American Journal of
Biomedical Science & Research

www.biomedgrid.com
ISSN: 2642-1747

Power Point

World's Coronavirus Death Regions and Why

John S Craven*

50 years of Industrial Experience in Manufacturing, Engineering Design, USA

***Corresponding author:** John S Craven, 50 years of Industrial Experience in Manufacturing, Engineering Design, 57 Red Fox Drive, Elkton, Maryland 21921 USA ORCID ID: 0000-0001-7576-5997.

To Cite This Article: *John S Craven*. World's Coronavirus Death Regions and Why. Am J Biomed Sci & Res. 2023 20(6) AJBSR.MS.ID.002773,* DOI: 10.34297/AJBSR.2023.21.002773

Received: November 28, 2023; **Published:** December 20, 2023

World Reached 3million Corona Virus Deaths April 16, 2021

a) 8 countries responsible for 60% of the world's corona virus deaths.

b) 19 countries responsible for 80% of the world's corona virus deaths.

c) >80% of world's corona virus deaths have occurred in countries of European Diaspora. Primary factors, required in combination, have been proposed to explain why limited world regions account for most of the world's deaths.

Outline of Evaluation Results Provided

a) hypothesized pathway for creation of regions with high corona virus deaths is provided.

b) Tables provided showing regions where high & low corona virus death rates are occurring.

c) Western world regions are far deadlier than regions of the Far East, Africa and Southeast Asia.

d) Major factors causing these deadly regions, which occur in combination, include

   i. Percent urban population greater than 80%

   ii. Presence of major operating pollution sources

   iii. Micron size pollutant concentration resulting from seasonal meteorological temperature inversions.

   iv. Interaction of the effect of concentrated pollutants on the tolerance for corona virus aerosols

   v. Exposure of pollutant-aerosol interaction to people with inhibited immunities

e) High deaths occurring during January - April 2021 in warm weather regions.

   i. 15 countries accounted for 79% of the world's corona virus deaths in Jan-Feb 2021.

   ii. Eight of these countries were sub-tropical with current temperatures from 65 to 85 F.

   iii. Subsidence temperature inversions annually occur this time of year in the sub-tropics.

   iv. Brazil experienced 208,701 deaths between Dec 29, 2020 and April 29, 2021.

   v. India experienced 59,838 during same period, now experiencing catastrophic daily deaths.

   vi. Bulk of deaths in Brazil and India in humid sub-tropical and tropical climate regions.

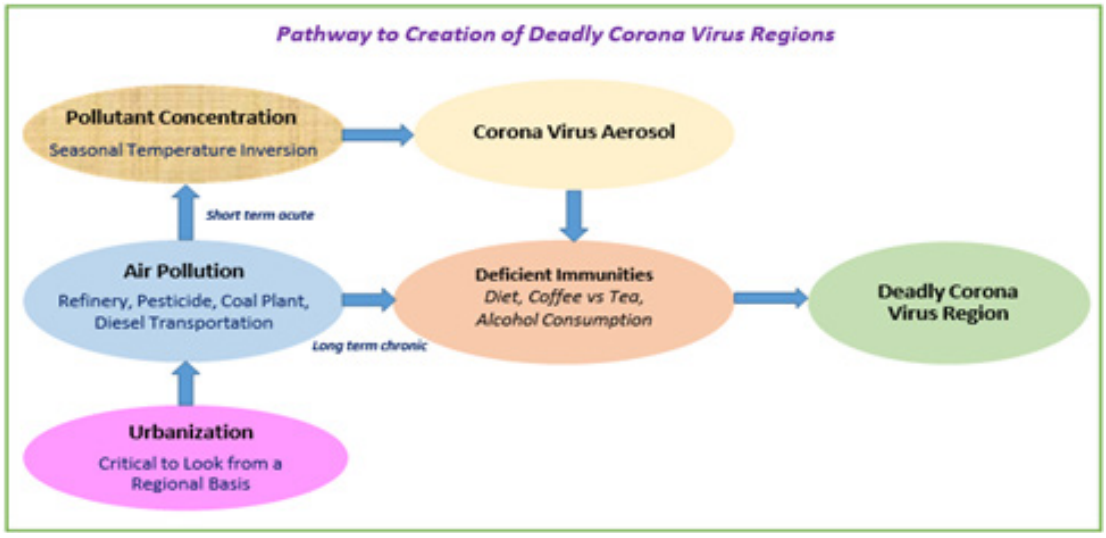


Table in descending order of corona virus deaths for the 19 deadliest countries in the world.

On April 29, 2021 Worldometer tracked 219 countries and territories. Table includes 130,626 additional deaths Mexico admitted on March 28, 2021.

	Pop, MM	Acc Pop	% of Pop	Urban %	Country	Religion	Oil Refineries	Deaths	Case Rate	Death Rate	Acc Deaths	% of Deaths
1	332	332	4%	83%	USA	P	Yes	589,181	99,340	1,771	589,181	18%
2	213	545	7%	87%	Brazil	RC	Yes	401,417	68,254	1,878	990,598	30%
3	130	675	9%	80%	Mexico	RC	Yes	346,544	17,970	2,666	1,337,142	40%
4	1,385	2,060	26%	35%	India	H	Yes	208,313	13,481	150	1,545,455	47%
5	68	2,128	27%	83%	UK	P	Yes	127,502	64,744	1,870	1,672,957	51%
6	60	2,188	28%	71%	Italy	RC	Yes	120,544	66,390	1,996	1,793,501	54%
7	111	2,299	29%	75%	European Russia	OC	Yes	109,731	32,856	977	1,903,232	58%
8	65	2,364	30%	81%	France	RC	Yes	104,224	85,520	1,594	2,007,456	61%
9	84	2,448	31%	77%	Germany	Ag,RC,P	Yes	83,221	40,159	991	2,090,677	63%
10	47	2,495	32%	80%	Spain	RC	Yes	78,080	75,154	1,669	2,168,757	66%
11	51	2,546	33%	80%	Colombia	RC	Yes	73,230	55,367	1,427	2,241,987	68%
12	84	2,630	34%	76%	Iran	M	Yes	71,351	29,217	841	2,313,338	70%
13	38	2,668	34%	60%	Poland	RC	Yes	67,073	73,662	1,774	2,380,411	72%
14	45	2,713	35%	93%	Argentina	RC	Yes	63,508	64,891	1,395	2,443,919	74%
15	33	2,746	35%	79%	Peru	RC	Yes	61,101	53,733	1,832	2,505,020	76%
16	60	2,806	36%	66%	South Africa	RC,P	Yes	54,331	26,359	907	2,559,351	77%
17	274	3,080	39%	56%	Indonesia	M	Yes	45,334	6,027	164	2,604,685	79%
18	44	3,124	40%	70%	Ukraine	OC	Yes	43,778	47,326	1,006	2,648,463	80%
19	84	3,208	41%	75%	Turkey	M	Yes	39,737	56,281	467	2,688,200	81%

Why do a limited number of countries account for the vast majority of the world's corona virus deaths?

North America	Death Rate	Deaths	Pop, MM	Ubn Pop %
Mexico	2,666	346,544	130	80%
Honduras	2,041	4,243	2	55%
USA	1,771	589,181	332	83%
Canada	636	24,167	38	81%
Guatemala	412	7,500	18	52%
	1,869	971,635	520	70%

South America	Death Rate	Deaths	Pop, MM	Ubn Pop %
Brazil	1,878	401,417	213	87%
Peru	1,832	61,101	33	79%
Panama	1,425	6,227	4	68%
Colombia	1,427	73,230	51	80%
Argentina	1,395	63,508	45	93%
Chile	1,363	26,247	18	85%
Bolivia	1,095	12,920	12	69%
Ecuador	1,039	18,552	18	63%
Paraguay	875	6,302	7	62%
	1,670	669,504	401	76%

North America & South America are the regions with world's highest corona virus death rates = 1,869 & 1,670.

Total population of these countries is 921 million people, 12% of world's population.

Total deaths in these regions 1.64 million, 50% of world's deaths.

3,309,250 world corona virus deaths Worldometer day April 29,2021.

Only countries with over 4,000 corona virus deaths included.

April 29, 2021. Corona Virus Deaths "Axis of Americas". 12% of World's Population.

Corona Virus "Axis of Americas"		
Country	Covid-19 Deaths	Death Rate per MM Pop
Canada	24,167	636
USA	589,181	1,771
Mexico	346,544	2,666
Guatemala	7,500	412
Honduras	4,243	2,041
Panama	6,227	1,425
Colombia	73,230	1,427
Ecuador	18,552	1,039
Peru	61,101	1,832
Brazil	401,417	1,878
Bolivia	12,920	1,095
Paraguay	6,302	875
Chile	26,247	1,363
Argentina	63,508	1,395
Axis Deaths	1,641,139	50%
World Deaths	3,309,250	of world's deaths

March 28, 2021 Mexico upped its death toll by 130,000. Worldometer has not included.

Western Europe	Death Rate	Deaths	Pop, MM	Ubn Pop %
Belgium	2,075	24,140	84	98%
Slovenia	2,041	4,243	2	55%
Italy	1,996	120,544	60	71%
UK	1,870	127,502	68	83%
Portugal	1,669	16,974	10	66%
Spain	1,669	78,080	47	80%
France	1,594	104,224	65	81%
Sweden	1,379	14,002	10	88%
Switzerland	1,220	10,625	9	74%
Austria	1,125	10,179	9	57%
Netherlands	998	17,124	17	92%
Ireland	983	4,899	5	64%
Germany	991	83,221	84	77%
Tunisia*	893	10,641	12	69%
Morocco**	242	9,020	37	63%
* near Italy ** Spain	1,224	635,418	519	75%

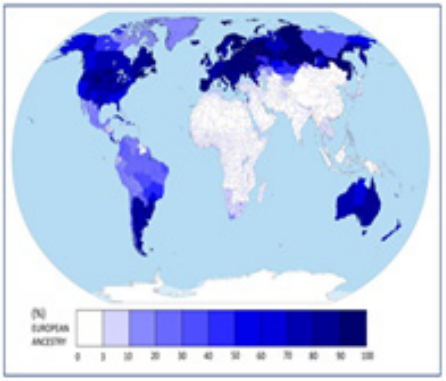
Eastern Europe	Death Rate	Deaths	Pop, MM	Ubn Pop %
Hungary	2,838	27,358	10	71%
Czechia	2,724	29,213	11	74%
Bosnia Herzegovina	2,608	8,512	3	52%
Bulgaria	2,370	16,368	7	75%
North Macedonia	2,313	4,818	2	58%
Slovakia	2,132	11,647	5	54%
Poland	1,774	67,073	38	60%
Croatia	1,724	7,040	4	57%
Romania	1,462	27,971	21	54%
Moldova	1,439	5,795	4	43%
Ukraine	1,006	43,778	44	70%
Greece*	994	10,315	11	79%
European Russia	977	109,731	111	75%
Serbia	728	6,337	9	56%
* borders Bulgaria	1,343	375,956	280	63%

Eastern Europe and Western Europe are regions with next highest death rates = 1,343 & 1,224. Combined population 799 million people or 10% of world's population. Total deaths for these two regions 1,011,374 or 31% of world's corona virus deaths. April 29, 2021

Circled portion of Europe has 10% of world's population and 31% of world's corona virus deaths.

Total population of Americas plus Europe is 22% of the world, but responsible for 81% of the world's corona virus deaths.

Why? What do these regions have in common?



Map is from Brilliantmaps.com and labeled "The European Diaspora". European emigration defined as emigration waves from the European continent to other continents. Origins of various European diasporas can be traced to people who left European nation states or stateless ethnic communities on European continent.

e.g. Argentina: 38,416,407
Mexico: 59,000,000
Brazil: 91,051,646
United States: 234,370,202

Australia is an exception as it has experienced minimal corona virus deaths. Professor Gary Geelhoed, executive director of Western Australian Health Translation Network, explained Australia's success as "because we were so big". Australia's population density is 3 people per square kilometer vs Italy at 206 and Spain at 91. "Just look at the streetscape of cities and towns of Italy and compare it to the average Australian suburban streetscape – the difference is obvious," he told the Australian Financial Review.

European Russia is Largest European Country in Population and Area -Wikipedia

European Russia has 77% of Russia's total population of 144 million but covers less than 25% of Russia's territory. European Russia includes Moscow and Saint Petersburg, the two largest cities in Russia. The eastern boundary of Europe is generally considered, by convention, to run along the Ural Mountains. See map on Chart 13.

European Russia contains 110 million people making it the most populous European country. It occupies nearly 4,000,000 km^2, making it by far the largest European country in area.

European Russia has an average population density of 27.5 people per km^2. Asian Russia has an average population density of 8.4. European Russia has an % Urban Population of 75%.

Total Corona Virus deaths in Russia 109,731 on April 29, 2021, 7th deadliest world country, with death rate of 752 per million people. Unable to find data on split of deaths between European Russia and Asian Russia. Australia has a population density of 3 and only 910 total deaths and a death rate of 35. It is reasonable to surmise that Asian Russia similarly has few deaths and a very low death rate. So, on chart 5 adjusted Russia data with assumption bulk of deaths have occurred in European Russia, which yields a European Russia death rate of 977.

Chart 14 shows location of Russia's petroleum refining and chemical industry, all in European Russia. These are the major sources of pollution emissions.

Source: World Population Clock.

The regions of pronounced European Ancestry are also the historical regions of Christianity, both Roman Catholic and Orthodox.

Table on chart 5 summarizes the countries responsible for 80% of the world's corona virus deaths-19 countries. A column is included in table showing the primary religions in these countries.

Following abbreviations used:

RC=Roman Catholic, OC=Orthodox Catholic, H=Hindu,

M=Moslem, P=Protestant, Ag=Agnostic

Charts 11 & 15 indicate that 81% of the world's corona virus deaths occurred in countries of European Diaspora and the top 19 countries accounting for 80% of the world's corona virus deaths all have significant religious history.

The "Pathway to Creation of Regions of High Corona Virus Deaths" doesn't directly address the role of overall culture, lifestyles, attitudes, leadership. But the roles of diet, increasing urbanization, increasing pollution, more pronounced extreme weather patterns are interrelated and a result of culture, lifestyles, attitudes, leadership.

One can speculate that the evolution of culture, lifestyle, attitudes, leadership are embedded in historical experience, very difficult to change, and always lag current events by centuries.

Middle East	Death Rate	Deaths	Pop, MM	Ubn Pop %
Armenia	1,377	4,087	3	1
Lebanon	1,066	7,249	7	79%
Georgia	1,028	4,095	4	59%
Jordan	856	8,801	10	91%
Iran	841	71,351	84	76%
Israel	692	6,362	9	93%
Turkey	467	39,737	84	75%
Azerbiajan	440	4,490	10	56%
Iraq	377	15,433	40	73%
Saudi Arabia	197	6,946	35	84%
Egypt	127	13,219	102	43%
	468	181,770	388	72%

Far East, Africa, and Southeast Asia have average death rate of 89, 1/17th that of Americas plus Europe.

These three regions combine for 5 billion people or 65% of the world's population.

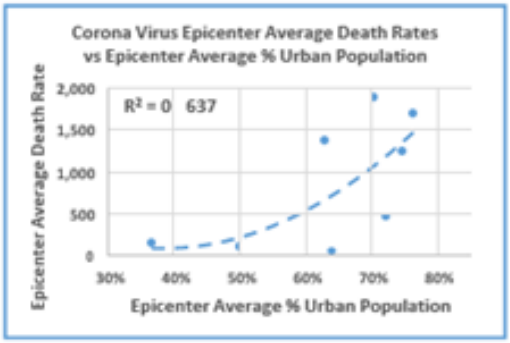
Total deaths for these three regions 436,384 or 13% of world's deaths. April 29, 2021.

Far East	Death Rate	Deaths	Pop, MM	Ubn Pop %
Indonesia	164	45,334	274	56%
Philippines	155	17,145	110	47%
Japan	80	10,107	127	92%
China	3	4,636	1,444	60%
Total Far East	39	77,222	1,955	64%

Africa	Death Rate	Deaths	Pop, MM	Ubn Pop %
South Africa	907	54,331	60	66%
Egypt+Morocco+Tunisia	218	32,880	151	58%
Other Africa	30	34,565	1,135	25%
Total Africa	90	121,776	1,346	50%

SE Asia	Death Rate	Deaths	Pop, MM	Ubn Pop %
India	150	208,313	1,385	35%
Pakistan	79	17,680	222	35%
Bangladesh	69	11,393	168	39%
	134	237,386	1,775	36%

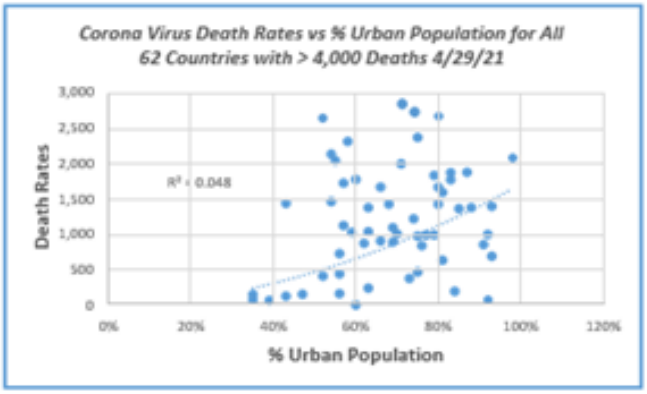
Middle East region has 30% of death rates of Americas and Europe and only 5% of the world's deaths.

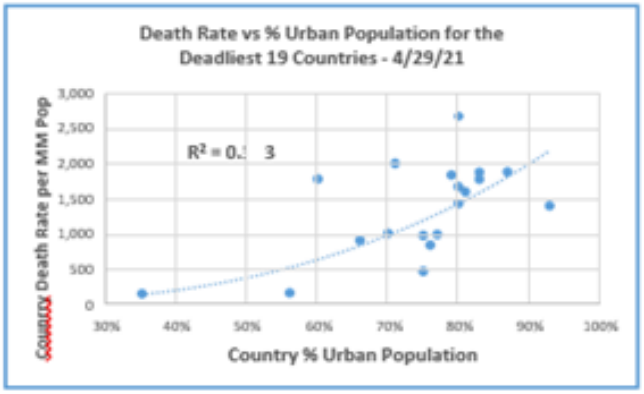


Epicenters of Corona Virus Deaths	Epicenter Ave Death Rates	Epicenter Ave % Urban Population	average death rates	total population, MM
North America	1,869	70%		
South America	1,670	76%	1,526	1,720
Eastern Europe	1,343	63%	↓	↓
Western Europe	1,224	75%	↓	↓
Middle East	468	72%	1736%	34%
SE Asia	134	36%	↓	↓
Africa	90	50%	88	5,076
Far East	39	64%		

Correlation of epicenter average death rates vs average % urban populations for principal corona virus death regions identified in this report.

R-squared low due to very high North America & Eastern Europe death rates and very low death rates in Middle East and Far East. April 16, 2021.





Plot of Corona Virus Death Rates for Each of the 62 Countries with > 4,000 Deaths on April 29, 2021 vs % Urban Population for Each Country Appears to Be Scatter, no real correlation.

Plot of Corona Virus Death Rates for 19 deadliest countries of corona virus deaths vs % Urban Population, April 29, 2021. All countries with urban population of 80%+ have death rates of 1500+.

Country	Deaths	Death Rate
Japan	8,119	64
South Korea	1,627	32
China	4,636	3
Taiwan	9	0.4
Hong Kong	201	27
Vietnam	35	0.4
Laos	0	0
Thailand	85	1
Cambodia	0	0
Malaysia	1,159	36
Philippines	12,423	112
Indonesia	37,026	134

Death Rates for Far East region on March 5, 2021 summarized in table are orders of magnitude lower than regions of Americas and Europe.

Why the difference vs the Western World?

Large gray area in Western China is the Tibetan Plateau. See Part 6 of this evaluation to understand importance.

Possible Reasons Western World Death Rates Dramatically Worse

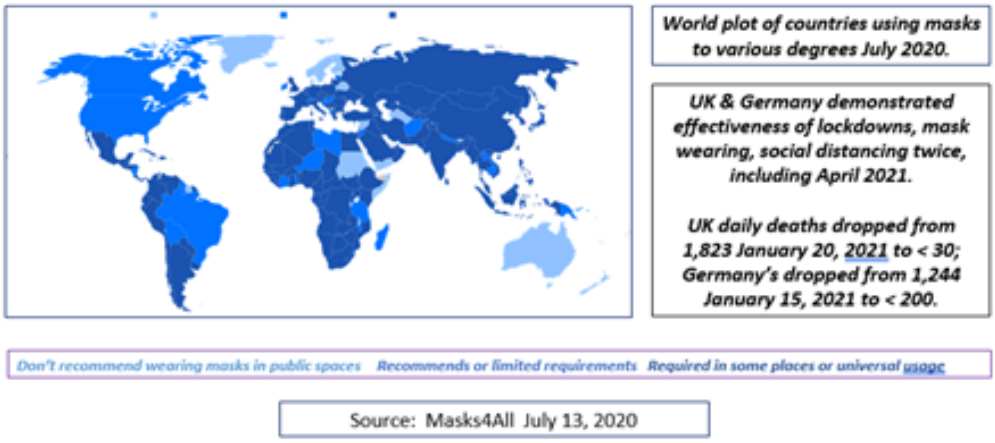
a) All of Far East, Africa, Southeast Asia received 98% effective vaccine secretly in early 2020 5 billion people involved; impossible to keep secret; idea dismissed.

b) Far East, Africa, Southeast Asia are grossly underreporting their corona virus deaths. Neither WHO, CDC, nor UN suggesting such an event occurring; idea dismissed.

c) Far East, Africa, Southeast Asia adapted mask wearing, overwhelming providing protection 22 countries in mid-2020 readily adopted mask wearing; some in Europe; insufficient data provided as to when masks were worn and if use was discarded in late 2020 when Europe hit far harder with virus deaths than spring of 2020.

d) Something natural, unaffected by leadership, existed in lives of Far East, Africa, Southeast Asia differentiating these regions from

Western World. Most likely factors would include food and/or drink; i.e. diet



T Colin Campbell, et al., (2020) (T. Colin Campbell is the Jacob Gould Schurman Professor Emeritus of Nutritional Biochemistry in the Division of Nutritional Sciences at Cornell University and co-author of "The China Study.")

"Gov. Andrew Cuomo is providing important leadership, but he could do a better job of keeping the curve flattened and the economy reopened by embracing nutritional science to defend against the worst effects of COVID-19.

Consuming a whole-food, plant-based diet can prevent illness and restore health. The effect is profound, broad in scope and acts rapidly when adopted. It does not rely on individual nutrients acting independently. Instead, nutrients consumed as food act together, like notes in an orchestral production.

Our work in rural China in the 1980s suggests that chronic degenerative diseases such as heart disease, diabetes, obesity, and cancer… associate with animal-based food consumption, even surprisingly small amounts. We also collected information on viral diseases and found evidence that may be relevant to our current COVID-19 dilemma.

The virus we studied most intensively in China was hepatitis B (HBV), which causes liver cancer. We measured HBV antibody and antigen prevalence and a large number of dietary and nutritional factors, and found a striking association: more plant food consumption, more disease-fighting antibodies, and more animal-based food, fewer antibodies and more HBV antigen and liver cancer.

This interplay of nutrition and viral activity for HBV likely applies to COVID-19, especially for older individuals who account for 80% of all deaths. Further, over 95% of these deaths occur among individuals compromised by the same poor nutrition associated with animal-based and processed food consumption typical in Western societies.

Additional evidence, now well publicized, suggests that individuals switching to a whole plant-based diet would not only decrease degenerative disease, thus lessening their COVID-19 risk, but also increase their production of antibodies. And there is ample information showing that this nutritional effect may begin in a matter of days.

By strengthening immunity while also addressing diet-related comorbidities, a nutritional strategy would reduce strain on hospitals and improve our ability to keep the economy open, now that it is restarting. A nutritional strategy can also position the population to withstand the effects of new viruses. It's time our health and political authorities acknowledge and embrace this idea."

T Colin Campbell, et al., PhD has been dedicated to science of human health for more than 60 years. His primary focus is on the association between diet and disease, particularly cancer. Although largely known for the China Study--one of most comprehensive studies of health and nutrition ever conducted, and recognized by The New York Times as the "Grand Prix of epidemiology". Dr. Campbell's profound impact also includes extensive involvement in education, public policy, and laboratory research.

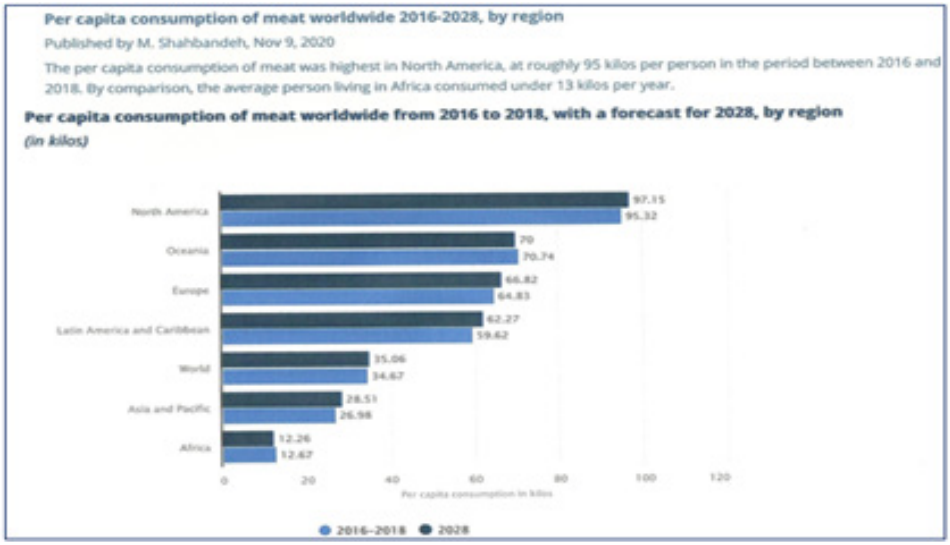
Dr. Campbell grew up on a dairy farm and was the first in his family to go to college, where he studied pre-veterinary medicine at Pennsylvania State University. After obtaining his bachelor's degree, and while completing his first year at the University of Georgia veterinary school, he received a telegram from a well known professor at Cornell University, offering a scholarship and research opportunity too good to turn down. And so he completed his education at Cornell University (M.S., Ph.D.) and MIT (Research Associate) in nutrition, biochemistry and toxicology. He then spent 10 years on the faculty of Virginia Tech's Department of Biochemistry and Nutrition before returning to Cornell in 1975 where he presently holds his Endowed Chair as the Jacob Gould Schurman Professor Emeritus of Nutritional Biochemistry in the Division of Nutritional Sciences.

