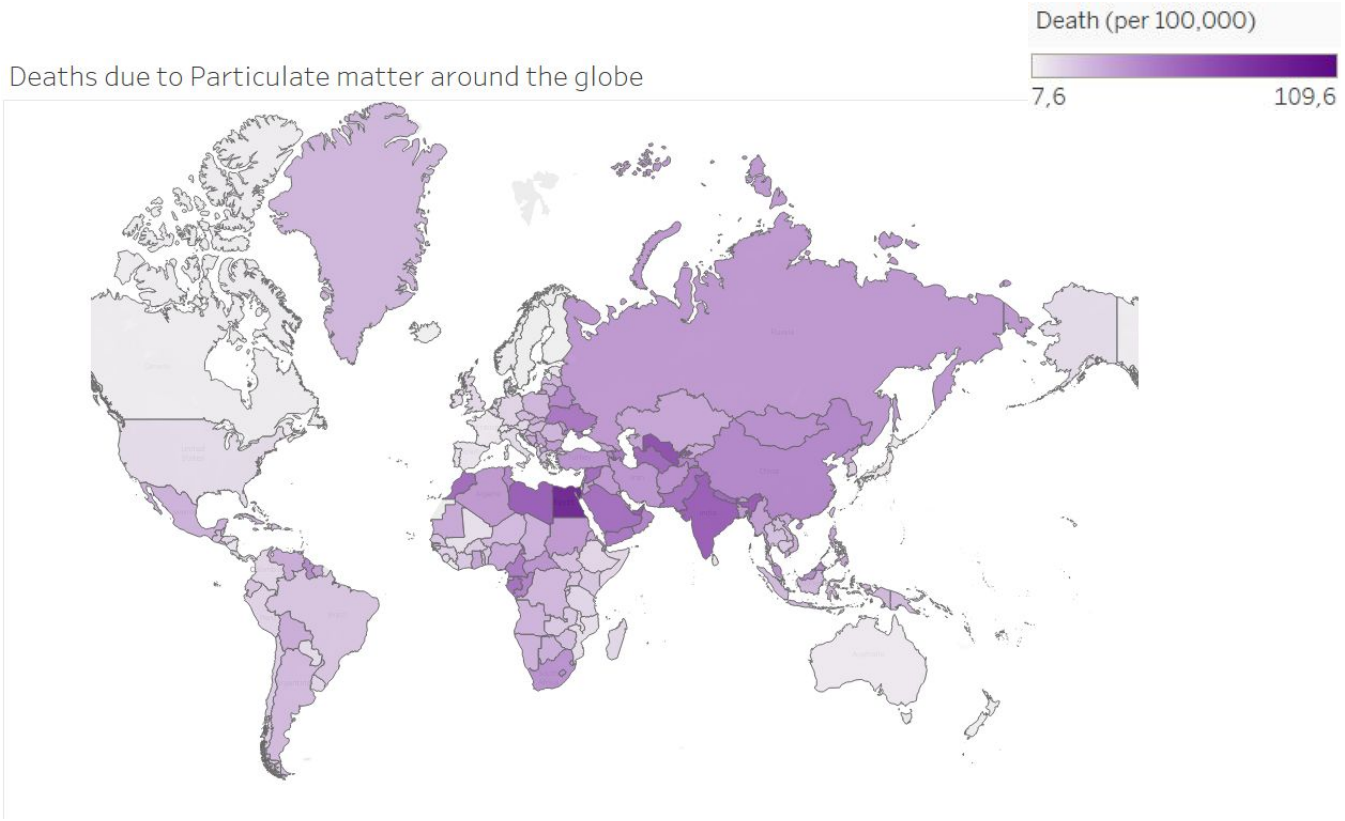
What is pm.2.5?

