For Discussion Purpose – April 11, 2020

Trying to Make Sense of the COVID-19 Pandemic Part 1: Global Perspective

Examination of covid-19 cases and population density, demographics, tourism, air travel, air pollution, health care expenditures, per-capita income, exposure to electromagnetic pollution and freedom the press/Internet.

Dr. Magda Havas, B.Sc., Ph.D., Professor Emerita

Trying to Make Sense of the COVID-19 Pandemic, Part 1: Global Perspective

This document is intended for discussion purposes.

Dr. Magda Havas, B.Sc., Ph.D., Professor Emerita

In this preliminary investigation I am trying to make sense of why we are experiencing this covid-19 pandemic and why it seems to differ somewhat across the globe. I did this to satisfy my own curiosity and I share it because others may find it useful.

I use data that is freely available on the Internet from such bodies as Johns Hopkins University, the World Health Organization, NASA, wigle.net and especially from our world in data.

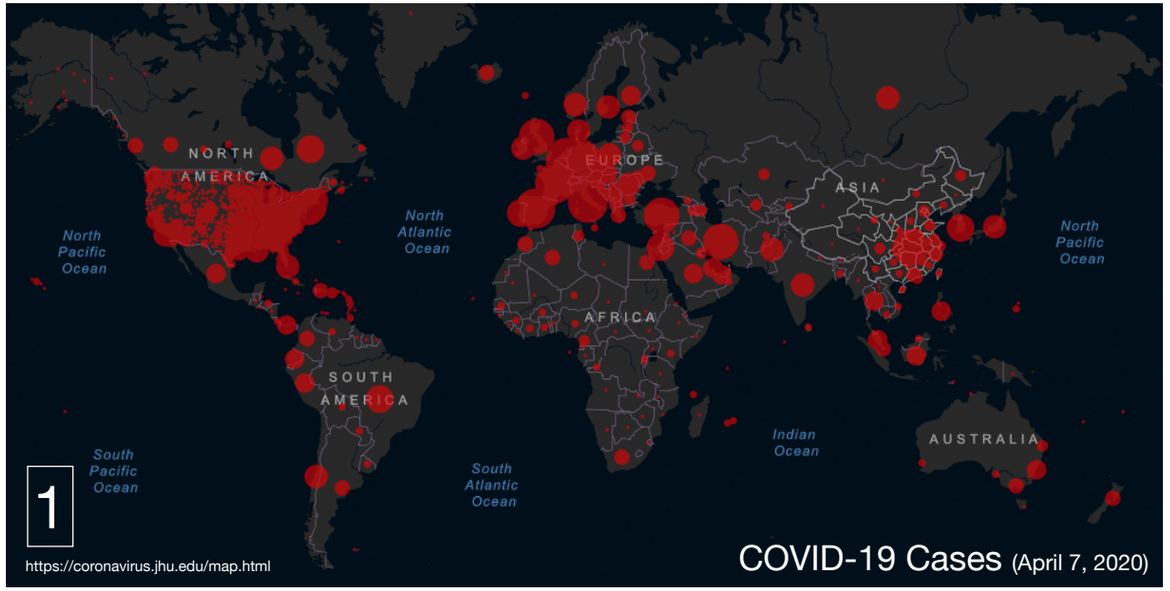
The focus is on data as opposed to political and economic influences or ideologies.

Let’s get started!

Covid-10 & Population Density

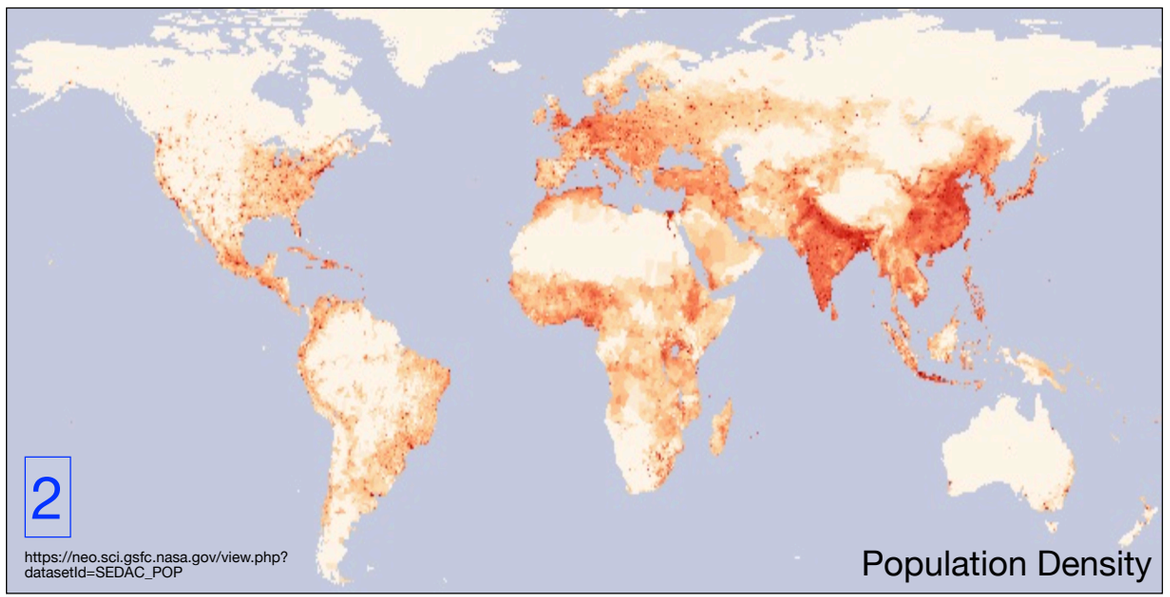
I started with this map of COVID-19 from Johns Hopkins University [1]. It shows the cases of covid-19 around the world as of April 7, 2020. For the U.S., Canada and Australia individual locations are shown whereas for other countries there is only one dot per country with no information about the location within the country.

I am trying to make sense as to why the incidence of covid-19 is so low in some places (Africa for example) and so high in others (Europe and North America).

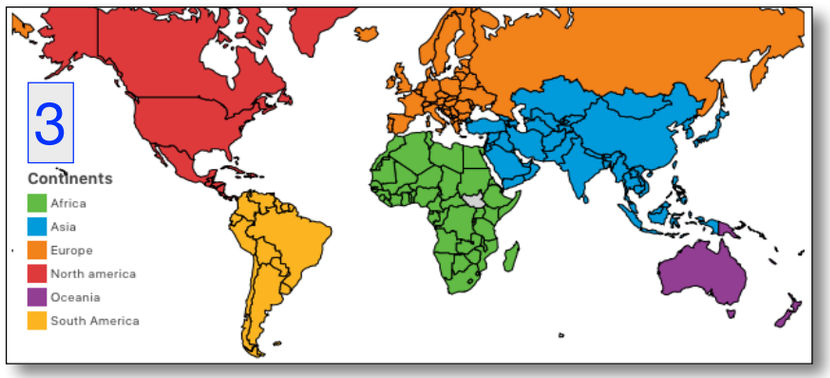


In trying to make sense of this pandemic, I decided to compare covid-19 cases [1] to a map showing population density [2]. Since this is a communicable disease the greater the population density, the more likely the contagion will spread to others. That is why social distancing is so important.

As you compare maps [1] and [2] you will notice a number of similarities. Densely populated areas do indeed have more cases of covid-19, with a few exceptions. The exceptions include Africa, possibly India and Russia.



Covid-19 Cases/Deaths by Continents



4

Continent	population (millions)	% of world's pop	population density/km2	COVID-19 cases	COVID-19 deaths	cases/1 million population	cases/population density	deaths/1 million population	deaths/population density	deaths/cases
				05-Apr-20						
Asia	4,642	59.5%	104	212,467	8,286	46	2,041	1.8	80	3.9%
Africa	1,341	17.2%	44	8,293	372	6	187	0.3	8	4.5%
Europe	748	9.6%	34	589,580	45,883	789	17,454	61.4	1358	7.8%
North America	369	4.7%	15	328,049	8,811	889	21,972	23.9	590	2.7%
South America	431	5.5%	24	28,826	101	67	1,194	0.2	4	0.4%
Oceania	43	0.6%	5	6,731	40	158	1,338	0.9	8	0.6%
Total	7,573	97%	nd	1,173,946	63,493	155	nd	8.4		5.4%

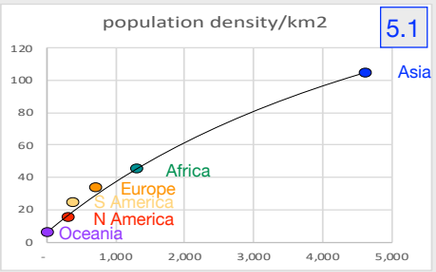
The next thing I did was look at continents and graphed the number of cases and the number of deaths with population and population density. The data I used is in Table [4].

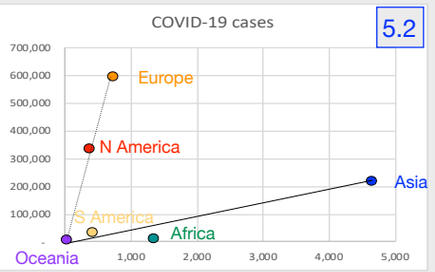
The graphs show that there is indeed a strong correlation between **total population** and **population density** [5.1], which is what one would expect.

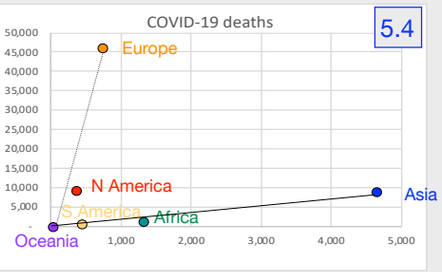
When I graphed covid-19 **cases** against population [5.2] and population density [5.3] there were two outliers–Europe and N.America. There were far too many cases based on population when compared globally.

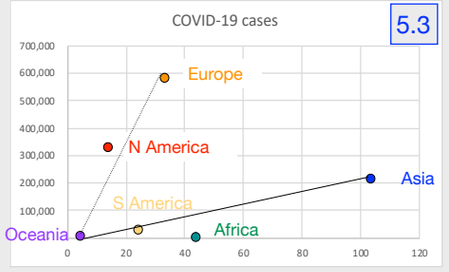
When I graphed **deaths** [5.4 & 5.5] Europe stood out from the rest due to the higher deaths in Italy and Spain. Over time this might change as the number of new cases is still increasing in North America and is beginning to decrease in most of Europe as well as other parts of the world.

