COVID-19 Worldwide pandemic

How the world is affected

(30/12/2019-08/03/2021*[1])

Topics

What is the world-wide spread?   How the pandemic changed
Where are all the cases?   What about the future
How severe the infection

If you live in Europe or the USA all you hear from the media and politicians about the China originated Covid-19 pandemic how wide-spread and serious it is. Living in that sensation seeking bubble it is hard to get a sense of the reality. Even some of the official websites are using deceptive tricks*. The way that world-wide vaccination programs are discussed gives the impression that the very existence of human-kind may be endangered.

The beginning of the viral outbreak is still not unquestionably defined as the initial report to WHO was delayed (1). The official number of cases that Chinese authorities reported on 31th December 2019 was 27 (2,3). and since then the virus has reached every corner of the globe. But its impact in cases and deaths has differed widely from region to region. This report focuses on the world wide change and dynamic of the pandemic during the first year.

Takeaway

- The highest density spread of the virus is restricted to just 1/3 of the world's countries. Overwhelmingly, these countries are in Europe (66%), 88% is infected over 3% of the population. Almost half of cases are in just 3 countries and 90% of the world adds only 36% of cases. Therefore, the prevalence (cases per population) is very imbalanced around the world.

- The world average Covid-19 mortality rate (deaths per population) is three times higher to the USA's flu average (0.011%) and some countries it is more serious up to 15 times higher (ie: USA). However, in 46% of countries, the Covid-19 mortality rate is below that of the USA flu average and 76% of countries have accounted for less the 5000 deaths. Countries with higher mortality rates are mostly those with higher infection rates - Europe, USA, the Middle East.

- Worldwide, the initial mortality of 6.6% of all those infected (fatality) has dropped to 2.2% and, in Europe from 11% to 2.4%. Although healthcare improved and every effort is being made to identify silent carriers the magnitude of this change is an indication of the normal evolutionary change of a pandemic where a less lethal strain takes over. This resulting in more infections but less deaths reducing the severity of the pandemic.

- Careful lockdown strategies have shown significant efficacy in controlling the spread. After the wave of infections has collapsed it remains stable until a new version of virus comes around.

- More waves are expected as mutations creates milder infection facilitating spread. Action strategies should focus on treatment and general healthcare support improvement. There is no guarantee that current and future vaccines will provide protection against new mutations. Investment in saving lives and improving healthcare system seems to be a more viable solution then forcing herd immunity. These improvements would have a more general utilisation as well benefiting whole societies in the long term

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1   * Comments available in the Q/A section at the end

	Flu (USA)	Covid (USA)	Covid (World)
Cases (prevalence)	9%	8.7%	1,5%
Death (mortality)	0.011%	0.157%	0.033%
Fatality	0.12%	1.8%	2.1%
Death on 100k people	11	157	33

Table 1. Comparison of flu and Covid-19 at the end of the year period. There is a large difference between countries in prevalence (cases per population) and mortality rate (deaths per population). Although in the USA Covid-19 fatality is 15 times higher than the flu's, the world average is only three times higher suggesting that we should not treat the whole world as danger zone.

What is the world-wide spread?

The virus spread reached every continents but the intensity differed widely from region to region. Compared to the lowest level of influenza occurrence in the US population* (prevalence), 3%, 69% of countries have lower infection rates. Africa, Oceania and most of Asia have been affected in this limited way (Figure 1,2), Of those that are higher, European countries account for 66%. The Middle Eastern region of Asia is the next most affected, while in the Americas only a few countries have higher spread (Table 2). See Appendix 1 for detailed statistics.

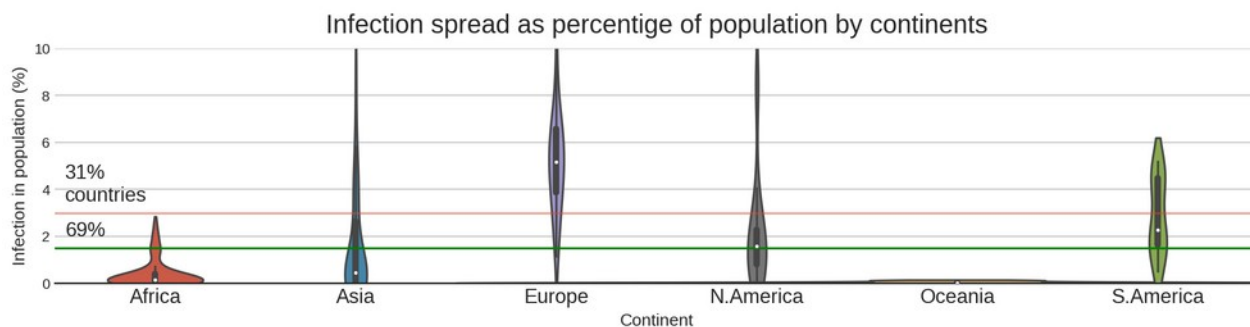The high spread indeed restricted only a few countries.

Figure 1: Infection spread between continents in percentage of population. The thicker the figure the more countries fall into that level. Red line: the USA 10yrs flu lowest prevalence (3%). Green line: world average (1.5%)
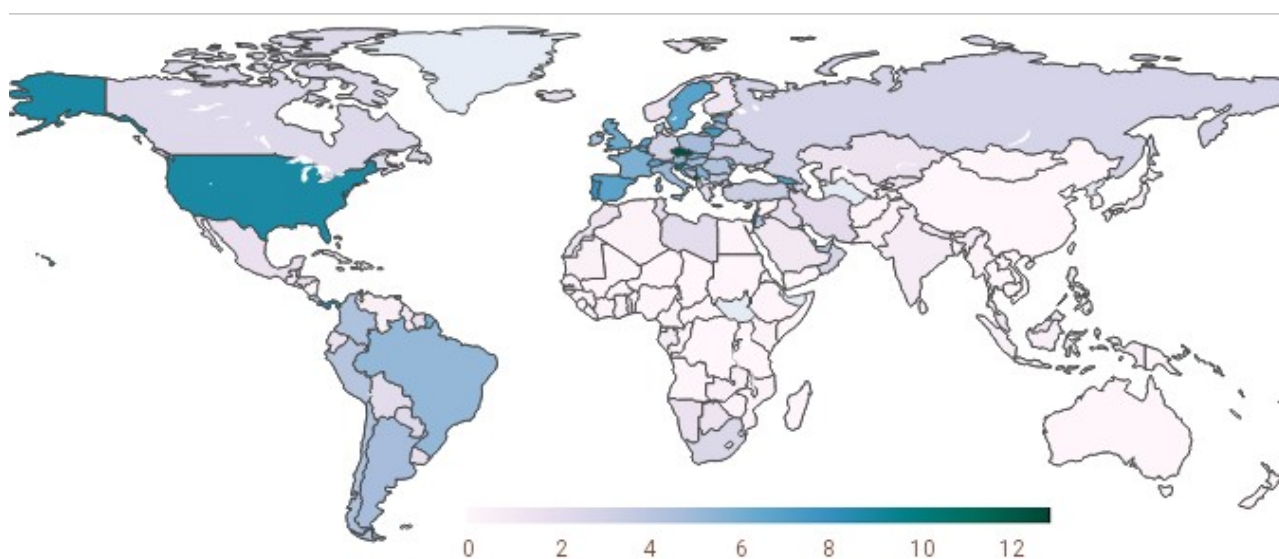