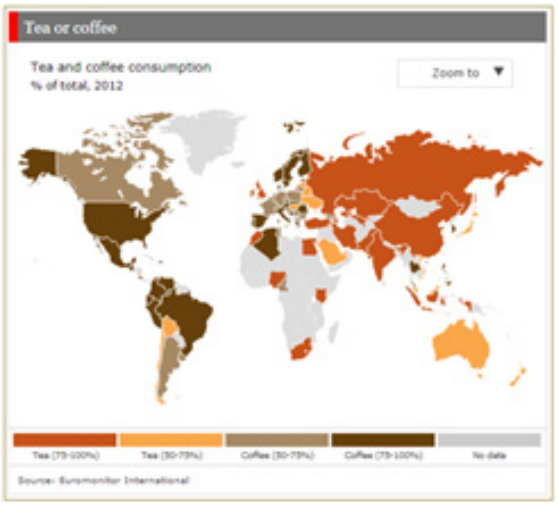
Dr. Campbell's research experience includes both laboratory experiments and large-scale human studies. He has received over 70 grant-years of peer-reviewed research funding (mostly with NIH), served on grant review panels of multiple funding agencies, actively participated in the development of national and international nutrition policy, and authored over 300 research papers. Throughout his career, he has confronted a great deal of confusion surrounding nutrition and its effects. It is precisely this confusion that he has focused so much on, in recent years.

Dr. Campbell Suggested Diet Has Role in Providing or Destroying Virus Immunities

1. **Plant Based Diet In lieu of Animal Based Diet – Profile of World Meat Consumption on Chart 26.**
2. **Profile of World Coffee vs Tea Consumption on Chart 27.**
3. **Profile of World Fresh Coffee vs Instant Coffee Consumption on Chart 28.**
4. **Paper Summarizing Effect on Virus Immunities Resulting from Excessive Alcohol Consumption on Charts 29, 30, 31. Profile of World Alcohol Consumption on Chart 32.**

Above illustrates substantial differences in diets between Western World and Far East and Africa. Likely to be many more differences.





In 2020 coffee was still an extremely popular beverage among Americans of all ages.

Nearly half of 18 to 24-year-olds drank the beverage and almost 70 percent of seniors did as well.

Not only are seniors more likely to be coffee drinkers than their younger cohorts, but they drink about three times as many cups a day as well.

How Alcohol Can Affect Your Immune System

Healthline, Julia Ries on April 22, 2020

- **A spike in alcohol sales has alarmed health experts and officials around the world.**
- **Increased drinking can make people even more vulnerable to respiratory diseases like COVID-19.**
- **Those who have any of the known risk factors for COVID-19, like diabetes or heart disease, should drink**

even less.

The U.S. surgeon general warned at-risk adults to refrain from drinking. The World Health Organization (WHO) also suggested that people cut back on drinking, since alcohol can increase risk of experiencing complications from COVID-19.

- "Alcohol consumption is associated with a range of communicable and noncommunicable diseases and mental health disorders, which can make a person more vulnerable to COVID-19. In particular, alcohol compromises the body's immune system and increases the risk of adverse health outcomes," the WHO stated.
- Though there's still limited data on the link between alcohol and COVID-19, past evidence shows alcohol consumption can worsen the outcomes from other respiratory illnesses by damaging the lungs and gut, and impairing the cells responsible for immune function.

Drinking impairs immune cells in key organs

When someone is exposed to a virus, the body mounts an immune response to attack and kill the foreign pathogen. In general, the healthier a person's immune system is, the quicker it can clear out a virus and recover from a disease like COVID-19. By default, alcohol makes it harder for the immune system to gear up and defend the body against harmful germs. "Alcohol has diverse adverse effects throughout the body, including on all cells of the immune system, that lead to increased risk of serious infections," said Dr. E. Jennifer Edelman, a Yale Medicine addiction medicine specialist.

In the lungs, for example, alcohol damages the immune cells and fine hairs that have the important job of clearing pathogens out of our airway. "If the cells lining a person's airway are damaged from alcohol, then viral particles, such as COVID-19, more easily gain access, causing immune cells, which fight off infection, to not work as well, leading to increased overall risks of more severe diseases as well as complications," said *Dr. Alex Mroszczyk McDonald* a practicing family physician in Southern California. Similarly, alcohol can trigger inflammation in the gut and destroy the microorganisms that live in the intestine and maintain immune system health. "Alcohol intake can kill normal healthy gut bacteria, which help to promote health and reduce risk of infection," *Mroszczyk-McDonald* said.

When the body is unable to clear a pathogen, an infection can worsen and lead to more severe, life threatening complications. Past research shows alcohol consumption leads to more severe lung diseases, like adult respiratory distress syndrome (ARDS) and other pulmonary diseases, including pneumonia, tuberculosis, and respiratory syncytial virus. Many health experts assume the same may be true with COVID-19. "With COVID-19, alcohol is likely to interfere with an individual's ability to clear SARS-CoV-2 and cause people to suffer worse outcomes, including ARDS, which commonly results in death," Edelman said.

Alcohol Distracts the Body from Other Functions

Drinking also makes it harder for your body to properly tend to its other critical functions, like fighting off a disease. According to the Cleveland Clinic, once you take a sip of alcohol, your body prioritizes breaking down alcohol over several other bodily functions. The body doesn't have a way to store alcohol like it does with carbohydrates and fats, so it has to immediately send it to the liver, where it's metabolized. In addition, alcohol is known to impair sleep quality. The less sleep a person gets, the higher their risk for getting sick. One study found that people who got less than 7 hours of sleep were nearly three times more likely to develop a cold compared with those who got 8 or more hours of sleep. A lack of sleep can also affect how long it takes for a person to recover if they do get sick.

How Much is too Much?

According to *Mroszczyk-McDonald*, it's unclear how much alcohol is too much and when it starts to impair the immune system. Past data shows binge drinking can have a massive effect on the immune system. "Research has shown that high doses of alcohol (around 14 drinks per week or more than five to six drinks at a time) does directly suppress the immune system, and that alcohol abuse is associated with increased risk of infectious diseases". That said, evidence also shows that even smaller amounts of alcohol can affect the immune system. *Mroszczyk-McDonald* advises against drinking more than a couple times a week, and only having two to three drinks at a time. For those who have a risk factor for COVID-19, like heart disease or diabetes, he recommends drinking even less. "Those at increased risk should cut down or abstain from alcohol because every little thing an individual can do to improve the health and reduce risk is worth it at this point, even if the evidence is not entirely clear".

The Bottom Line

The World Health Organization (WHO) and U.S. surgeon general have warned people to avoid drinking too much alcohol during the COVID-19 pandemic. Alcohol can have a range of harmful effects on the body, which can diminish a person's immune response and put them more at risk for COVID-19. Consequently, health experts recommend drinking no more than a couple times a week, if that. Those who have any of the known risk factors for COVID-19, like heart disease or diabetes, should drink even less.

Role of World Population and Urban Population on Creation and Spread of Global Viruses

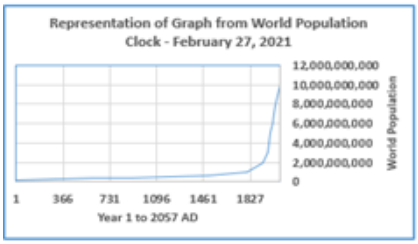
1. Rampant 20th Century Global Population Growth Major Factor in Virus Origins, Chart 34.
2. World Population Explosion Graphs , Charts 35 & 36.
3. Profile of World Population by Most Populous Countries on Chart 37.
4. Profile of Urban Population Growth vs Rural Population Growth since 1950 on Chart 38.
5. Descriptions of What Urban Population Means on Chart 39.
6. Profile of % Urban Populations by World Regions on Chart 40.
7. Projection of Where Urban Population Will Occur by 2050 on Chart 41.
8. Profiles of Corona Virus Death Rates vs % Urban Population on Chart 18 & 19.

Why So Many Epidemics Originate in Asia and Africa, Suresh V Kuchipudi, March 4, 2020, Conservation: The coronavirus disease, known as COVID-19, is a frightening reminder of the imminent global threat posed by emerging infectious diseases. Although epidemics have arisen during all of human history, they now seem to be on the rise. In the past 20 years, coronaviruses have caused three major outbreaks worldwide. Even more troubling, the duration between these three pandemics has gotten shorter. I am a virologist and associate director of the Animal Diagnostic Laboratory at Penn State University, and my laboratory studies zoonotic viruses, those that

jump from animals and infect people. Most of the pandemics have at least one thing in common: They began their deadly work in Asia or Africa. Reasons why may surprise you.

Population explosion and changing urban landscapes: An unprecedented shift in human population is one reason why more diseases originate in Asia and Africa. Rapid urbanization is happening throughout Asia and the Pacific regions, where 60% of the world already lives. According to the World Bank, almost 200 million people moved to urban areas in East Asia during the first decade of the 21st century. To put that into perspective, 200 million people could form the eighth most populous country in the world. Migration on that scale means forest land is destroyed to create residential areas. Wild animals, forced to move closer to cities and towns, inevitably encounter domestic animals and the human population. Wild animals often harbor viruses; bats, for instance, can carry hundreds of them. And viruses, jumping species to species, can ultimately infect people. Eventually, extreme urbanization becomes a vicious cycle: More people bring more deforestation, and human expansion and the loss of habitat ultimately kills off predators, including those that feed off rodents. With the predators gone-or at least with their numbers sharply diminished-the rodent population explodes. And as studies in Africa show, so does the risk of zoonotic disease. The situation is only likely to get worse. A major proportion of East Asia's population still lives in rural areas. Urbanization is expected to continue for decades.

Tens of thousands of years for world population to grow to 1 billion people
230 years to grow from 1 billion to 7.8 billion people.
Data from World Population Clock, August 2018



Year	World Population
1	200,000,000
1800	1,000,000,000
1930	2,000,000,000
1960	3,000,000,000
1974	4,000,000,000
1987	5,000,000,000
1998	6,000,000,000
2011	7,000,000,000
2021	7,850,000,000
2057	10,000,000,000

World Population Projected to be 10 billion by 2057.

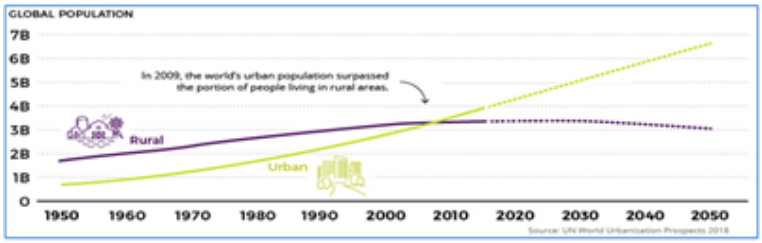
World & USA Population Growth from When US Constitution Was Written
Coincident with Beginning of the Industrial Revolution
(ref: World Population Clock)

US Population vs World Over Time			
Year	US	World	US %
	in millions of people		
1790	4	1,000	0.4%
1890	63	1,600	3.9%
1940	132	2,300	5.7%
1990	280	6,000	4.7%
2020	330	7,800	4.2%
2060	427	10,000	4.3%

#	Country (or dependency)	Population (2020)	Yearly Change	Net Change	Density (P/Km²)	Land Area (Km²)	Migrants (net)	Fert. Rate	Med. Age	Urban Pop %	World Share
1	China	1,439,323,776	0.39 %	5,540,090	153	9,388,211	-348,399	1.69	38	60.8 %	18.5 %
2	India	1,380,004,385	0.99 %	13,586,631	464	2,973,190	-532,687	2.2402	28	35 %	17.7 %
3	United States	331,002,651	0.59 %	1,937,734	36	9,147,420	954,806	1.7764	38	82.8 %	4.2 %
4	Indonesia	273,523,615	1.07 %	2,898,047	151	1,811,570	-98,955	2.3195	30	56.4 %	3.5 %
5	Pakistan	220,892,340	2 %	4,327,022	287	770,880	-233,379	3.55	23	35.1 %	2.8 %
6	Brazil	212,559,417	0.72 %	1,509,890	25	8,358,140	21,200	1.74	33	87.6 %	2.7 %
7	Nigeria	206,139,589	2.58 %	5,175,990	226	910,770	-60,000	5.4168	18	52 %	2.6 %
8	Bangladesh	164,689,383	1.01 %	1,643,222	1,265	130,170	-369,501	2.052	28	39.4 %	2.1 %
9	Russia	145,934,462	0.04 %	62,206	9	16,376,870	182,456	1.8205	40	73.7 %	1.9 %
10	Mexico	128,932,753	1.06 %	1,357,224	66	1,943,950	-60,000	2.14	29	83.8 %	1.7

Countries with red Urban Pop %, corona virus death rates of > 1,700;
countries with purple Urban Pop %, death rates of < 120;

Since 1950, the world's urban population has risen almost six-fold, from 751 million to 4.2 billion in 2018. In North America alone, significant urban growth observed in Mexico and the East Coast of the United States as this shift takes place.



Over the next few decades, the rural population is expected to plateau and eventually decline, while urban growth will continue to shoot up to six billion people and beyond.

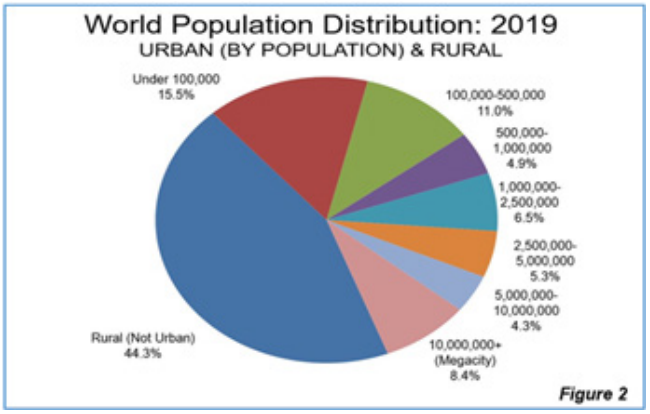
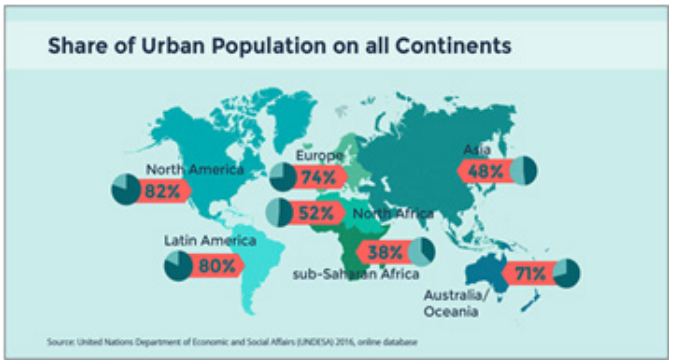
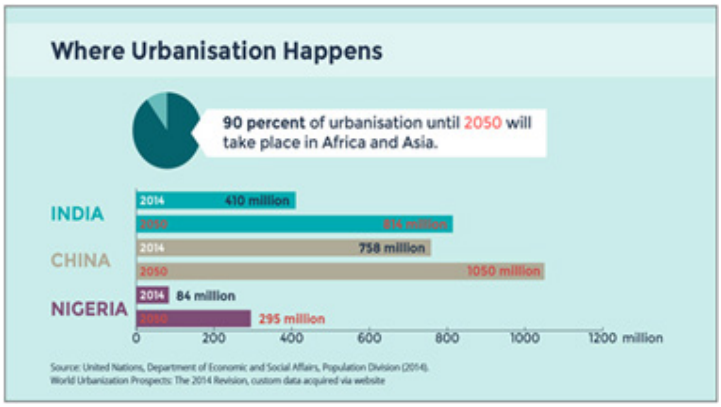


Figure 2





Corona Virus Evaluation (Part 3)

Dramatic Increase of World Corona Virus Deaths in 2021 in Regions Having Humid Sub-Tropical and Tropical Climates.

From December 2020 through 2nd April 2021, countries with humid sub-tropical and tropical climates have accounted for over 700,000 of world's daily corona virus deaths.

Charts 43-58 provide data analysis to support this observation.

Charts 52-55 focus on the April 2021 Catastrophy of Deaths in India.

Evidence is provided showing that combination of heavy pollution and seasonal temperature inversions combined with presence of the corona virus are major contributors to high number of corona virus deaths in these regions.

December 29 - January 7, 2021 Coronavirus Deaths Peaking in Warmer Climates – Why?

	Brazil	South Africa	Colombia	Mexico
December 29	1,075	497	246	429
December 30	1,224	465	289	990
December 31	1,036	436	304	1,052
January 5	1,186	513	239	546
January 6	1,266	392	297	1,065
January 7	1,455	441	344	1,165
January 8	1,044	616	364	1,044
January 9	1,115	399	353	1,038
January 10				1,135
July 29	1,554 *(2020 high)*			
July 22		572 *(2020 high)*		1,055 *(2020 high))*
August 22			400 *(2020 high)*	
Temperature	80+ F	80 F	70 F	65 F

Charts 46 & 47 summarize types of temperature inversions. Chart 47: ***"Subsidence inversions common over northern continents in winter and over the subtropical oceans"***. Chart 49-50 summarizes sub-tropical climates and locations.

	days	1	8	15	22	29	36			
2021	Date	19-Jan	26-Jan	2-Feb	9-Feb	16-Feb	23-Feb	Total	% World	
1	USA	2,810	4,198	3,707	3,269	1,819	2,444	100,371	23%	deaths
2	Mexico	544	659	564	531	450	429	39,841	9%	deaths
4	Brazil	1,183	1,206	1,166	1,340	1,088	1,370	38,056	9%	deaths
3	UK	1,610	1,631	1,449	1,052	799	548	31,445	7%	deaths
5	Germany	1,139	988	990	674	587	442	21,108	5%	deaths
6	Russia	586	564	539	530	459	417	18,010	4%	deaths
7	Spain	404	591	724	766	530	443	14,310	3%	deaths
8	Italy	603	541	499	422	336	356	13,794	3%	deaths
9	France	441	417	485	508	410	341	12,355	3%	deaths
10	South Africa	839	680	547	396	219	263	11,964	3%	deaths
11	Colombia	398	381	304	217	163	144	10,114	2%	deaths
12	Poland	291	264	253	227	196	247	9,021	2%	deaths
13	Indonesia	308	336	304	213	229	323	8,732	2%	deaths
14	Portugal	218	291	260	203	111	63	7,058	2%	deaths
15	Peru	113	220	173	159	176	224	6,556	2%	deaths
	Sub-Total	11,487	12,967	11,964	10,507	7,572	8,054	342,735	79%	deaths
	World	14,793	16,098	14,815	13,195	9,836	10,337	436,383		deaths
	% of World	78%	81%	81%	80%	77%	78%	79%		

Table shows daily corona virus deaths for 15 countries accounting for 79% of world's daily deaths for 36 Day Period January 19 through February 23, 2021. Table compressed to fit chart. Shaded countries have humid sub-tropical climates and account for about 1/3 of the daily deaths. Portion of USA is also humid sub-tropical States. See Chart 45.

USA States with humid sub-tropical climate		
US State	Deaths	Death Rate
New Jersey South	23,814	2,681
Mississippi	6,864	2,306
Louisiana	9,828	2,114
Alabama	10,274	2,095
Arkansas	5,410	1,793
South Carolina	8,822	1,713
Georgia	18,117	1,706
Tennessee	11,623	1,702
Texas	46,228	1,594
Delaware	1,494	1,534
Florida	32,079	1,494
DC	1,038	1,471
California South	55,137	1,395
Maryland East	8,030	1,328
Oklahoma East	4,701	1,188
Virginia East	9,902	1,160
North Carolina	11,622	1,108
Kentucky	4,921	1,101
Sub-total	269,904	
US Total	545,757	*11:30 a.m.*
%	49%	*March 12, 2021*

Temperature Inversion - Meteorology

Temperature inversion, also called thermal inversion, a reversal of the normal behavior of temperature in the troposphere (the region of the atmosphere nearest Earth's surface), in which a layer of cool air at the surface is overlain by a layer of warmer air. (Under normal conditions air temperature usually decreases with height.)

Inversions play an important role in determining cloud forms, precipitation, and visibility. An inversion acts as a cap on the upward movement of air from the layers below. As a result, convection produced by the heating of air from below is limited to levels below the inversion. The diffusion of dust, smoke, and other air pollutants is likewise limited. In regions where a pronounced low-level inversion is present, convective clouds cannot grow high enough to produce showers and, at the same time, visibility may be greatly reduced below the inversion, even in the absence of clouds, by the accumulation of dust and smoke particles. Because air near the base of an inversion tends to be cool, fog is frequently present there.

Inversions also affect diurnal variations in air temperature. The principal heating of air during the day is produced by its contact with a land surface that has been heated by the Sun's radiation. Heat from the ground is communicated to the air by conduction and convection. Since an inversion will usually control the upper level to which heat is carried by convection, only a shallow layer of air will be heated if the inversion is low and large, the rise in temperature will be great.

There are Four Kinds of Inversions: Ground, Turbulence, Subsidence, and Frontal

A ground inversion develops when air is cooled by contact with a colder surface until it becomes cooler than the overlying atmosphere; this occurs most often on clear nights, when the ground cools off rapidly by radiation. If the temperature of surface air drops below its dew point, fog may result. Topography greatly affects the magnitude of ground inversions. If the land is rolling or hilly, the cold air formed on the higher land surfaces tends to drain into the hollows, producing a larger and thicker inversion above low ground and little or none above higher elevations. A turbulence inversion often forms when quiescent air overlies turbulent air. Within the turbulent layer, vertical mixing carries heat downward and cools the upper part of the layer. The unmixed air above is not cooled and eventually is warmer than the air below; an inversion then exists.

A subsidence inversion develops when a widespread layer of air descends. The layer is compressed and heated by the resulting increase in atmospheric pressure, and, as a result, the lapse rate of temperature is reduced. If the air mass sinks low enough, the air at higher altitudes becomes warmer than at lower altitudes, producing a temperature inversion. Subsidence inversions are common over the northern continents in winter and over the subtropical oceans; these regions generally have subsiding air because they are located under large high-pressure centers.

A frontal inversion occurs when a cold air mass undercuts a warm air mass and lifts it aloft; front between the two air masses then has warm air above and cold air below. This kind of inversion has a considerable slope, whereas other inversions are nearly horizontal. Humidity may be high, and clouds may be present immediately above it.

The Subtropics and Tropics

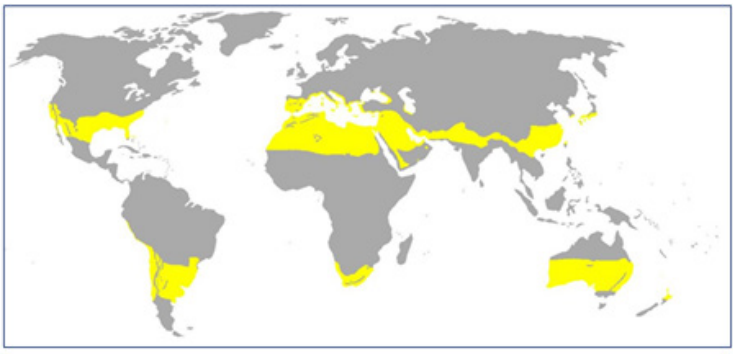
Areas of the world with subtropical climates according to Köppen climate classification

The subtropics are geographic and climate zones located roughly bordered the tropics at latitude 23°27' (the Tropic of Cancer and the Tropic of Capricorn) and the temperate zones (normally referring to latitudes between 35° and 66°33'), north and south of the Equator.

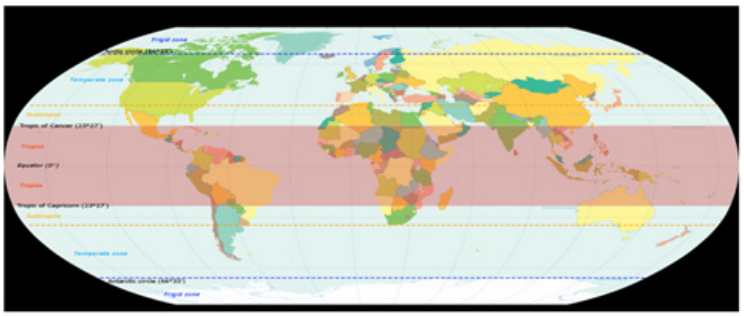
Subtropical climates are often characterized by hot summers and mild winters with infrequent frost. Most subtropical climates fall into two basic types: humid subtropical, where rainfall is often concentrated in the warmest months, for example southeast China and the southeast United States, and dry summer or Mediterranean climate, where seasonal rainfall is concentrated in the cooler months, such as the Mediterranean Basin or southern California.

Subtropical climates can occur at high elevations within the tropics, such as in the southern end of the Mexican Plateau and in the Vietnamese Highlands. Six climate classifications use the term to help define the various temperature and precipitation regimes for planet Earth.

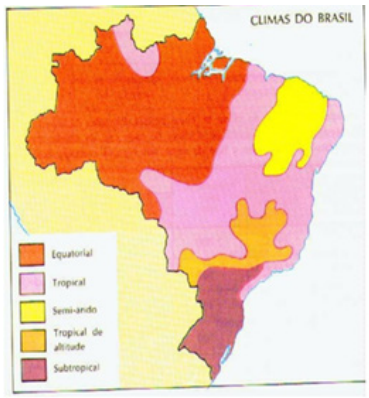
A great portion of the world's deserts are located within the subtropics, due to the development of the subtropical ridge. Areas bordering warm oceans (typically on the southeast sides of continents) are prone to locally heavy rainfall from tropical cyclones, which can contribute a significant percentage of the annual rainfall. Areas bordering cool oceans (typically on the southwest sides of continents) are prone to fog, aridity, and dry summers. Plants such as palms, citrus, mango, pistachio, lychee, and avocado are grown in the subtropics.



Areas of the world with subtropical climates according to Köppen climate classification, highlighted in yellow.



Deadliest corona virus countries are USA, Brazil, Mexico - 1,337,142 combined April 29, 2021. Lower USA, Brazil, Mexico all tropical to sub-tropical in climate. Mexico's additional 130,000 deaths reported on March 28 included in these numbers.
Geographic proximity of these countries is phenomenal – Axis of Americas.



Map at left shows regions of Brazil with humid sub-tropical and tropical climates.

Brazil reached 400,000 corona virus deaths on April 29, 2021 with most deaths occurring in these regions.

Starting in mid-April 2021, corona virus deaths began exploding in India. The two tables below show the states of India where the cases and deaths began occurring during the week of April 15-22, 2021.

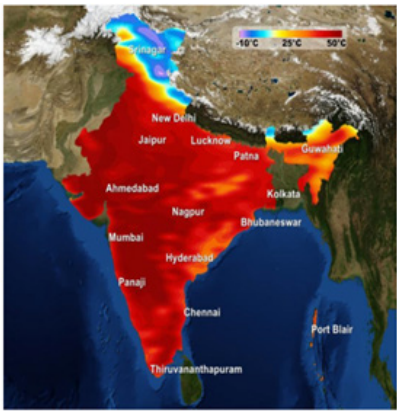
Reported cases and deaths by state and unic 22-Apr-21
Table is sorted by places with the most cases per 100,000 residents last seven days.

Cases	TOTAL CASES	PER 100,000	DAILY AVG. IN LAST 7 DAYS	PER 100,000
Delhi	930,179	5,541	13,729	118
Lakshadweep	1,526	2,367	70	109
Ladakh	12,739	4,644	183	67
Dadra and Nagar Haveli anc	5,672	2,332	143	59
Goa	70,814	4,855	785	54
Chhattisgarh	588,818	2,305	12,579	49
Maharashtra	4,027,827	3,584	54,600	49
Chandigarh	35,770	3,389	452	43
Puducherry	49,593	3,574	504	40
Kerala	1,295,059	3,877	11,924	36

Reported cases and deaths by state and union territory 22-Apr-21
Table is sorted by places with the most cases per 100,000 residents last seven days.