You may not be aware of it, but every time you breathe you breathe in pm. Pm stands for particle matters; it is generally used to describe a mixture of particles and droplets. Those particle matters can be found both outside and inside, however there is usually a lower rate of pm when inside. We will be talking about pm2.5: “fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller. How small is 2.5 micrometers? Think about a single hair from your head. The average human hair is about 70 micrometers in diameter – making it 30 times larger than the largest fine particle.”.
What are the health effects of those small particle matters? The main problem is that the particles are so small you inhale them without notice, this increases the likelihood of respiratory problems when they get in your lungs and some particles might end up in the bloodstream. Besides being bad for human health, pm.2.5 is also bad for the environment, it causes an increase in acidity in water bodies and in soil.

What is my risk of premature death from particulate matter?

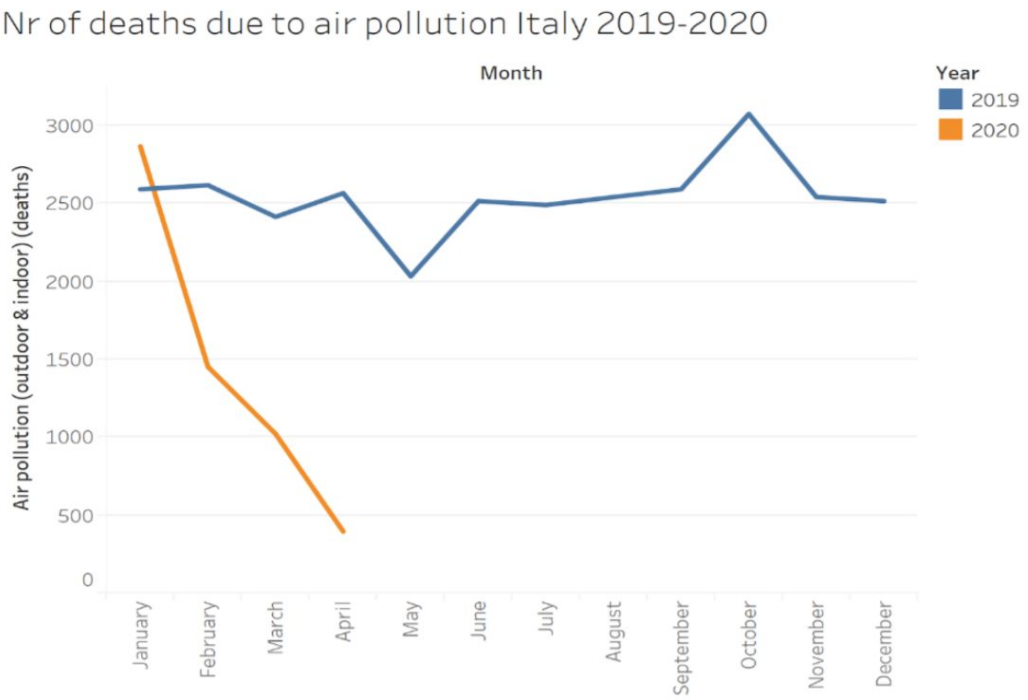
Deaths due to air pollution can be mainly categorized due to three main categories. Indoor pollution, which is generally due to indoor burning of solid fuels. Outdoor pollution, which is generally due to exposure to the ambient outdoor ozone and ambient particulate matter (PM) pollution. The graph below shows the number of deaths due to air pollution.