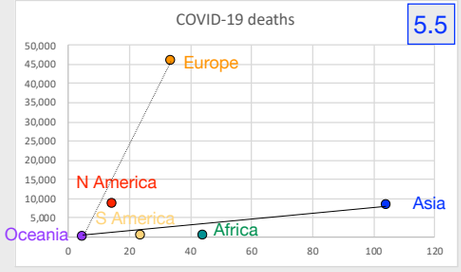
5



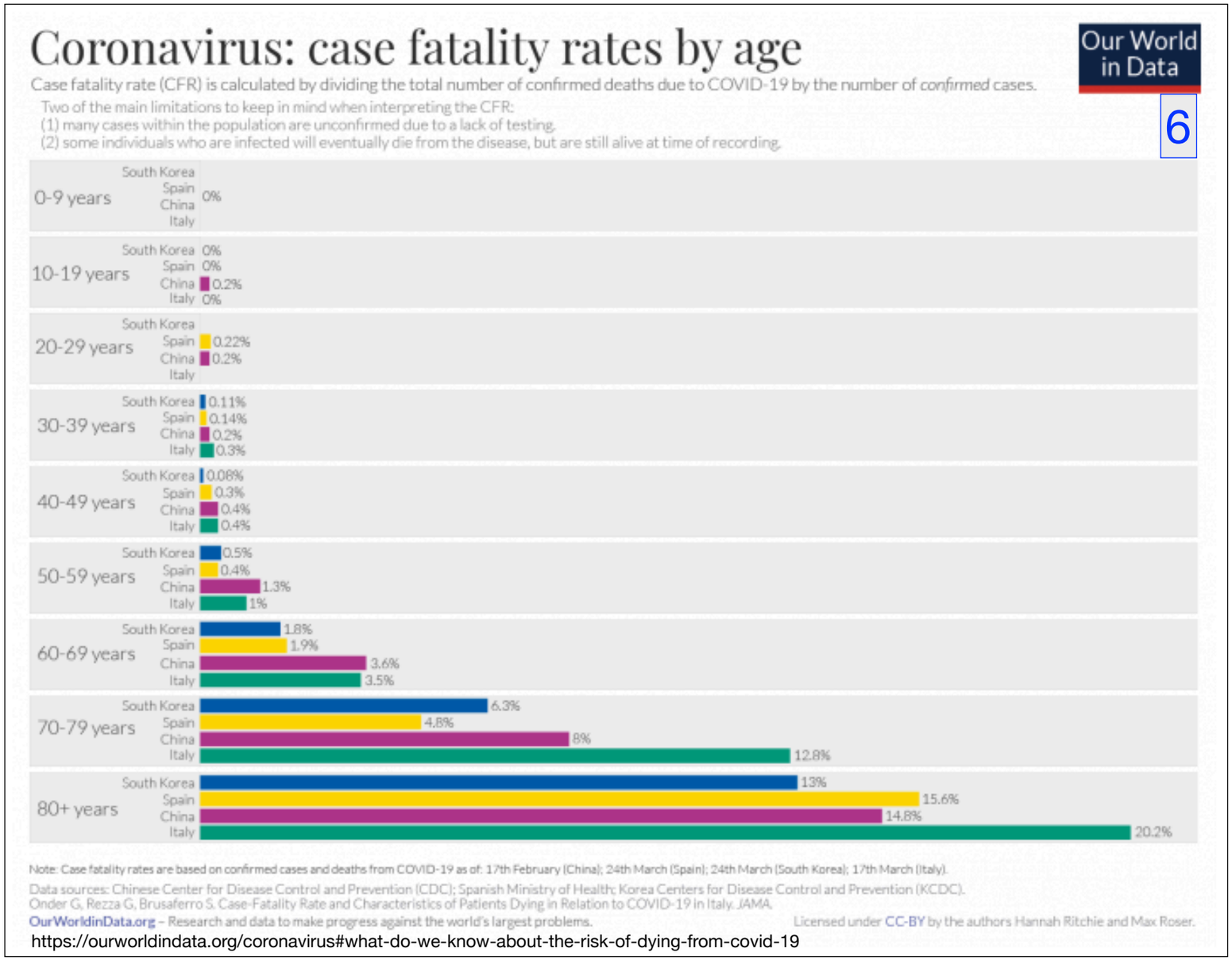








We were told that mostly older people [6] and those who were already suffering from other health conditions died due to covid-19 and so the virus was a co-factor and not the only factor causing death.



https://ourworldindata.org/coronavirus#what-do-we-know-about-the-risk-of-dying-from-covid-19

Covid-19 and the Elderly

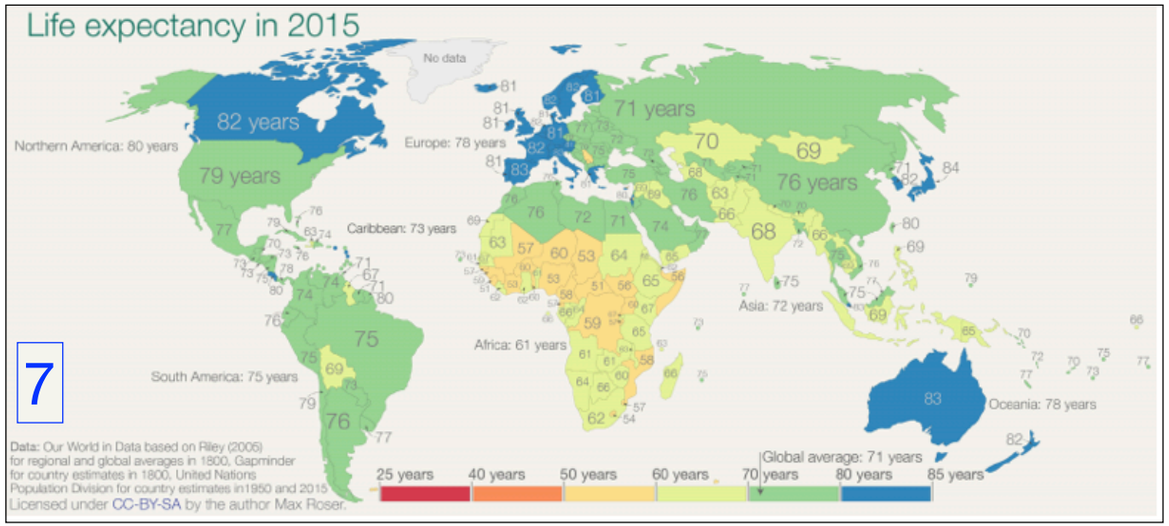
So I examined **life expectancy** for 2015 [7]. The countries with life expectancy over 80 years are shown in dark blue and include Canada, most of Europe, Syria, Costa Rica, Australia, New Zealand, Japan, and South Korea.

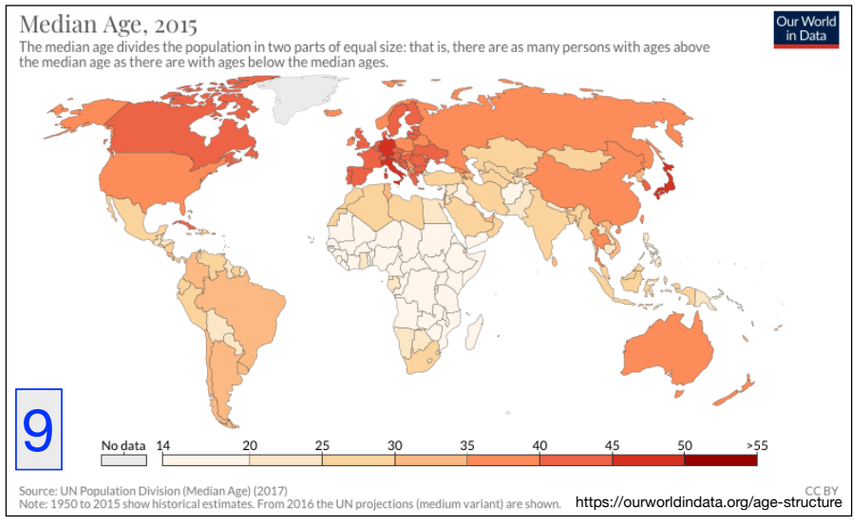
However, this does not tell us how many people are elderly, so I also examined old-age dependency ratio [8], which is the ratio of people older than 64 relative to the number of people in the working age from 15 to 64 years.

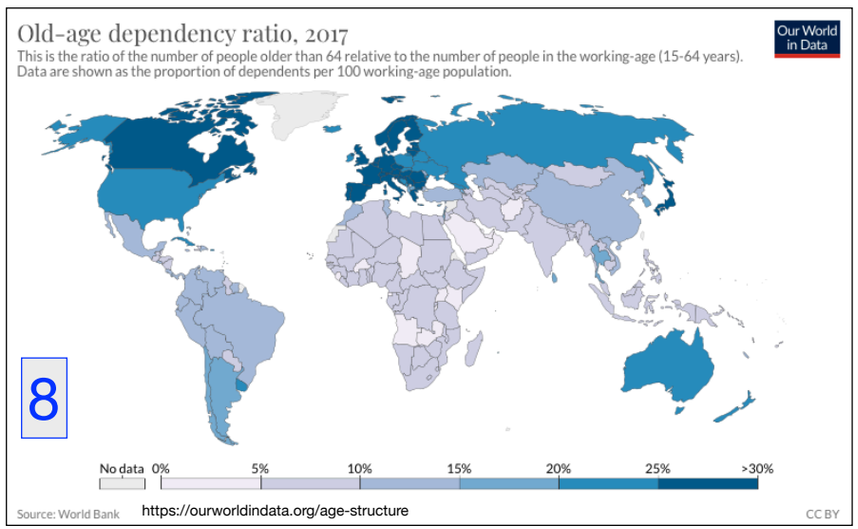
Median age [9] is another indicator of population demographics. While the data are for two different years 2015 and 2017 and provide similar but not identical information they seem to support each other.

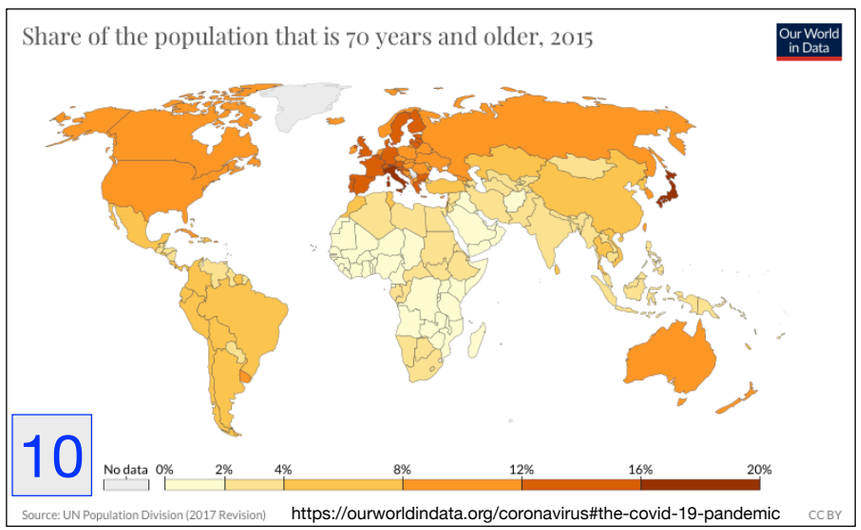
Our World in Data also provides information on the share of the population that is 70 years and older [10] and in this data set Italy stands out from the rest as does Japan and a large part of Western Europe.

This could explain why some countries had higher death rates (Europe and North America) and why others had lower death rates (Africa).