Deaths	TOTAL DEATHS	PER 100,000	DAILY AVG. IN LAST 7 DAYS	PER 100,000
Delhi	12,887	77	156.9	0.93
Goa	943	65	9.9	0.68
Chhattisgarh	6,467	25	138.1	0.54
Maharashtra	61,911	55	362.7	0.32
Chandigarh	423	40	2.4	0.23
Puducherry	722	58	2.7	0.22
Punjab	8,114	29	53.3	0.19
Uttarakhand	1,953	19	18	0.18
Himachal Pradesh	1,236	18	10.1	0.15
Gujarat	5,740	9	88.6	0.15

Charts 53-55 show regions in India having humid sub-tropical/tropical climates, prevailing temperatures mid-April 2021, frequency of temperature inversions annually by month, annual deaths from air pollution in 2017.



Month	Occurrence Frequency, %	India Temperature Inversions
Jan	49	HALOE temperature series evaluation over India tropical region during period 1991-2001. Occurrence frequency calculated by considering the days with amplitudes of inversions greater than 5 degrees Kelvin.
Feb	62	
Mar	63	
Apr	72	
May	88	
Jun	58	
Jul	52	
Aug	74	
Sep	76	
Oct	78	
Nov	80	
Dec	57	

Table at left summarizes study of frequency of temperature inversions in tropical region of India for decade 1991-2001.

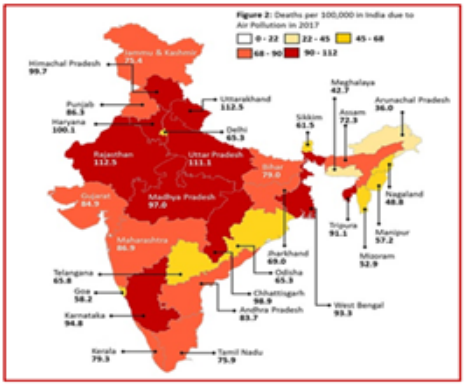


Figure 2 at left provides breakdown of deaths in each of India's states caused by air pollution in 2017.

Countries in orange & red range from 68-112 deaths per 100,000 people = to 680-1,120 deaths per million population using Worldometer units.

Pollution is widespread in India, the most polluted country in the world.

Comparing regions of pollution to regions of humid sub-tropical and tropical climate to regions of high corona virus cases and deaths shows an overlap.

This India experience supports proposed premise that corona virus deaths readily occur in regions of high pollution in regions with humid sub-tropical and tropical climates during periods of seasonal temperature inversions.

As of week ending 12/31/20, two more countries reached the "4,000 corona virus death club" milestone-Panama and Bosnia-Herzegovina. This brings total global countries with over 4,000 deaths to 46. All 46 have had refineries. Death rates in both countries very high at 910 in Panama and 1238 in Bosnia-Herzegovina. These are small countries with populations of 3-4 million. Temp in Panama on 12/31/20 was 85F, location north of Colombia. Bosnia-Herzegovina is in northern climate east of Adriatic Sea and Alps Mountains.

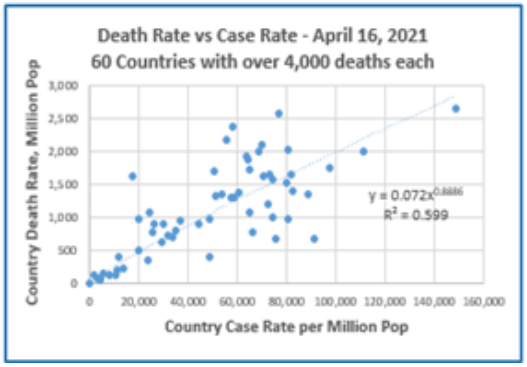
Panama had refineries in poor operating condition and shut down within past decade. In 2007 Spain planned to put $40 billion into building refineries in Panama, but apparently not done. Panama was concerned about risk of building vs risk to Panama Canal operations. But tanker operations themselves are a major source of pollution.

"The Guardian has reported on new research showing that in one year, a single large container ship can emit asthma and cancer-causing pollutants equivalent to that of 50,000 cars. The low grade bunker fuel used by the worlds 90,000 cargo ships contains up to 2,000 times the amount of sulfur compared to diesel fuel used in automobiles. The recent boom in the global trade of manufactured goods has also resulted in a new breed of super sized container ship which consume fuel not by the gallons, but by tons per hour, and shipping now accounts for 90% of global trade by volume."

"Ships carrying cargoes around the world are waiting for days to pass through the Panama Canal, as pandemic-hit staffing caused

congestion at the key pinch point…The waiting time, which for vessels with unbooked slots is as long as between 10 and 15 days, have contributed to a rally in the cost of chartering an LNG tanker on the spot market and added to disruptions affecting the supply of super-chilled fuel… "Due to a combination of seasonal fog, higher-than-average arrivals, and added Covid-19 safety procedures, the Panama Canal has seen an extended waiting time for vessels that arrive at the waterway without a reservation in recent days," the Panama Canal Authority said in an emailed statement."

Bosnia-Herzegovina refinery has been heavy polluter. Shutdown in 2019 and scheduled to restart 3Q2020 switching from heavy fuel oil to natural gas as fuel.



After a year of global data of corona virus cases and deaths, it is appropriate to confirm correlation of deaths per case for the 60 countries accounting for 96% of world's corona virus deaths.

Correlation is a "power" relationship.
R-squared 150% vs "linear" relationship.

Mexico Dramatically Increased Number of Deaths Per Day During January-February 2021 Now Third Most Deadly Country in Corona Virus Deaths

Air quality management strategies and trends

During the 20th century, Mexico City experienced a huge increase in population and urbanized area as it attracted migrants from other parts of the country and industrialization stimulated economic growth. Population growth, increasing motorization and industrial activities, a constrained basin and intense solar radiation combined to cause intense air-quality problems of both primary and secondary pollutants. The automatic air-quality monitoring network, established in the late 1980s, revealed high concentrations of all criteria pollutants: lead, carbon monoxide, nitrogen dioxide, sulphur dioxide, ozone and particulate matter (PM). Ozone exceeded the air quality standards more than 90 per cent of days and peaked above 300 parts per billion (about three times the standard) 40-50 days a year, among the worst in the world (Molina and Molina, 2002).

Climate of Mexico

From Wikipedia, the free encyclopedia

Between 1,000 and 2,000meters (3,281 and 6,562 ft), one encounters yearly average temperatures between 16 and 20°C (60.8 and 68.0°F). Towns and cities at this elevation south of the twenty-fourth parallel have relatively constant, pleasant temperatures throughout the year, whereas more northerly locations experience sizeable seasonal variations. Above 2,000 meters (6,562ft), temperatures drop as low as an average yearly range between 8 and 12°C (46.4 and 53.6°F) in the Cordillera Neovolcánica. At 2,300 meters (7,546ft), Mexico City (primarily subtropical highland climate) has a yearly median temperature of 15°C (59°F) with pleasant summers and mild winters. Average daily highs and lows for May, the warmest month, are 26 and 12°C (78.8 and 53.6°F), and average daily highs and lows for January, the coldest month, are 19 and 6°C (66.2 and 42.8°F).

80 Percent of COVID-19 Deaths in These European Countries Were in Areas with High Levels of Air Pollution

Israeli researcher found link between high COVID-19 fatality rates in four European countries and significant levels of nitrogen dioxide (NO_2) pollution. Yaron Ogen, postdoctoral researcher at Institute of Geosciences and Geography at Martin Luther University of Halle-Wittenberg, Germany, says results could indicate long-term exposure to this pollutant may play an important role in deaths resulting from the virus; study published in journal Science of The Total Environment.

Nevertheless, Ogen only identified a strong correlation between these factors, and more research will be required to determine whether there is a direct causal link between NO2 pollution and a higher risk of death from COVID-19.

Nitrogen dioxide is a gas emitted by both natural processes and human sources- vehicle traffic, industrial activity. Long-term exposure to NO_2 has been linked to wide range of severe health problems- hypertension, diabetes, cardiovascular diseases. Many health problems

that result from long- term exposure to air pollutants are same as those that increase risk of death from COVID-19, as it is a respiratory disease.

Ogen looked at relationship between long-term exposure to NO2, a two-month period (January and February) prior to outbreak of COVID-19 in Europe, and fatality from novel coronavirus. "When pandemic started and reached Europe, I saw a pattern. I noticed that distribution of fatality was not equal, it concentrated mostly in north Italy, Madrid, Wuhan, and Tehran. I asked question: what do these areas have in common? As a geographer, I was familiar with topography and regions. Led me to assumption that there might be a connection to air pollution."

The researcher examined data collected by European Space Agency's Sentinel-5P satellite, which mapped distribution of NO2 in lowest layer of Earth's atmosphere, and information on number of COVID-19 fatalities taken from 66 administrative regions in Italy, Spain, France, Germany. Ogen identified 4,443 deaths in these four countries as of March 19: 78% occurred in five regions located in northern Italy and central Spain - Lombardy, Emilia- Romagna, Piedmont, Veneto in Italy; Community of Madrid in Spain. Ogen found that these five regions had highest concentrations of nitrogen dioxide of areas studied. He noted these regions exhibited poor airflows. Community of Madrid and parts of northern Italy are surrounded by mountain ranges, meaning air pollution is not easily dispersed.

"Results indicate that long-term exposure to pollutant [NO2] may be one of most important contributors to fatality caused by COVID-19 virus in these regions and maybe across whole world," Ogen wrote in the paper. According to the researcher, these geographic conditions and significant concentrations of NO2 can lead to a high incidence of respiratory problems and lung inflammation ...

"This chronic exposure could be an important contributor to high COVID-19 fatality rates observed in these regions. Earlier studies have shown that exposure to NO2 causes inflammatory in the lungs, it is now necessary to examine whether the presence of an initial inflammatory condition is related to the response of the immune system to the coronavirus," Ogen wrote in the study.

"Hence, poisoning our environment means poisoning our own body and when it experiences a chronic respiratory stress, its ability to defend itself from infections is limited," he said.

Urban centers in northern Italy and central Spain have been the worst hit areas of Europe in terms of number of coronavirus cases, it might be expected that they would have highest fatality rates. However, Ogen said that before he started analyzing the results, he also checked other factors such as population and population density and no connection was found…However, more studies should be conducted..."

In light of his results, Ogen stressed that more research is needed to determine the extent to which different factors, such as age and the presence of pre-existing conditions, in addition to NO2 pollution may contribute to COVID-19 fatality rates.

"This was only a preliminary work, and there is a lot more to do. Other pollutants should be considered such as PM2.5 and Ozone. In addition, more studies should be conducted using higher resolutions, and check differences between neighborhoods, residents living near main roads and combine it with in-situ measurements," Ogen said.

"The environmental factors and their impact on our health should always be considered and maybe this will change the way we plan and build our cities," he said.

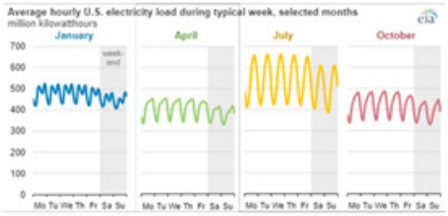
Source: EPA Document

What is NO_2 and how does it get in the air?

Nitrogen Dioxide (NO_2) is one of a group of highly reactive gases known as oxides of nitrogen or nitrogen oxides (NOx). Other nitrogen oxides include nitrous acid and nitric acid. NO_2 is used as the indicator for the larger group of nitrogen oxides. NO_2 primarily gets in the air from the burning of fuel. NO_2 forms from emissions from cars, trucks and buses, power plants, and off-road equipment.

Health Effects of NO_2

Breathing air with a high concentration of NO_2 can irritate airways in the human respiratory system. Such exposures over short periods can aggravate respiratory diseases, particularly asthma, leading to respiratory symptoms (such as coughing, wheezing or difficulty breathing), hospital admissions and visits to emergency rooms. Longer exposures to elevated concentrations of NO_2 may contribute to the development of asthma and potentially increase susceptibility to respiratory infections. People with asthma, as well as children and the elderly are generally at greater risk for the health effects of NO_2. NO_2 along with other NOx reacts with other chemicals in the air to form both particulate matter and ozone. Both of these are also harmful when inhaled due to effects on the respiratory system.



The electricity consumed in a given period (often referred to as electricity load) varies throughout the year in somewhat predictable patterns. Total U.S. hourly electricity load is generally highest in the summer months when demand peaks in the afternoon as households and businesses are using air conditioning on hot days. During the winter months, hourly electricity load is less variable but peaks in both the morning and the evening. Load is generally lowest in the spring and autumn when homes and businesses have less need for space heating or cooling.

During April 2020, nitrogen oxide emissions decreased 13%, but particulate matter remained unchanged. One possible explanation is that particulate matter is emitted by diesel vehicles, which handle most of the nation's deliveries. While traffic with regard to gasoline-fueled passenger vehicles was down in April, the diesel trucks and the regular freight traffic didn't change significantly. In addition, more particulate matter is emitted when individuals use heat to warm their personal homes when compared to office spaces.

Reflections on this Evaluation of "What Leads to High Corona Virus Death Regions"

Every block in diagram of proposed "Pathway to Creating Regions of High Corona Virus Deaths" is controlled by humanity-culture, lifestyle, attitudes, leadership. Large numbers of choices by large numbers of choices have been made randomly focusing on "short term self-interests". When a coherent global plan to provide for a sustainable world doesn't exist, these many choices are ultimately counter-productive and potentially create a monster…

Consider world population of 1 billion people in 1790, 7.8 billion people in 2021, 10 billion people in 2057. This explosion of humanity alone creates an explosion of wastes to support itself. But as World Population Clock suggests, this explosion of people resulted coincidentally or was accelerated by the Industrial Revolution. As a result the standard of living in the Western industrialized world infinitely expanded via the manufacture and transportation of goods, all requiring the burning of energy and its accompanying pollution. Massive increases in pollution wasn't the goal, just the reality. As the world population has exploded, all of its peoples desired to improve their standard of living to the standard of the Western industrialized world. It has been accomplished by copying the model set by the Western industrialized world. It has been aggravated as the corporations of the Western industrialized world migrated their manufacturing and transportation to the third world using technologies obsolete or barred as heavily polluting in the Western industrialized world. And then these same corporations have turned around and challenged the Western world regulations as too burdensome, further aggravating the generation of pollutants to meet the growing demand caused by the population explosion.

Population explosion has had other impacts. Natural ecological systems and balances have been totally disrupted to make room for people and industry. Penn State Professor's article discusses its role in destroying natural predators that used to control populations of small virus carrying species. Bulging population has migrated to cities away from agriculture to industry making cities with urban populations of 80-95%.

US population has remained at 4% of world's population since 1890. US no longer can do whatever it wants without consequences to the whole world. And the rest of the world has 96% of the world's 7.8 billion population and it is obviously going to impact life in the US. Nothing can stop this…

World population in 1940 was 2.3 billion people. Now 7.8 billion or 3.4_x. The US population in 1940 was 132 million people or 40% of today. The naïve, who have avoided understanding the reality of the impact of global population explosion, hallucinate about returning to the post-WWII era.

Short-sighted choices continue to be made throughout the world without a coherent plan to sustain humanity. What is needed is an integrated global society planning together a half century ahead with commitment!

Wave 4 of Corona Virus Cases and Deaths started in mid-March 2021. Highest cases and death totals in Wave 3 were 845,000 daily cases and 17,367 daily deaths on January 7, 2021. Daily case total on April 16, 2021-Wave 4-was 845,000 with 13,896 daily deaths. No factor in the "Pathway to Creation of High Death Rate Regions" has changed across the world. All hope to end the cases and deaths of corona virus are based on world-wide vaccinations. How long will this take? How bad will Wave 4 be? And what about Wave 5?

The prevailing historical nationalism of the past thousands of years led by greed and arrogance for dominion over others, exclusion of one society or religion vs another, and individual capture of profit is the enemy of a sustainable global future! Resolution will not come from political leaders, industrial leaders, religious leaders, etc. These entities created the current situation and are fighting boldly to maintain it!

Corona Virus Evaluation (Part 4)

Charts 15 & 16 added on July 17, 2021 are critically important

World Reached 3.5 Million Corona Virus Deaths May 28, 2021

a. Primary factors, required in combination, have been proposed to explain why limited world regions account for most of the world's deaths.

b. This Part 4 focuses on Pesticide Use, sprayed or ingested, and provides ample evidence that pesticides use is a major pollutant in creating high death rate regions.

Outline of Evaluation Results Provided

a. Pathway for creation of regions with high corona virus deaths rates is shown as originally hypothesized in Part 2 of this evaluation.

b. World corona virus deaths by country and region through June 6, 2020 provided.

c. Parts 1 & 2 focused on role of pollutants from refineries, coal-fired power plants, diesel transportation by land and sea. Part 1 touched on role of pollutants from pesticides in USA, but didn't consider role worldwide. Part 3 focused on period from January through May 2021 where large number of corona virus deaths occurred in regions with humid sub-tropical and tropical climates.

d. End of March through 1st week of June, major changes in corona virus death numbers occurred in South America. Mexico acknowledged underreporting deaths by 120,000; Peru similarly acknowledged underreporting by 113,000; Colombia passed Germany in total deaths; Argentina passed Spain and Iran in total deaths.

e. Explored pesticides use across South America as large quantities of coffee and fruits are exported to USA and elsewhere. Results strongly show that pesticides use is major contributor to creating regions of high corona virus death rates.

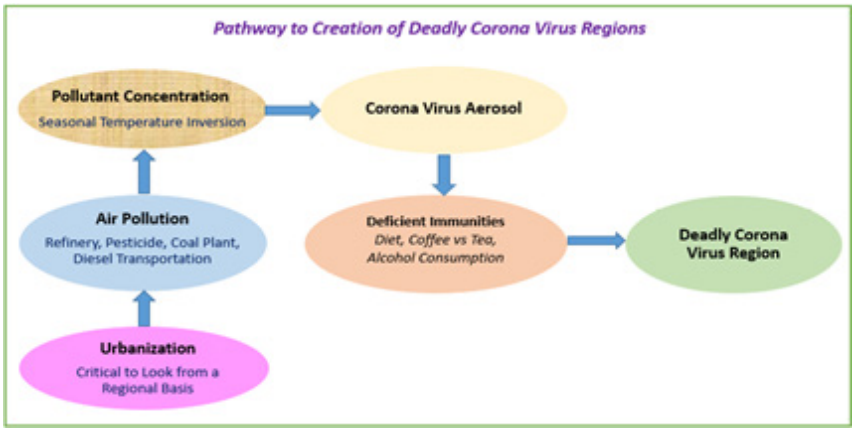


Table (descending order) of corona virus deaths for 19 deadliest countries in world June 6, 2021.

	Pop, MM	Acc Pop	% of Pop	Urban %	Country	Religion	Oil Refineries	Deaths	Case Rate	Death Rate	Acc Deaths	% of Deaths
1	332	332	4%	83%	USA	P	Yes	612,363	102,795	1,840	612,363	16%
2	213	545	7%	87%	Brazil	RC	Yes	473,404	79,207	2,213	1,085,767	28%
3	1,385	1,930	25%	35%	India	H	Yes	349,229	20,760	251	1,434,996	37%
4	130	2,060	26%	80%	Mexico	RC	Yes	348,754	18,683	2,683	1,783,750	46%
5	33	2,093	27%	79%	Peru	RC	Yes	186,073	59,299	5,572	1,969,823	51%
6	68	2,161	28%	83%	UK	P	Yes	127,840	66,214	1,874	2,097,663	54%
7	60	2,221	28%	71%	Italy	RC	Yes	126,523	70,079	2,095	2,224,186	58%
8	111	2,332	30%	75%	European Russia	OC	Yes	123,787	35,114	1,101	2,347,973	61%
9	65	2,397	31%	81%	France	RC	Yes	109,998	87,341	1,682	2,457,971	64%
10	51	2,448	31%	80%	Colombia	RC	Yes	91,161	69,496	1,790	2,549,132	66%
11	84	2,532	32%	77%	Germany	Ag,RC,P	Yes	89,851	44,135	1,069	2,638,983	68%
12	45	2,577	33%	93%	Argentina	RC	Yes	81,214	86,780	1,782	2,720,197	70%
13	84	2,661	34%	76%	Iran	M	Yes	81,063	34,903	954	2,801,260	73%
14	47	2,708	35%	80%	Spain	RC	Yes	80,196	79,065	1,715	2,881,456	75%
15	38	2,746	35%	60%	Poland	RC	Yes	74,152	76,045	1,961	2,955,608	77%
16	60	2,806	36%	66%	South Africa	RC,P	Yes	56,974	28,276	950	3,012,582	78%
17	274	3,080	39%	56%	Indonesia	M	Yes	51,612	6,720	187	3,064,194	79%
18	44	3,124	40%	70%	Ukraine	OC	Yes	51,182	50,921	1,177	3,115,376	81%
19	84	3,208	41%	75%	Turkey	M	Yes	48,164	62,081	565	3,163,540	82%

Table includes 120,000 additional deaths Mexico acknowledged on March 28, 2021. Worldometer did not update.

Why do 10-19 countries account for vast majority of the world's corona virus deaths?

North America	Death Rate	Deaths	Pop, MM	Ubn Pop %
Mexico	2,683	348,754	130	80%
Honduras	2,110	4,388	2	55%
USA	1,840	612,363	332	83%
Canada	676	25,722	38	81%
Guatemala	455	8,294	18	52%
	1,922	999,521	520	70%

South America	Death Rate	Deaths	Pop, MM	Ubn Pop %
Peru	5,572	186,073	33	79%
Brazil	2,213	473,404	213	87%
Colombia	1,790	91,161	51	80%
Argentina	1,782	81,214	45	93%
Chile	1,554	29,937	18	85%
Panama	1,461	6,395	4	68%
Paraguay	1,350	9,739	7	62%
Uruguay	1,331	4,640	4	96%
Bolivia	1,267	14,981	12	69%
Ecuador	1,163	20,809	18	63%
Costa Rica	808	4,153	5	79%
	2,250	922,506	410	78%

South America & North America are the regions with world's highest corona virus death rates = 2,250 & 1,922.

Total population of these countries is 921 million people, 12% of world's population.

Total deaths in these regions 1.92 million, 50% of world's deaths.

3,863,079 world corona virus deaths Worldometer day June 6, 2021 including Mexico's 120,000 underreported.

Only countries with over 4,000 corona virus deaths included.

June 6, 2021. Corona Virus Deaths "Axis of Americas". 12% of World's Population.

Corona Virus "Axis of Americas" - June 6, 2021		
Country	Covid-19 Deaths	Death Rate per MM Pop
Canada	25,722	676
USA	612,363	1,840
Mexico	348,754	2,683
Guatemala	8,294	455
Honduras	4,388	2,110
Costa Rica	4,153	808
Panama	6,395	1,461
Colombia	91,161	1,790
Ecuador	20,809	1,163
Peru	186,073	5,572
Brazil	473,404	2,213
Bolivia	14,981	1,267
Paraguay	9,739	1,350
Uruguay	4,640	1,331
Chile	29,937	1,554
Argentina	81,214	1,782
Axis Deaths	1,922,027	50%
World Deaths	3,863,079	of world's deaths

Western Europe	Death Rate	Deaths	Pop, MM	Ubn Pop %	Eastern Europe	Death Rate	Deaths	Pop, MM	Ubn Pop %
Belgium	2,150	25,019	84	98%	**Hungary**	3,098	29,854	10	71%
Slovenia	2,110	4,388	2	55%	**Bosnia Herzegovina**	2,874	9,374	3	52%
Italy	2,095	126,523	60	71%	**Czechia**	2,811	30,159	11	74%
UK	1,874	127,840	68	83%	**North Macedonia**	2,618	5,455	2	58%
Spain	1,715	80,196	47	80%	**Bulgaria**	2,583	17,880	7	75%
France	1,682	109,998	65	81%	**Slovakia**	2,271	12,404	5	54%
Portugal	1,675	17,034	10	66%	**Croatia**	1,981	8,086	4	57%
Sweden	1,426	14,485	10	88%	**Poland**	1,961	74,152	38	60%
Switzerland	1,243	10,832	9	74%	**Romania**	1,612	30,815	21	54%
Austria	1,175	10,639	9	57%	**Lithuania**	1,603	4,307	3	71%
Germany	1,069	89,851	84	77%	**Moldova**	1,524	6,134	4	43%
Netherlands	1,030	17,678	17	92%	**Greece***	1,183	12,277	11	79%
Tunisia*	1,088	12,980	12	69%	**Ukraine**	1,177	51,182	44	70%
Ireland	990	4,941	5	64%	**European Russia**	1,101	123,787	111	75%
Morocco**	246	9,178	37	63%	**Serbia**	795	6,917	9	56%
***near Italy **Spain**	1,275	661,582	519	75%	***borders Bulgaria**	1,495	422,783	283	63%

Eastern Europe and Western Europe are regions with next highest death rates=1,495 & 1,275.

Combined population 799 million people or 10% of world's population. Total deaths for these two regions 1,084,365 or 28% of world's corona virus deaths. June 6, 2021.

Circled portion of Europe has 10% of world's population and 28% of world's corona virus deaths.

Total population of Americas plus Europe is 22% of the world, but responsible for 78% of the world's corona virus deaths.

Middle East	Death Rate	Deaths	Pop, MM	Ubn Pop %
Armenia	1,502	4,458	3	1
Georgia	1,233	4,910	4	59%
Lebanon	1,142	7,763	7	79%
Iran	954	81,063	84	76%
Jordan	926	9,530	10	91%
Israel	688	6,418	9	93%
Turkey	565	48,164	84	75%
Azerbiajan	483	4,941	10	56%
Iraq	403	16,538	40	73%
Kazakhstan	213	4,042	18	56%
Saudi Arabia	211	7,456	35	84%
Egypt	147	15,352	102	43%
	519	210,635	406	71%

Far East	Death Rate	Deaths	Pop, MM	Ubn Pop %
Philippines	197	21,898	110	47%
Indonesia	187	51,612	274	56%
Japan	107	13,523	127	92%
China	3	4,636	1,444	60%
Total Far East	47	91,669	1,955	64%

Africa	Death Rate	Deaths	Pop, MM	Ubn Pop %
South Africa	950	56,974	60	66%
Egypt+Morocco+Tunisia	248	37,510	151	58%
Ethiopia	36	4,209	115	22%
Other Africa	33	33,888	1,020	20%
Total Africa	99	132,581	1,346	42%

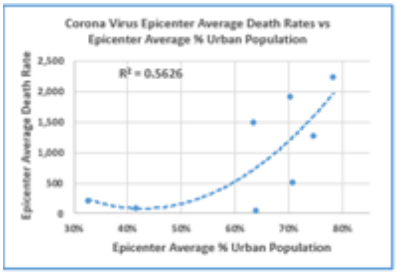
SE Asia	Death Rate	Deaths	Pop, MM	Ubn Pop %
Nepal	267	7,898	28	21%
India	251	349,229	1,385	35%
Pakistan	95	21,265	222	35%
Bangladesh	77	12,830	168	39%
	217	391,222	1,803	33%

Far East, Africa, and Southeast Asia have average death rate of 121, 1/14th that of Americas plus Europe.

These three regions combine for 5 billion people or 65% of the world's population.

Total deaths for these three regions 615,472 or 16% of world's deaths. June 6, 2021.

Middle East region has 25% of death rates of Americas and Europe and only 5% of the world's deaths.