Correlation between Covid 19 and air pollution

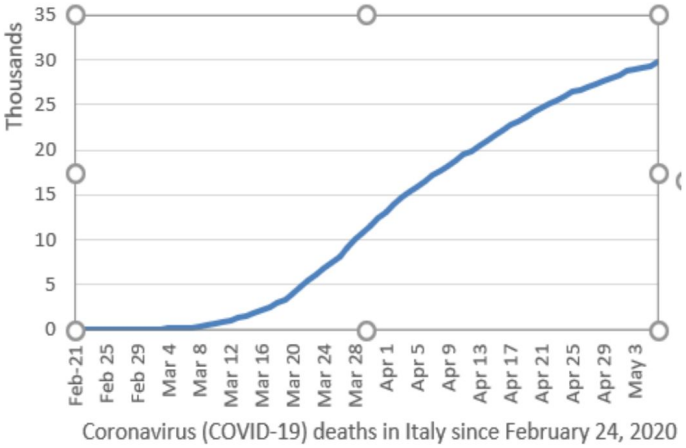
It would make sense that since Covid 19 and air pollution both go through well, air, and that Covid particles can attach themselves to particulates that in high density area's the Covid would spread faster and with more ease.
Though we need to take in a few other aspects, since in countries that have high income the people live in a higher density in cities, which means that the air pollution is higher per cubic metre. Now we need to take into consideration that there is a higher density of lower income people in those cities, and they mostly use transportation methods like the metro, bus and so on. This means that a lot of people will be contained in a smaller space, without a lot of air filtration against microbes. That would mean that if one person being infected with Covid 19 would cough, brush his hands or breath heavily in the bus the particulates would spread through the contained space and infect with high probability the rest of the population that is in the same transport vehicle.
In the lower income areas communities would spend time with each other without taking many precautions against the spread of Covid 19, and combining it with a lower hygienic level would mean that the virus can spread with lesser interruptions from air and/or water filtration systems. Alongside that the virus could survive longer than in a clean, higher income community.



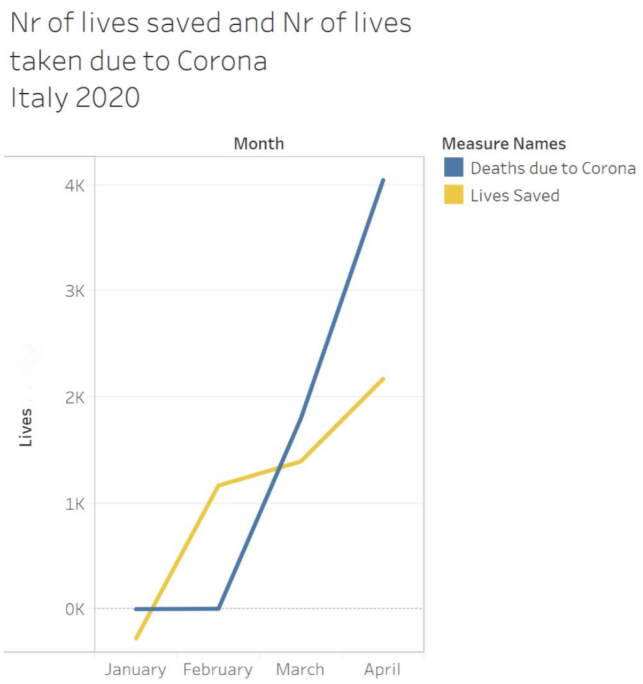
By observing the above noted graph, we can notice that January saw a lot of premature deaths in 2019 (2.590) and 2020 (2865) in 2019, the number stayed approximately the same, having a value between 2050-2500 but during October, Italy has seen an increase in the number of cases, with approximately 500 deaths and then a decrease again. However, since Italy went into total lockdown in February 2020, there has been a continuous decrease in the number of deaths, this due to less travel and business resulting in less (air-)pollution.

Deaths due to Coronavirus in Italy

By looking at the graph above, we can notice that after the first infection in Italy, the coronavirus (COVID-19) has been spreading relatively fast. February was the month with the least number of deaths as only on the 21th, the first death from covid-19 was registered. In the following days and months, the number kept growing and it reached approximately 30,000 premature deaths. From almost zero deaths in february to thirty thousand in may, we can specify that the deaths from the coronavirus have increased exponentially in the last months.