Figure 2: World-wide distribution of Covid-19 on percentage of population infection. 69% of the world has low incidence, below 3%. The highest population infection rate comes from Europe, the Middle East and the USA. Some South American countries has medium spread.

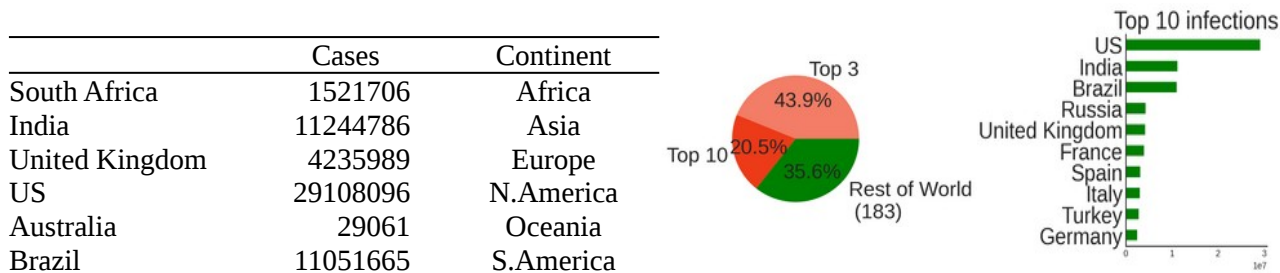|	Precent of above 3%	Countries	Percent of the Continent
Europe	66	38	88
Asia	17	10	21
S.America	8	5	41
N.America	7	4	20

Table 2, Number of countries on each continent above 3% of population infection (flu USA, lowest level). Europe is highly dominant while Asian countries with high prevalence are exclusively Middle East countries (see Precent of above 3%). Most of Europe belongs to that category (see Percent of the Continent)

The World overall spread is 1.5%, far below the average (9%) or even the lowest flu (3%) prevalence in the USA. Despite the average being low some countries have much higher prevalence. As an example in the USA it is equal to the average flu prevalence (8,7% vs 9% respectively).

Where are all the cases?

The absolute infection case numbers are dominated by 3 countries: USA, India and Brazil (Table 3c). The top 10 most infected countries cover 64% of all the cases leaving only 36% for the rest of the world (Table 3b, Appendix 2). This is another demonstration of how imbalanced the virus spread is.

While there are one or two countries on every continent which have higher incidences (Table 3a, Appendix 3) these are usually the most populous ones in the region. Their contribution to the whole can be judged on the scaled graph (Appendix 3). The true number of incidences in some cases are considered unreliable, so China did not make it on the list even though it is the most populous country* (4).

	Cases	Continent
South Africa	1521706	Africa
India	11244786	Asia
United Kingdom	4235989	Europe
US	29108096	N.America
Australia	29061	Oceania
Brazil	11051665	S.America

Table 3a. The highest absolute number of cases on each continent at the end of the term. These numbers are influenced by the population size. 3b. Pie chart indicates the infection shares between ranks from all cases of the world. 3c. Rank of top 10 countries having the most infections. There is a high difference in magnitude between ranks linked to the population size.

Although the absolute numbers shows the virus distribution around the world it does not very well represent the burden on individual countries. Population normalised data* shows that some countries deal with heavy infection load. The most infected countries are not always the ones with highest burden. Figure 3 shows details of the pulled infection rates from Figure 1. The rates are the highest in Europe*.