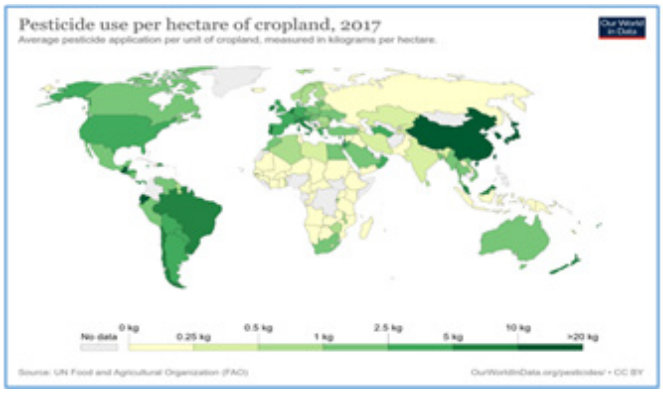


Epicenters of Corona Virus Deaths	Epicenter Ave Death Rates	Epicenter Ave % Urban Population	average death rates	total population, MM
North America	1,922	70%		
South America	2,250	78%	1,735	1,732
Eastern Europe	1,495	63%	↓	↓
Western Europe	1,275	75%	↓	↓
Middle East	519	71%	1437%	34%
SE Asia	217	33%	↓	↓
Africa	99	42%	121	5,104
Far East	47	64%		

Correlation of epicenter average death rates vs average % urban populations for principal corona virus death regions identified in this report. June 6, 2021

Focus on Pesticides

Relationship between pesticides exposure and regions of high corona virus deaths likely related to spraying under temperature inversion conditions, but could also be related to consumption.



North & South Americas, Europe, Africa North & South Extremities use substantial quantities of pesticides.

India and Middle East use significant pesticides also.

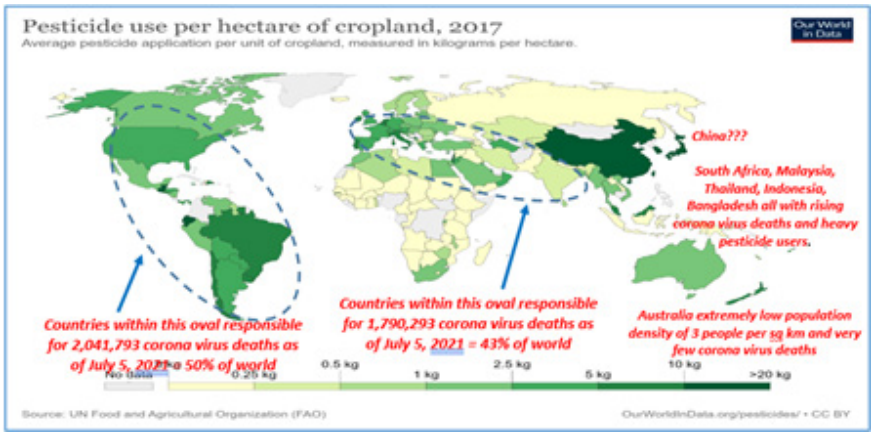
These are the regions of high corona virus deaths and death rates worldwide.

China uses the most pesticides. Charts 43-48 focus on China and Xinjiang in particular.

ME/SE Asia	Death Rate	Deaths	Pop, MM	Ubn Pop %
Armenia	1,525	4,527	3	63%
Georgia	1,350	5,373	4	59%
Lebanon	1,157	7,861	7	79%
Iran	999	84,949	84	76%
Jordan	949	9,781	10	91%
Israel	689	6,429	9	93%
Turkey	586	49,959	84	75%
Azerbiajan	487	4,978	10	56%
Iraq	422	17,345	40	73%
Nepal	312	9,248	28	21%
India	289	403,310	1,385	35%
Kazakhstan	235	4,469	18	56%
Saudi Arabia	223	7,891	35	84%
Egypt	156	16,264	102	43%
Afghanistan	135	5,360	40	25%
Pakistan	100	22,427	222	35%
Bangladesh	92	15,229	168	39%
	300	675,400	2,249	59%

Region	Ave Death Rate	Deaths	MM pop
So Amer	2,504	1,026,601	410
No Amer	1,952	1,015,192	520
East Eur	1,572	444,766	283
West Eur	1,291	670,127	519
ME/SE Asia	300	675,400	2,249
	963	3,832,086	3,981
July 5, 2021 total deaths		4,120,135	7,800
		93%	51%

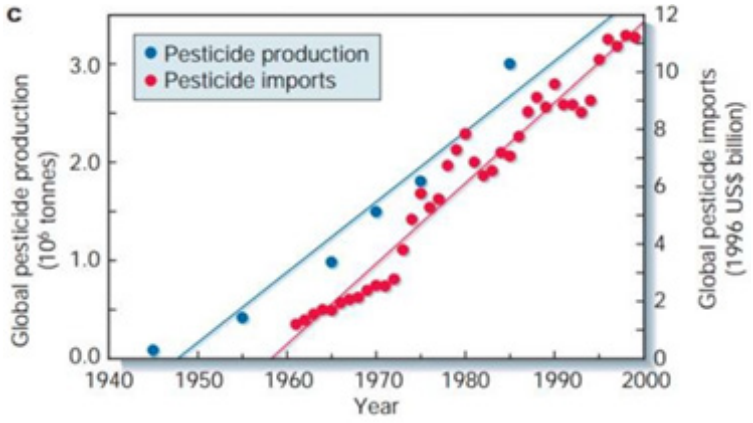
July 12, 2021 realized evaluation not fully considering large number of deaths in India. Decided to combine Middle East and Southeast Asia Regions into one. See table above left. Table above right summarizes death rates and deaths in five world regions accounting for 93% of world's corona virus deaths. Overlaying this data onto chart 14 results in Chart 16.



Pesticide Production

Graph shows increase of total global pesticide production over last decades. Production measured in million tonnes.

Total global pesticide production and global pesticide imports, 1940s-2000-*Tillman, et al.,* (2002)



World Atlas April 25, 2017

Rank	Country	Annual Pesticide Consumption (millions of kilograms)
1	China	1,806
2	United States	386
3	Argentina	265
4	Thailand	87
5	Brazil	76
6	Italy	63
7	France	62
8	Canada	54
9	Japan	52
10	India	40

Seven of these countries are in the top 24 of corona virus deaths.

Japan has low deaths and death rate.

China and Thailand each have very low deaths and death rates.

Pesticides are chemical applications commonly used in agriculture. These chemicals serve to destroy such unwanted agents as fungi, weeds, and insects that might otherwise destroy crops or reduce output. Other industries utilize pesticides to clear roadways of weeds and shrubs, to kill invasive plants, or to control algae growth in bodies of water. Worldwide, 40% of pesticide use is contributed to herbicides, 17% to insecticides, and 10% to fungicides. By using pesticides to ensure maximum crop yield, farmers save money. Some estimates suggest a 4-time return on pesticide investments. Negative consequences of pesticide use, however, are many. Application of these chemicals results in environmental degradation, particularly water pollution, and reduced human health, ranging from nerve damage to cancers.

A. China

The number one consumer of pesticides is China, where 3,981,548,455 pounds are applied every year. China was one of the first nations to begin using pesticides, copying US practices, and relies on its application for rice crops in particular. Experts suggest that its current use surpasses safe levels and is contributing to environmental pollution and human health problems. The country practices year-round planting and harvesting which has increased pesticide use which has led to soil contamination. The contaminated soil must be treated with increased fertilizers which creates a never ending cycle of agricultural additives. Excessive use of pesticides leads to runoff into waterways. When lakes or rivers have high levels of pesticides, excessive numbers of plants are able to take over. These plants consume the majority of oxygen available thereby killing off fish life.

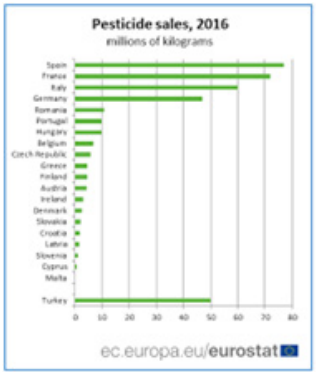
B. United States

United States is next largest consumer of pesticides, applying 850,984,332 pounds annually. Pesticides are so common that even households apply them to lawns and municipalities use them for parks. One study found that every waterway is contaminated with some form of the chemical and approximately 90% of wells sourced by groundwater contain pesticides as well. Pesticide residues on food lead to between 4,000 and 20,000 new cases of cancer every year. The contamination results in 6 million to 14 million fish deaths and 67 million bird deaths. Other animal life, especially amphibians, have suffered birth deformities due to nerve damage which also results in population declines.

C. Reducing Pesticide Use

While many researchers have suggested that pesticide use is logical when the costs are weighed against the benefits, others suggest that such a rationale simply is not well founded, particularly when damage to the environment and human health is considered. Many

countries have begun a movement toward decreasing pesticide use. One way they are doing this is by applying pesticide only when risk of pests is highest rather than year-round. Another method to avoid overuse is by practicing crop rotation rather than monoculture crop planting which drains resources and soil nutrients.



Spain, France, Italy, Germany, Turkey sales are the most in European Union by 5-10X.

These five countries are in the top 19 deadliest corona virus countries.

New Study Shows the Growing Risks of Pesticide Poisonings, CIVIL EATS, ANNA LAPPÉ, MARCH 25, 2021

For decades, data on pesticide exposure has been vague and non-existent. Anna Lappé talks to researchers who have put hard numbers to unintentional pesticide poisonings and fatalities globally. December 2020, four researchers from Germany, Malaysia, and United States published results of a systematic review estimating number of unintentional pesticide poisonings and fatalities globally. Conclusion was startling:

estimated 44 percent of farmers, farmworkers, and pesticide applicators experience at least one incident of acute pesticide poisoning on the job every year, and 11,000 die annually from accidental pesticide poisoning.

We've been hearing more and more about impact of pesticides on insects, other wildlife, and ecosystems, but this research puts a magnifying glass on another huge concern about explosive use of pesticides around world: their impact on people.

When I learned about this study, I thought: finally. For years, I had been tracking global estimates for pesticide poisonings and fatalities. I had noticed something strange-numbers I saw reported in various outlets had stayed the same, about 1 million pesticide poisonings and about 200,000 fatalities, annually. The fatality figure made headlines most recently in 2017 when the United Nations released a report on pesticides and human rights, and one article after another repeated the figure like it was breaking news: "U.N. report estimates pesticides kill 200,000 people per year…".

This new study-based on a review of more than 170 studies from 140 countries-provides up-to-date estimates for occupational pesticide poisoning incidents and unintentional fatalities.

The conclusions should alarm us all and kick policy makers into gear on long-standing commitments to crack down on world's most toxic pesticides, like insecticide chlorpyrifos still widely used even though it's a known brain-damaging chemical with no safe level of exposure for children.

I had a chance to dive into the study with two of its authors, Wolfgang Boedeker, an epidemiologist and board member of Pesticide Action Network-Germany, and Emily Marquez, a staff scientist with Pesticide Action Network-North America. Boedeker shared what this study reveals about how widespread pesticide poisonings are; Marquez helped highlight what can be done, particularly in the United States.

Boedeker: WHO defines acute pesticide poisoning as when one or more symptoms - such as headaches or dizziness, developing a rash, or feeling dizzy or nauseous-have been reported by workers or farmers within 48 hours of contact with these chemicals. In most cases, these poisonings are experienced as unspecific symptoms after you've used pesticides in your field. They may show up a couple of hours after applying pesticides, then be gone again.

Boedeker**:** If you get intoxicated by pesticide poisoning, you get sick, often can't work, lose income. Every acute exposure can lead to long-term, chronic disease. Acute intoxication is an unacceptable sign of an exposure to dangerous chemicals. We have to take it very seriously. This is one of key messages in this paper: not just to look to fatal intoxication, but enlarge perspective to non-fatal intoxication because these poisonings are an expression of dangerous exposure to chemicals.

Many of these acute exposures can lead to chronic illnesses, like cancer. We didn't include an investigation into that literature because it would have made this study much more complicated, but we need a systematic review on the chronic effects of pesticides, too. And while

in this study, we didn't include the public health effects of the uptake of pesticides via food either, we know there are residues in food and drinking water - and that's another important issue that needs systematic review. See charts 30-34.

You estimate 11,000 fatalities every year from unanticipated pesticide poisonings, a much lower figure than the previous one from WHO, but notably, yours does not include fatalities from intentional poisoning. And, your paper notes how widespread that is: An estimated 14 million people have died by suicide using pesticides since the advent of the Green Revolution in the 1960s.

Boedeker**:** Right. Our fatality figure is lower but as you say we don't include suicides. Suicides by pesticide

poisoning have been investigated for a long while now, and yes, the numbers are alarming.

One reason for the number of poisonings is that pesticide use has skyrocketed: up 81 percent in the past 35 years. In certain regions, you note, that increase has been dramatic. South America saw almost a 500 percent increase while Europe saw just a 3 percent bump.

Boedeker: Yes, profile of pesticide use has changed dramatically these 35 years. Amount of pesticides used has grown and size of rural populations larger, so more people are being exposed to more pesticides.

What did you find in Terms of Geographic Hotspots for Pesticide Poisonings?

Boedeker: Countries in the Global South are most affected, which is to be expected: Not only are these

regions where pesticide use is high, but also where there are fewer protective measures against exposure.

Boedeker: There was a push years ago to stop export to Global South of highly hazardous pesticides, or HHPs, but push died off. Nearly 300 HHPs on market, known to be highly toxic to humans, linked to cancer or endocrine disruption or have shown to be particularly damaging to the environment. We have a new push for this discussion based on this data in this report. In Germany, for instance, we have governmental discussions on prohibition of export of HHPs and we are hoping to see this throughout Europe.

Marquez: Pesticide Action Network - North America got its start campaigning on export of HHPs banned in United States but sold in other countries where not banned. It's important to watchdog this, as PAN Germany, PAN Europe, and other partners in PAN International like Public Eye do with their "double standards" campaigns.

Boedeker: We haven't seen more progress on this ban, I believe, because of successful international lobbying by the chemical industry, which has made sure these recommendations have not come far. See charts 36-42.

There is a United Nations ethical code of conduct on pesticide use and management with clear messages that these pesticides - which are dangerous and not to be used in certain conditions because they need to be applied with protective measures - should not be exported or used in certain countries. We hope this study will help policy makers realize how getting these codes of conduct in place, and putting real restrictions on HHPs, is an urgent public health issue.

United States Environmental Protection Agency

What is Endocrine Disruption?

What are concerns regarding endocrine disruptors?

How can chemicals disrupt the endocrine system?

What are examples of endocrine disruption?

A. **What are Concerns Regarding Endocrine Disruptors?**

In last two decades there has been growing awareness of possible adverse effects in humans and wildlife

from exposure to chemicals that can interfere with the endocrine system. These effects can include:

a) developmental malformations

b) interference with reproduction

c) increased cancer risk

d) disturbances in the immune and nervous system function

Clear evidence exists that some chemicals cause these effects in wildlife, but limited evidence exists for potential of chemicals to cause these effects in humans at environmental exposure levels. Very few chemicals have been tested for their potential to interfere with the endocrine system. Current standard test methods do not provide adequate data to identify potential Endocrine Disruptors (EDs) or to

assess their risks to humans and wildlife. Some scientists have proposed that chemicals might inadvertently be disrupting the endocrine system of humans and wildlife.

A variety of chemicals have been found to disrupt the endocrine systems of animals in laboratory studies, and there is strong evidence that chemical exposure has been associated with adverse developmental and reproductive effects on fish and wildlife in particular locations. The relationship of human diseases of the endocrine system and exposure to environmental contaminants, however, is poorly understood and scientifically controversial *Kavlock, et al.,* (1996).

B. **How Can Chemicals Disrupt the Endocrine System?**

Disruption of the endocrine system can occur in various ways. Some chemicals mimic a natural hormone, fooling the body into over-responding to the stimulus (e.g., a growth hormone that results in increased muscle mass), or responding at inappropriate times (e.g., producing insulin when it is not needed). Other endocrine disruptors block the effects of a hormone from certain receptors (e.g. growth hormones required for normal development). Still others directly stimulate or inhibit the endocrine system and cause overproduction or underproduction of hormones (e.g. an over or underactive thyroid). Certain drugs are used to intentionally cause some of these effects, such as birth control pills. In many situations involving environmental chemicals, however, an endocrine effect is not desirable.

C. **What are Examples of Endocrine Disruption?**

One example of devastating consequences of exposure of developing animals, including humans, to endocrine disruptors is the case of the potent Drug Diethylstilbestrol (DES), a synthetic estrogen. Prior to its ban in the early 1970's, doctors mistakenly prescribed DES to as many as five million pregnant women to block spontaneous abortion and promote fetal growth. It was discovered after the children went through puberty that DES affected the development of the reproductive system and caused vaginal cancer.

Since then, Congress has improved evaluation and regulation process of drugs and other chemicals. The statutory requirement to establish an endocrine disruptor screening program is a highly significant step.

Growing scientific evidence shows that humans, domestic animals, and fish and wildlife species have exhibited adverse health consequences from exposure to environmental chemicals that interact with the endocrine system. To date, such problems have been detected in domestic or wildlife species with relatively high exposure to:

i. Organochlorine compounds (e.g., 1,1,1- trichloro-2,2-bis(p-chlorophenyl)

ii. Ethane (DDT) and its metabolite Dichoro Diph Enyldichloroethylene (DDE)

iii. Poly Chlorinated Biphenyls (PCBs), and dioxins)

iv. Some naturally occurring plant estrogens

Effects from exposure to low levels of endocrine disruptors has been observed as well (e.g., parts per trillion levels of tributyl tin have caused masculinization of female marine molluscs such as the dog whelk and ivory shell).

Adverse effects have been reported for humans exposed to relatively high concentrations of certain contaminants. However, whether such effects are occurring in the human population at large at concentrations present in the ambient environment, drinking water, and food remains unclear.

Several conflicting reports have been published concerning declines in the quality and quantity of sperm production in humans over the last 4 decades, and there are reported increases in certain cancers (e.g., breast, prostate, testicular). Such effects may have an endocrine-related basis, which has led to speculation about the possibility that these endocrine effects may have environmental causes.

However, considerable scientific uncertainty remains regarding the actual causes of such effects. Nevertheless, there is little doubt that small disturbances in endocrine function, particularly during certain highly sensitive stages of the life cycle (e.g., development, pregnancy, lactation) can lead to profound and lasting effects *Kavlock, et al.,* (1996).

The Dirty Dozen-Contaminated Foods, By Renee Loux, Nov 3, 2011, Prevention

FDA and USDA Research Shows High Levels of Pesticide and Chemicals in These Commonly Contaminated Foods

The "dirty dozen" are the most commonly and highly contaminated foods with pesticides and chemicals, even after washing and peeling. The research used to compile this list is from extensive independent tests run by the FDA and the USDA from more than 100,000 samples of food. The chemical pesticides detected in these studies are known to cause cancer, birth defects, nervous system and brain damage, and developmental problems in children.

1. **Beef, Pork and Poultry** EPA reports that meat is contaminated with higher levels of pesticides than any plant food. Many chemical pesticides are fat-soluble and accumulate in fatty tissue of animals. Animal feed that contains animal products compounds accumulation, which is directly passed to the human consumer. Antibiotics, drugs, and hormones are a standard in animal husbandry, all of which accumulate and are passed on to consumers as well. Ocean fish carry a higher risk heavy metals than pesticides, though many freshwater fish are exposed to high levels of pesticides from contaminated water.
2. **Milk, Cheese and Butter** For reasons similar to those for meat, fat in dairy products poses a high risk for contamination by pesticides. Animals concentrate pesticides and chemicals in their milk and meat. Growth hormones and antibiotics are also serious concerns and are invariably found in commercial milk, cheese, and butter.
3. **Strawberries, Raspberries and Cherries** Strawberries are the crop most heavily dosed with pesticides in America. On average, 300 pounds of pesticides are applied to every acre of strawberries (compared to an average of 25 pounds per acre for other foods). Thirty-six different pesticides are commonly used on strawberries, and 90% of strawberries tested register pesticide contamination above safe levels. Raspberries trump strawberries with application of 39 chemicals: 58% of the raspberries tested registered positive for contamination. Cherries are almost as dodgy with 25 pesticides and 91% contamination.
4. **Apples and Pears** With 36 different chemicals detected in FDA testing, half of which are neurotoxins (meaning they cause brain damage), apples are almost as contaminated as strawberries. Ninety-one percent of apples tested positive for pesticide residue. Peeling nonorganic apples reduces but does not eliminate the danger of ingesting these chemicals. Pears rank hazardously near apples with 35 pesticides and 94% contamination.
5. **Tomatoes** Standard practice for more than 30 pesticides to be sprayed on conventionally grown tomatoes. Thin skin does not stop chemicals from infiltrating the whole tomato, so peeling won't help.
6. **Potatoes** Potatoes are one of the most popular vegetables, but they also rank among the most contaminated with pesticides and fungicides. Twenty-nine pesticides are commonly used, and 79% of potatoes tested exceed safe levels of multiple pesticides.
7. **Spinach and Other Greens** FDA found spinach to be the vegetable most frequently contaminated with the most potent pesticides used on food. Eighty-three percent of the conventionally grown spinach tested was found to be contaminated with dangerous levels of at least some of the 36 chemical pesticides commonly used to grow it.
8. **Coffee** Most coffee grown in countries with little to no standards regulating use of chemicals and pesticides on food. United States produces and exports millions of tons of pesticides, some of which are so dangerous that they are illegal to use on American farmland. Foreign countries import these chemicals to cultivate food, sold back to United States. Coffee an unfortunate culprit in this vicious cycle of malevolent agriculture. Purchasing "Fair Trade" coffee provides insurance that premium price paid for this treasured beverage supports farms and workers with more equanimity and reward.
9. **Peaches and Nectarines** Forty-five different pesticides are regularly applied to succulent, delicious peaches and nectarines in conventional orchards. The thin skin does not protect the fruit from the dangers of these poisons. Ninety-seven percent of nectarines and 95% of peaches tested for pesticide residue show contamination from multiple chemicals.
10. **Grapes** Grapes are delicate fruit, sprayed multiple times during different stages of growth. The thin skin does not offer protection from 35 different pesticides used in conventional vineyards. Imported grapes are more heavily treated than grapes grown in United States. Several of the most poisonous pesticides banned in United States still used on grapes grown abroad. 86% percent of grapes test positive for pesticide contamination; samples from Chile showed highest concentration of most poisonous chemicals.
11. **Celery** Conventionally grown celery is subjected to at least 29 different chemicals, which cannot be washed off because, of course, celery does not have any protective skin. Ninety-four percent of celery tested was found to have pesticide residues in violation of safe levels.
12. **Red and Green Bell Peppers** Bell peppers are one of the most heavily sprayed foods, with standard use of 39 pesticides. Sixty-eight percent of bell peppers tested had high levels of chemical pesticide residues. The thin skin of peppers does not offer much protection from spraying and is often waxed with harmful substances.

Summary

Pollution from pesticide use, like pollution from refineries, coal-fired power plants, and diesel transportation on land and sea, during periods of seasonal temperature inversions correlate with the countries and regions experiencing high corona virus deaths.

All of these pollution sources are consistent with the "Pathway to Creation of Deadly Corona Virus regions".

Global Agrochemicals Industry Analysis 2020, BizVibe

Agricultural chemicals, or agrochemicals, mainly include pesticides and fertilizers. These chemical agents are widely used in the agricultural industry to protect crops from disease and pests. Many agrochemicals are also used to improve the yields of agricultural plants. Despite the massive use of pesticides and fertilizers, their use is heavily criticized around the world due to increasing health concerns.

According to recent market data from Statista, the global agrochemicals market was worth US$243.1 billion in 2019. It is expected to increase to nearly US$300 billion by 2024, representing a steady CAGR of over 3.4% during the forecast period.

With the help of agrochemicals products such as pesticides and fertilizers to increase yields, farmers will be able to grow more crops on less land, which makes the crops production cost less and final products cheaper for consumer to purchase.

As the world population continues to increase, causing the demand of food and other agricultural products to rise, the use of the pesticides and fertilizers is expected to grow. Other driving factors, such as the supportive policy provided by governments and the consistent investments in the development of new agrochemicals that are more effective and eco-friendlier will further boost the growth of the global agrochemicals market in the near future.

Geographically, Asia-Pacific is the largest agrochemicals market in terms of production and consumption, generating almost 51% of the global market's growth every year. The adoption of modern-day practices and integrated farming processes, the growing demand for food grains and the ever-rising population, and the growing economy and currency stabilizing strategies will significantly drive the growth of the agrochemicals market in this region. India and China are the key markets for agrochemicals. Market growth in this region will be faster than the growth of in other regions over the next five years.

The global agricultural chemicals industry, also known as agrochemicals industry, plays a vital role in maintaining a stable output of the agricultural products around the world, while the top 10 largest pesticide companies are some of the most important contributors protecting the global crop production and food supply from pest threat. The recent estimate by UN's Food and Agriculture Organization (FAO), the world population will reach nearly 10 billion by 2050, meaning that the world demand for food and agricultural products will have a significant increase. This will further emphasize the importance of the pesticide and other agrochemical solutions in support of the agricultural production, the revenues are also expected to grow with a strong pace over the near future.

Top 10 Largest Pesticide Companies in the World 2020

Rank	Company	Headquarters	2019 Revenue ($ billion)
1	Syngenta (ChemChina)	Switzerland	10.4
2	Bayer Crop Science	Germany	8.16
3	BASF	Germany	6.76
4	Dow AgroScinces	United States	4.66
5	FMC	United States	4.28
6	ADAMA	Israel	3.88
7	Nufarm	Australia	3.76
8	Sumitomo Chemical	Japan	3.14
9	UPL	India	3.14
10	Huapont Life Sciences	China	1.41

Future Trends of the Global Agrochemicals Industry

One the latest agrochemicals market trends is that the growing demand for effective and eco- friendly pesticides and herbicides has prompted many world's largest pesticide companies to develop new formulations.

These leading agrochemicals are investing heavily in the development of new categories of pesticides herbicides that are more effective and environment friendly.

Most of these pesticides and herbicides are formulated to decompose within a short span after application. The shift of consumers' preferences toward non-harmful and eco-friendly agrochemicals is expected to fuel the development of pesticides and herbicides in the agricultural applications over the next few years.

5 Top-Selling Companies of Highly Hazardous Pesticides Rake in Profit by the BILLIONS 02/27/2020 / By Darnel Fernandez, DiCamba. News

Five of the world's biggest pesticide companies are making billions of dollars, accounting for more than a third of their total income, from selling chemicals that pose several hazards to both human health and the environment, recent analysis reveals.

A joint investigation by Unearthed, a journalism group funded by Greenpeace UK, and the Swiss NGO Public Eye, found that higher proportions of these Highly Hazardous Pesticides (HHPs) were sold in low- and middle-income countries compared to industrialized nations. For example, 60 percent of sales in India were of HHPs in contrast to the 11 percent sales in the United Kingdom.

A. Poison Sells

The data analyzed was obtained from the market analysis company Phillips McDougall, which covered $23.3 billion in pesticide sales, amounting to about 40 percent of the global agrochemical market. These sales represent the leading products in 43 different countries that buy the most pesticides worldwide. However, the researchers claim that the income from these chemicals will be billions of dollars greater because the data only included less than half of the total global sales. Agrochemical giants BASF, Bayer, Corteva (formerly Dow and DuPont), FMC and Syngenta-five of the six members of the lobby group CropLife International-profited off products that have been banned in other parts of the world, such as neonicotinoids and glufosinate. In fact, about 41 percent of the leading products of these pesticide companies contained at least one HHP.