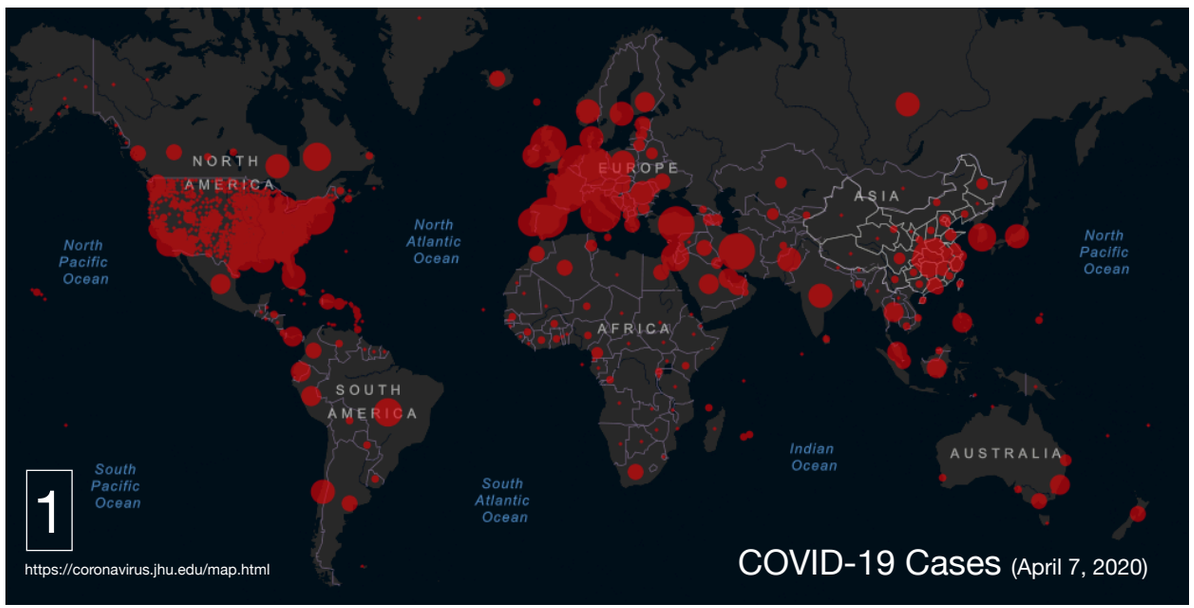


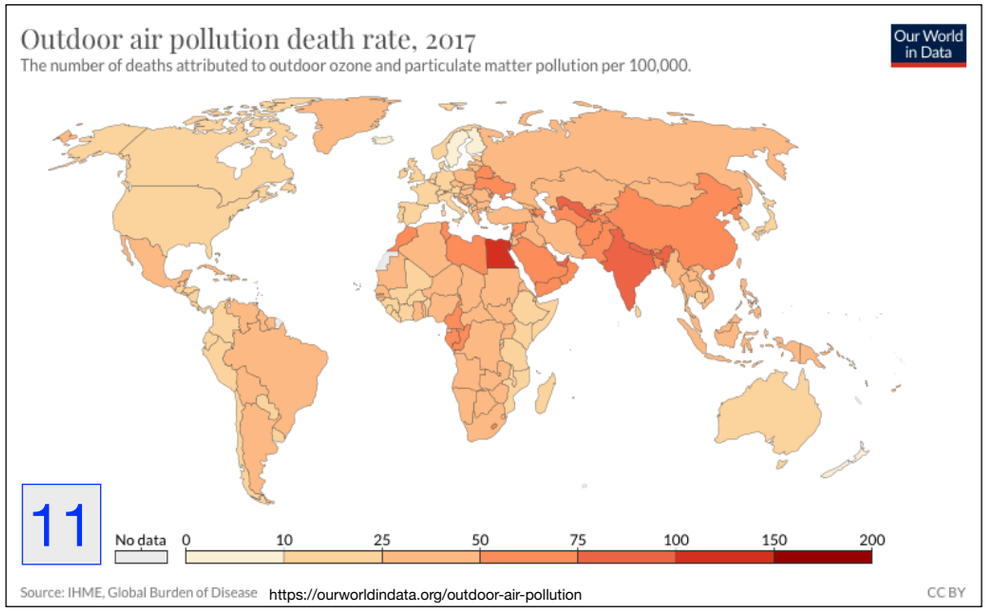


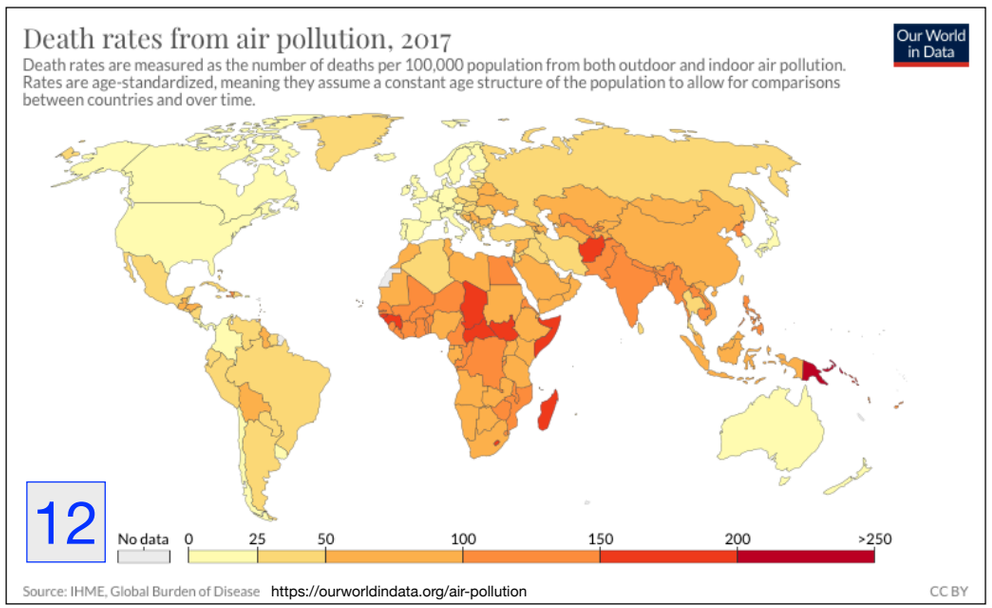


Covid-19 and Air Pollution

Some hypothesized that air pollution could be making this illness worse since both air pollution and the virus affect the lungs. The death rate (i.e. the number of people per 100,000 population whose death is attributed to outdoor air pollution [11] and both indoor and outdoor air pollution [12] does not correspond to the global trend for covid-19.

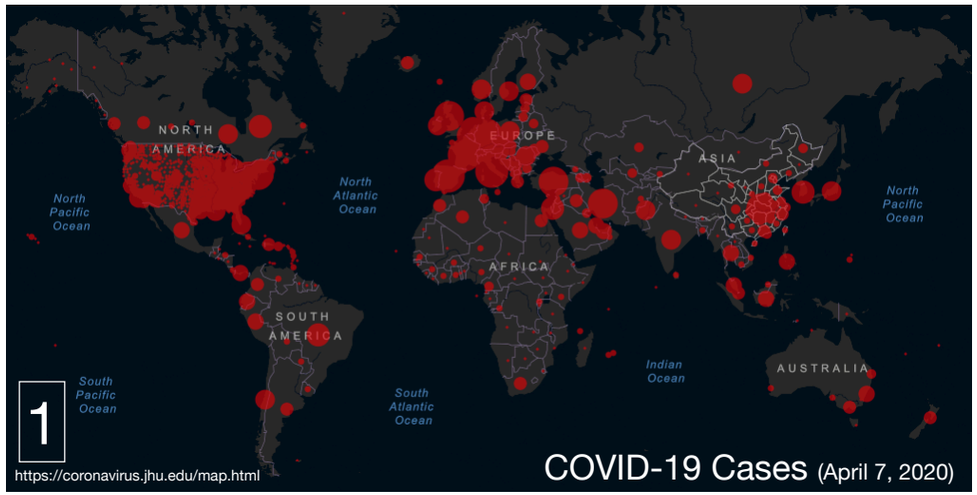


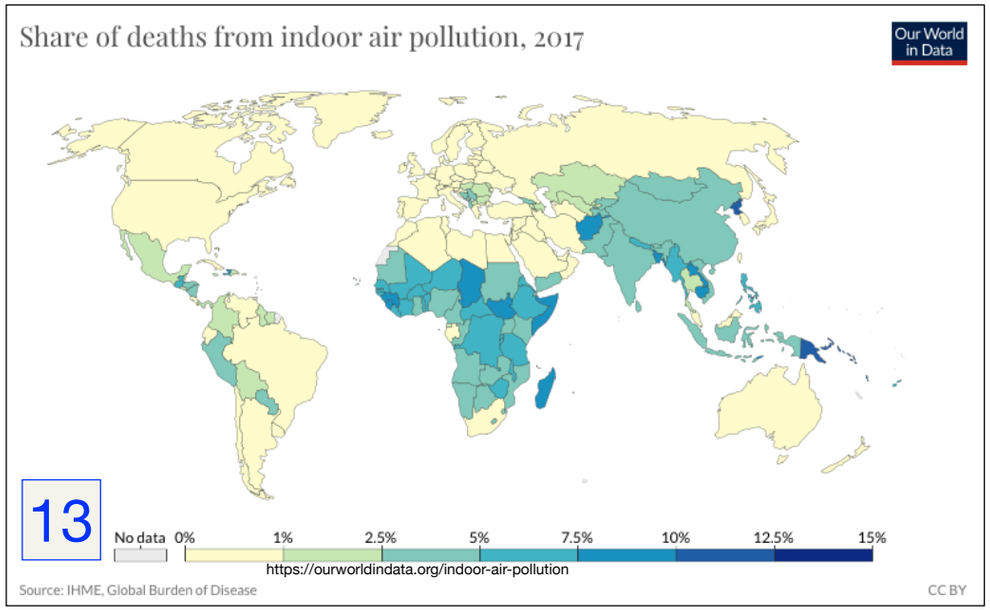




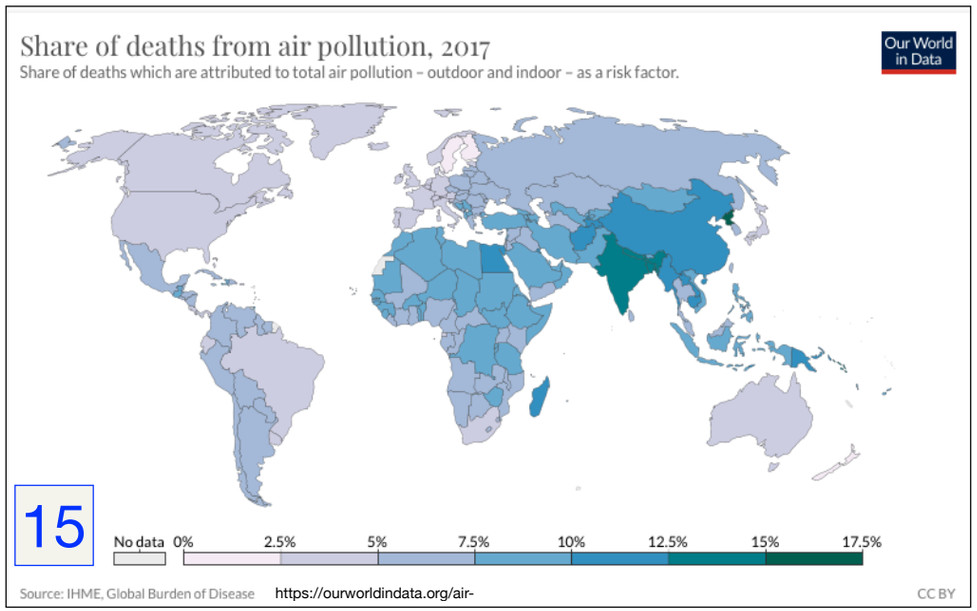
Covid-19 and Air Pollution

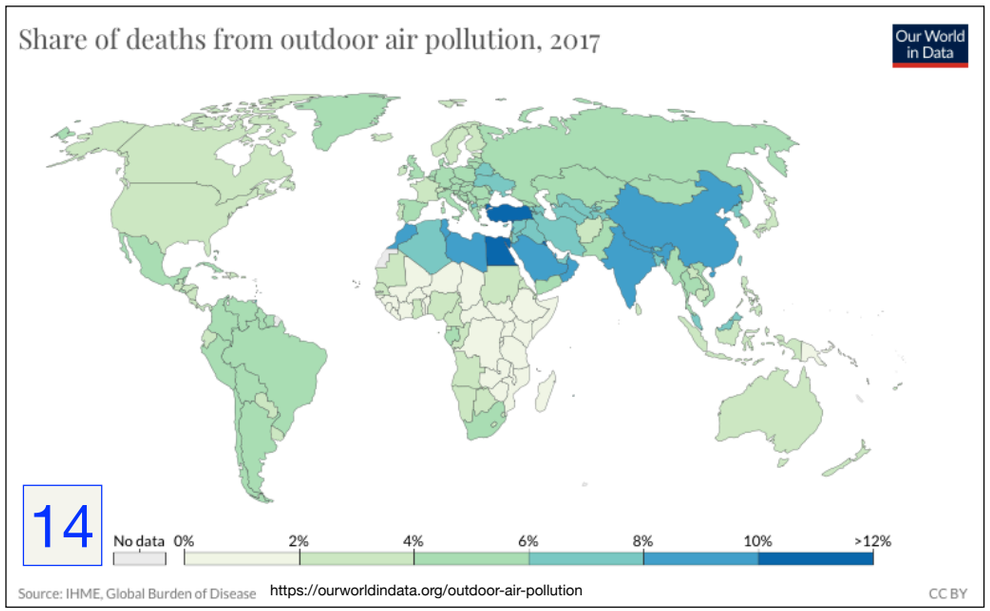
Another way to examine the effect of air pollution is by “share of deaths” and this is provided for indoor [13], outdoor [14] and both indoor/ outdoor [15] sources of air pollution.





Air pollution may be making things worse in some countries (India, China, parts of northern Africa) but it is unlikely to contribute significantly to the high number of cases in either Europe or North America.