The average of the USA flu infection rate on the population is 9%. Only 4 countries surpass this level (Figure 5) while 53 countries are in between the lowest US flu prevalence (3%) and this average, taking up 31% of countries, This leaves 69% of the countries having infection rates below the lowest flu prevalence (Figure 1, 5). Therefore the world spread is generally not overwhelming the main problem then being how severe the infection itself is aka many people die.
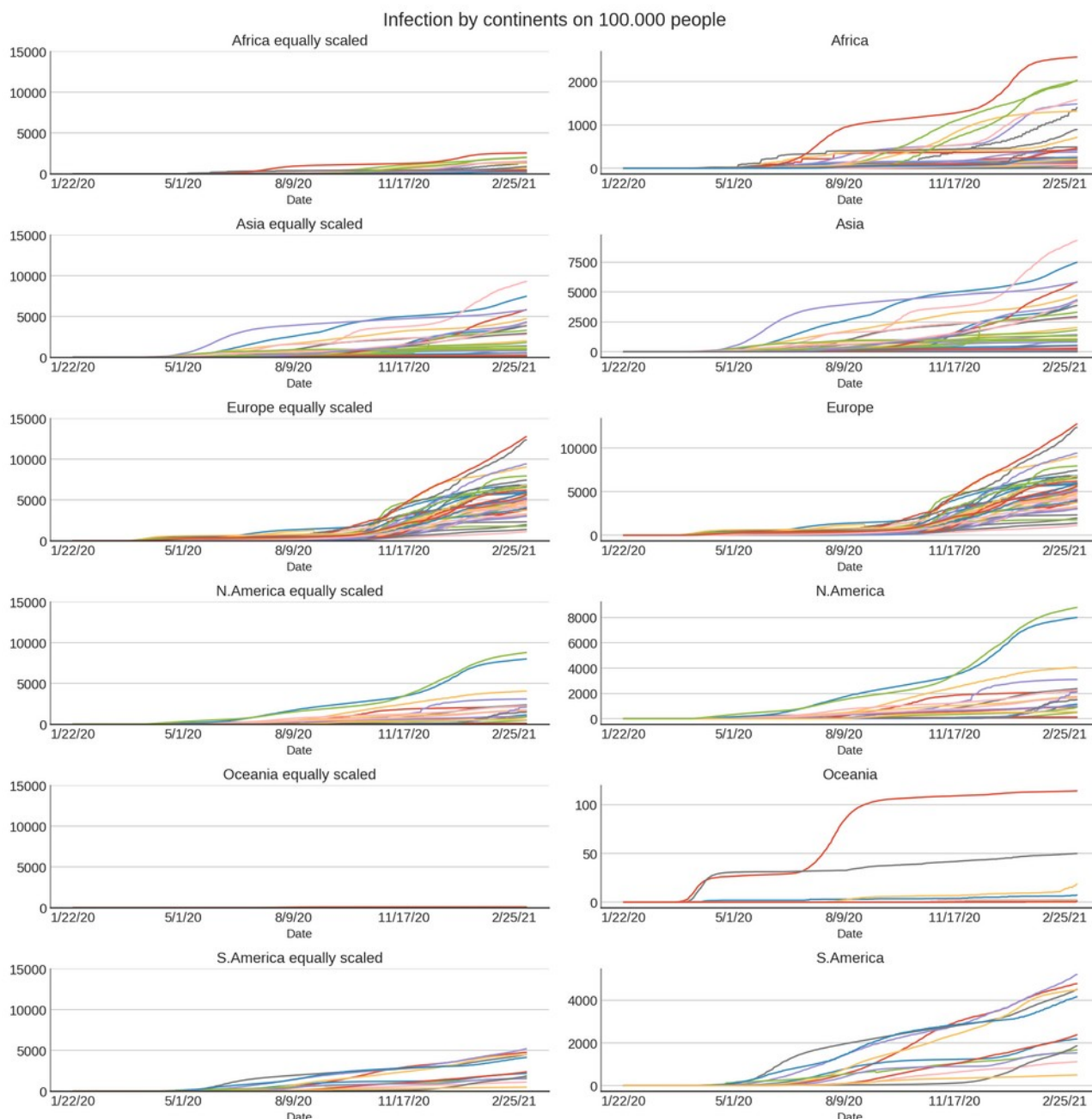
Figure 3: Normalised infection data on 100k population. 5000 interpreted as 5% of population infected. Left side, equal-scaled graph to the highest country in the word so overall comparison can be seem. Right column: ranking can be seem within the continent. The step-like shape represent an infection wave. The flat curve between two steps shows no significant increase in new cases. The steady rise of the curve displays continuous infection.

How severe the infection

Without question Covid-19 is more serious than influenza at the moment. In the USA the average number of deaths from flu is 0.011% of the population while Covid-19 is triple that in world average. That may not seem high - 11 and 33 people from 100k respectively but this rate is not uniform everywhere. The absolute numbers shows 72% of countries have less than 5000 deaths altogether (Table 3, Appendix 4). More informative as regards individual countries is the population normalised mortality rate (Figure 4). Mortality rates in almost half of countries are below the USA flu level and only 37% of the countries are above the world average (Table 3). Just like the spread, mortality also has a high range of deviation but only a few

countries have very high rates. Death depends not only on the virus and population genetical traits* but also the general health level of the population, the available therapies and the quality of healthcare systems. Yet Western countries are the among the highest* affected together with some South American and Middle East countries. The reason for the elevated numbers could be different between countries and regions (Figure 5). Perhaps some of the reasons could be social behavioural, population density, relationship between public and government, elderly care and response strategy.

	No of Countries	% of world
Counties under 5000	130	72
Countries over 5000	50	28
Countries under flu (0.011%)	84	46
Countries above flu	96	53
Countries below World avg (0.033%)	115	63

Table 3. Absolute and population normalised mortality.

High rate of mortality could merely be the result of the size of a country or a large number of infections. The ultimate measure of how severe the virus is the fatality rate - how many deaths occur among the infected. If the prevalence is high but the fatality is low as oppose to low prevalence and high fatality a different strategy is needed to approach the pandemic. As can be expected the fatality rate shows up the differences between countries though much less than does prevalence and mortality itself (Figure 6).

The 66 countries where the death rate is higher than the world average have good reason to worry about protecting their citizens (Figure 5).

The normal process in viruses is that they accumulate mutations*. Some do so slowly while others, like the flu, do so seasonally. So, Covid-19 is also changing over time and some of the changes lead to changes in the virus's dynamics. Therefore it is worth making a timeline comparison.
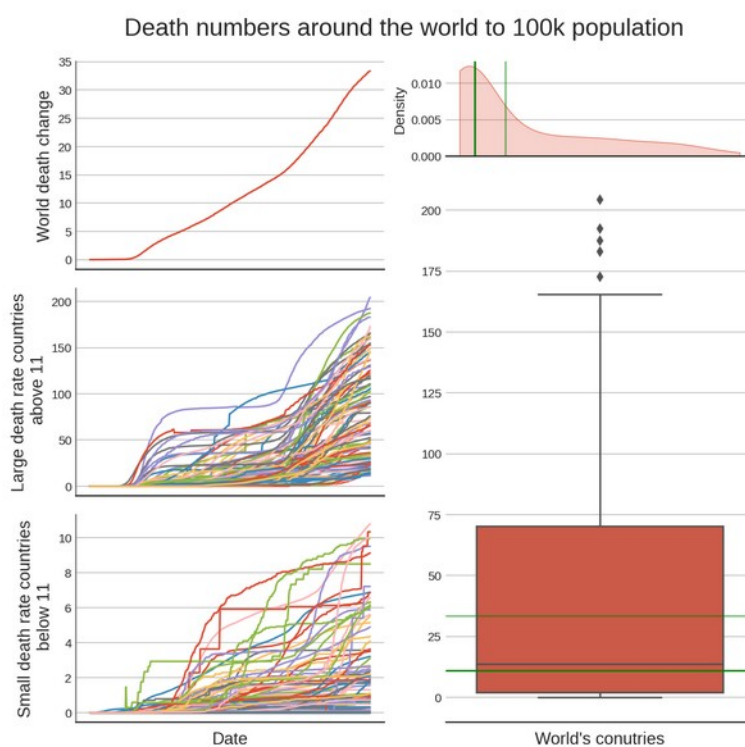