In 2018, these companies sold about $4.8 billion on products containing pesticides linked to hazardous effects, which accounted for 36 percent of their total income.

Almost a quarter of the sales (22 percent) of these five pesticide giants consisted of products associated with human health hazards like glyphosate, which is classified by the International Agency for Research on Cancer (IARC) as a "probable human carcinogen." However, glyphosate manufacturer Bayer and various regulators like the European Food Safety Authority do not agree with this classification, saying it was incorrect to categorize the herbicide as hazardous based on the IARC alone.

Another 10 percent of their leading product income came from chemicals classified by the Environmental Protection Agency (EPA) as highly toxic to bees. Among these chemicals were chlorfenapyr and fipronil-chemicals linked to mass bee deaths -manufactured by the chemical giant BASF.

"There is overwhelming evidence that we are in the middle of a biodiversity crisis, with extinction roughly 1,000 times the natural rate," said University of Sussex biology professor Dave Goulson. "We are losing wildlife, particularly insects. The crisis is driven by a combination of factors but there is no doubt that pesticides are harming pollinators."

Four percent of sales from pesticides are classified as highly toxic by the World Health Organization (WHO) or as fatal if inhaled. According to the analysis, Syngenta holds the majority of these sales with its top sellers including paraquat.

Accidental or deliberate ingestion of even small amounts of paraquat is often fatal, and it is one of the most common methods of intentional self-poisoning or suicide in poor or rural areas in countries where it's available. In fact, the United Nations report that 200,000 cases of suicide each year involved pesticide poisoning. (Related: Report: Pesticide poisoning has resulted in 200,000 deaths.)

"This practice of the agrochemical giants is irresponsible and contradicts their public commitment to a more sustainable agricultural model," said Baskut Tuncak, U.N. Special Rapporteur on human rights and toxics. "Whether they poison workers, extinguish biodiversity, persist in the environment, or accumulate in a mother's breast milk, highly hazardous pesticides are unsustainable. They should have been phased out long ago."

What about China?

The world's major pesticides users are experiencing high corona virus deaths or death rates except China the world's largest user?

A. Is this possible?

The largest pesticide using region in China appears to be Xinjiang, the region growing cotton as well as wheat, soybeans, corn, and rice.

The Uighurs heavily populate Xinjiang

China has experienced large and sustained reductions in pesticide use as a result of adopting GMO cotton, according to the largest-ever scientific study on the impacts of Bt cotton use in that country.

Bt was only targeting the cotton bollworm, subsequent reduction in pesticide applications allowed natural predators to further control

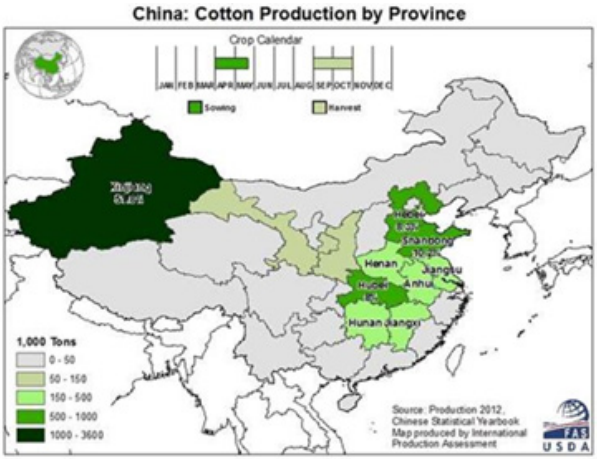
other insect pests, such as aphids, suggesting benefits to farmers from a more healthy ecosystem.

Reduction in broad-spectrum insecticide sprays allowed some insect pests, particularly mirid bugs, to proliferate and present new problem for farmers. This meant continued insecticide use.

Reducing pesticides in Chinese cotton farming is top priority because China is largest cotton producer in the world, using four times more pesticides (in tons of active ingredients) than the United States.

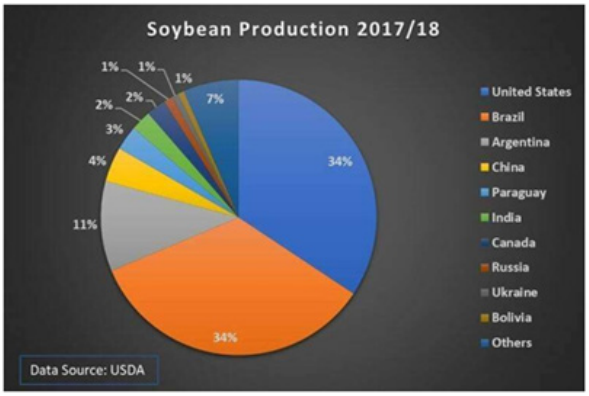
A third of pesticides in China are used on cotton, and many are classed as extremely hazardous by World Health Organization, contributing to 400-500 farmer deaths annually due to pesticide poisoning.

A study, lead-authored by Wei Zhang of the International Food Policy Research Institute, examines cotton pest severity and insecticide use at a county scale in China over a 25-year period, from 1991 to 2015.

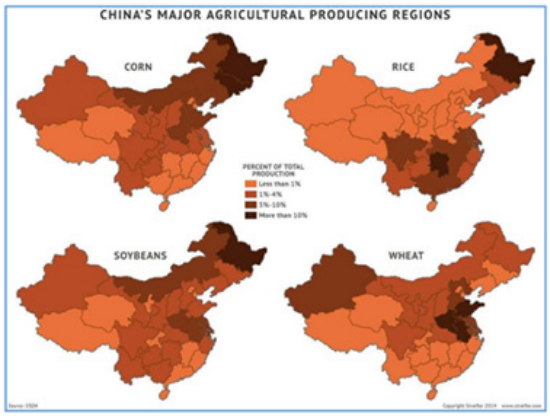


Uighurs are concentrated in Xinjiang an area that uses large quantities of pesticides.

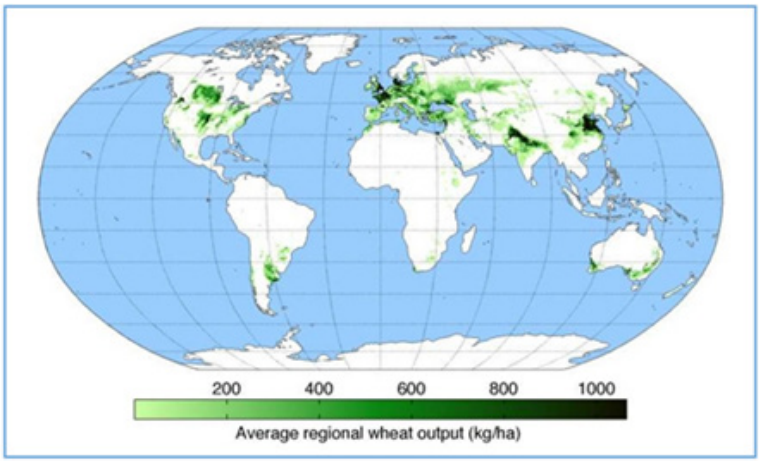
Is it really possible that this region hasn't experienced significant corona virus deaths like similar regions of the world?



10 countries produce 93% of the world's soybeans. Only China and Bolivia are not in top 25 of deadliest corona virus deaths countries. Bolivia is 34th.



Xinjiang is a highly significant grower of wheat, a significant grower of corn and soybeans, a moderate grower of rice. All of these products are large pesticide users.



All of these wheat growing regions of the world have experienced significant corona virus deaths, except China.

Is this really possible?

Corona Virus Evaluation (Part 5)

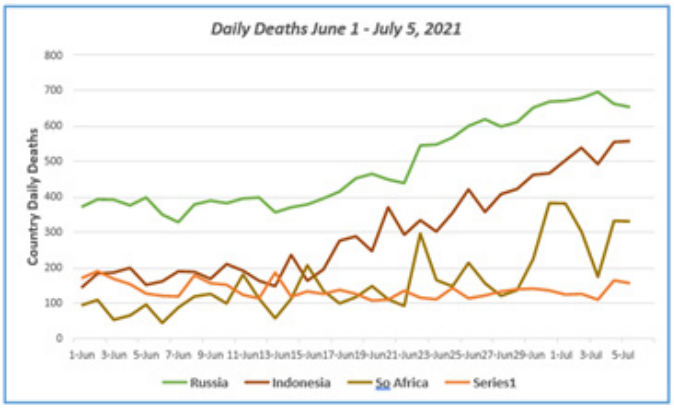
World Reached 4million Corona Virus Deaths July 5, 2021

a) Part 5 focuses corona virus daily deaths in Moscow & Russia, 6th most deadly world country Tehran and Iran, 13th most deadly world country.

b) Jakarta and Indonesia, 17th most deadly world country.

c) Johannesburg and South Africa, 16th most deadly world country.

d) Russia, Indonesia, South Africa Also Excessively Use Pesticides in Farming Regions Without Effective Attention to Hazards.



Daily Corona Virus Deaths currently accelerating in Russia, Indonesia, and South Africa

Iran has had four waves of corona virus deaths, which never seem to end

Summer in Moscow; winter in Johannesburg; always warm in Indonesia.

Outline of Evaluation Results Provided

a) World corona virus deaths by country and region through July 5, 2020 provided.

b) Parts 1 through 4 focused on reason why limited world regions of deadly corona virus exist; resulting in proposed "Pathway for creation of deadly corona virus regions".

c) During recent period, daily deaths have accelerated in Russia, Indonesia, South Africa and continue in Iran. These countries are #6, #17, #16, and #13 in world corona virus deaths.

d) Part 5 focuses on these regions to see if they indeed fit the "Proposed Pathway".

e) Results provided show overwhelmingly consistency with the "Proposed Pathway".

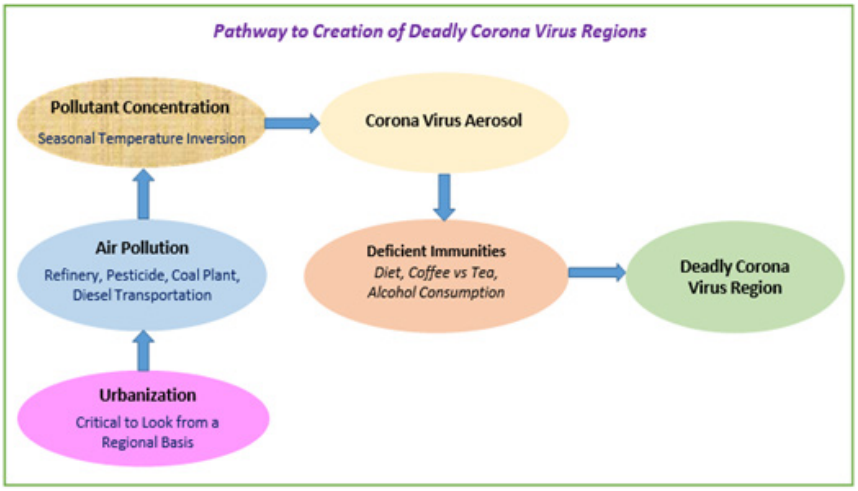


Table (descending order) corona virus deaths for 19 deadliest countries in world July 5, 2021.										
	Pop, MM	Acc Pop	% of Pop	Urban %	Country	Deaths	Case Rate	Death Rate	Acc Deaths	% of Deaths
1	332	332	4%	83%	USA	621,324	103,911	1,866	621,324	15%
2	213	545	7%	87%	Brazil	525,229	87,783	2,453	1,146,553	28%
3	1,385	1,930	25%	35%	India	403,310	21,970	289	1,549,863	38%
4	130	2,060	26%	80%	Mexico	353,622	19,495	2,720	1,903,485	46%
5	33	2,093	27%	79%	Peru	193,230	61,769	5,780	2,096,715	51%
6	111	2,204	28%	75%	European Russia	138,579	38,599	1,232	2,235,294	54%
7	68	2,272	29%	83%	UK	128,231	72,248	1,879	2,363,525	57%
8	60	2,332	30%	71%	Italy	127,680	70,625	2,115	2,491,205	60%
9	65	2,397	31%	81%	France	111,197	88,461	1,700	2,602,402	63%
10	51	2,448	31%	80%	Colombia	109,466	85,087	2,129	2,711,868	66%
11	45	2,493	32%	93%	Argentina	96,521	99,813	2,116	2,808,389	68%
12	84	2,577	33%	77%	Germany	91,595	44,482	1,090	2,899,984	70%
13	84	2,661	34%	76%	Iran	84,949	38,448	999	2,984,933	72%
14	47	2,708	35%	80%	Spain	80,934	82,665	1,730	3,065,867	74%
15	38	2,746	35%	60%	Poland	75,085	76,189	1,986	3,140,952	76%
16	60	2,806	36%	66%	South Africa	62,171	34,556	1,035	3,203,123	78%
17	274	3,080	39%	56%	Indonesia	61,140	8,370	221	3,264,263	79%
18	44	3,124	40%	70%	Ukraine	52,484	51,481	1,207	3,316,747	81%
19	84	3,208	41%	75%	Turkey	49,959	63,923	586	3,366,706	82%

Table includes 120,000 additional deaths Mexico acknowledged on March 28, 2021. Worldometer did not update.

Why do these Countries Account for Vast Majority of the World's Corona Virus Deaths?

North America	Death Rate	Deaths	Pop, MM	Ubn Pop %
Mexico	2,720	353,622	130	80%
Honduras	2,126	4,420	2	55%
USA	1,866	621,324	332	83%
Canada	692	26,365	38	81%
Guatemala	518	9,461	18	52%
	1,952	1,015,192	520	70%

South America	Death Rate	Deaths	Pop, MM	Ubn Pop %
Peru	5,780	193,230	33	79%
Brazil	2,453	525,229	213	87%
Colombia	2,129	109,466	51	80%
Argentina	2,116	96,521	45	93%
Paraguay	1,848	13,346	7	62%
Chile	1,724	33,249	18	85%
Uruguay	1,632	5,689	4	96%
Panama	1,500	6,574	4	68%
Bolivia	1,433	16,951	12	69%
Ecuador	1,209	21,660	18	63%
Costa Rica	912	4,686	5	79%
	2,504	1,026,601	410	78%

South America & North America are the regions with world's highest corona virus death rates = 2,504 & 1,952.

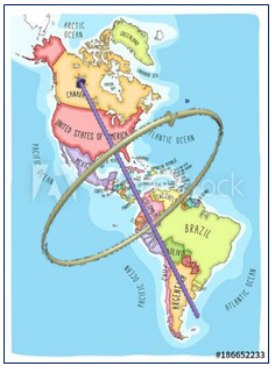
Total population of these countries is 921 million people, 12% of world's population.

Total deaths in these regions 2,041,793 million, 50% of world's deaths.

4,120,135 world corona virus deaths Worldometer day July 5, 2021 including Mexico's 120,000 underreported on 3/28/21.

70 countries with over 4,000 corona virus deaths as of July 5, 2021 included in analysis; account for 97% of global corona virus deaths.

July 5, 2021. Corona Virus Deaths "Axis of Americas". 12% of World's Population.



Corona Virus "Axis of Americas" - July 5, 2021		
Country	Covid-19 Deaths	Death Rate per MM Pop
Canada	26,365	692
USA	621,324	1,866
Mexico	353,622	2,720
Guatemala	9,461	518
Honduras	4,420	2,126
Costa Rica	4,686	912
Panama	6,574	1,500
Colombia	109,466	2,129
Ecuador	21,660	1,209
Peru	193,230	5,780
Brazil	525,229	2,453
Bolivia	16,951	1,433
Paraguay	13,346	1,848
Uruguay	5,689	1,632
Chile	33,249	1,724
Argentina	96,521	2,116
Axis Deaths	2,041,793	50%
World Deaths	4,120,135	of world's deaths

Eastern Europe	Death Rate	Deaths	Pop, MM	Ubn Pop %	Western Europe	Death Rate	Deaths	Pop, MM	Ubn Pop %
Hungary	3,113	29,996	10	71%	Belgium	2,164	25,185	84	98%
Bosnia Herzegovina	2,965	9,667	3	52%	Slovenia	2,126	4,420	2	55%
Czechia	2,825	30,311	11	74%	Italy	2,115	127,680	60	71%
North Macedonia	2,633	5,486	2	58%	UK	1,879	128,231	68	83%
Bulgaria	2,623	18,084	7	75%	Spain	1,730	80,934	47	80%
Slovakia	2,291	12,513	5	54%	France	1,700	111,197	65	81%
Croatia	2,015	8,219	4	57%	Portugal	1,684	17,117	10	66%
Poland	1,986	75,085	38	60%	Sweden	1,436	14,592	10	88%
Romania	1,778	33,973	21	54%	Tunisia*	1,296	15,482	12	69%
Lithuania	1,636	4,391	3	71%	Switzerland	1,250	10,895	9	74%
Moldova	1,540	6,197	4	43%	Austria	1,183	10,713	9	57%
European Russia	1,232	138,579	111	75%	Germany	1,090	91,595	84	77%
Greece*	1,227	12,722	11	79%	Netherlands	1,034	17,757	17	92%
Ukraine	1,207	52,484	44	70%	Ireland	1,001	5,000	5	64%
Serbia	811	7,059	9	56%	Morocco**	250	9,329	37	63%
* borders Bulgaria	1,572	444,766	283	63%	* near Italy ** Spain	1,291	670,127	519	75%

Eastern Europe and Western Europe are regions with next highest death rates = 1,572 & 1,291.

Combined population 799 million people or 10% of world's population.

Total deaths for these two regions 1,114,893 or 27% of world's corona virus deaths. July 5, 2021

Circled portion of Europe has 10% of world's population and 27% of world's corona virus deaths.

Total population of Americas plus Europe is 22% of the world, but responsible for 77% of the world's corona virus deaths.

Middle East	Death Rate	Deaths	Pop, MM	Ubn Pop %
Armenia	1,525	4,527	3	1
Georgia	1,350	5,373	4	59%
Lebanon	1,157	7,861	7	79%
Iran	999	84,949	84	76%
Jordan	949	9,781	10	91%
Israel	689	6,429	9	93%
Turkey	586	49,959	84	75%
Azerbiajan	487	4,978	10	56%
Iraq	422	17,345	40	73%
Kazakhstan	235	4,469	18	56%
Saudi Arabia	223	7,891	35	84%
Egypt	156	16,264	102	43%
Afghanistan	135	5,360	40	25%
	541	219,826	406	71%

Far East, Africa, and Southeast Asia have average death rate of 121, 1/14th that of Americas plus Europe.

These three regions combine for 5 billion people or 65% of the world's population.

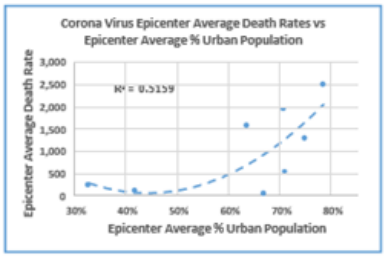
Total deaths for these three regions 708,350 or 17% of world's deaths. July 5, 2021.

Far East	Death Rate	Deaths	Pop, MM	Ubn Pop %
Philippines	227	25,192	110	47%
Indonesia	221	61,140	274	56%
Malaysia	170	5,574	33	78%
Japan	118	14,848	127	92%
China	3	4,636	1,444	60%
Total Far East	56	111,390	1,988	67%

Africa	Death Rate	Deaths	Pop, MM	Ubn Pop %
South Africa	1,035	62,171	60	66%
Egypt+Morocco+Tunisia	272	41,075	151	58%
Ethiopia	37	4,331	115	22%
Other Africa	38	39,169	1,020	20%
Total Africa	109	146,746	1,346	42%

SE Asia	Death Rate	Deaths	Pop, MM	Ubn Pop %
Nepal	312	9,248	28	21%
India	289	403,310	1,385	35%
Pakistan	100	22,427	222	35%
Bangladesh	92	15,229	168	39%
	250	450,214	1,803	33%

Middle East region has 25% of death rates of Americas and Europe and only 5% of the world's deaths.



Epicenters of Corona Virus Deaths	Epicenter Ave Death Rates	Epicenter Ave % Urban Population	average death rates	total population, MM
South America	2,504	78%		
North America	1,952	70%	1,830	1,732
Eastern Europe	1,572	63%	↓	↓
Western Europe	1,291	75%	↓	↓
Middle East	541	71%	1324%	34%
SE Asia	250	33%	↓	↓
Africa	109	42%	138	5,137
Far East	56	67%		

Correlation of epicenter average death rates vs average % urban populations for principal corona virus death regions identified in this report. July 5, 2021

Focus on Moscow and Russia

a) Russia is world's 6th most deadly country in corona virus deaths.

b) Moscow recorded highest June temperature in 120 years -Chart 15.

c) Half of Russians Are Worried About the Environment Where They Live -Chart 16.

d) Russia Breaks 16-Year Air Pollution Record -Chart 18.

e) Air temperature lower troposphere over Moscow heat wave summer of 2010 -Chart 22.

f) Weekly patterns and weekend effects of air pollution in the Moscow megacity -Chart 23.

Moscow Records Highest June Temperature in 120 years

Moscow Published: Jun 23, 2021, 09:47 PM(IST)

Russian capital Moscow reported hottest temperature in over 100 years in June, with mercury hitting 34.7°C. Russia's meteorological service, Roshydromet forecasted temperatures to remain on high side for next two days. Capital city's temperature was highest in 120years as Muscovites struggled with the heatwave.

St. Petersburg also recorded highest temperature of 34°C, which was hottest since 1998.

Half of Russians Are Worried About the Environment Where They Live-Survey

Almost half of Russians are concerned about environment in their regions, according to study by Moscow- based NAFI Research Center obtained by state-run TASS news agency. Environmental issues have taken center stage at protest rallies across Russia over the past year, with citizens drawing attention to concerns including landfills, air pollution and a proposed water bottling plant at Lake Baikal.

"Russians' opinions on the environmental situation where they live have split almost down the middle: 50 percent of respondents believe the environmental background in their city or region is safe," TASS cited. "48 percent describe the state of the environment as unsatisfactory," NAFI was cited as saying.

Siberians and Russians in the country's Far East were most likely to express concerns about the environment where they live at an average of 68 percent.

Residents of central Russia (56 percent) and the country's southern and North Caucasus regions (60percent) were more likely to say they are satisfied with the environment.

Emissions from vehicles and industrial enterprises, as well as noise pollution, were named as key factors impacting the environment, TASS cited the research as saying.

Russia Breaks 16-Year Air Pollution Record-Analysis

Updated: Nov. 17, 2020

Russia has measured its highest levels of air pollution in 16 years, according to expert analysis cited by RBC

news website Tuesday.

Experts found three times as many "high" and "extremely high" air pollution instances in first nine months of 2020 than all of 2019, outlet cited Finexpertiza consulting firm as saying.

Russia's Hydrometeorology Center, whose data Finexpertiza based its study on, has recorded 171 "high" or "extreme" instances of pollution so far, highest total since data became available in 2005. July-September saw 125 instances alone, one fewer than in all of 2010 and double yearly number in 2019.

Study identified carcinogen benzopyrene (chart 20) and poisonous gas hydrogen sulfide as main pollutants.

"High" pollution refers to concentration of one or more pollutants at 10 or more times the maximum permissible levels. "Extreme" pollution refers to concentrations of pollutants between 20 and 50 times the

allowable levels, which are accompanied by persistent smells, acid rain and other visual or sensory signs.

Finexpertiza president Yelena Trubnikova said that this spring's widespread coronavirus lockdowns did not significantly reduce air pollution overall.

"It was often suggested at beginning of coronavirus pandemic that closing businesses and reducing traffic would have positive impact on the environment," Finexpertiza president Yelena Trubnikova said.

"But the situation may not be so simple: Key industrial facilities continued operations while environmental compliance issues may have taken a backseat during the pandemic," she added.

Roman Pukalov, head of Russia's Green Patrol NGO, told RBC that 2020's record-setting air pollution is result of increased government-mandated measurements, not necessarily higher pollutant emissions.

Finexpertiza said the record could also be linked to a series of major accidents that caused toxic emissions at production facilities this year, according to RBC.

RBC reported that Russia's Hydrometeorology Center measures air pollution with stationary and mobile observation stations that are placed near facilities that are likely to harm the environment.

Owners of these companies are required to install monitoring systems.

Benzo(A)Pyrene What Is Benzo(A)Pyrene? Delaware Health and Social Services, Dept of Public Health

Benzo(a)pyrene is part of a class of chemicals called Polycyclic Aromatic Hydrocarbons (PAH). PAHs usually occur as complex mixtures, not single compounds. Benzo(a)pyrene is on priority pollutant list published by U.S. Environmental Protection Agency (EPA).

Benzo(a)pyrene is found in nature from eruption of volcanoes and forest fires. Chemical compound also man-made. Benzo(a)pyrene found in surface water, tap water, rainwater, groundwater, wastewater and sewage sludge. Man-made releases of benzo(a)pyrene are to the air, where sunlight turns chemical into a dry form that falls to ground and breaks down in soil. Chemical results from burning plants, wood, coal, and operating cars, trucks, other vehicles. Major indoor sources in air are wood-burning fireplaces and stoves, and tobacco smoking. There is no known industry production or use of benzo(a)pyrene.

Potential exposure to benzo(a)pyrene through: Breathing air containing benzo(a)pyrene in workplace in coking, coal-tar and asphalt production plants, or smokehouses or where local trash is burned. Can also breathe from cigarette smoke, wood smoke, vehicle exhaust, asphalt roads or smoke from burning farm plants. Contact with benzo(a)pyrene in air, water, or soil near a waste site, or another polluted site. Eating grilled or charred meats. Can also be exposed through contaminated cereals, flour, bread, vegetables, fruits, meats; processed or pickled foods. Drinking contaminated water or cow's milk. Nursing infants may be exposed through breast milk, if mother lives near a waste site containing benzo(a)pyrene.

Remote Sensing of Atmosphere, Hydrosphere, and Underlying Surface, Published: 15 June 2016.

Air temperature in the lower troposphere over Moscow during heat wave in the summer of 2010.

M. A. Lokoshchenko, I. A. Korneva, A. Z. Dubovetsky & A. V. Kochin; Atmospheric and Oceanic Optics volume 29, pages267-273 (2016), Abstract.

Dynamics of air temperature in lower 4-km layer have been studied during heat wave in summer of 2010 by radio sounding data from Dolgoprudny and ground-based meteorological measurements at Moscow State University. Results have been compared with aeroclimatic data for previous 19 years.

Long-term average estimates of vertical thermal gradients and thickness and intensity of nocturnal surface inversions (200-300m and

2.0°C, respectively) are presented for summer months in Moscow region.

Record high air temperature for period from at least 1991 has been shown in air layer up to 2km above Moscow in summer of 2010. Among others, the 30°C value has been detected for the first time in air layer from 400 to 800m. During heat wave 2010, as result of clearly pronounced anticyclone conditions, thickness and intensity of nocturnal surface inversions were higher than usual (up to 700m and 12°C, respectively). Mean temperature profiles have been studied for different types of air masses.

Tropical air mass predominated over Moscow region in summer of 2010 during more than half of period.

A. Weekly Patterns and Weekend Effects of Air Pollution in the Moscow Megacity, Abstract

Elansky NF, Shilkin AV, Ponomarev NA, Semutnikova EG, Zakharova PV (2020) Weekly patterns and weekend effects of air pollution in the Moscow megacity. Atmospheric Environment 224: 117303.