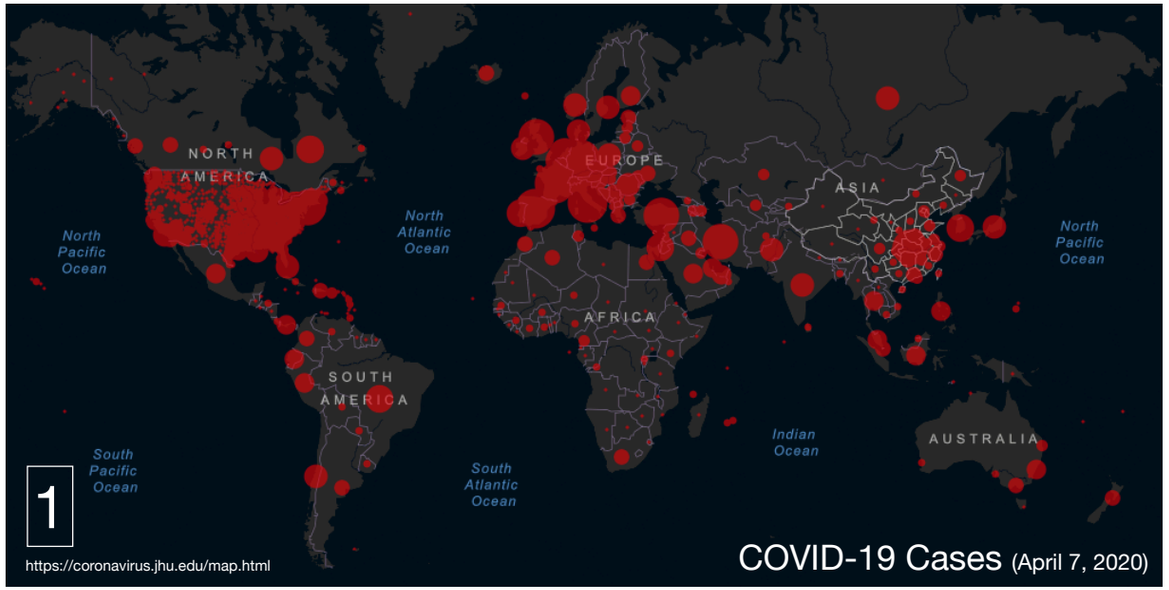


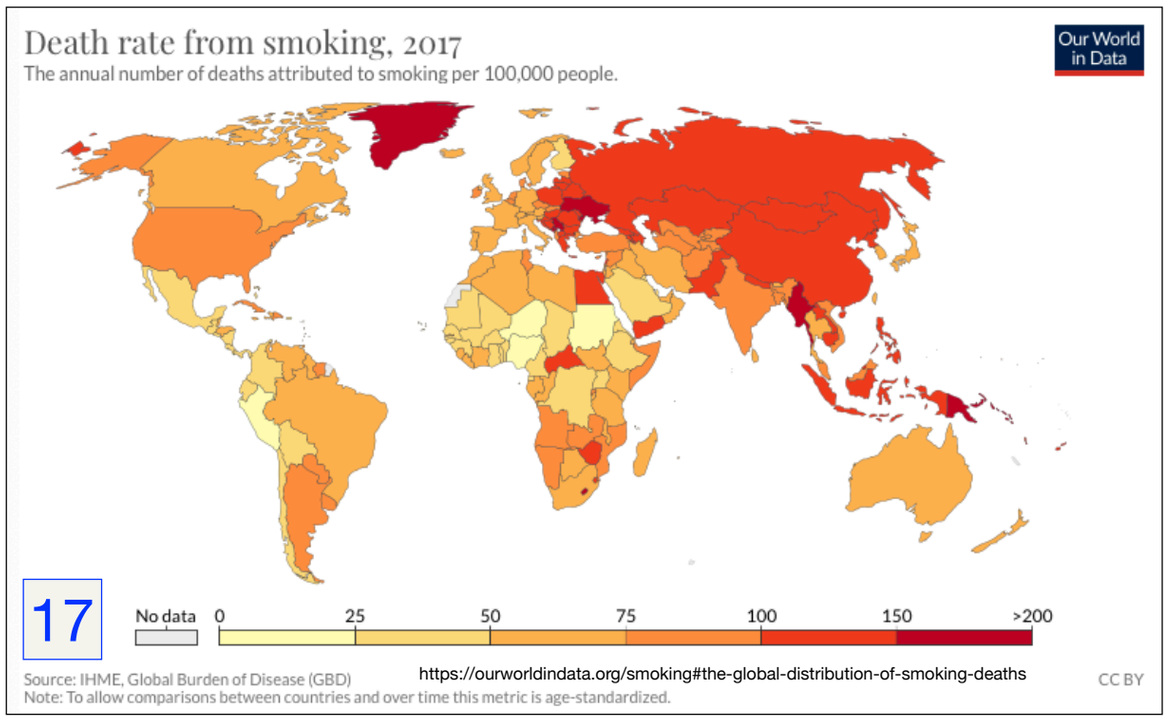


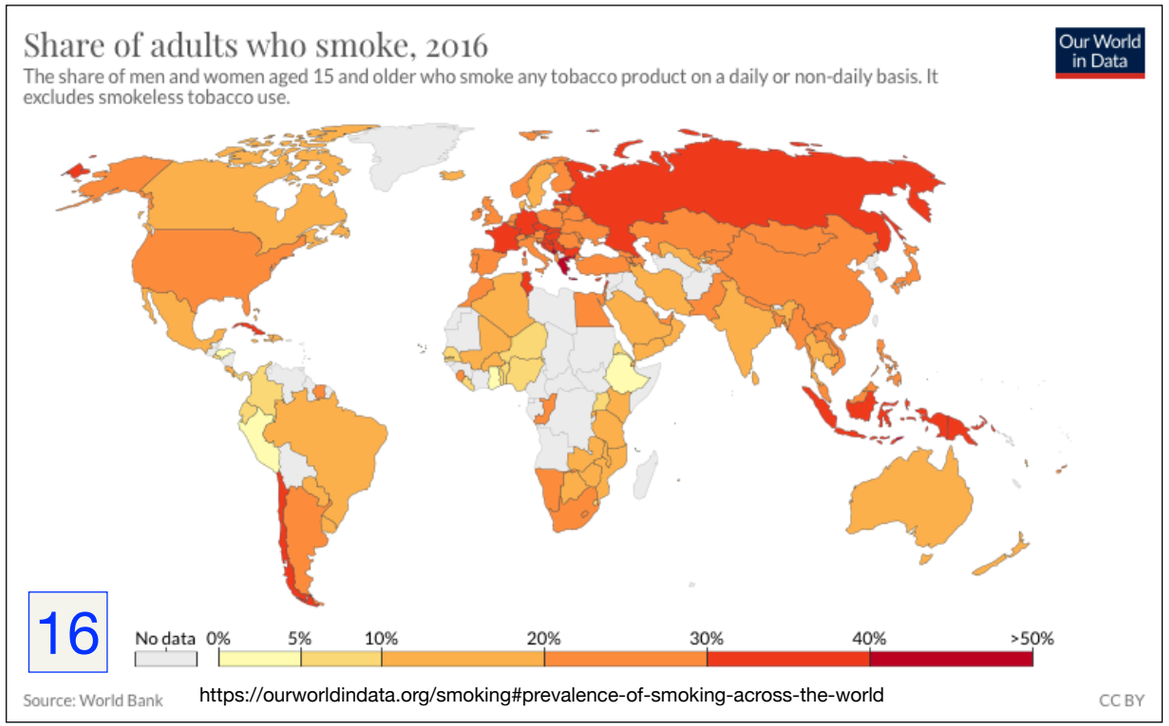
Covid-19 and Smoking

Men seem to be dying at a higher rate than women, and some suggested that it could be due to the fact that there are more male smokers than female smokings and since smoking affects lung function it could be making the virus more lethal. We have two maps: share of adults who smoke [16] and death rate from smoking [17].

On a continent-wide scale neither map does not seem to support this hypothesis and perhaps we need to examine this on a finer scale (by country for example rather than by continent).

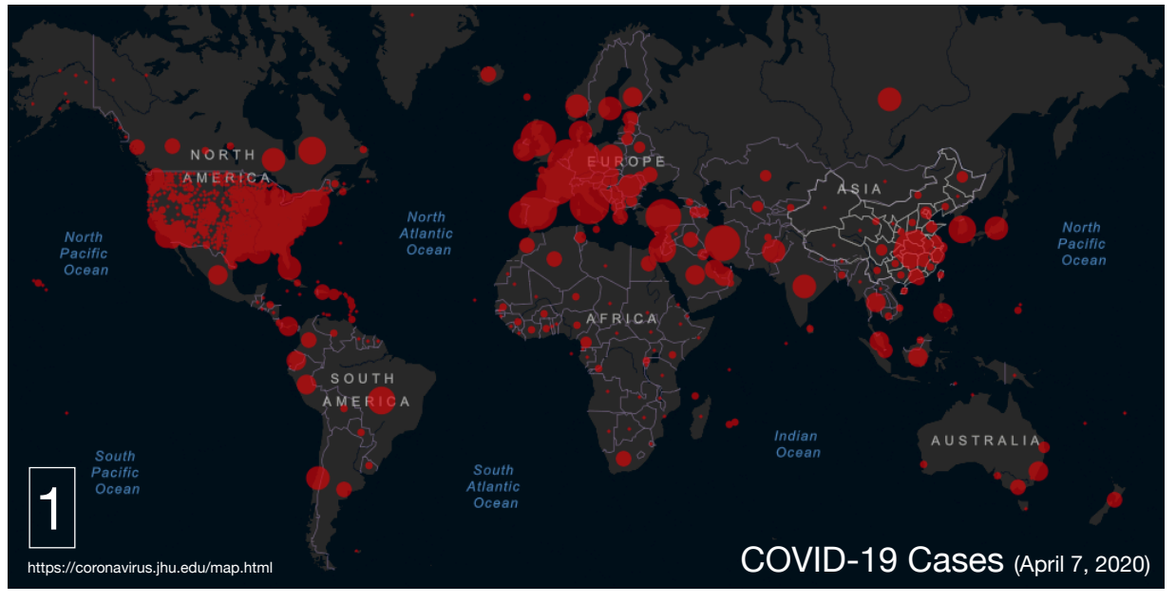




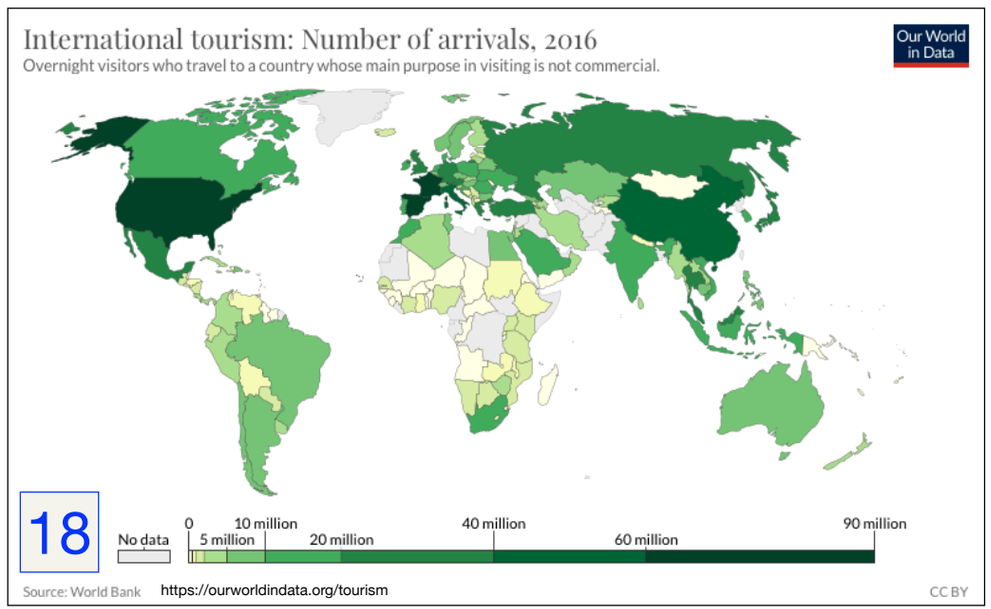


Covid-19 & Tourism

Since this virus is contagious, the more travellers that come to a country the more likely they are to bring the virus with them, thus promoting its spread. That is why there are now travel restrictions in many countries and within some countries.