Figure 4: Distribution of death among countries on 100k population at the year period. Dark green line: the USA average flu dead (11). Light green line: global average dead (33). Left side showed how death changed over time. Right side shows the distribution of countries according to the number of death on 100k population. See Table 3 for proportions.
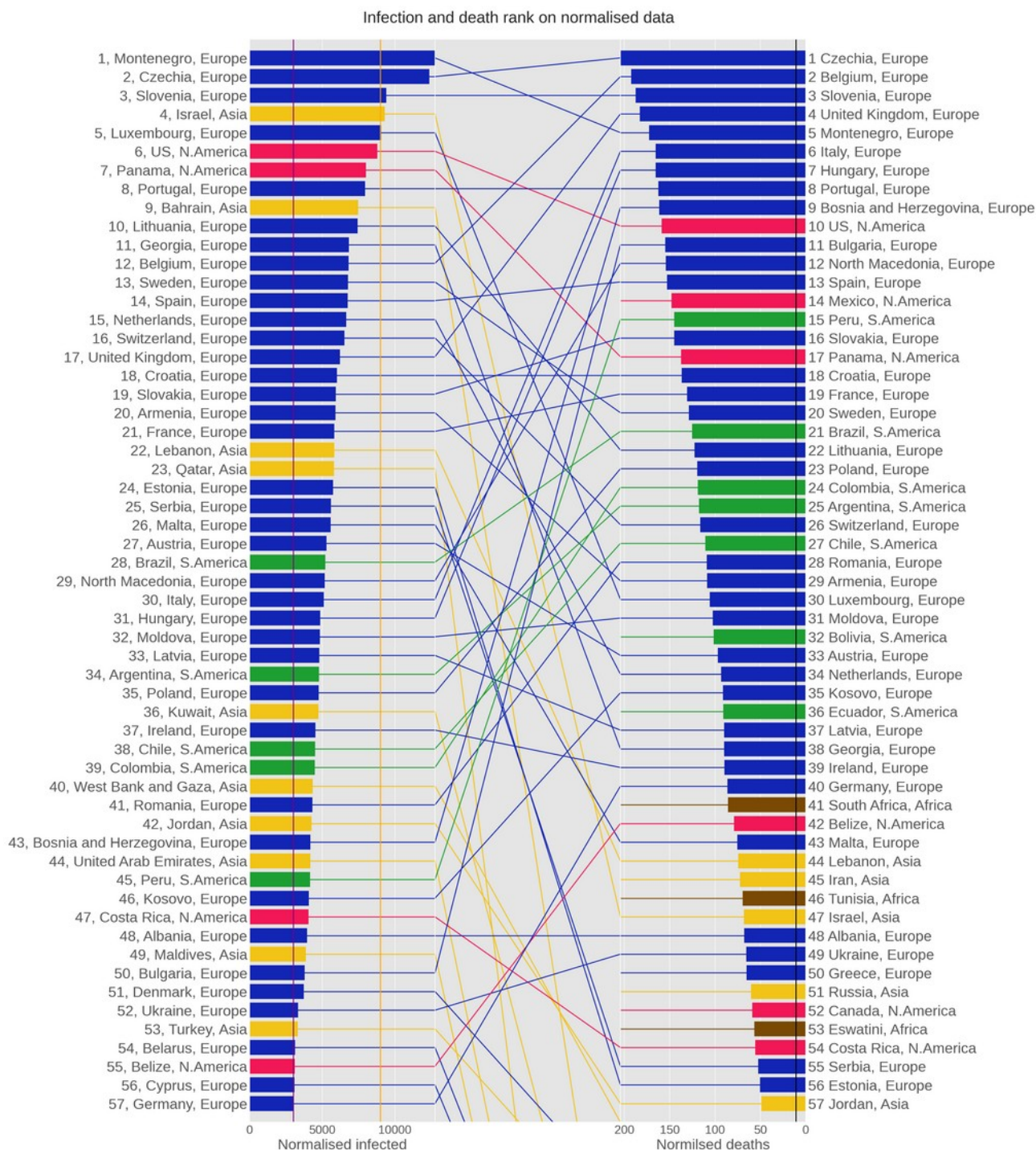
Figure 5: Ranking infection (left column) and death rate (right column) of countries above 3% population infection. Line thresholds: purple: 3% minimum US flu, orange: 9% average US flu, black: US flu mortality. Colours: Brown – Africa, Yellow – Asia, Blue – Europe, Red – North America, Green – South America. See Table 2 for continental distribution.

Fatality ranking change

5/21/20		3/8/21
1 Yemen		1 Yemen
2 Belgium		2 Mexico
3 France		3 Syria
4 United Kingdom		4 Sudan
5 Italy		5 Egypt
6 Hungary		6 Ecuador
7 Netherlands		7 China
8 Spain		8 Bolivia
9 Sweden		9 Afghanistan
10 Bahamas		10 Liberia
11 Belize		11 Mali
12 Mexico		12 Tanzania
13 Chad		13 Zimbabwe
14 Liberia		14 Bulgaria
15 Suriname		15 Comoros
16 Canada		16 Bosnia and Herzegovina
17 Ecuador		17 Eswatini
18 Guyana		18 Niger
19 Zimbabwe		19 Somalia
20 Barbados		20 Guatemala
21 Algeria		21 Iran
22 Slovenia		22 Peru
23 Trinidad and Tobago		23 Chad
24 World		24 Tunisia
25 Romania		25 Hungary
26 Niger		26 South Africa
27 Ireland		27 Malawi
28 Brazil		28 Greece
29 Burkina Faso		29 Italy
30 Indonesia		30 Gambia
31 Mali		31 El Salvador
32 Philippines		32 Australia
33 US		33 Fiji
34 Switzerland		34 North Macedonia
35 Nicaragua		35 United Kingdom
36 Sierra Leone		36 Lesotho
37 Bosnia and Herzegovina		37 Germany
38 Greece		38 Belgium
39 North Macedonia		39 Indonesia
40 Iran		40 Nicaragua

Figure 6: Fatality ranking after the first wave and at the end of the time period. The Fatality rate changes between different waves. That is mostly attributed to the change in virus properties.