Weekly cycle and weekend effect in O_3, NO, NO_2, CO, CH_4, SO_2, NMHC, PM_{10} concentrations investigated in Moscow megacity using in-situ measurements January 1, 2005 to December 31, 2014 at 49 stations of Moscow Environment Monitoring network. Daily variations in CO, NOx, NMHC, PM_{10} concentrations depend mainly on motor transport emissions and the atmospheric boundary layer vertical stratification. Characteristic feature of Moscow is time coincidence of rush hours and surface temperature inversion during the cold season, which results in pollutant accumulation in the atmospheric surface layer. Found surface concentrations of pollutants (except ozone, methane) decrease on weekends. Weekday -Sunday differences in the daytime (08:00-22:00 LT) NO, NO2, CO, SO2, NMHC, PM10 concentrations relative to those of weekday period averaged for all stations over 2005-2014 amounted to 23.9%, 16.7%, 13.6%, 7.6%, 6.3%, 14.5%, respectively. Ozone concentration increased on Sunday by 16.5%. Methane concentration same on weekends as weekdays. Weekend effects in pollutant concentrations weakened within greenbelt around Moscow. In different sectors of Moscow pollutant weekend effects except SO_2 were approximately same. Vertical structure of NO, NO_2, and CO weekend effects was analyzed based on data obtained from measurements at TV tower 500 m in height. Weekend effects decreased nonlinearly with height. Estimates obtained for basic criteria of activity of photochemical processes determining formation of weekly cycle and weekend effect of ozone (NMHC/NOx ratio, fraction of radical loss via NOx chemistry, concentration of Ox) show that the VOC-limited chemistry is characteristic of Moscow.

Focus on Tehran and Iran

a) Iran is world's 13th most deadly country in corona virus deaths

b) Tehran's Air Unbreathable Winter 2020-2021-Chart 25

c) Annual occurrence, temperature inversions

d) The main pollutants include mobile sources like vehicular traffic and stationary sources like oil refineries, power plants and manufacturing industries-Chart 26

Air in Tehran 'unbreathable' as pollution peaks, January 14, 2021 (during Iran's 4th daily death wave)

A. Tehran

For past several weeks, air in Tehran and other major metropolises across Iran has become irrespirable, with pollution index touching dangerously high levels. Air Quality Index (AQI), which measures levels of air contamination, has seen an alarming upturn in Tehran in recent weeks, crossing threshold of 200, deemed "heavily polluted."

Tehran, a bustling financial hub surrounded by the majestic Alborz Mountains, presents an interesting predicament to urban planners, government agencies and environmentalists.

A thick layer of smog enveloping the city remains trapped for winter months due to the phenomenon called 'temperature inversion,' say experts. The long spell of dryness makes it only worse.

The World Health Organization (WHO) had in 2018 put Tehran in the category of 'most polluted cities in the world,' while the World Bank in its 2018 report said the city accounts for 4,000 of the 12,000 deaths due to air pollution in Iran annually.

This year has been worse, according to government officials and environmentalists, with the AQI touching a record high not only in Tehran but also in other major cities such as Tabriz, Isfahan and Mashhad.

No recent figures available to show impact of polluted air, but experts say deaths due to diseases caused by air pollution are likely to be higher this year than previous years. Amid battle against the COVID-19 pandemic, rising pollution levels present bigger challenge for government agencies and healthcare professionals with surge in hospitalizations.

B. Dire Situation

According to recent reports published by Tehran Air Quality Control Company, inhabitants of Tehran inhaled more contaminated air in the past few months than during same period last year. Throughout the month of December, the AQI remained in the 'red zone' (151-200), meaning "unhealthy." On some days, the index even breached the 300 mark, deemed "hazardous.

"The main pollutants, environmental experts say, include mobile sources like vehicular traffic and stationary sources like oil refineries, power plants and manufacturing industries.

Iran's Oil Minister Bijan Namdar Zanganeh recently created a tizzy by suggesting that a shortage of fuel had forced power plants to use refined diesel and mazut, a low-quality fuel oil. The main fuel source for the plants is Euro-7 diesel, but to keep the plants running, mazut is being used," he said, blaming people for high electricity and gas usage.

Massoud Farahmand, an environmental expert from Tehran, said the authorities need to "seriously implement measures" including restrictions on private vehicles and consumption of fuel oil.

"It is an emergency situation by all environmental standards," he told Anadolu Agency. "It's a problem that recurs every year, and this year, the situation has turned extremely worrying."

A city with a population of about 9 million, Tehran becomes even busier and more crowded during the daytime, with people from nearby cities and counties flocking for work.

Focus on Jakarta and Indonesia

a) Indonesia is world's 17th most deadly country in corona virus deaths; population 256 million.

b) Smog problems and temperature inversions-Charts 28 & 29 & 30

c) A variety of sources contribute to particulate air pollution in Indonesia. In Jakarta, motor vehicles accounted for 31.5% of city's PM2.5 in 2008-2009 and 70% of PM10, largest form of particulate matter with diameter less than 10 microns. Since 2010 there have been sharp increases in electrical generation from coal-fired power plants and gasoline and diesel consumption, both contributors to PM2.5 air pollution.

d) Over last two decades, Indonesia has seen dramatic changes in quality of its air. From 1998 to 2016, country went from being one of cleaner countries in the world to one of twenty most polluted, as particulate air pollution concentrations increased 171 percent. The greatest spike has happened over just the last few years.

e) Decrease in life expectancies-1 to 4 years across Indonesia.

GeSMOGraphy! Jakarta's Smog Problem and the Temperature Inversion

Indonesia's Pollution Challenge

Over last two decades, Indonesia has seen dramatic changes in quality of its air. From 1998 to 2016, country went from being one of cleaner countries in the world to one of twenty most polluted, as particulate air pollution concentrations increased 171 percent. The greatest spike has happened over just the last few years. Pollution more than doubled from 2013 to 2016 alone, with at least some of the increase likely due to intense fires. Regardless of causes, 80 percent of Indonesia's 256 million people lived in areas where the annual average particulate pollution level exceeded the WHO guideline in 2016. This high air pollution is now undermining Indonesians' health.

In 1998, air pollution barely impacted life expectancy of Indonesians. In fact, even in 2013, it shaved only a few months off of average life expectancy. If today's concentrations are sustained, it will cut the average life expectancy by 1.2 years, relative to what it would be if the WHO guideline of 10 μg/m^3 for long-term fine particulate matter (PM2.5) pollution was met. Some areas of Indonesia fare much worse. In Indonesia's capital Jakarta, home to more than 10 million people, the average resident will live 2.3 years less if PM2.5 levels remain at current levels, relative to if the WHO guideline was met. The analogous figure for residents on the islands of Sumatra and Kalimantan is about 4 years of life expectancy loss.

A variety of sources contribute to particulate air pollution in Indonesia. In Jakarta, motor vehicles accounted for 31.5% of city's PM2.5 in 2008-2009 and government estimated 70% of PM10, the largest form of particulate matter with diameter less than 10 microns. Since 2010 there have been sharp increases in electrical generation from coal-fired power plants and gasoline and diesel consumption, both contributors to PM2.5 air pollution.

Indonesia does not currently have a national standard for air pollution levels. As the government begins to recognize the air quality problem, the AQLI demonstrates that Indonesia has the opportunity to accrue enormous health benefits by successfully cleaning up its air.

Other countries in the Asia/Pacific region provide a useful benchmark. If, for example, Indonesia achieved sustained improvements in air quality comparable to what China has achieved in the last 5 years, the typical Indonesian could expect to live eight months longer. Those in the most polluted areas would capture even larger benefits, living up to 2.5 years longer on average.

Focus on Johannesburg and South Africa: 16th Most Deadly Corona Virus Country

a) Johannesburg Can't Compromise On Air Pollution-Chart 32

b) The city completed a baseline assessment of its air quality, which identified that city's air pollution emanates from domestic fuel burning, vehicle emissions, industries, biomass burning and mine storage facilities.

c) Air pollution affects more of our Johannesburg's communities because of inequality and years of poor infrastructure planning-Chart 33

d) Corner of South Africa has world's deadliest air pollution, home to a dozen coal-fired power stations, "the world's largest NO2 hotspot-Charts 34-36

e) South Africa is world's 27th largest economy yet is 12th highest CO2 emitter Chart 35

f) Atmospheric temperature inversions, especially during cold winter months-May to August

World News 01/23/2018

A. Johannesburg Can't Compromise on Air Pollution

Herman Mashaba, Mayor of Johannesburg, Special to HuffPost

In South Africa, air pollution is more severe in urban areas, and city of Johannesburg is no exception. The majority of our country's population migrates to the cities from rural areas for economic reasons, attracted by employment opportunities available in urban centers. This results in mushrooming of dense, low-income, informal settlements--which are mostly under-resourced and do not have access to basic amenities, including electricity supply.

The city completed a baseline assessment of its air quality, which identified that city's air pollution emanates from domestic fuel burning, vehicle emissions, industries, biomass burning and mine storage facilities.

The city has a network of nine ambient air-quality monitoring stations that include stations in Alexandra, Ivory Park, Diepsloot, Jabavu, Orange Farm, Buccleuch, Davidsonville, Delta Park and Newtown. Seven of the stations are in residential areas, and two are traffic-emission stations. Data from these monitoring stations is compared to national applicable standards, which are set to protect the public's health and well-being.

City's poorest communities often bear brunt of higher levels of poor air quality. Over time, monitoring stations located in city's residential areas have observed record pollution levels higher than the national standard, especially during the cold winter months, when most people still use fossil fuel for heating. It is city of Johannesburg's priority to improve the city's air quality--to ensure pro-poor development that addresses inequality and poverty, and provides meaningful redress. Unfortunately, air pollution affects more of our poor communities in the city because of inequality and years of poor infrastructure planning.

To improve city's air quality, we completed a review of our air quality management plan and our air pollution control bylaws. Plan

provides city's vision and goals for next five years. A regulatory framework has been developed to manage other sources of air pollution in the city. The two documents are in the final stage of completion, and public consultations will take place prior to their finalization.

In terms of the national Air Quality Act 39 of 2004, city is responsible for air quality management-both in terms of regulations and compliance enforcement. In terms of city's regulatory function, all industrial activities that are identified in the act as significant emitters that contribute to poor air quality are licensed, and 37 such facilities exist in city. These facilities are issued with atmospheric emission licenses, which set out emission limits that are regularly monitored for compliance. Those that are found to be noncompliant are subject to enforcement actions.

Interventions that deal with emissions from domestic fuel burning are complex and require a multifaceted approach. Materials used for domestic fuel are often not by choice, since in many cases people don't have access to electricity--and even when it is available, they can't afford it.

B. Breathing Space: This Picturesque Corner of South Africa has the World's Deadliest Air Pollution

by Lynsey ChutelReporter, Published October 29, 2018

One of world's most air-polluted regions is a province of green rolling hills and wild flowers in eastern South Africa. Mpumalanga has the largest single area infected by the deadly air pollutant nitrogen dioxide, according to an analysis of satellite imagery released by Greenpeace on Monday (Oct. 29).

Out of satellite data across six continents, the province in South Africa's east emerged as "the world's largest NO2 hotspot," said Greenpeace Africa. The area is home to a dozen coal-fired power stations, owned and operated by South Africa's national power supplier Eskom.

Greenpeace analyzed satellite images taken daily by the Copernicus Sentinel-5P from Jun. 1 to Aug. 31. Researchers measured the amount of trace gas in a vertical column the full height of the earth's atmosphere. The sample period took place during the South African winter which may account for increased electricity generation.

C. Johannesburg's Appalling Air Quality: We Can't Let Sasol and Eskom off the Hook

By Glenn Ashton · 19 Aug 2014

Air in interior of South Africa is amongst some of most polluted in the world. It is killing our people. We see photographs and reports of air pollution in China and elsewhere but seldom do we see any comparable local coverage of the scourge of South African air pollution. Our coal addiction silently kills thousands of people every year, with impunity.

Over the past two decades South Africa has developed some of the most comprehensive environmental legislation in the world. Despite this we continue to struggle against the fossilized thinking of those intent on continuing business as usual, reliant on green-washing themselves out of trouble. This is no longer an option in 2014.

South Africa is world's 27th largest economy yet is 12th highest CO_2 emitter. Our incredibly carbon intensive economy burns its way through an estimated 190 million tonnes of coal per annum to power the economy. On top of this we export around 70 million tonnes of coal per year to the rest of the world, mainly to Europe, China and India.

Most of this coal is exploited by two of our industrial giants, our tweedledum and tweedledee of energy expenditure, Eskom and Sasol. Eskom, a parastatal, is world's fifth largest electricity company and one of world's top three polluters through its continued reliance on coal to fuel its power stations. Sasol, which began life as a parastatal until it was floated in 1979, is world's leading converter of coal, and subsequently gas, to liquid fuels. It is now responsible for world's largest single spot source of CO2 emissions at its massive Secunda processing plant.

These two world-class emitters of climate-changing carbon dioxide also spew out a soup of polluting compounds, including sulphur, nitrous oxide and particulates, each linked to specific negative health and environmental impacts. Other noxious chemicals included in this brew include radically toxic substances like cadmium, chromium, lead, barium and mercury.

To compound the problem these emissions are released over South Africa's interior plateau, where they are trapped by atmospheric temperature inversions, especially during the cold winter months, which causes dangerous concentrations of noxious compounds. A recent visit to Johannesburg reminded me of just how bad this problem has become, with the city barely visible from Sandton, a few miles away. Yet the pollution in Jo'burg is not nearly as bad as hotspots like Witbank in Mpumalanga, which EU scientists have found to be amongst the worst in the world, exceeding even China's infamous pollution levels.

South Africa's environmental legislation arises out of Section 24 of the Constitution, which promises citizens the right to a healthy environment by, amongst other things, legislating against pollution. National Environmental Management Act (NEMA) is keystone environ-

mental legislation. It was promulgated in 1997, after a comprehensive consultation process. It has led to further legislation to specifically address the worsening scourge of air pollution.

The National Environmental Management Air Quality Act, or NEM:AQA was years in the making and was finally promulgated in 2004. Regulations only came into effect in 2010, again after extensive consultation with industry, including Sasol and Eskom. All major industrial emitters were fully informed of the process and were well aware that they would have to comply with this legislation.

Google searches on farming regions of Russia, Iran, Indonesia, South Africa all indicate attempts to regulate pesticide application and use, but virtually no enforcement, woeful lack of knowledge by users,

regions with unusually high concentrations of pests, excessive pesticide usage.

Use of pesticides in developing countries and their impact on health and the right to food Directorate-General for External Policies Policy Department, European Union.

A. Abstract

Study provides a broad perspective on main trends regarding use of pesticides in developing countries and impacts on human health and food security. Information is provided on challenges of controlling these hazardous substances, along with extent to which pesticides banned within the European Union (EU) are exported to third countries. Analysis assesses factors behind continuation of these exports, along with rising demand for better controls. Recommendations are intended to improve the ability for all people, including future generations, to have access to healthy food in line with United Nations declarations.

These recommendations include collaborating with Rotterdam Convention to strengthen capacity building programs and use of knowledge base maintained by the Convention; supporting collaboration among developing countries to strengthen pesticide risk regulation; explore options to make regulatory risk data more transparent and accessible; strengthen research and education in alternatives to pesticides; stop all exports of crop protection products banned in the EU; only allow the export of severely restricted pesticides if these are regulated accordingly and used properly in the importing country; and support the re-evaluation of pesticide registrations in developing countries to be in line with FAO/WHO Code of Conduct.

Corona Virus Evaluation (Part 6)

Corona Virus Pandemic Shows No Signs of Slowing Globally

a) Examination of Daily Death Profile from March 9, 2020 to date of August 11, 2021

b) Global Wave 2 ended June 28, 2021; global deaths continued at 8,459 per day over 61 day period from June 1 to July 31, 2021; Waves 1 & 2 averaged about 240 days in length.

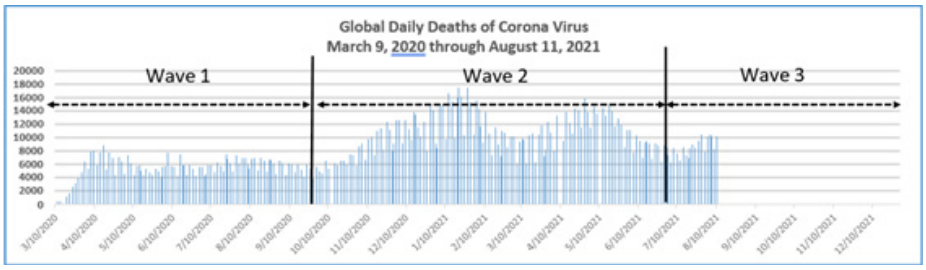
c) Wave 3 projected to have 8,459 x 240 x 150%=3.5 million deaths by April 2022.

d) 1 million deaths have occurred in countries surrounding China in a pattern suggesting a jet stream;

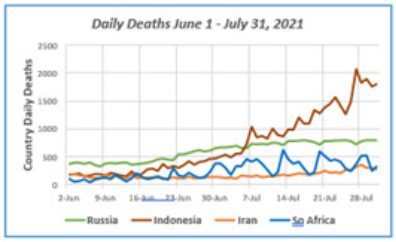
similar patterns were formed in corona virus deadly countries spring & fall 2020.

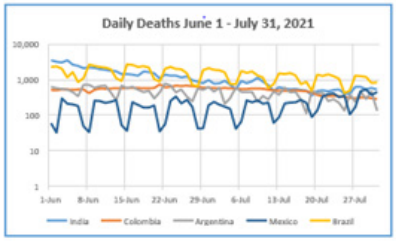
e) Mediterranean Sea countries having increased daily deaths from patterns of severe pollution, heat.

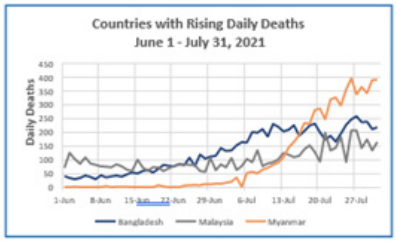
f) Papers discussing jet streams, their causes & movements, further info on temperature inversions.



	Wave 1	Transition	Wave 2	Transition
Start	3/9/2020	9/1/2020	10/5/2020	6/1/2021
End	10/4/2020	10/31/2020	6/28/2021	7/31/2021
Total Days	210	61	267	61
Total Deaths	1,117,295		2.833,335	
Average Deaths/Day	5,320	5,624	10,612	8,459







Daily Corona Virus Deaths

Rising in Indonesia, Myanmar, Bangladesh, Russia, South Africa, Malaysia, Iran, Philippines, Vietnam

decreasing in India and Brazil

steady in Colombia, Argentina, rising in Mexico.

These 14 countries averaged 6,500 deaths per day over 61 day period June 1 to July 31, 2021.

Country – August 11,2021	Covid-19 Deaths
Russia	167,241
Kazakhstan	7,103
Georgia+Armenia+Azerbaijan	15,989
Turkey	54,098
Iraq	19,402
Iran	95,647
Afghanistan + Pakistan	31,073
Nepal	10,180
India	429,702
Bangladesh	23,398
Myanmar	12,452
Thailand + Vietnam	10,940
Malaysia	11,373
Indonesia	112,198
Philippines	29,374
Japan	15,311
Total Deaths	1,045,381

Arrows on previous chart converted to the red line on this chart. This appears to be a similar pattern to a jet stream.

Is it possible these three lines approximate the jet stream pattern over Eurasia during the following periods?

- Black line early spring 2020
- Dark blue line fall 2020
- Dark red line late spring 2021

Relationship of Jet Streams to Creation of Temperature Inversions

Charts 8-10 provide a technical paper to understand this relationship; focuses particularly on safe spraying of pesticides.

Articles throughout summer of 2021 have discussed Jet Streams forming stable, blocking air masses and have attributed this phenomenon to drenching rain and flooding in Europe and extreme heat and fires in Siberia and Western USA.

Charts 11-13 provides technical paper from SCIENTIFIC American describing earth's jet streams, their causes and their movements.

Charts 20-23 provides an article from ThoughtCo on Thermal Inversion-Its Impact on Microclimates and Smog

Pesticide Drift and Temperature Inversions, July 26, 2017

Jarrod Miller, Extension Educator, Somerset County Maryland

Pesticide drift and pesticide volatility have been in news a lot due to increased use of Dicamba out west. Volatility is a chemical property describing how likely pesticide will become gas which can leave fields and go off target. Best way to control volatility is to choose less volatile pesticides or apply during cooler weather. Pesticides can also move offsite due to drift associated with wind and small, lighter particles. This can typically be controlled through proper nozzle selection and application when winds are less than 10 mph. While wind speed can be easy to determine, another cause of drift, a temperature inversion, is not.

Earth's atmosphere is typically warmer at surface (due to sun warming fields), and cools 2-5°F for every 1000 feet elevation. As air warms at earth's surface, expands and rises, then cools and falls, giving atmosphere circulation. This process can produce cumulus clouds and storms, also move pollutants and smog out of lower atmosphere. Inversion occurs when a pocket of warm air sits above cooler air at surface, preventing circulation. On these days, smells of manure application may linger over a region, and also keep pesticide vapors in the air, allowing them to drift on gentle breezes. Inversions can be easy to spot where you have fires or smokestacks, as the smoke will rise so high before flattening out and moving sideways. Inversions can occur high in the atmosphere, and may not affect drift. While you can't wake up and see inversions as easily as you can measure wind, there are some signs you can follow.

Most common times to have an inversion is on clear nights in summer. As fields cool at night (through longwave, infrared radiation), air near surface becomes cooler than air above it. Anytime see stars at night, and minimal wind, can expect to have an inversion early in the morning. As the sun warms fields back up, atmosphere should gain circulation again, which will be obvious when if see cumulus clouds in

sky. Another likely location of an inversion is in valleys, where cool air can drop off mountains in evening, leaving cap of warmer air over the valley. Cool air can also move off of water bodies causing inversions until sun warms surface again. Both of these situations likely to result in fog.

Most of above cases are considered short term inversions, which are dissipated as the sun warms lower atmosphere again. However, some weather patterns can sit longer, sometimes for days. If listen to weather talk about high/low pressure or cool/warm fronts, you can possibly predict an incoming inversion. At least 30,000 feet in the air is where the jet stream flows, and where these converge together, air is forced down creating a high pressure area. High pressure areas create low winds and clear nights, great conditions for an inversion. There are often high variations in night and daytime temperatures associated with high pressure, another factor in creating inversions. Additionally, as air is forced down by converging jet streams, it is compressed and warms, creating a pocket of warm air over cooler surface air. Cooler air at the surface doesn't necessarily mean it feels like fall, this warmer pocket of air may only be 2°F warmer but is enough to create an inversion and trap pollutants beneath it.

Low pressure areas occur where jet stream diverges above, pulling air up and lowering air pressure at the surface. Often associated with clouds, precipitation and minimal temperature variation. Without sun warming surface, inversions less likely on days with low pressure. Cold fronts associated with low pressure. These air masses are cooler and denser, so they can move below warmer air along surface. As cold fronts move across warmer landscapes, air rises and condenses into cumulus clouds, and sometimes severe thunderstorms. Inversions are not likely in these cases. However, some cold fronts are shallow, and could sit under warm air and cause an inversion. Low pressure areas occur where jet stream diverges above, pulling air up and lowering air pressure at the surface. Often associated with clouds, precipitation and minimal temperature variation. Without sun warming surface, inversions less likely on days with low pressure. Cold fronts associated with low pressure. These air masses are cooler and denser, so they can move below warmer air along surface. As cold fronts move across warmer landscapes, air rises and condenses into cumulus clouds, and sometimes severe thunderstorms. Inversions are not likely in these cases. However, some cold fronts are shallow, and could sit under warm air and cause an inversion.

Warm fronts less dense and will move over-top of cooler air masses. As they rise over cooler air, they cause higher pressure at surface. Slower moving than cold fronts, warm fronts will have more stable air, and longer, less severe rainfall. It is these slower moving warm fronts that may sit longer and cause inversions, which will cause more drift the closer they are to the surface. If see cirrus clouds high in the atmosphere, it indicates a coming warm front.

To avoid increased drift under an inversion, can certainly check weather reports on fronts and pressure. Incoming thunderstorms also a good sign there won't be an inversion, although could have high winds.

Inversions More Likely

a) In morning, in valleys or near large water bodies after clear nights in summer (look for cumulus clouds later in day to indicate good air circulation)

b) With shallow cold fronts (typically a cold front with no storms, but I'm not a meteorologist)

c) High pressure, warm fronts that linger (Look for incoming cirrus clouds).

What Causes the High-Speed Winds, or "Jet Stream," in the Stratosphere? And Why Does the Path of the Jet Stream Wander? Scientific American July 21, 1997

James Partain, science and operations officer at the Marine Prediction Center (part of the National Centers for Environmental Prediction) in Camp Springs, Md., replies:

"Earth's atmosphere contains two major 'jet streams' (one in each hemisphere). They have considerable impact on human affairs. As we often hear during the weather segment of the nightly news, jet streams are related to weather patterns of high and low pressure. Airline pilots are well aware of consequences of being in or near the jet stream in an aircraft. Detailed knowledge of the jet stream--its location, altitude and strength--is therefore critical to modern-day weather forecasting…

A jet in fluid dynamics is simply a core (or 'stream') of fluid moving at a higher velocity than the surrounding fluid. Although complicated to describe mathematically, jet streams in the atmosphere are straightforward, natural result of the meridional (that is, equator-to-pole) temperature gradient in the earth's atmosphere.

"The temperature gradient derives from differential solar heating of the spherical surface of a planet: the surface is generally warmest at the equator and grows progressively cooler as one moves poleward. Centrifugal effects of earth's rotation, often called Coriolis force, deflect north-south transport of heat from the equator to the poles into the predominantly east-west motion of the jet stream. The relative strength, or velocity, of the jet stream is proportional to the intensity of this thermal gradient. During the winter months, when the

equator-to-pole temperature disparity is at its greatest, the jet stream reaches its maximum velocity. During the summer months, when the temperature gradient between the equator and the pole is considerably less (only about half the winter value), the jet stream reaches its minimum velocity.

"The altitude of the jet stream is a function of the vertical and horizontal distribution of temperature in the earth's atmosphere. The earth's atmosphere is broken into several layers, or 'spheres.' The troposphere (in Latin, literally the 'turning' or 'changing' sphere) is the lowest layer of the earth's atmosphere, ranging in depth from around nine kilometers at the poles to around 16 kilometers at the equator. Within the troposphere, the temperature decreases with altitude, at a rate of approximately seven degrees Celsius per kilometer. Starting where the troposphere leaves off, the stratosphere (literally the 'layered' sphere) extends to an altitude of roughly 45 to 50 kilometers. Temperatures within the stratosphere increase with height, a phenomenon known as a temperature inversion. The transition between the troposphere and the stratosphere, called the tropopause, represents the coldest point of the troposphere. It is at this level, just under the tropopause, that the jet stream resides.

"As seen on high-altitude weather maps, jet stream does not maintain a straight, zonal flow from west to east but rather takes on a more serpentine look, often with dramatic dips to the south or rises to the north. Two major reasons for these nonzonal motions: temperature gradient between equator and poles and presence of land masses on earth's surface.

"The meridional temperature gradient between the equator and poles that gives rise to the jet stream also produces secondary atmospheric circulations, or eddies. These eddies, referred to by meteorologists as 'baroclinic waves,' have a complex interaction with the jet stream. The eddies modify the distribution of temperature and kinetic energy within the atmosphere, a process that has a pronounced effect on location and movement of the jet stream. The jet stream itself interacts with these waves, not only as a transport or steering mechanism but also in the transfer of momentum and energy back to the waves.