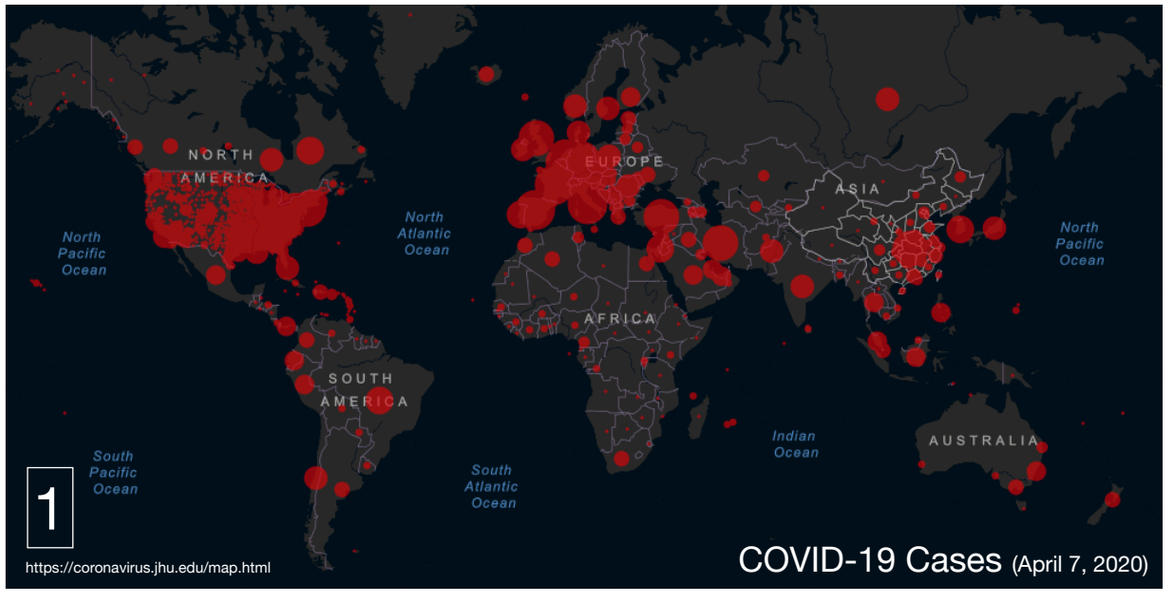


Tourism may contribute for the higher incidence of covid-19 in China, Europe, and the United States and it may also account to some degree for the lower incidence in central Africa [18].

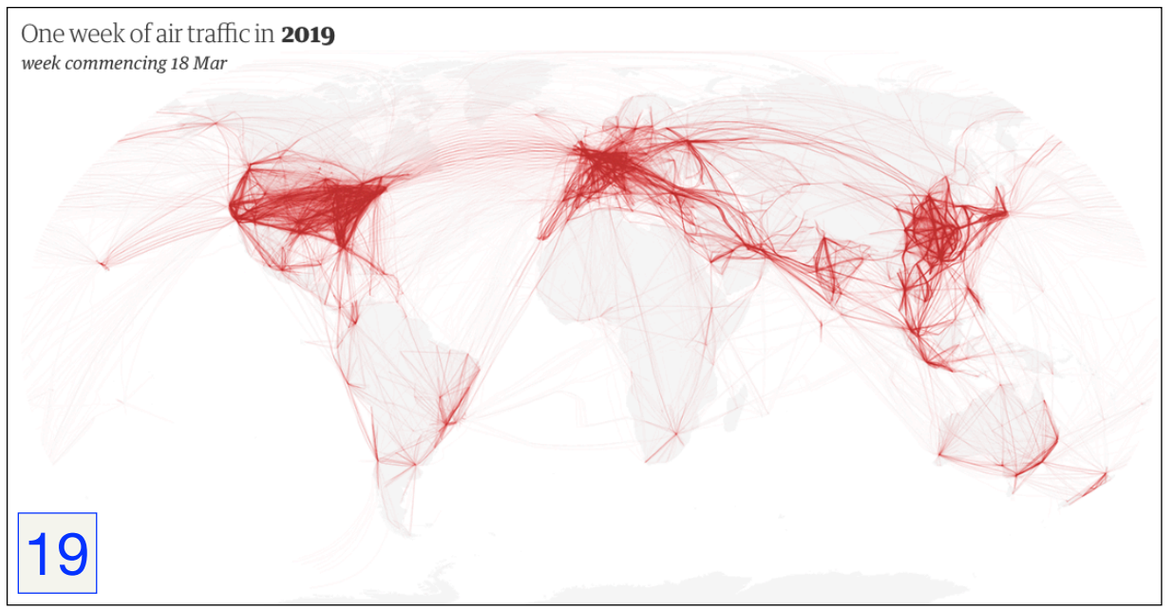


Covid-19 & Air Travel

Many now travel internationally on business and the farther you travel the more likely you are to fly. And when you fly you are close to other passengers and are breathing recirculated air for hours.



One week of air traffic in 2019 [19] shows that the areas that received the most number of flights include China, India, parts of the middle East, Europe and North America, which is most likely how the virus spread. Very few flights landed in Africa and parts of South America and this may have contributed to fewer cases of covid-19.



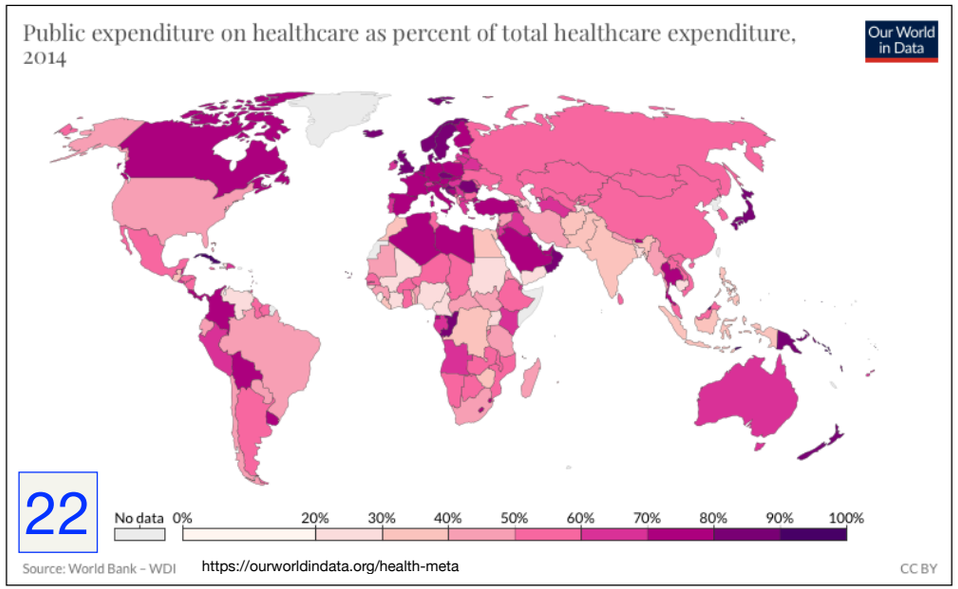
Covid-19 & Health Care Expenditures

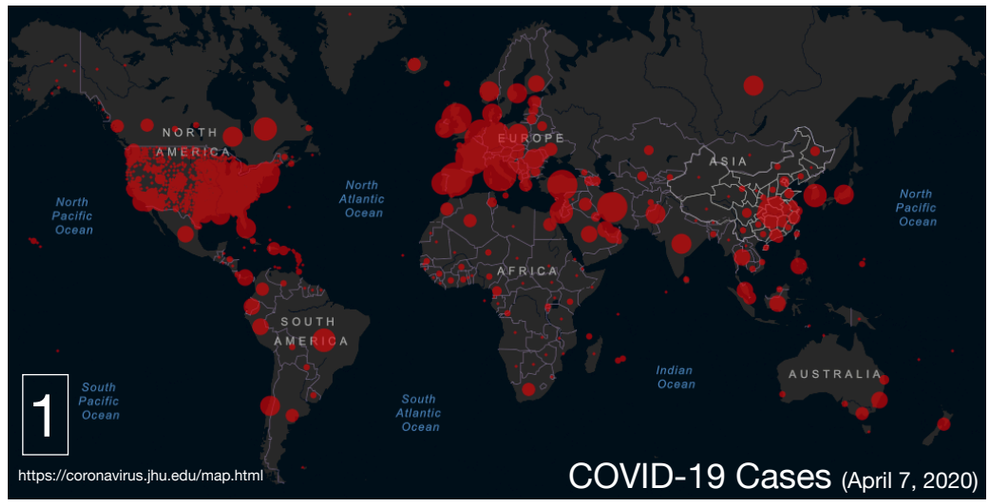
Health care expenditures vary greatly across the globe.

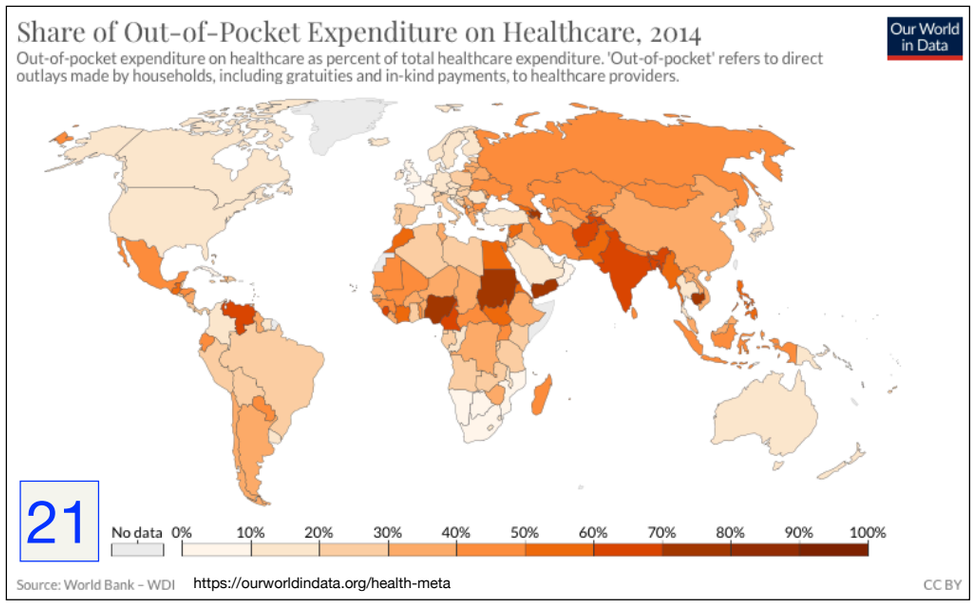
Total health care expenditures as a percentage of national gross domestic product (GDP) [20] and how much of this comes from public expenditures [21] vs. out-of-pocket expenditures [22] may help to explain various aspects of the incidence and death rates associated with covid-19.

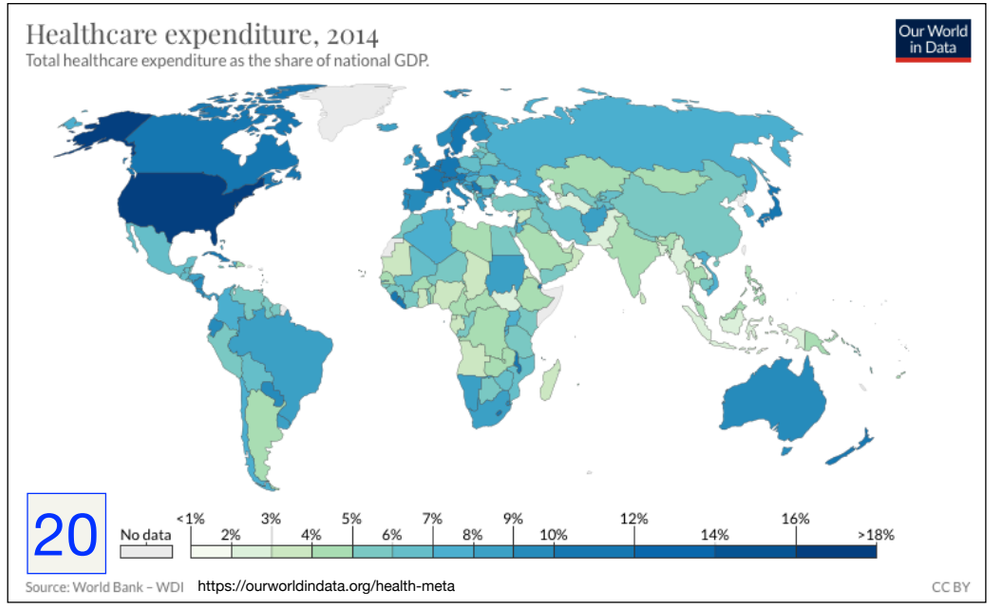
People may have access to more testing for covid-19 and thus the number of cases reported may be higher in countries that provide a larger portion of their GDP to health care (US, Canada, Eastern Europe, Australia, New Zealand for example).