Number of lives saved and number of lives taken due to Corona in Italy 2020

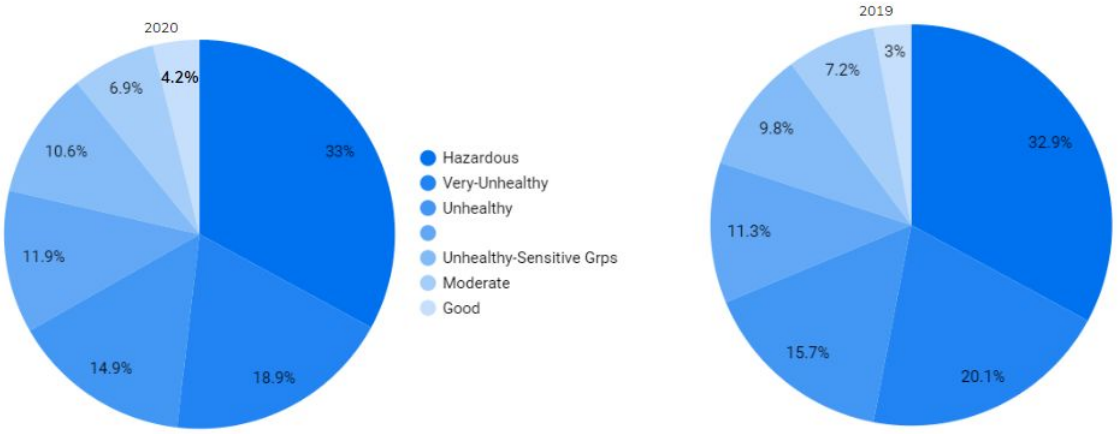


By analysing the graph above, we can observe that till April about 28 thousand premature deaths were recorded due to Coronavirus. On the other hand, till April 2020, about 2100 lives were saved due to less air pollution. Although a considerable amount of lives have been saved due to less pollution, Coronavirus appears to have stolen much more lives.

	City	Specie	Air Level	µg ▾	µg
1.	Trieste	pm25	Hazardous	2.2	
2.	Brescia	pm25	Hazardous	2.13	
3.	Florence	pm25	Hazardous	2.11	
4.	Prato	pm25	Hazardous	2.01	
5.	Naples	pm25	Hazardous	1.88	
6.	Parma	pm25	Hazardous	1.64	
7.	Bologna	pm25	Hazardous	1.62	
8.	Milan	pm25	Hazardous	1.61	
9.	Turin	pm25	Hazardous	1.58	
1...	Modena	pm25	Hazardous	1.43	