"The presence of land masses on the earth's otherwise watery surface modifies the distribution of temperature, because continents heat and cool at a dramatically different rate than do the oceans. The topography of the land also influences the jet stream's location. Mountain ranges and plains on large continents, for example, significantly affect the distribution of atmospheric temperature. And since the jet stream is a thermally driven phenomenon, the more complicated the three-dimensional temperature structure of the earth's atmosphere, the more 'wandering' will take place in the course of the jet stream.

"Knowing where the jet stream will be located is essential for forecasting the movement and evolution of weather systems. The first step in the forecast process is observation. Many thousands of atmospheric observations are made each day by civilian and military aircraft, land and maritime weather reporting stations and ships and weather balloons. These observations help to define the present state and location of atmospheric circulations and weather systems, including the jet stream.

"These observational data are then plugged into numerical weather-prediction models. These models assimilate this snapshot of the present state of the atmosphere and mathematically diagnose how the jet stream and other circulations and weather systems will change with time. The output from the models is then made available to meteorologists, who apply their knowledge, experience and expertise in making the final forecast."

Topographic Impacts on Jet Streams and Storm Tracks: The Mongolian Mountains Matter

White Rachel, Battisti David (2015) EGU General Assembly, held 12-17 April, 2015 in Vienna, Austria. id.3495. Pub Date: April 2015 Bibcode: 2015EGUGA..17.3495W.

A. Abstract

The sub-tropical and eddy-driven jets, and related storm tracks, greatly affect weather and climate in the Northern Hemisphere (NH) mid-latitudes. Jet location and strength has been shown to be influenced by high orography, in particular the Rocky Mountains and Tibetan Plateau (e.g. *Molnar, et al.,* 2010). GCM simulations by *Brayshaw, et al.,* 2009, using idealised continental distributions and topography, show that NH storm-tracks are influenced by topographic features similar to the Tibetan Plateau. We perform 30-year experiments using the CESM1 GCM at ~2-degree horizontal resolution, to study impact of removing particular topographic features. We find that it is in the mountains to the north of the Tibetan plateau (including the Altai mountains) that have greatest influence on jet and storm tracks, much more than the higher altitude, but lower latitude, topography of the Tibetan plateau and Himalayan mountains. Using simulations with a combination of realistic and semi-idealised topography changes with fixed SSTs, we study mechanisms behind this finding. We show that dominant mechanism is changes to surface temperature gradient; however increase in jet stream speed from the northern mountains is also helped by low-level wind changes. EP fluxes are calculated to quantify the feedback from the storm track changes onto the jet stream. Further simulations with a slab ocean show the influence of SST changes on the topographic impact. Brayshaw, D.J., B.J. Hoskins & M. Blackburn 2009: The Basic Ingredients of the North Atlantic Storm Track. Part I: Land-Sea Contrast and Orography. J Atmos Sci, 66,2539 Molnar, P., W.R. Boos & D.S. Battisti 2010: Orographic controls on climate and paleoclimate of Asia: Thermal and mechanical roles for the

Tibetan Plateau. Annu Rev Earth Planet Sci,38,77 Wilson, C., B. Sinha, and R.G. Williams, 2009: The effect of ocean dynamics and orography on atmospheric storm tracks. J. Climate, 22, 3689-3702

Tibetan Plateau from Wikipedia, The free Encyclopedia

The Tibetan Plateau lies between the Himalayan range to the south and the Taklamakan Desert to the north.

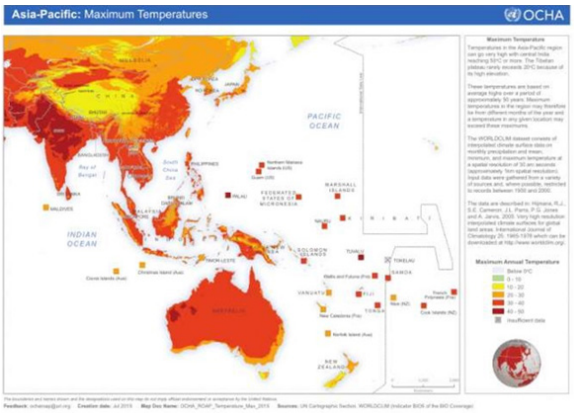
The Tibetan Plateau also known as the Qinghai-Tibet Plateau or the Qing-Zang Plateau or as the Himalayan Plateau in India, is a vast elevated plateau in Central Asia, South Asia and East Asia, covering most of the Tibet Autonomous Region, most of Qinghai, Northwestern Yunnan, Western half of Sichuan, Southern Gansu provinces in Western China, the Indian regions of Ladakh and Lahaul and Spiti (Himachal Pradesh) as well as Bhutan. It stretches approximately 1,000 kilometres (620mi) north to south and 2,500 kilometres (1,600mi) east to west. It is the world's highest and largest plateau above sea level, with an area of 2,500,000square kilometers (970,000sq mi) (about five times the size of Metropolitan France). With an average elevation exceeding 4,500metres (14,800ft) and being surrounded by imposing mountain ranges that harbor the world's two highest summits, Mount Everest and K2, the Tibetan Plateau is often referred to as "the Roof of the World".

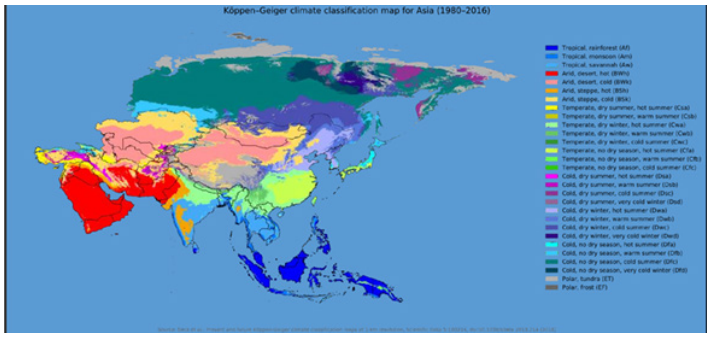
The Tibetan Plateau contains the headwaters of the drainage basins of most of the streams in surrounding regions. Its tens of thousands of glaciers and other geographical and ecological features serve as a "water tower" storing water and maintaining flow. It is sometimes termed the Third Pole because its ice fields contain the largest reserve of fresh water outside the polar regions. The impact of global warming on the Tibetan Plateau is of intense scientific interest.

See Chart 15 for description of the Plateau of Tibet.

The two black lines bound the region of current high corona virus deaths – August 2021. These are very likely associated with the northern and southern jet streams. The bound area is tropical.

North or Polar side of the upper black line, number of corona virus deaths very low.





Thermal Inversion - Its Impact on Microclimates and Smog - Amanda Briney Updated January 23, 2020

Temperature inversion layers, also called thermal inversions or just inversion layers, are areas where the normal decrease in air temperature with increasing altitude is reversed and the air above the ground is warmer than the air below it. Inversion layers can occur anywhere from close to ground level up to thousands of feet into the atmosphere.

Inversion layers are significant to meteorology because they block atmospheric flow which causes the air over an area experiencing an inversion to become stable. This can then result in various types of weather patterns.

More importantly, though, areas with heavy pollution are prone to unhealthy air and an increase in smog when an inversion is present because they trap pollutants at ground level instead of circulating them away.

A. Causes

Normally, air temperature decreases at a rate of 3.5°F for every 1,000 feet (or roughly 6.4°C for every kilometer) you climb into the atmosphere. When this normal cycle is present, it is considered an unstable air mass, and air constantly flows between the warm and cool areas. The air is better able to mix and spread around pollutants.

During an inversion episode, temperatures increase with increasing altitude. The warm inversion layer then acts as a cap and stops atmospheric mixing. This is why inversion layers are called stable air masses.

Temperature inversions are a result of other weather conditions in an area. They occur most often when a warm, less dense air mass moves over a dense, cold air mass. This can happen when air near the ground rapidly loses its heat on a clear night. Ground becomes cooled quickly while air above it retains heat the ground was holding during the day. Temperature inversions also occur in some coastal areas because upwelling of cold water can decrease surface air temperature and the cold air mass stays under warmer ones. Topography can also play a role in creating a temperature inversion since it can sometimes cause cold air to flow from mountain peaks down into valleys. This cold air pushes under warmer air rising from the valley, creating the inversion. Inversions can also form in areas with significant snow cover because the snow at ground level is cold and its white color reflects almost all heat coming in. Thus, the air above the snow is often warmer because it holds the reflected energy.

B. Consequences

Some of most significant consequences of temperature inversions are extreme weather conditions they can sometimes create. One

example is freezing rain. This phenomenon develops with a temperature inversion in a cold area because snow melts as it moves through the warm inversion layer. Precipitation continues to fall and passes through the cold layer of air near the ground. When it moves through this final cold air mass, it becomes "super-cooled" (cooled below freezing without becoming solid.) The supercooled drops then become ice when they land on items like cars and trees and the result is freezing rain or an ice storm.

Intense thunderstorms and tornadoes are also associated with inversions because of the intense energy that is released after an inversion blocks an area's normal convection patterns.

C. **Smog**

Although freezing rain, thunderstorms, and tornadoes are significant weather events, one of the most important things impacted by an inversion layer is smog. This is brownish-gray haze that covers many of the world's largest cities and is a result of dust, auto exhaust, and industrial manufacturing. Smog is impacted by the inversion layer because it is, in essence, capped when the warm air mass moves over an area. This happens because the warmer air layer sits over a city and prevents the normal mixing of cooler, denser air. The air instead becomes still and, over time, the lack of mixing causes pollutants to become trapped under the inversion, developing significant amounts of smog.

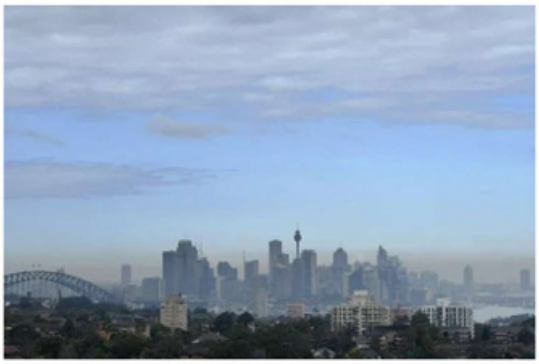
During severe inversions that last over long periods, smog can cover entire metropolitan areas and cause respiratory problems for the inhabitants.

In December 1952 such an inversion occurred in London. Because of the cold December weather, Londoners began to burn more coal, which increased air pollution in the city. Since the inversion was present over the city, these pollutants became trapped and increased London's air pollution. The result was the Great Smog of 1952 that was blamed for thousands of deaths.

Like London, Mexico City has also experienced problems with smog that have been exacerbated by the presence of an inversion layer. This city is infamous for its poor air quality, but these conditions are worsened when warm subtropical high-pressure systems move over the city and trap air in the Valley of Mexico.

When these pressure systems trap the valley's air, pollutants are also trapped and intense smog develops. Since 2000, Mexico's government has developed a plan aimed at reducing ozone and particulates released into the air over the city. London's Great Smog and Mexico's similar problems are extreme examples of smog being impacted by the presence of an inversion layer. This is a problem all over the world, though, and cities like Los Angeles, Mumbai, Santiago, and Tehran frequently experience intense smog when an inversion layer develops over them.

Many of these cities and others are working to reduce their air pollution. To make the most of these changes and to reduce smog in the presence of a temperature inversion, it's important to first understand all aspects of this phenomenon, making it an important component of the study of meteorology, a significant subfield within geography.



Haze over Sydney, Australia.
John Pryke/Getty Images

Part 4 of this Evaluation Focused on Global Overuse of Pesticides and Their Deleterious Impact on Human Health and the Environment

Charts 25-28 connect global corona virus deaths to the global regions using most pesticides.

Chart 27 shows the 19 countries responsible for 81% of world's corona virus deaths; includes columns on pesticide consumptions taken from the worldometer. 4 countries highlighted in yellow showing very low consumptions, which needs further investigation.

Chart 30 focuses on overuse of pesticides in Java, Indonesia, a country currently experiencing 1,500-2,200 corona virus deaths per day summer of 2021, but on Chart 29 showing low pesticide consumption. Part 5 of this evaluation showed similar situation in Russia, Iran, India.

ME/SW Asia	Death Rate	Deaths August 11, 2021	Pop, MM	Ubn Pop %
Armenia	1,571	4,664	3	63%
Georgia	1,565	6,230	4	59%
Lebanon	1,171	7,952	7	79%
Iran	1,123	95,647	84	76%
Jordan	985	10,158	10	91%
Israel	706	6,580	9	93%
Turkey	616	52,565	84	75%
Azerbiajan	498	5,095	10	56%
Iraq	471	19,402	40	73%
Nepal	343	10,180	28	21%
India	308	429,702	1,385	35%
Kazakhstan	373	7,103	18	56%
Saudi Arabia	236	8,366	35	84%
Egypt	159	16,588	102	43%
Afghanistan	175	6,988	40	25%
Pakistan	107	24,085	222	35%
Bangladesh	141	23,398	168	39%
	327	734,703	2,249	59%

Region	Ave Death Rate	Deaths	MM pop	% Urban pop
So Amer	2,717	1,113,823	410	78%
No Amer	2,006	1,042,979	520	70%
East Eur	1,682	475,727	283	63%
West Eur	1,224	688,915	563	75%
ME/SW Asia	327	734,703	2,249	59%
	1008	4,056,147	4,025	
August 11, 2021 total deaths		4,456,418	7,800	
		91%	52%	

On July 12, 2021 considered India's large number of corona virus deaths and that this evaluation wasn't fully incorporating. Decided to combine Middle East and Southwest Asia into one region. Table above left combines these countries. Table above right summarizes regions with their death rates and deaths, which equal 91% of all world's corona virus deaths. Both tables updated to August 11, 2021.

A. **See Charts 27 and 28. Which one is actually correct?**

Charts 27 takes the data on corona virus deaths from the Worldometer and overlays

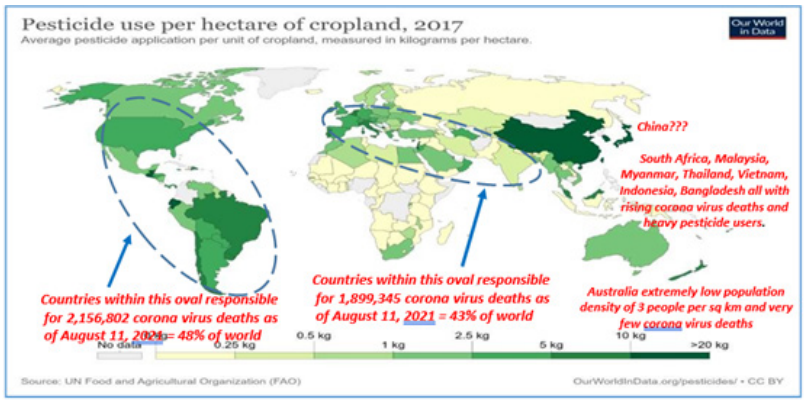
them on the world distribution of pesticides. See chart 23.

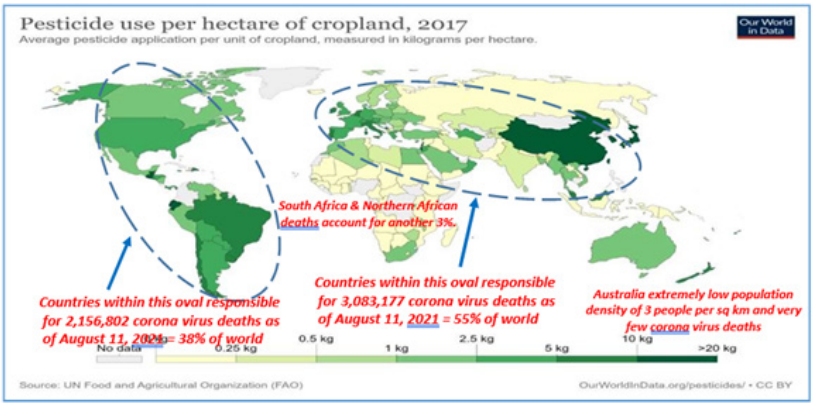
1. However, China uses by far the most pesticides and has only 4,636 deaths.

Chart 28 makes assumption China underreported its deaths and actually has a million.

1. The two ovals now overlay all major consumers of pesticides.

Australia always an outlier as its population density is only 3 and is has been routinely locked down since the pandemic started any time cases exceed 100.





76 Countries with more than 4,000 Corona Virus Deaths on 8/11/21.							
	Pop, MM	% of Pop	Country	Pesticide kg per hectare cropland	Pesticide tonnes	Deaths	% of Deaths
1	332	4%	USA	2.5	407,779	635,538	14%
2	213	7%	Brazil	6	377,176	566,013	27%
3	1,385	25%	India	**0.3**	52,750	429,702	37%
4	130	26%	Mexico	1.8	47,128	**365,476**	45%
5	33	27%	Peru	1.8	8,992	197,102	49%
6	111	28%	European Russia	**0.2**	25,961	167,241	53%
7	68	29%	UK	3.2	19,844	130,607	56%
8	60	30%	Italy	6.1	56,641	128,304	59%
9	51	31%	Colombia	9.9	37,698	122,953	62%
10	65	31%	France	3.6	70,589	112,410	64%
11	274	35%	Indonesia	**0**	1,600	112,198	67%
12	45	35%	Argentina	4.9	196,009	108,388	69%
13	84	37%	Iran	**0.3**	4,480	95,647	71%
14	84	38%	Germany	4	48,193	92,330	73%
15	47	38%	Spain	3.6	60,896	82,320	75%
16	60	39%	South Africa	2.2	26,497	75,774	77%
17	38	39%	Poland	2.2	25,075	75,289	78%
18	44	40%	Ukraine	2.3	78,201	53,149	80%
19	84	41%	Turkey	2.3	54,098	52,565	81%

The Tsunami of Pesticide Use for Rice Production on Java and Its Consequences

Adlinanur Prihandiani, Dea Rifia Bella, Nadira Reza Chairani, Yunita Winarto & James Fox Published online: 20 Jul 2021

A. Abstract

The consequences of the 'Green Revolution' persist in Indonesia and are most evident in the continuing high use of pesticides. After 1986, Indonesia made dramatic reductions in its use of pesticides for rice by adopting methods of integrated pest management, but these reductions were significantly reversed after 2002, producing a 'tsunami' in a costly and deleterious promotion of a wide range of pesticides. By destroying natural predators, this deleterious increase enabled the brown planthopper (Nilaparvata lugens Stal.), a major pest on rice, to become endemic, causing substantial crop losses. This paper provides an ethnographic examination of this excessive pesticide use focusing on usage in two villages in major rice producing areas, one in West Java and the other in Central Java. Faced with uncertainty and the risk of crop loss, farmers are prompted to ever greater spraying and even resort to 'cocktails' of multiple pesticides. Yet both villages have suffered brown planthopper infestation and the viruses associated with infestation. The consequences of this pesticide tsunami are considered at both local and national levels.

B. During August 2021, the Mediterranean Sea Region is Experiencing Rising Corona Virus Deaths

Charts 32 through 34 illustrate that pollution from low quality diesel fuels in cargo and ocean liners account for 40% of pollution in Mediterranean cities and overuse of pesticides by desperately poor farmers is a continuing problem.

This is the same scenario for combination of events leading to creation of corona virus deadly regions world-wide. See chart 35.

Country	Covid Deaths
Spain	82,320
France	112,410
Italy	128,304
Greece	13,106
Turkey	52,565
Egypt	16,588
Libya	3,811
Tunisia	21,220
Algeria	4,654
Morocco	10,607
Total Aug 11	**455,585**

I. What crops grow in a Mediterranean climate?

Traditional Mediterranean fruit and nut crops include grapes, olives, figs, almonds, hazelnuts, pistachios,

pomegranates, apricots, and citrus.

II. Why is the Mediterranean climate good for agriculture?

Farming is intensive and highly specialised. A variety of crops are raised. Citrus fruits, olives and figs, with long, widespread roots, scant foliage and thick skinned fruits are best adapted to the Mediterranean type of climate.

Adaptations in Irrigated Agriculture in the Mediterranean Region: An Overview and Spatial Analysis of Implemented Strategies

Kina Stientje Harmanny & Žiga Malek, Regional Environmental Change volume 19, pages1401-1416.

A. **Abstract**

In order to meet future food demand while sustainably managing available land and water resources, irrigated agriculture in semi-arid regions needs to adapt as a response to climate and socio-economic change. In this study, we focus on the Mediterranean region, a dynamic region, which is highly dependent on irrigated agriculture. We provide insight on adaptation strategies implemented on farm level, by doing a systematic review of studies in the region. Our analysis reports 286 implemented adaptations, on 124 different locations throughout the Mediterranean. Additionally, 142 drivers and 324 effects of adaptations were noted. We identified 31 adaptation strategies in 5 main categories:

1) Water management
2) Sustainable resource management
3) Technological developments
4) Farm production practices
5) Farm management.

Strategies in the categories water management and farm production practices are most often implemented by farmers in the region. The main driver in the area is water scarcity and adaptations often affected water use and resources in addition to farm practices. Subsequently, we studied the spatial context of adaptations by analyzing the location factors of the five main strategies, using Geographic Information Systems and maximum entropy modeling. Our results show that farmers are more likely to adapt in less rural areas with lower poverty values and better market access, and in areas with higher temperatures and less rainfall. This demonstrates that both biophysical and socio-economic factors determine the context in which adaptations are implemented and that considerable spatial variability in the area exists.

Text from article on Chart 33…Mediterranean region agriculture

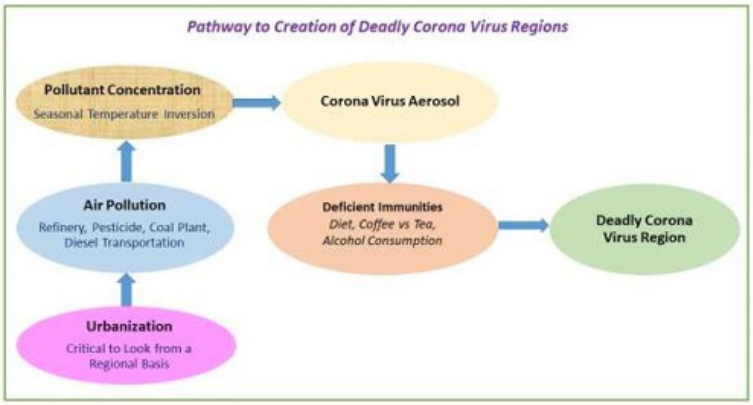
…Apart from water scarcity, other environmental factors also put pressure on farmers in the Mediterranean. Besides global socio-economic drivers, farmers experience changes on a local level such as a decreasing agricultural output due to soil erosion *Calatrava, et al.,* (2011); *Quinton, et al.,* (2010). Intensive farming and increasing use of pesticides and fertilizers have greatly benefitted the overall farm efficiency. However, the adverse effects on soil and the environment increase the need for a more sustainable use of resources through more nature-based solutions *Keesstra, et al.,* (2018).

a) France and others plan to tackle air pollution in Mediterranean sea

ENVIRONMENT 21 January 2019By Michael Le Page

Cleaning up air pollution from shipping in the Mediterranean Sea would have financial benefits as well as saving lives. A feasibility report looking at implementing a low emission zone for ships in the region has concluded the benefits would outweigh the costs threefold. The proposal already has the backing of France, Spain, Italy and Morocco, says Charlotte Lepitre of France Nature Environment, an environmental group. Only Greece and Malta are opposed. The clean-up is certainly needed. Many ships burn dirty fuels, such as heavy fuel oil, that contain high levels of sulphur and pollute the air with sulphur dioxide, particulates and black carbon. Up to 40 per cent of the air pollution in coastal towns around the Med can come from shipping.

It's not just tankers and cargo ships that are to blame. Many cruise ships still use heavy fuel oil, and burn it even while in port to power their generators. In 2017 the French TV programme Thalassa reported measuring extremely high air pollution levels on the deck of a cruise ship as well as in surrounding areas.



This evaluation has shown that "Urbanization" and "Air Pollution" are directly related to the massive global population explosion of the 20th century; and that "Pollutant Concentration" via Temperature Inversions is controlled by meteorogical jet streams, exasperated by global warming.

Op-ed Submitted to Tom Englehardt of The Nation - August 10, 2021

"Limited world regions are responsible for vast majority of corona virus deaths. Causes identified as simultaneous combination of jet streams, temperature inversions, pollution, high population density. World corona virus deaths by region: North + South America 48%; Europe 26%; Middle East + India & neighbors 17%. Overlaying these regions on map of world pesticide consumers shows 91% of all corona virus deaths in countries using largest quantities of pesticides. Deaths only occurred during temperature inversions from Torino Valley to East of Appalachians to Sao Paulo to Himalayas to Andes, always in areas of known severe pollution from refineries, coal-fired power, diesel transportation, pesticide spraying. June/July 2021 data shows that a covid-19 death line is formed of countries from Russia to Iran to India, Bangladesh, Myanmar, Thailand, Vietnam, Malaysia, Indonesia, Philippines, to Japan. Line is a jet stream, all death countries on tropical side of jet stream. Similar analogy spring 2020 when all deaths occurred in Europe west/south of Ardennes & Alps. Similar analogy also fall 2020 when all deaths occurred on tropical side of line (jet stream) from Russia to east of Middle East to East of India. Jet streams known to create seasonal temperature inversions, recently articles summer 2021 on jet streams generating stable blocking patterns of weather" causing severe rain and flooding in Europe and severe heat and fires in Siberia, US, Greece.

Corona Virus Evaluation (Part 7)

Globe Reached 5million Covid-19 Deaths 10/29/21 Global Statistics through 10/29/21 when globe reached 5 million global coronavirus deaths.

a) 20 countries responsible for 80% of global deaths, 3,991,042 vs 5,003,852; 41% world population

b) Five specific regions responsible in descending order by average death rate: South America, North

America, Eastern Europe, Western Europe, Middle East/Southwest Asia

c) "Axis of Americas" responsible for 45% of global deaths, 2,279,040 vs 5,003,852; 12% world population

d) Tables of World Port container traffic and USA port container traffic, deduced in Part 1 as primary mode of coronavirus transmission from region-to-region

e) Parts 1 through 6 provided evaluation concluding common attributes of these regions

i. High population densities

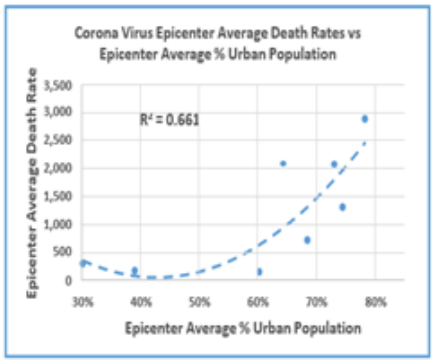
ii. Massive pollutants from oil/gas refining, coal burning, diesel transportation, spraying of pesticides

iii. Topography and seasonal weather patterns causing high frequency of temperature inversions, which concentrate and provide for horizontal drift of these pollutants.

f) Final perspective of historical model of how "Creation of Deadly Virus Regions" evolved.