Who pays for health care (out-of-pocket vs public expenditures) may also determine who receives health care and who is tested for covid-19.





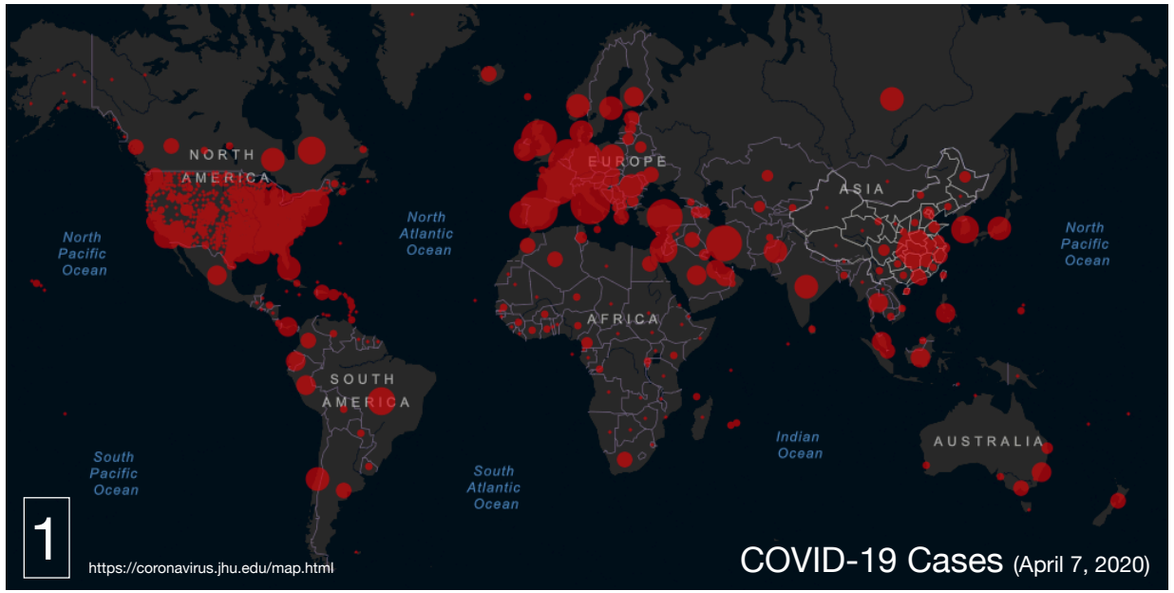


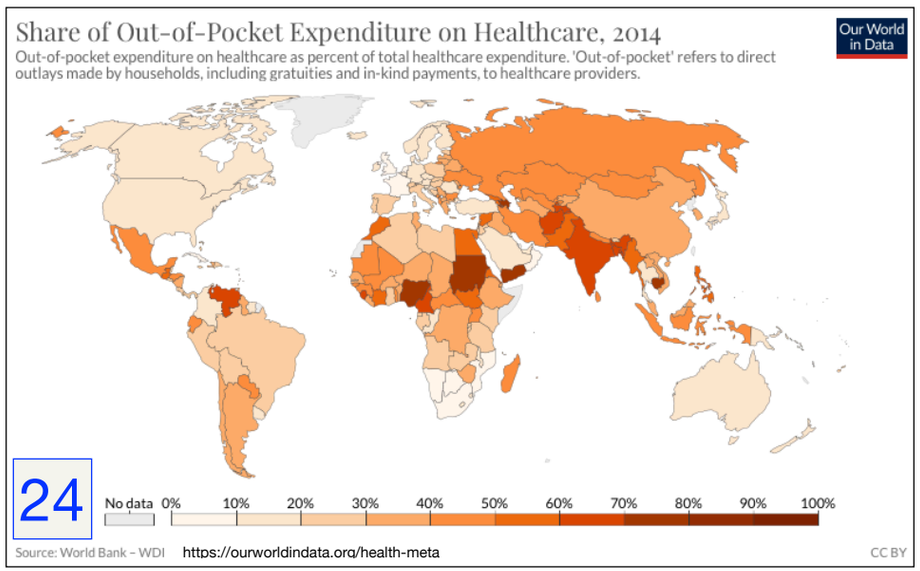


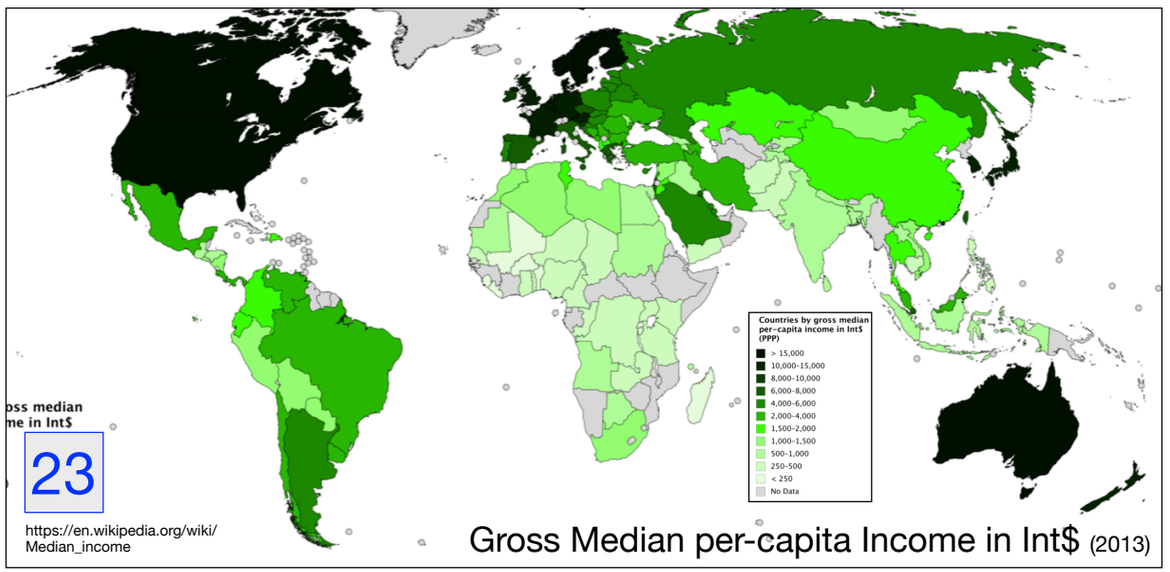
Gross Median per-capita Income

Those who pay for a high percentage of total medical expenses out-of-pocket [18] may be more reluctant to be tested due to cost and this would relate to gross median per capita income in the various countries [19].

Covid-19 seems to be more prevalent in countries with the higher gross median per-capita income and in countries that have the lowest percentage of out-of-pocket health care expenditures (Canada, U.S., eastern Europe, Australia, New Zealand and Japan).





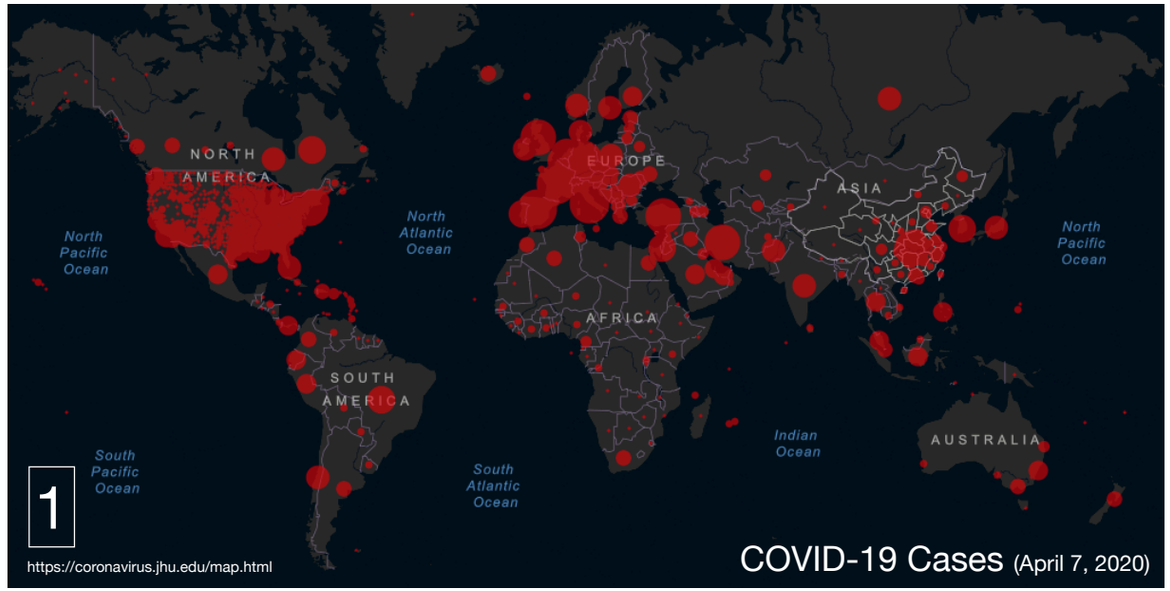


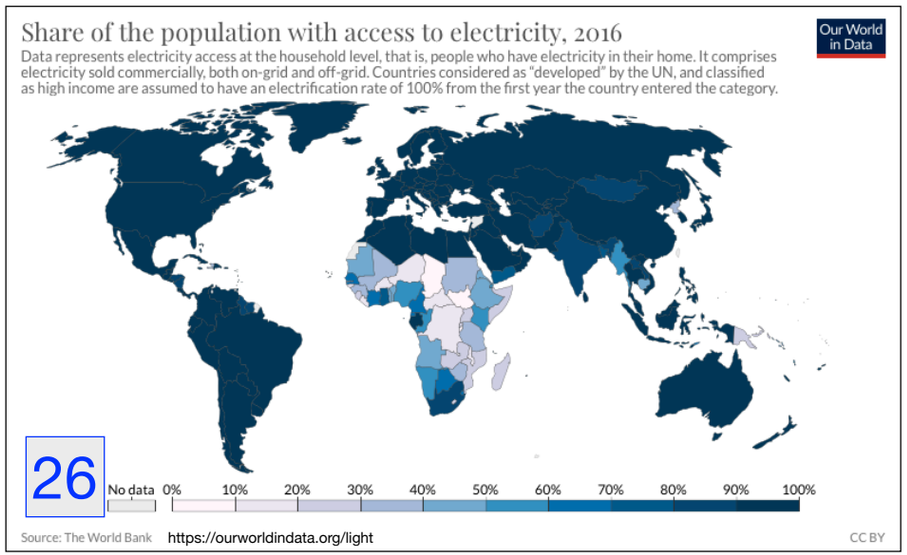
Electricity Use

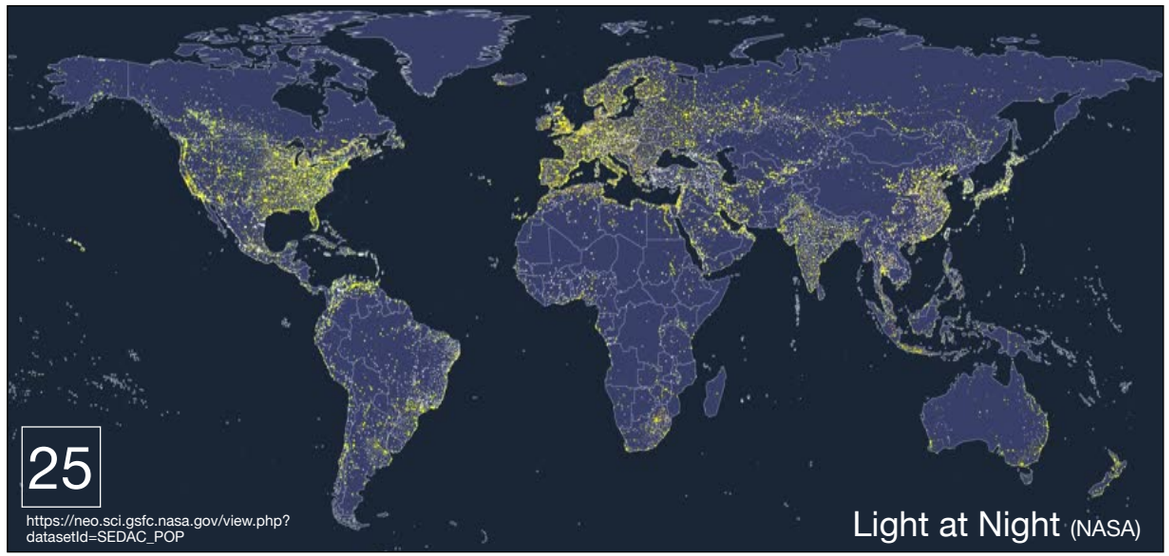
Since I am interested in the biological effects of electromagnetic pollution, I decided to examine light at night [20], which is an indicator of use of electricity. I compared that to countries with access to electricity in 2016 [21] and there is a good match. When different sources of information agree it provides greater confidence in the accuracy of the data.