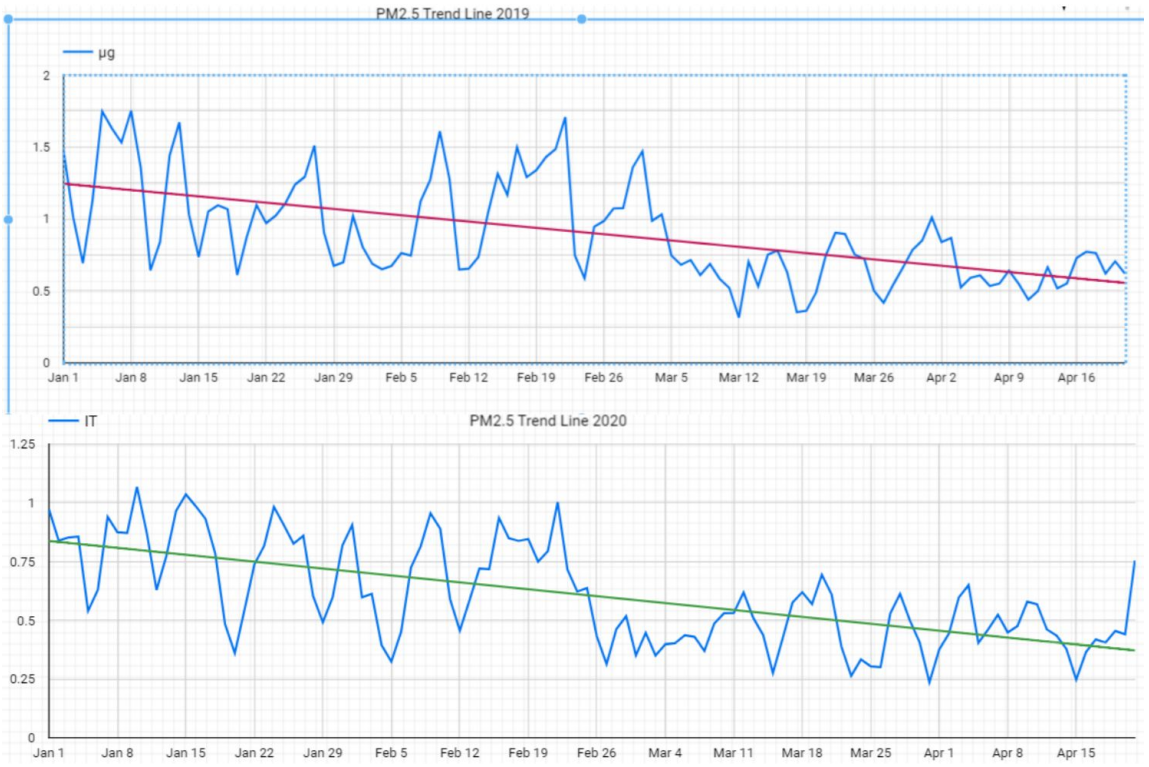
	City	Specie	Air Level	µg ▾	µg
1.	Trieste	pm25	Hazardous	2.4	
2.	Brescia	pm25	Hazardous	2.24	
3.	Bologna	pm25	Hazardous	2.13	
4.	Florence	pm25	Hazardous	2.12	
5.	Prato	pm25	Hazardous	2.06	
6.	Modena	pm25	Hazardous	1.85	
7.	Turin	pm25	Hazardous	1.78	
8.	Milan	pm25	Hazardous	1.66	
9.	Naples	pm25	Hazardous	1.55	
1...	Florence	no2	Hazardous	1.49	

From the insight derived from these two graphs , 2019 and 2020 data shows that higher levels of PM-2.5 in hazardous levels was found in Trieste city over the range of date topped the charts, this could be linked to the heavy amount of industries found in Tries



Year **2020** data shows a drop of **1.2 %** of unhealthy Air pollution

The 2020 (right) Pie chart shows that a total of 79.8% of the total PM2.5 emitted into the air in 2020 was not safe for the health to breath. From the "Unhealthy " color code and above the 2019 (left) pie chart shows that a total of 81% of the total PM2.5 emitted into the air in 2019 was not safe for the health to breath.



Comparing 2019 and 2020 using a time series graph, year 2020 shows that there is a drop of 1.2 pm of unhealthy graphs.

Exploration

In order to find a correlation between pollution and the coronavirus, our group needed information and various data. We partook in reading corona-related news daily, comparing different data sources and monitoring the changes of the parameters we deemed necessary for our research, as any offset can jeopardise the outcomes of the project. The first thing that we focussed on was getting an understanding of the total scope of our project, and the smaller, individual parts it was made out of. There were a lot of different factors in play. The most basic and first step we started with, was analyzing the situation of premature deaths in Italy due to the coronavirus. Premature deaths are deaths that occur before the average age of death. We started with analyzing datasets and news articles, reading daily recordings of news about pollution and coronavirus and comparing the data from different sources. Refining the data we extracted from those sources wasn't as difficult as we imagined as the records that we received were very accurate and up to date.

When we were done with refining the data from premature deaths, we decided that the next step we had to take was to find the decrease in air pollution pre-, and post coronavirus. We were curious if the imposed nationwide lockdown of Italy had some, if any effect on the pollution levels throughout Italy. This question was an important piece which needed to be answered for the research and the project to proceed.