2020 – 08 March 2021) (Appendix 5).

It is clearly noticeable that the daily infections soar up tenfold as time goes by while daily deaths only increase about twofold. That results a change in fatality aka the severity of the pandemic.

If in a comparision we see the fatality as an accumulated data average (01 Jan 2020 – 21 May 2020 vs. 01 Jan 2020 – 08 March 2021) (Figure 6, 8), the average fatality rate on the world was 6.6% during the first wave. As Europe was the most affected during that time it was much higher at 10.9%. Due to the larger increase in infections and the modest increase in deaths there was a significant drop in severity to 2.2% for the world and a dramatic 2.4% for European countries by the end of the year period.

How the pandemic changed

As mutations accumulate the properties of the pandemic are changing. There can be 3 main time-periods distinguished (Figure 7, Appendix 5). The reason for separation is understandable on the world-wide daily case report graph as the lines change shape during the course of time. The early spread period (spring, 01 Jan 2020 – 21 May 2020) includes China, Oriental Asian countries and Western Europe*. Most of the Asian countries have previous experience with pandemics (eg. SARS) and they quickly and strictly closed borders with China. The early spread was therefore characterised with European involvement. The first wave diminished by May. It left alone Western Europe for the summer and travelled around the world from here (summer 22 May 2020 – 28 Aug 2020). Until September. The new wave which coincided with the opening of schools, appeared almost everywhere at the same time . The third period then started in September to the end of the study period (winter, 29 Aug

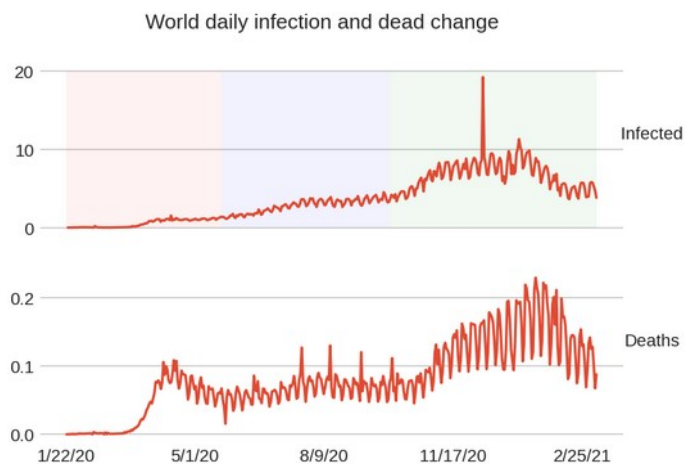World daily infection and dead change

Figure 7: Spread periods during the first year on the daily case numbers on 100k people. Pink: early period, spring, includes Asia and Western Europe. Purple: summer spread around the world. Green: winter period universal spread. The incidence in the early period dwarfs compared to later periods while the death remains on same magnitude. Notice the different scale of the two graphs.
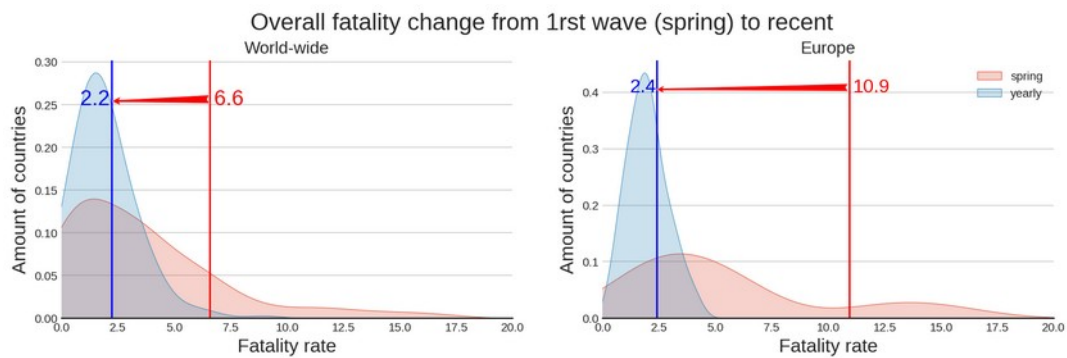
Figure 8: Average fatality rates of world-wide and Europe. Change between the spring and by the end of the year period is large especially in Europe.

So far the change during whole year was compared to the spring period but as the winter period is a separate event, it is reasonable to look at the periods by themself (Figure 9). The change is even more robust. The 16.4 times higher infection rate increase in the world was accompanied only a 4.7 times increase in deaths. As a consequence the world's fatality rate of 6.6% during the spring shrank to 1.9% in the winter.
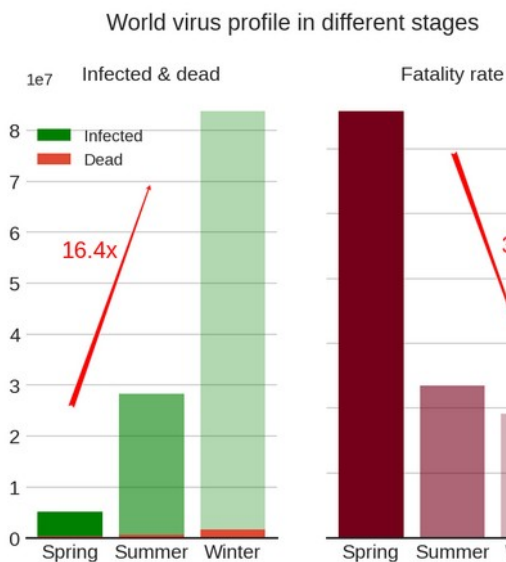
Figure 9: Change of infection between time periods on the world cases. The large increase in infections was not followed with the same increase in death resulting a 3.5 times drop in fatality from summer to winter period. The current severity of the pandemic drastically decrease since the beginning

This is behind the change in ranking as well (Figure 6). It is interesting to see that China was awarded 7th place on the fatality rank at the end of the year. The reason behind this is China reported only a few sporadic cases since the first outbreak. resulting an unusual curve (Appendix 4).