What stands out is that Africa has very low cases of covid-19 [1] and also has very limited access to electricity [20, 21] compared with the rest of the world. The few countries in Africa that have more reliable electricity (South Africa, Gabon, Algeria, Morocco, Tunisia, Egypt, Senegal, Guinea, & Ghana) are where the covid-19 cases are higher. In Asia, Myanmar and Cambodia both have less access to electricity and also have lower covid-19 cases.

While there seems to be an association between electricity use and cases of covid-19, it would be wrong, at this stage, to think that this relationship is causal since electricity comes with greater infrastructure, possibly higher economic status, perhaps better health care, more reporting of cases, etc.





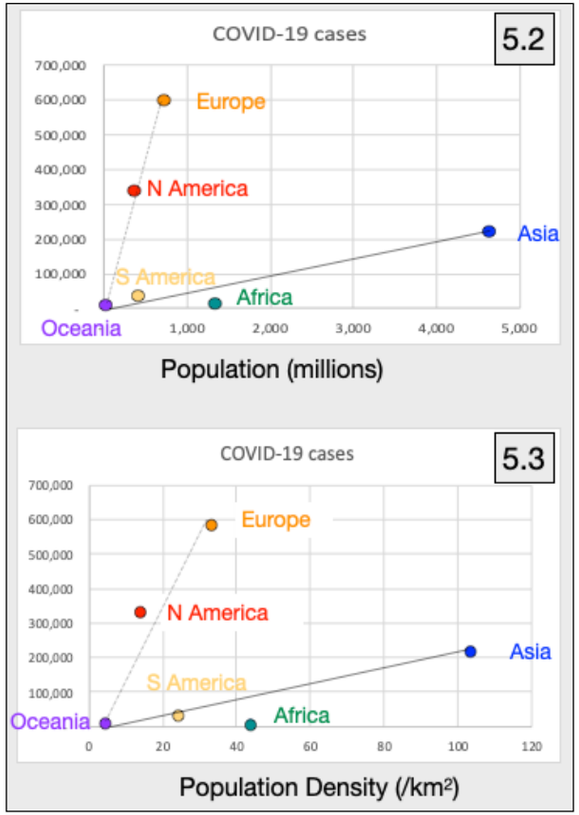


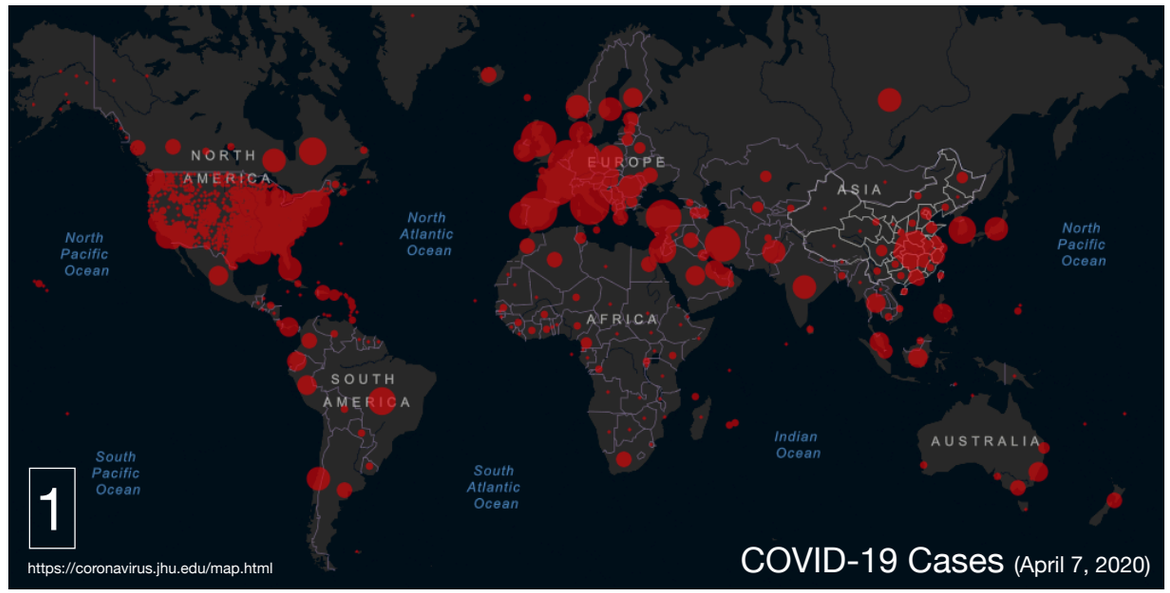
Wireless Networks

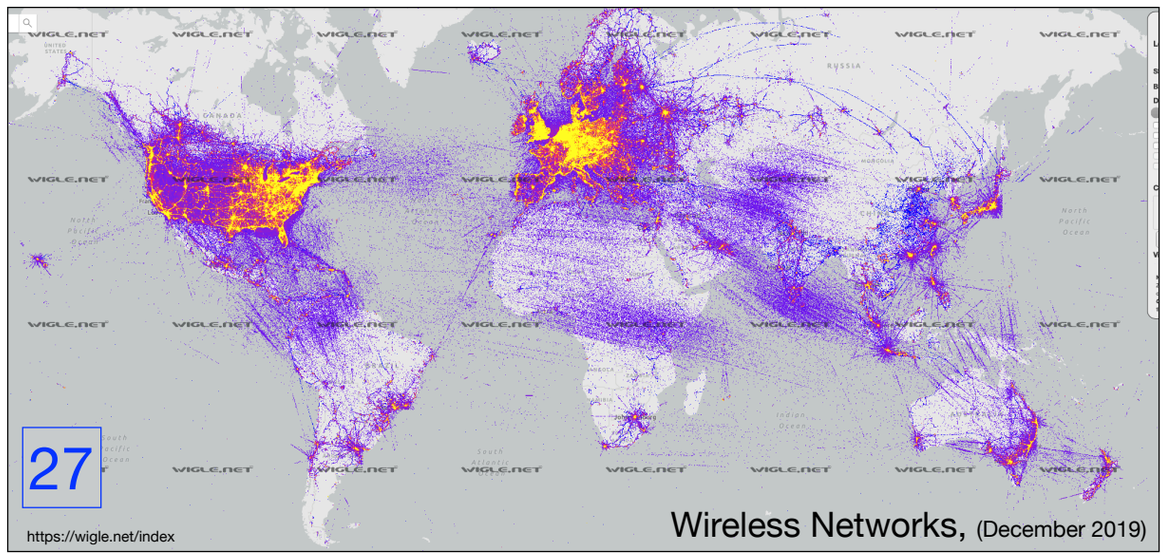
I then examined wireless networks using wigle.net [27]. Once again there is a good correlation between covid-19 cases [1] and density of wireless networks [27].

However, the more people you have the more networks you are likely to have in any one country. So the relationship between density of wireless networks and covid-19 cases may be due to population density rather than to the adverse effects of wireless radiation.

It is temping to think that perhaps the higher number of cases in Europe and North America [5.2 & 5.3] may be due to microwave radiation associated with wireless technology, but at this level of assessment we cannot make that statement.



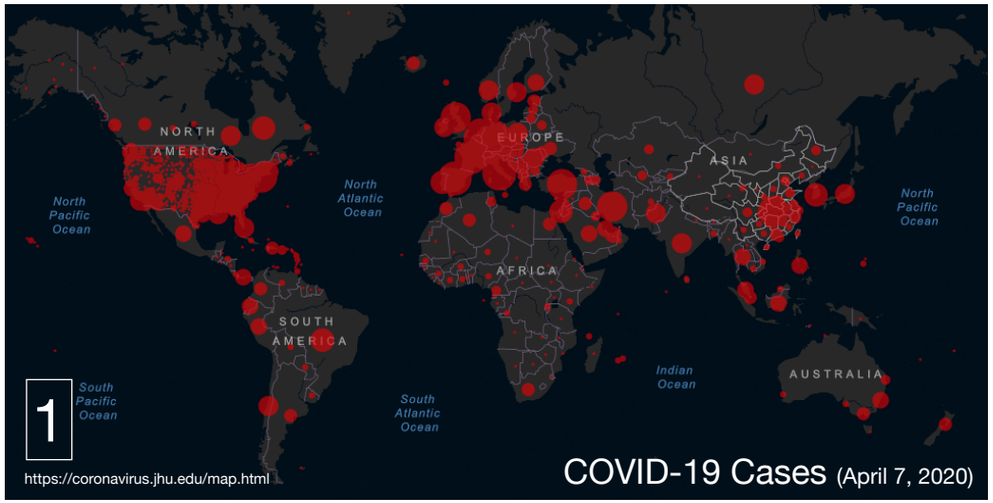


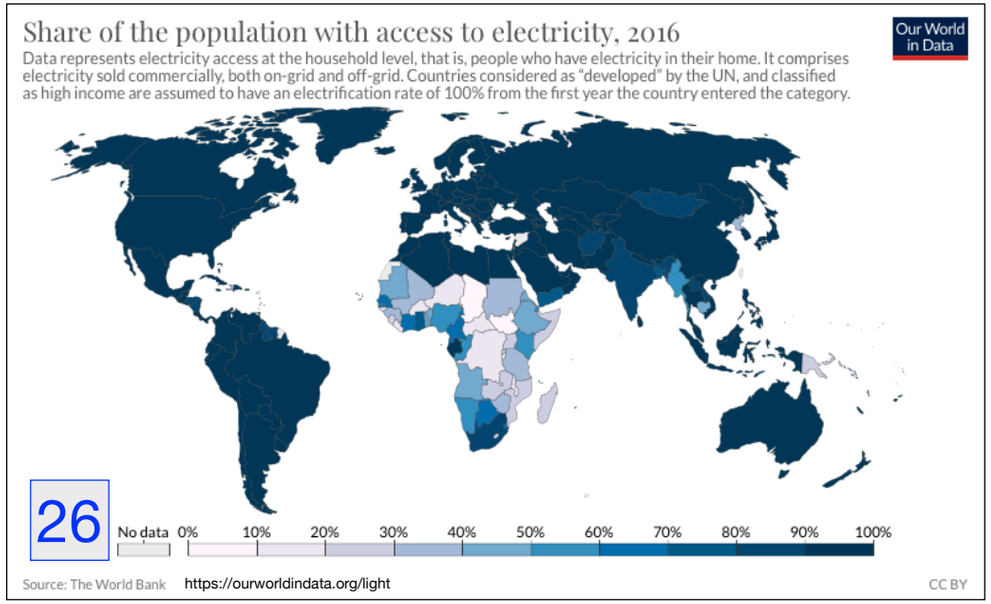


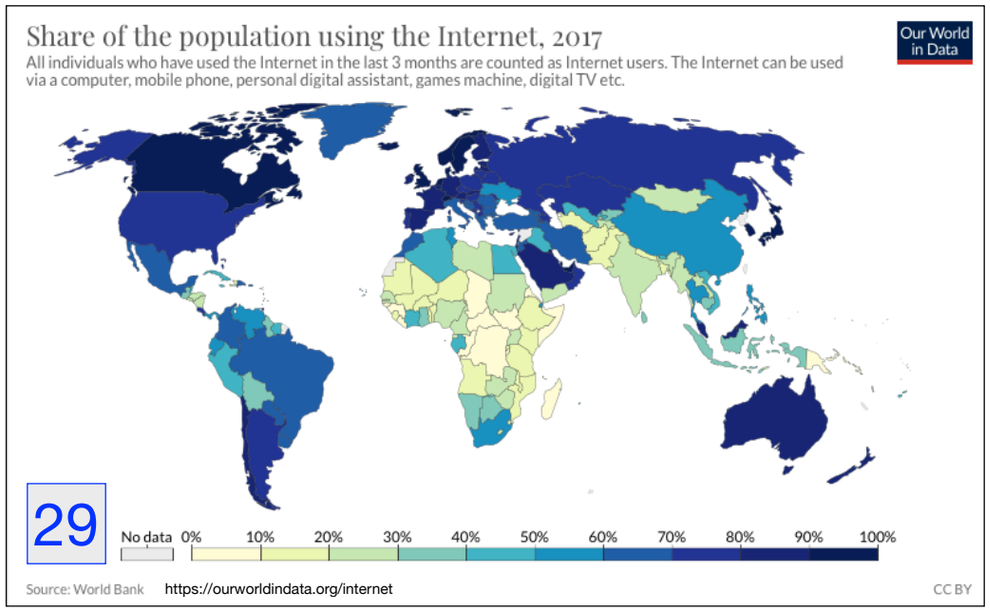
Electricity, Internet & Cellular Subscriptions