After debating for a while we decided that we would split up and research two topics at once, one being the pollution level and the second being the question which pollution type is the most dangerous. After thorough research on pollutants and the pollution levels we have discovered that PM2.5 is the most dangerous type. Alongside that we were able to obtain a lot of needed data which had to be filtered, refined and visualised in order to be able to make graphs about the reduction of pollution in various regions of Italy. After making the graphs we moved onto our next step, which was finding out the amount of deaths due to pollution, and finding out the decrease in deaths due to decrease in pollution levels.

We encountered some troubles while searching for the datasets about deaths in Italy due to air pollution since all the data related to that gets recorded annually instead of monthly.

In order to fix that mishap we talked with our teacher and we came to the conclusion that it could be possible to discover the amounts of deaths per month instead of per year if we applied mathematical equations. Some time later we created a data set which contained the monthly death rate before corona, and even after corona got to Italy.

Sadly, even after Corona hit and the country went into full-lockdown mode the amount of deaths due to the air pollution did not become 0, instead it had a big drop due time in months after the Lockdown. While visualizing the data it was important to have the P.M 25 pollution included in order to make proper comparisons. A final visualization was then made to the number of premature deaths that were saved due to reduction in pollution levels in contrast to the number of lives that were lost to Corona.

Used methods and strategies

We used the following methods and strategies to enhance our research:

- **Library**[4];

1. Literature Study:

In order to find a correlation between pollution and the coronavirus, we needed information and various data.We partook in reading corona-related news daily, comparing different data sources.
We selected which materials to read in detail in order to get more knowledge about coronavirus and air pollution and summarised our findings.
The information that we obtained was used in the following sections of the document: “Introduction”, “What is Covid-19?”, ”How did Covid-19 come about?”,“What is air pollution?”, “Correlation between Covid-19 and air pollution”.

- **Lab**[5];

1. Data analytics:

We gained insights by measuring and analysing the data collected by different people and institutions. Using various data collected, we analyzed how did Covid-19 affect all countries in terms of international travel restrictions, the number of Covid-19 deaths per race and the poverty in comparison to total deaths due to Coronavirus.

We also analyzed what is the risk of premature death from air pollution, number of deaths due to air pollution in Italy (2019-2020), the levels of PM-2.5 (2019-2020) and the number of lives saved due to Coronavirus.

- **Showroom**[6]**;**

Using peer review we regularly organized meetings with our teachers in order to have them look at our work and get feedback. Using the received feedback, we improved our deliverables weekly.

[4] *Category:Library - ICT research methods*. (z.d.).from http://ictresearchmethods.nl/Category:Library

[5] *Category:Lab - ICT research methods*. (z.d.). from http://ictresearchmethods.nl/Category:Lab

[6] *Category:Showroom - ICT research methods*. (z.d.). from http://ictresearchmethods.nl/Category:Showroom

Conclusion

In Italy, air pollution poses a major threat to human health as it increases the mortality from heart disease, stroke, lung cancer, pulmonary disease and acute respiratory infections. But ever since the outbreak of the coronavirus we came across a lot of news about a steep decline in the pollution level across the world, which meant that the number of premature deaths due to pollution should decrease too. Therefore, to check if our hypothesis was correct, we did some research in order to find the number of premature deaths in Italy due to air pollution, before and post coronavirus.

We collected the data from various sources and refined it into a sensible bunch of datasets that we later visualize as graphs to show the contrasts between the number of lives lost due to corona and number of lives saved due to better air quality.
Corona affected our ecosystem in a lot of ways, from better air quality to returning the animals back to their homes, from reduced water pollution to cleaner rivers. All these effects have positive impacts not only on human lives directly but also on the lives on which human lives depend.

To answer our main question: When deaths due to corona are compared to lives saved due to better air quality(which is one of the many factors that were affected by corona), we find Corona did end up taking more lives than it saved.