Although patient care improved in many countries most of the money spent was poured into vaccine development and not direct treatment and care. So the drop of fatalities is dominantly attributed to the virus change due to the incurred mutations*. New virus variants seem to become to cause less symptoms and deaths, though elevating infection cases and attenuating fatality. Of course any avoidable death is tragic and the actual burden depends on the capacity of any given country's healthcare system. But the change in the virus severity requires a different approach to prevention strategy.

What about the future

- World -wide tendencies show that infection numbers are elevating with the increase of asymptmatic cases. Counting though needs to start afresh for the next 12-month period to evaluate the characteristics of the pandemic. A further drop in the fatality rate can be expected.

- With the increase of cases the chance of new mutations are also increasing. More waves can be expected as the new variant sweep across the globe. It is important therefore to remain vigilant on personal and global levels to monitor and test new variants. But it is unnecessary to keep strict restrictions between waves and the measures in place should be adjusted to the fatality rate avoiding unnecessary repercussions on economy and society.

- New variants could hamper the vaccination effort. With the elevation of asymptomatic and mild cases the focus should go to prevent the deaths of those who are in real danger. Fortunately there is progress to improve antiviral treatment which serves this effort (5,6), although without extensive media coverage. It is not only useful in Covid treatment but also in general healthcare.

- With the change of the virus, vaccination remains an important tool to protect people at higher risk (elderly, medical workers etc). The improvement of general healthcare systems nevertheless have universal benefits against Covid-19 and other health issues providing broader benefit for the whole of the society.

Q/A:
1. Why this time-frame has been chosen

    Although we compare one year of flu data to the Covid time-frame, the Covid is actually 2 months longer. That makes the Covid data higher than the flu data showing Covid to be more serious. The early Chinese and East-Asia spread nevertheless had low reported case numbers so this bias is not that significant. The last wave which started in September attenuated by late February in most countries so leaving out its end would give a wrong impression. This is because we would miss a lot of data from the end of the wave and that would lower the severity of Covid in general. So expanding the time-frame gives a fairer view with less bias.

2. Some tricks to be careful with statistics

    Statistics is a branch of mathematical discipline and as such it is rigorous and logical. Yet it is highly sensitive to the understanding of data and used transformations. One of the trickiest points is how to present the results. Some common tricks to emphasise or blur differences or relationships are:

    example:

    vs. Appendix 2 or Figure 2

- If the colours used are too similar they blur differences.

- Grouping data (bin): eg: 0-1000,1001-10000. This method could hide differences.

- Use of different scales on graphs. If the y axis (vertical line) is different then it could give the impression that the graph data is in similar magnitude (see example Figure 3 scaled vs. non-scaled)

- Change of origo. The graph starts at a certain value instead of 0, like 1000. This way a difference between 1001 and 1003 can be magnified.

9

3. What is the base of infection comparison?

The average American influenza spread was taken as a comparison to Covid-19. Flu shares many symptoms and characteristics with Covid-19, yet it's presence is accepted by the general public and we have learnt to live with it. It has a general spread around the world and reasonably accurate estimations are available from the USA from over decades. The last 10 years average was therefore calculated based on public CDC data (7) for prevalence, mortality rate and fatality.

4. What is this business with normalisation?

Population normalisation is necessary to compare countries' case numbers objectively as bigger countries obviously could give larger numbers. Population normalisation was calculated to 100k population to reduce the magnitude of these numbers for practical reasons. Countries with population smaller than 100k would show as outlayers on the graphs distorting the overall scheme of the pandemic therefore they were removed (12 countries). As their absolute number is low anyway leaving them out for the sake of clarity does not make a difference. Accumulated World data still includes these cases.

5. Where does the data come from and how reliable is it?

Although the data is the best available (8), it still has known flaws which results in the underestimation of both incidents and death:

• Ununified criteria of Covid-related death or infection declaration

• Level of screening and testing to discover silent infections differs between countries and time-frame.

• Manipulation of data, misreporting

Despite these flaws general tendencies and proportions can be revealed with confidence.

6. What about asymptomatic cases?

There was an estimated 25-30% of cases without any symptoms during the spring outbreak. These cases are hard to identify yet they can spread to others. Despite the efforts for general screening in some countries many could still go unnoticed. Since not every country implement these screens the prevalence comparison of real numbers are biased. Yet I decided to use the reported numbers as they are because any attempt to compensate for that bias would only introduce other inaccuracies. The new virus strains appear to result in fewer deaths presuming also the increase in asymptomatic cases. Because the death declaration is more reliable in the reports, the increase of prevalence, compared to the reported, reduces the fatality rate significantly. So the actual severity of the virus is milder in reality then the report indicates.
Vaccines also reduce the severity of symptoms and increase the proportion of asymptomatic cases. Keep in mind that to overestimate the severity is a lesser mistake than underestimating it.

7. Why does Europe have the highest population infection rates?

This can only partly be explained by the fact that after China locked down its own country still freely allowed international travel (9). European countries failed to react in time unlike the USA and many Asian countries to block the influx of virus carriers (10). The main focus of Chinese tourism was directed toward Western Europe so Middle and Eastern European countries had no significant early infection. By September the spread homogenised around the continent. There are two main reasons for the EU response: following the WHO recommendation (11) which later turned out biased (12); dreading China's retortions against countries which imposed travel restrictions (13,14,15). The EU is tendentiously soft on China (16,17), desperately avoiding confrontation and upsetting it's leader in fear of economical retaliation and bullying (18,19).

8. What is the human genetical background of infections?

The virus – host interaction based on specific protein interactions where the proteins structure defines the interaction. The structure coded in the genes. There are natural differences between individuals' genetic background, that is what makes us different. These differences could influence the virus interaction and modify the outcome of the infection. Several such differences have already been discovered (20,21,22). It could be the subject of another study to investigate the distribution of these differences among distinct populations which may add to explain the differences among countries and continents.

9. Why do the western countries have the highest mortality rates?

The individual strategy responding to the pandemic varies between countries. Political mistakes regarding the spread (see point 7) are an important factor but not the only one. Because of the large number of cases, hospital capacities and stockpiles of equipment were in short supply very early. That was the point when the world realised that China had depleted all their resources (23,24,25,26) by procuring all around the world and accepting large quantities of aid from all over the world (27) while playing down the severity of the then epidemic. Later on China's image restoring attempts – mask diplomacy (28,29) - to 'generously' support countries for favour of praise (30) turned out to be low quality or refuse (31). These problems in the early wave resulted in high fatality rates. By the winter period these problems were eliminated and the fatalities have fallen back significantly to the world average.