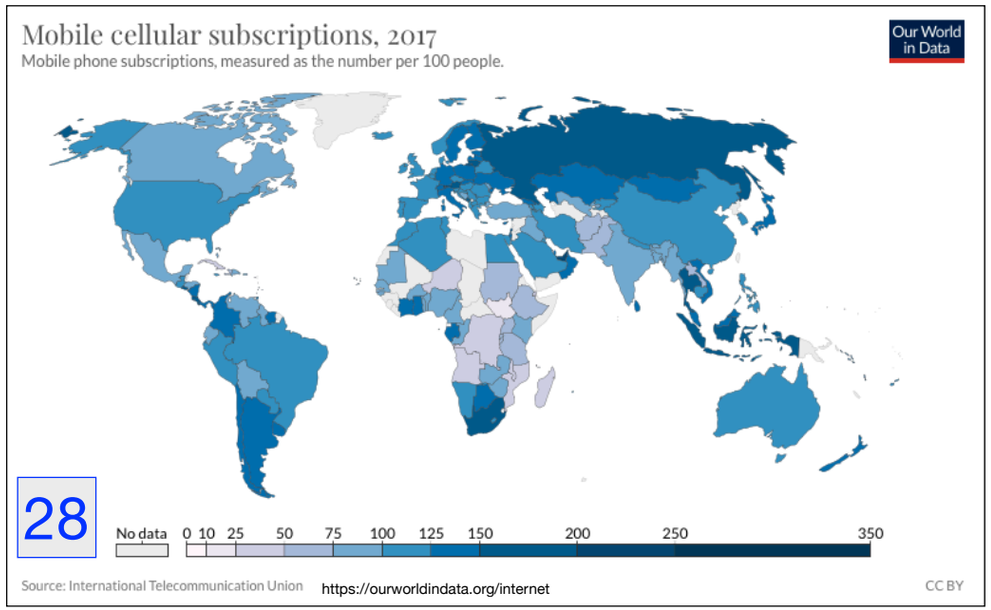
Since I'm concerned about the quality of the data I also compared mobile cellular subscriptions [28] and internet use [29] both for 2017. They seem to correlate to some degree, especially for Africa.

The countries that have access to electricity [26] have a greater population using the internet [29] that relies on electricity and also have more cellular subscriptions [28]. These are the countries that are likely to have more electromagnetic pollution.







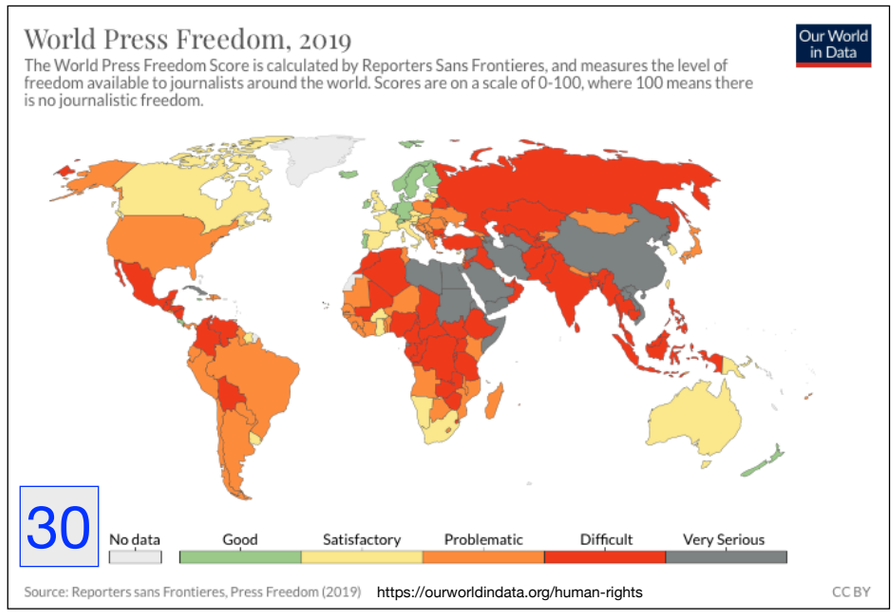


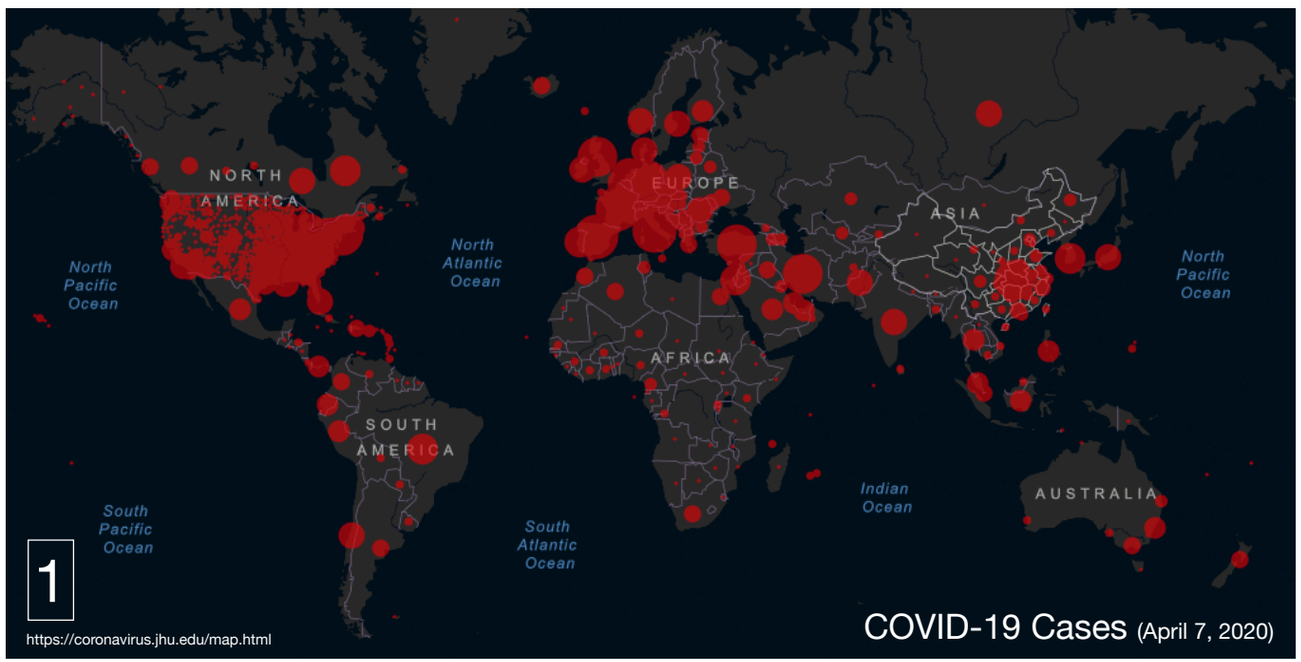
Media Censorship & Surveillance

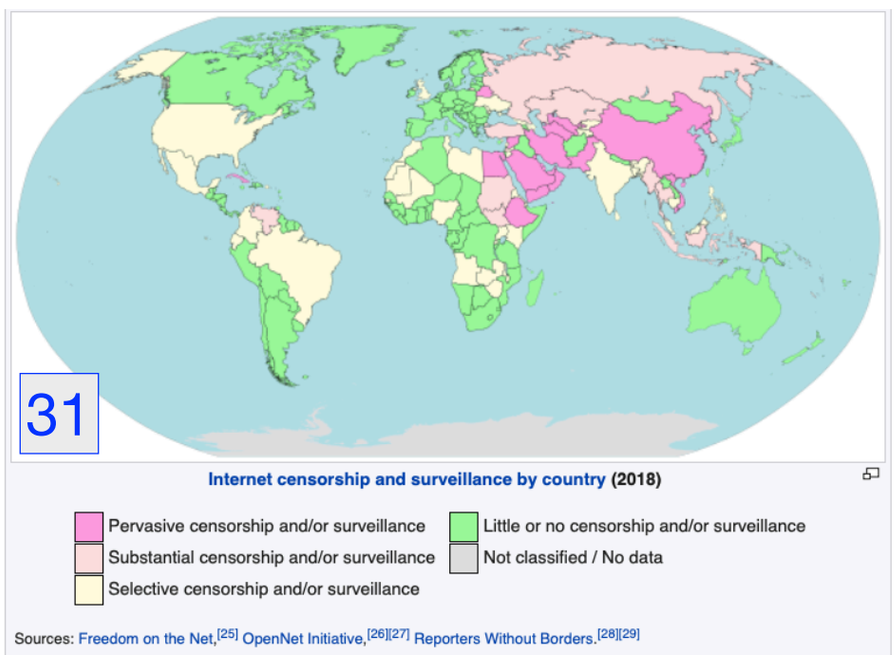
Reporting on the news via the world press or via Internet may limit what is released about the number of cases and deaths from covid-19. Here, once again there is some convergence as the countries where there is a very serious absence of press freedom [30, dark grey] overlap with pervasive censorship and/or surveillance [31, pink] (China, …). With this type of control what percentage of the information coming from these countries is accurate? So the information on covid-19 may not be as accurate as one might hope.

Indeed it is disturbing to learn that so few countries have good to satisfactory freedom of the press.

Currently there is much less censorship of the Internet than the World Press and this allows individuals to share their information with the rest of the world.







So what can we conclude from this exercise?

1. Countries with the **highest incidence of covid-19** (as of April 7, 2020) include the United States, countries in western Europe, UK, China, Iran and Turkey [1].

2. Those with the **lowest incidence** include most countries in Africa and a few countries in Asia [1].

3. While **population density** [2] can explain the incidence of covid-19 cases in Oceania, South America, Africa and Asia, the number of covid-19 cases in Europe and in North America seems excessively high based on population density [5.2].

4. The higher rates of covid-19 cases in Europe and North America and the lower rates in Africa may be due to a **population demographics** based on the percentage of the population that is elder [6, 10].

5. There is no correlation between covid-19 cases and **air pollution** [12] or with **smoking** [17] when examined on a continent-wide basis.

6. There appears to be a correlation in covid-19 cases with **tourism** [18], **air travel** [19], **total health care costs as percentage of GDP** [20], **out-of-pocket expenses for health care**, and **per capita income** [23].

7. The association between covid-19 cases and the use of **electricity** [25], **number of wireless networks** [27], **cell phone subscriptions** [28], **Internet access** [29] and remains unclear at this time and at this scale of comparison. While there is a strong correlation it may be due primarily to population density. Obviously this needs further examination at a more refined level.

8. **Freedom of the press** [30] and the degree of **Internet censorship** [31] may contribute to the accuracy or lack there of for the reporting of the number of cases and deaths associated with covid-19.

9. The pandemic is not over, although many countries are reporting fewer cases and deaths and seem to be over the hump. A re-examination of the data at some later day may provide a different assessment.