10. Why are China's case numbers so low?

The actual number of cases is highly questionable regarding both infections and deaths (32). It is also true that China imposed strict measures to isolate infections and imposed total information control. Although these lockdowns were not much more than mass imprisonment without actual social-wise medical support. Many westerners praised China's leadership for its efficacy (3334) but it is easy to see that if you don't care about your subjects then you can just lock them up to live without any assistance or until they die. It is up to the reader's conscience to judge. Nevertheless even now sporadic mass scale isolations are being reported from all over the country where millions being incarcerated without cases reliably reported to the WHO.

11. What is about mutations?

Like in every living organisms mutations occur almost randomly in every generation as a normal 'side-effect'. Mutations are the source of genetical diversity which under the pressure of environmental selection and competition drives the evolution. The main reward is survival and the generation of offsprings. Viruses follow the same rules. If a virus causes high fatalities the victims die quickly and less people get infected. So those viruses which cause no symptoms and linger longer in the host have higher reward. So viruses tends to evolve in this direction. Since the viruses interfere with the host's biology it results in the death of the host in many cases. But in order to cause that interference all steps in the infection have to be very specific. So because breaking something is easier then refining the chance that a virus will be weaker by time is higher then it will be stronger and the evolutionary pressure supports the weaker ones. It is a normal phenomenon therefore that epidemics and pandemics get milder as the spread goes ahead if there is enough time and number of cases. SARS for example was too deadly to cause a pandemic, because it killed the host quickly and caused severe symptoms. It was therefore easy to isolate and stop the spread before it had enough time and cases to go through the above mentioned process. The Covid-19 apparently stepped on this pathway but that does not mean that there is no chance for an occurrence of a more virulent variant. Therefore the continuous monitoring and vigilance is paramount to keep for a long time.

Appendix:

1. Infection statistics on normalised data by continents

Continent	Countries	mean	std	min	10%	50%	90%	max
Africa	51	398	599	0	40	151	1399	2565
Asia	46	1614	2245	0	6	454	4536	9301
Europe	43	5365	2482	1128	2469	5174	7845	12767
N.America	20	2158	2371	97	129	1575	4450	8793
Oceania	8	24	39	0	0	4	69	113
S.America	12	2862	1639	502	1161	2281	4740	5199
World	1	1503	0	1503	1503	1503	1503	1503

2. Absolute number of infection by countries
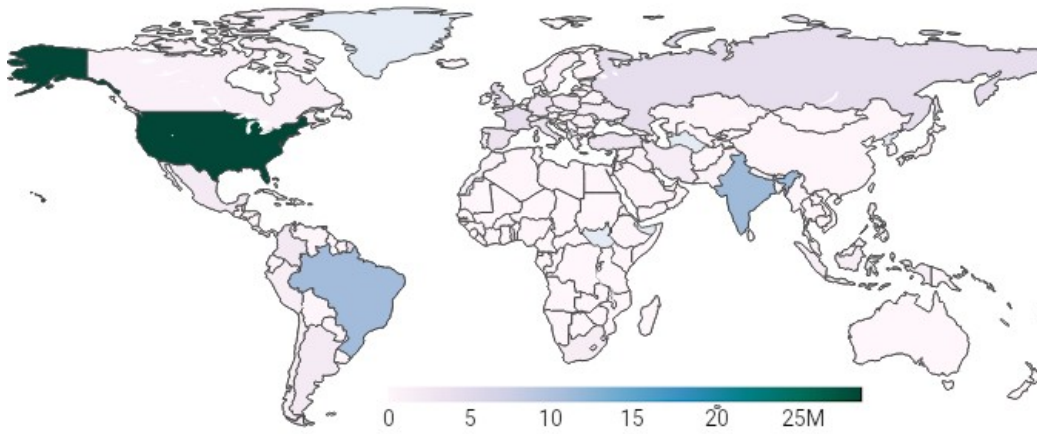
3.

Absolute infection numbers by continents
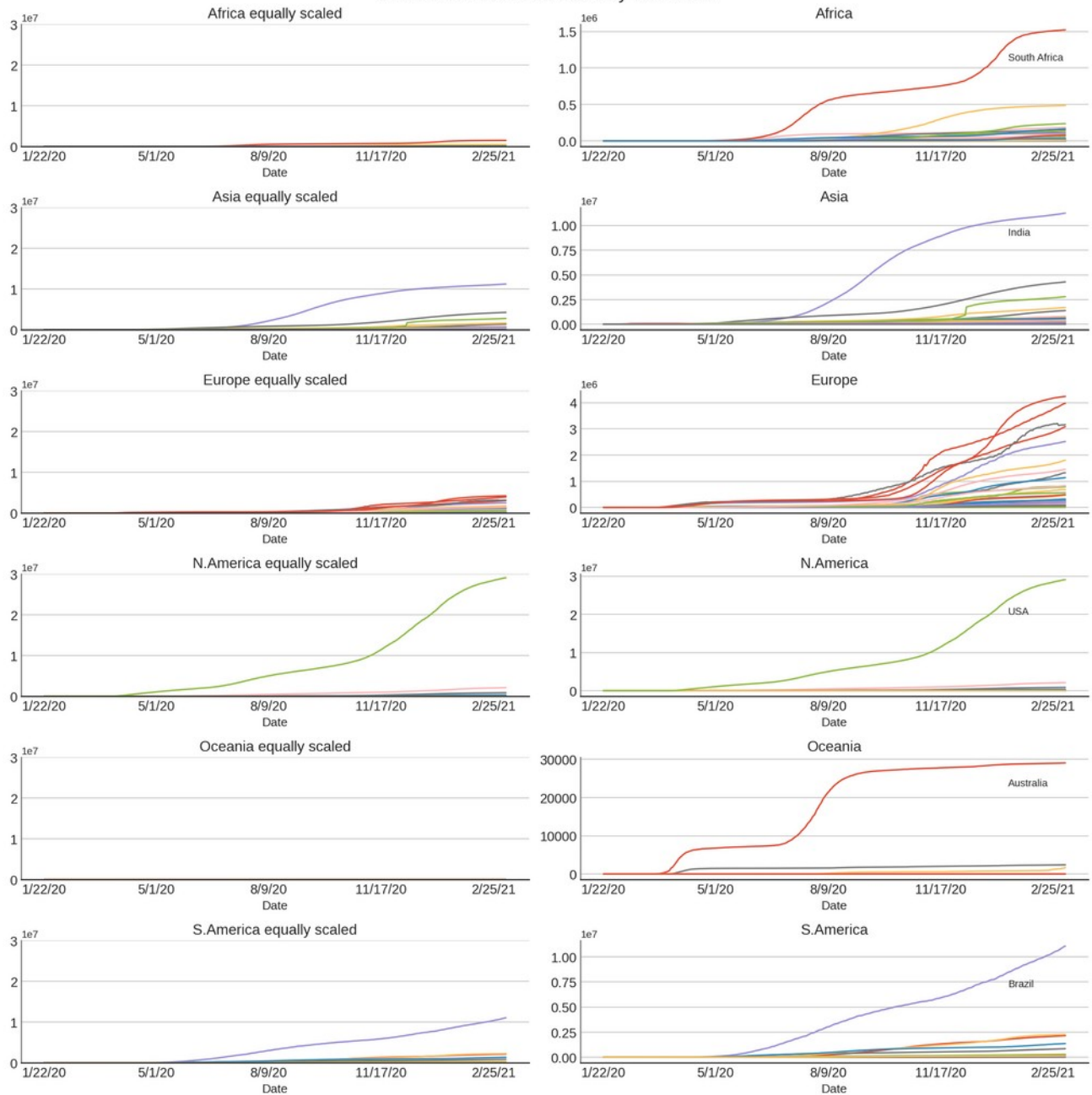
Although there is one country on every continent which has a outstanding amount of cases compared to its neighbours (right column), the overall contribution to the world cases or relative to the most infected one (USA) is low (left column)

4.
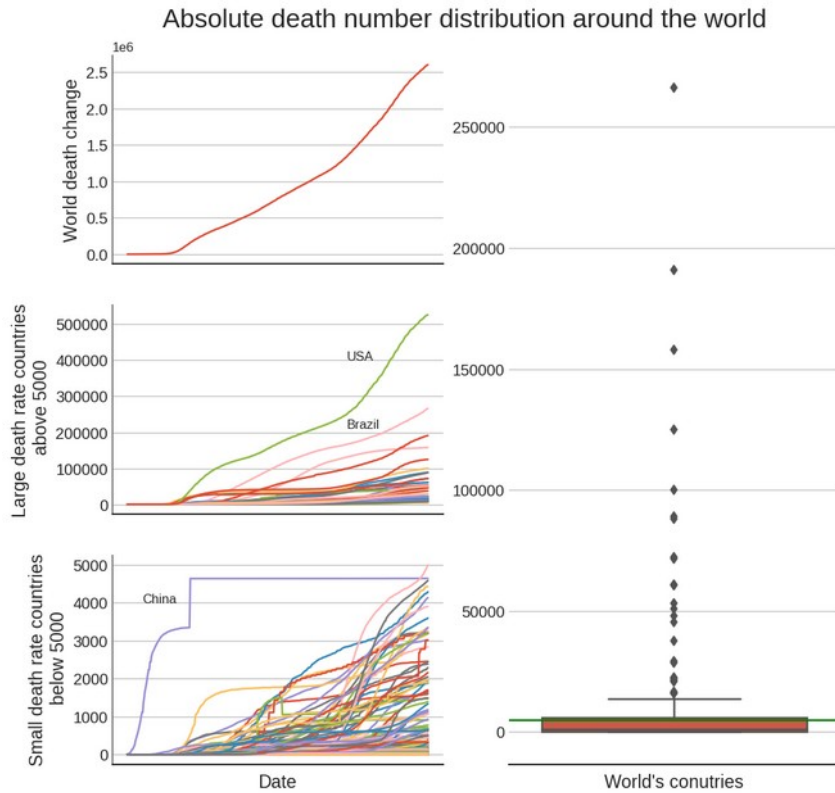
Absolute death rate shows that most of the countries have very similar number of deaths. Green line: 5000 deaths at the whole country. 76% of the countries are below this low arbitrary threshold. (In comparison during Ukraine annexation an estimated 13000 people died as of the publication, (35). Interesting to see the trend change in China.*

5. .
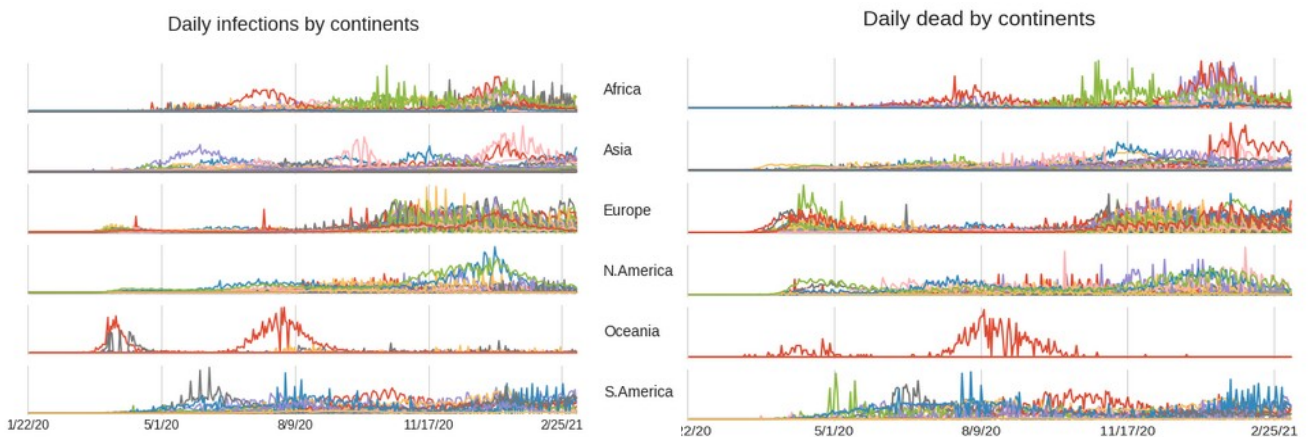
Daily cases on population size during the time period. Left and right has different scale so only the trends are comparable.

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