84 Countries with more than 4,000 Corona Virus Deaths on 10/29/21.										
	Pop, MM	Acc Pop	% of Pop	Urban %	Country	Deaths	Case Rate	Death Rate	Acc Deaths	% of Deaths
1	332	332	4%	83%	USA	765,647	140,196	2,295	765,647	15%
2	213	545	7%	87%	Brazil	607,504	101,572	2,831	1,373,151	27%
3	1,385	1,930	25%	35%	India	457,773	24,507	327	1,830,924	37%
4	130	2,060	26%	80%	Mexico	287,631	29,056	2,213	2,118,555	42%
5	111	2,171	28%	75%	European Russia	236,220	57,750	1,618	2,354,775	47%
6	33	2,204	28%	79%	Peru	200,179	65,489	5,961	2,554,954	51%
7	274	2,478	32%	56%	Indonesia	143,361	15,299	517	2,698,315	54%
8	68	2,546	33%	83%	UK	140,392	131,357	2,054	2,838,707	57%
9	60	2,606	33%	71%	Italy	132,037	78,923	2,188	2,970,744	59%
10	51	2,657	34%	80%	Colombia	127,225	96,850	2,466	3,097,969	62%
11	84	2,741	35%	76%	Iran	125,998	69,186	1,475	3,223,967	64%
12	65	2,806	36%	81%	France	117,649	109,268	1,797	3,341,616	67%
13	45	2,851	37%	93%	Argentina	115,935	115,585	2,534	3,457,551	69%
14	84	2,935	38%	77%	Germany	96,127	54,233	1,142	3,553,678	71%
15	60	2,995	38%	66%	South Africa	89,151	48,658	1,479	3,642,829	73%
16	47	3,042	39%	80%	Spain	87,368	107,124	1,868	3,730,197	75%
17	38	3,080	39%	60%	Poland	76,875	79,602	2,034	3,807,072	76%
18	84	3,164	41%	75%	Turkey	70,207	90,361	821	3,877,279	77%
19	44	3,208	41%	70%	Ukraine	66,852	66,350	1,541	3,944,131	79%
20	21	3,229	41%	54%	Romania	46,911	85,406	2,460	3,991,042	80%
Global Population		7,800	million	Global deaths		5,003,852			10/29/2021	

Epicenters of Corona Virus Deaths	Epicenter Ave Death Rates	Epicenter Ave % Urban Population	average death rates	total population, MM
South America	2,871	78%		
North America	2,056	73%	2,066	1,807
Eastern Europe	2,040	64%	↓	↓
Western Europe	1,296	75%	↓	↓
Middle East	711	69%	1054%	34%
SW Asia	297	30%	↓	↓
Africa	162	39%	196	5,382
Far East	129	60%		



Region	Ave Death Rate	Deaths	MM pop	% Urban pop
So Amer	2,871	1,177,110	410	78%
No Amer	2,056	1,114,279	542	73%
East Eur	2,040	595,439	292	64%
West Eur	1,296	729,625	563	75%
ME/SW Asia	374	842,204	2,249	59%
	1099	4,458,657	4,056	
October 29, 2021 total deaths		5,003,852	7,800	
		89%	52%	

South America	Death Rate	Deaths	Pop, MM	Ubn Pop %
Peru	5,961	200,179	33	79%
Brazil	2,831	607,504	213	87%
Argentina	2,534	115,935	45	93%
Colombia	2,466	127,225	51	80%
Paraguay	2,241	16,245	7	62%
Chile	1,952	37,729	18	85%
Ecuador	1,831	32,958	18	63%
Uruguay	1,741	6,077	4	96%
Panama	1,661	7,314	4	68%
Bolivia	1,592	18,915	12	69%
Costa Rica	1,363	7,029	5	79%
	2,871	1,177,110	410	78%

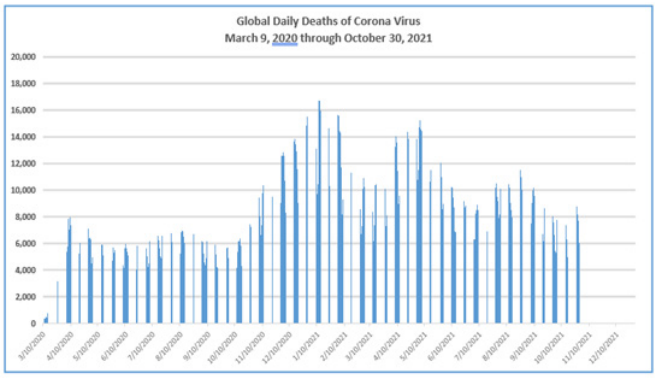
Eastern Europe	Death Rate	Deaths	Pop, MM	Ubn Pop %
Hungary	3,192	30,729	10	71%
Bosnia Herzegovina	3,533	11,495	3	52%
Czechia	2,860	30,705	11	74%
North Macedonia	3,412	7,108	2	58%
Bulgaria	3,470	23,872	7	75%
Slovakia	2,380	13,000	5	54%
Croatia	2,252	9,168	4	57%
Poland	2,034	76,875	38	60%
Romania	2,460	46,911	21	54%
Lithuania	1,703	4,561	3	71%
European Russia	1,618	236,220	111	75%
Moldova	1,906	7,665	4	43%
Greece*	1,531	15,856	11	79%
Ukraine	1,541	66,852	44	70%
Serbia	1,131	9,826	9	56%
Belarus	487	4,596	9	79%
* borders Bulgaria	2,040	595,439	292	64%

North America	Death Rate	Deaths	Pop, MM	Ubn Pop %
Mexico	2,213	287,631	130	80%
USA	2,295	765,647	332	83%
Honduras	2,275	4,730	2	55%
Guatemala	817	14,993	18	52%
Canada	758	28,929	38	81%
Cuba	727	8,223	11	77%
Dominican Republic	375	4,126	11	83%
	2,056	1,114,279	542	73%

Western Europe	Death Rate	Deaths	Pop, MM	Ubn Pop %
Slovenia	2,275	4,730	2	55%
Belgium	2,228	25,976	84	98%
Italy	2,188	132,037	60	71%
Tunisia*	2,106	25,231	12	69%
UK	2,054	140,392	68	83%
Spain	1,868	87,368	47	80%
France	1,797	117,649	65	81%
Portugal	1,787	18,153	10	66%
Sweden	1,472	14,991	10	88%
Switzerland	1,287	11,245	9	74%
Austria	1,249	11,333	9	57%
Germany	1,142	96,127	84	77%
Netherlands	1,070	18,384	17	92%
Ireland	1,085	5,436	5	64%
Morocco**	391	14,660	37	63%
Algeria **	132	5,913	44	74%
* near Italy ** Spain	1,296	729,625	563	75%

ME/SW Asia	Death Rate	Deaths August 11, 2021	Pop, MM	Ubn Pop %
Georgia	2,503	9,961	4	59%
Armenia	2,098	6,232	3	63%
Iran	1,475	125,998	84	76%
Lebanon	1,250	8,480	7	79%
Jordan	1,066	11,016	10	91%
Israel	867	8,085	9	93%
Turkey	821	70,207	84	75%
Azerbiajan	684	7,021	10	56%
Kazakhstan	632	12,053	18	56%
Iraq	558	23,111	40	73%
Nepal	382	11,388	28	21%
India	327	457,773	1,385	35%
Saudi Arabia	247	8,790	35	84%
Afghanistan	181	7,269	40	25%
Egypt	177	18,535	102	43%
Bangladesh	167	27,854	168	39%
Pakistan	125	28,431	222	35%
	374	842,204	2,249	59%

Corona Virus "Axis of Americas" - October 29, 2021		
Country	Covid-19 Deaths	Death Rate per MM Pop
Canada	28,929	758
USA	765,647	2,295
Mexico	287,631	2,213
Guatemala	14,993	817
Honduras	4,730	2,275
Costa Rica	7,029	1,363
Panama	7,314	1,661
Colombia	127,225	2,466
Ecuador	32,958	1,831
Peru	200,179	5,961
Brazil	607,504	2,831
Bolivia	18,915	1,592
Paraguay	16,245	2,241
Uruguay	6,077	1,741
Chile	37,729	1,952
Argentina	115,935	2,534
Axis Deaths	2,279,040	46%
World Deaths	5,003,852	of world's deaths

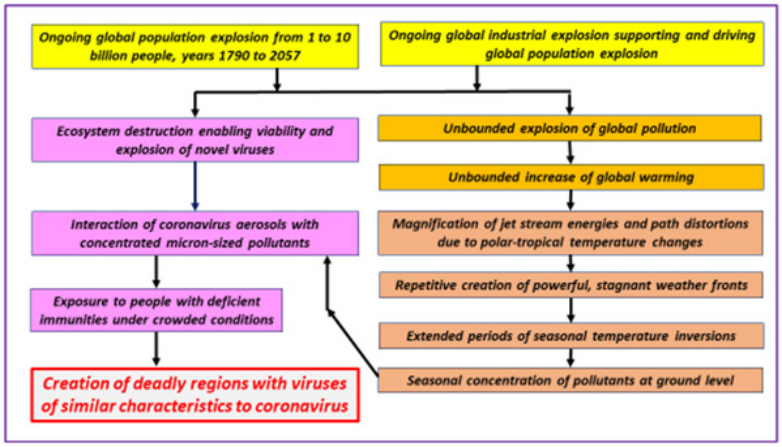


Global Trade Magazine' Top 50 Power Ports – 7/16/2018		
US Port – 7/16/2018	Million containers	State Covid-19 Deaths 10/14/21
South Louisiana	262	14,206
Houston	248	68,918
New York/New Jersey	133	83,941
New Orleans	90	
Beaumont	85	
Corpus Christi	82	
Long Beach, CA	82	70,653
Baton Rouge	73	
Los Angeles	63	
Mobile	57	15,101
Plaquemines, LA	57	
Lake Charles, LA	56	
Virginia	54	13,345
Cincinnati	43	
Texas City	41	
Baltimore	39	10,664
Huntington, WV	37	4,098
Savannah	36	27,565
Tampa	35	57,711
Port Arthur, TX	35	
Total		352,647

In Part 1 of this evaluation, deduced that primary mode of transmission of coronavirus from region-to-region was by transportation workers. Two tables to left show world and USA Port traffic.

US State Covid-19 death figures from 10/14/21. 50% of USA deaths.

The Port of Long Beach is common to both tables, half of Antwerp traffic.



Corona Virus Evaluation (Part 8)

5million Covid-19 Deaths 10/29/21

55% of global coronavirus deaths occurred in Countries/States bordering World's largest Seas

a) Deadly Seas in descending order:

Mediterranean, Gulf of Mexico, Arabian, Black, South China, Baltic, Caribbean, North, Japan/East China

b) For each Sea, based on common death rates, a predominant profile of deaths is provided, which is up to 1,500 miles broad

Evidence provided that common attributes of these Sea regions are

c) Known airborne corrosive salinity

d) Known propensity for acid rain

e) Vast oil and gas drilling, refining, transportation by ship and pipeline, associated pollution

f) Pesticides

10 Largest Seas in the World			
Sea Name	Area, Square Miles	Average Depth Feet	Ocean
Arabian	1,491,000	4,652	Indian
Mediterranean	1,144,800	4,688	Atlantic
Caribbean	1,049,500	8,685	Atlantic
South China	895,400	5,419	Pacific
Bering	884,900	5,075	Pacific
Gulf of Mexico	615,000	4,874	Atlantic
Okhotsk (Siberia)	613,800	2,749	Pacific
East China (Korea)	482,300	617	Pacific
Hudson Bay	475,800	420	Artic
Japan	389,100	4,429	Pacific

The Black Sea has been determined to be source of deadly coronavirus by this evaluation. It has an area of 168,500 square miles, average depth of 1,253 feet, exchanges water with the Mediterranean, and has high salinity.

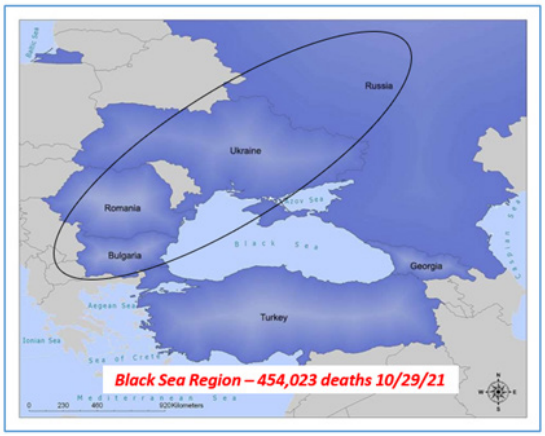
Seas shown in grey are very cold, icy.

70 percent of Earth's surface is covered with water. This water is composed of world's five oceans as well as many other bodies of water. One of these water body types is a sea, a large lake-type water body that has saltwater and is sometimes attached to an ocean. However, a sea does not have to be connected to an ocean outlet; e.g., Caspian.

Major World Sea	Covid-19 Deaths 10/29/21	% of World's Deaths
Arabian Sea	484,413	9.7
Gulf of Mexico	487,761	9.7
Mediterranean Sea	492,534	9.8
Black Sea	454,023	9.1
South China Sea	276,967	5.5
Baltic Sea	207,880	4.2
Caribbean Sea	190,930	3.8
North Sea	190,188	3.8
East China + Japan	26,559	0.5
Total for Border Countries	2,741,036	55% of World's Deaths

5,003,852 global coronavirus deaths through 10/29/21 per Worldometer.

Black Sea and Mediterranean Seas both include Deaths in Turkey. Total deaths are corrected to not double-count.



Black Sea		
Country	Deaths	Death Rate
Euro Russia	236,220	2,101
Ukraine	66,852	1,541
Romania	46,911	2,460
Bulgaria	23,872	3,470
Turkey	70,207	821
Georgia	9,961	2,503
Total	454,023	

Based on similar death rates, oval indicates predominant profile of deaths surrounding Black Sea.

Turkey common to both Black and Mediterranean Seas with death rate below those in oval.

Mediterranean Sea Region – 492,534 deaths 10/29/21

Mediterranean Sea		
Country	Deaths	Death Rate
Turkey	70,207	821
Greece	15,856	1,531
Italy	132,037	2,188
France	117,649	1,797
Spain	87,368	1,868
Morocco	14,660	391
Algeria	5,913	132
Tunisia	25,231	2,106
Libya	5,078	726
Egypt	18,535	177
	492,534	

Based on similar death rates, oval indicates predominant profile of deaths surrounding Mediterranean.

Northern African countries have significant deaths, but much lower death rates, except Tunisia.

Turkey common to both Black Sea and Mediterranean Sea with death rate lower than countries in oval.

South China Sea Region - 276,967 Deaths 10/29/21

Gulf of Mexico – 487,761 deaths 10/29/21

Gulf of Mexico		
Country	Deaths	Death Rate
Mexico	287,631	3,136
Texas	71,506	2,469
Louisiana	14,457	3,129
Mississippi	10,075	3,385
Alabama	15,532	3,176
Georgia	29,065	2,737
Florida	59,495	2,770
	487,761	

Mexican Gov't admitted underreporting 120,000 deaths 3/28/21, not included by Worldometer or this chart.

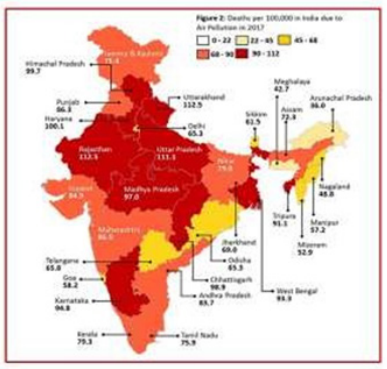
Cuba deaths included in Caribbean Sea.

See later Chart about Gulf of Mexico Winds.

Arabian Sea Region – 484,413 Deaths – 10/29/21

Arabian Sea		
Country	Deaths	Death Rate
India*	278,226	327
Pakistan	28,431	125
Afghanistan	7,269	181
Iran	125,998	1,475
Iraq	23,111	558
Kuwait	2,461	565
Bahrain	1,393	783
Qatar	610	217
UAE	2,136	213
Saudi Arabia	8,790	247
Yemen	1,877	319
Oman	4,111	779
* guestimated portion of India		
	484,413	

- *Next chart summarizes coronavirus deaths in States of India on 10/25/21.*
- *States highlighted accounted for 278,226 coronavirus deaths 10/25/21 vs India's 458,000 total.*



States shown with pink fill border Arabian Sea and accounted for 278,226 coronavirus deaths on 10/25/21.

State	Covid-19 Deaths
Maharashtra	140,016
Kerala	28,592
Karnataka	38,007
Tamil Nadu	36,019
Andhra Pradesh	14,343
Uttar Pradesh	22,899
West Bengal	19,055
Delhi	25,091
Odisha	8,309
Chhattisgarh	13,572
Rajasthan	8,954
Gujarat	10,087
Madhya Pradesh	10,523
Haryana	10,049
Bihar	9,661
Telangana	3,947
Assam	5,973
Punjab	16,551
Total 10/25/21	421,648

Caribbean Sea Region – 190,930 Deaths – 10/29/21

Caribbean Sea		
Country	Deaths	Death Rate
Venezuela	4,860	172
Colombia	127,225	2,466
Panama	7,314	1,661
Costa Rica	7,029	1,363
Nicaragua	207	31
Honduras	10,236	1,012
Guatemala	14,993	817
Belize	491	1,206
Cuba	8,223	727
Jamaica	2,217	751
Haiti	662	58
Dom Rep	4,126	375
Puerto Rico	3,229	954
Virgin Islands	118	1,213
	190,930	

Baltic Sea is 142,857 square miles with an average depth 57 feet.

Baltic Sea		
Country	Deaths	Death Rate
Estonia	1,610	1,213
Latvia	3,499	1,883
Lithuania	6,111	2,288
Belarus	4,745	502
Poland	76,875	2,034
Germany	96,127	1,142
Denmark	2,738	470
Sweden	14,991	1,472
Finland	1,184	213
	207,880	

NEWS RELEASE 28-MAY-2021 Countries in violation of Baltic Sea Convention, polluting marine environment. The countries around the Baltic Sea do not respect their binding international agreement to reduce agricultural pollution of the marine environment. Peer-Reviewed Publication AARHUS UNIVERSITY.

Countries around Baltic Sea do not respect their binding international agreement to reduce agricultural pollution of the marine environment, despite farming activities being most important source of nutrient pollution to the Baltic Sea.

International research team presents evidence on these circumstances in a recent scientific article in the journal Ambio, published by the Royal Swedish Academy of Sciences.

The countries made a commitment 20 years ago to implement 10 specific reduction measures in their national legislation on agricultural pollution-e.g. featuring minimum storage capacity for manure and regulations on animal densities.

Now the researchers' study of legislations and regulations in place at national level, to address nutrients, finds that none of the nine signatories to the Convention is respecting fully the legally binding agreement. Hence, nutrients are leaching to the marine environment in excess of the Baltic Sea's tolerance limits, causing excess algae growth and eutrophication even in the open sea.

The larger countries, Poland, Germany and Russia, have weakest record of implementing the reduction measures in their national legislation. Performance is especially poor in Russia and Poland, but also Germany, despite a ruling by European Court…

North Sea		
Country	Deaths	Death Rate
Netherlands	18,384	1,070
Belgium	25,976	2,228
UK	140,392	2,054
Ireland	5,436	1,085
	190,188	

North Sea is 220,077 square miles with an average depth of 295 feet.

Britain's oil and gas rigs most polluting in North Sea, Guardian, Jillian Ambrose, Sept 28, 2020.

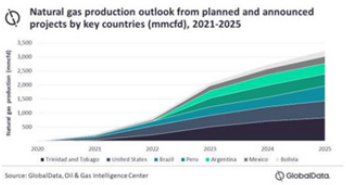
Britain's oil and gas rigs are the most polluting in the North Sea oil basin, according to industry data, with enough unwanted gas burned off every year to heat a million homes.

Oil rigs in the UK Continental Shelf (UKCS) released 13.1m tonnes of carbon dioxide emissions into the atmosphere last year, according to data from Rystad Energy, significantly more than those from the Norwegian and Danish regions of the North Sea, which produced 10.4m tonnes and 1.4m tonnes of CO_2 respectively in the same year.

The report found that oil rigs in UK waters released 3m tonnes of carbon through routine "flaring" of unwanted gas totalling billions of cubic feet. Another 10.1m tonnes of CO_2 were released in large part because the industry regulator, the Oil and Gas Authority (OGA), continues to allow oil producers to run their rigs on fossil fuels, according to Rystad. These figures suggest that the UK emits 21kg of carbon dioxide for every barrel of North Sea oil produced, compared to only 8kg of CO_2 in Norway, where oil producers run their rigs on renewable energy.

This could hold serious implications for the UK's carbon targets if oil production from the UKCS is allowed to rebound by 25% in the 2030s in line with forecasts by Rystad.

The figures have emerged eight years after the World Bank warned nations that global gas flaring contributes as much to climate crisis as a major economy such as Italy.


Natural gas production outlook from planned and announced projects by key countries (mmcfd), 2021-2025
Source: GlobalData, Oil & Gas Intelligence Center
GlobalData

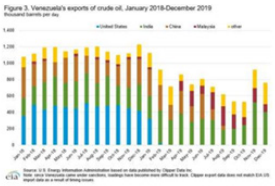
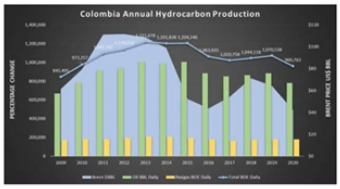
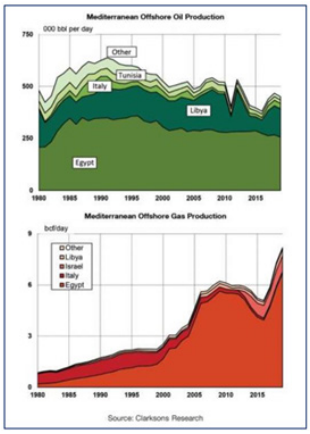
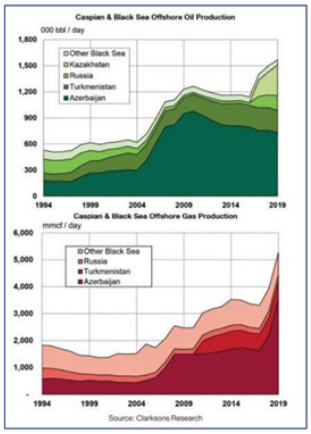


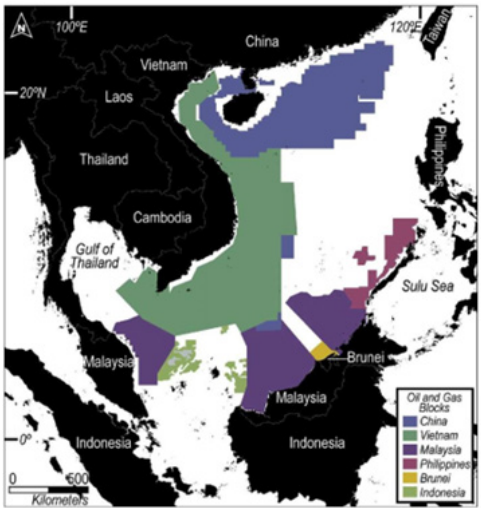
Figure 3. Venezuela's exports of crude oil, January 2018-December 2019


Colombia Annual Hydrocarbon Production

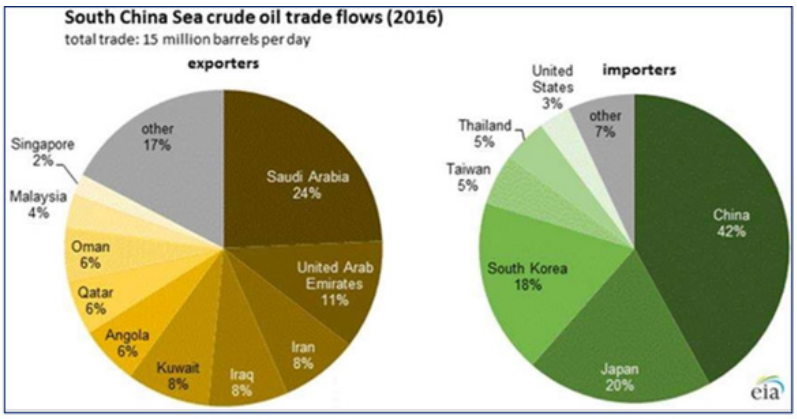

Mediterranean Offshore Oil Production
000 bbl per day
Other
Tunisia
Italy
Libya
Egypt
Mediterranean Offshore Gas Production
bcf/day
Other
Libya
Israel
Italy
Egypt
Source: Clarksons Research

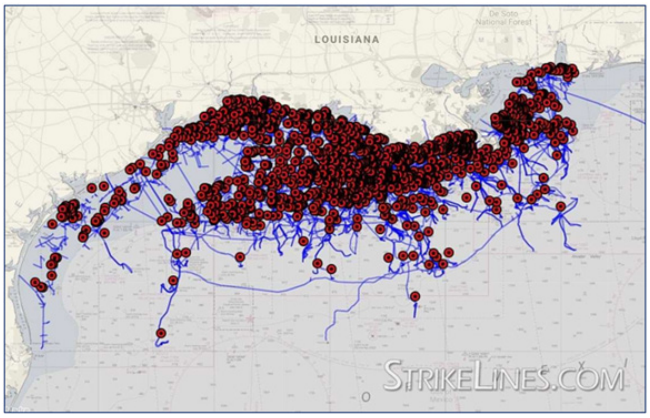

Caspian & Black Sea Offshore Oil Production
000 bbl / day
Other Black Sea
Kazakhstan
Russia
Turkmenistan
Azerbaijan
Caspian & Black Sea Offshore Gas Production
mmcf / day
Other Black Sea
Russia
Turkmenistan
Azerbaijan
Source: Clarksons Research


EMC 2021



South China Sea 'major' trade route for crude oil - More than 30 percent of global maritime crude oil trade moves through South China Sea, according to US energy agency





The Response of the Gulf of Mexico to Wind and Heat Flux Forcing: What has been Learned in Recent Years?

Jorge Zavala-Hidalgo Rosario Romero-Centeno Adriana Mateos-Jasso Steven L. Morey Benjamín Martínez-López

A. Abstract

The Loop Current and its shed eddies dominate the circulation and dynamics of the Gulf of Mexico (GoM) basin. Those eddies are strongly energetic and are the cause of intense currents that may penetrate several hundred meters deep. However, there are regions in the GoM and periods of time in which the local atmospheric forcing plays an important role in its dynamics and thermodynamics. The circulation on the shelves, and particularly on the inner shelf, is mainly wind-driven with seasonality, changing direction during the year with periods of favorable upwelling/downwelling conditions. The wind-driven circulation is associated with the transport of waters with different temperature and salinity characteristics from one region to another. The interannual variability of the circulation on the shelves is linked to the atmospheric variability. Intraseasonal variability of the wind patterns considerably affects the likelihood and magnitude of upwelling and downwelling. The geometry of the GoM is such that large-scale winds may drive opposing upcoast/downcoast currents along different parts of the curving coast, resulting in convergence or divergence zones. The width of the shelves in the GoM is variable;while the West Florida Shelf, the Texas-Louisiana shelf and the Campeche Bank are more than 200 km wide, they are narrower near Veracruz and Tabasco. Another consequence of the GoM physiography and the wind forcing is the development of cross-shelf transports in the southern Bay of Campeche, the southern Texas shelf and southeast of the Mississippi river, which in turn vary during the year. During autumn-winter (from September to April), the GoM is affected by cold fronts coming from the northwest United States, which are associated with strong, dry, and cold winds that mix its waters and generate large sensible and latent heat fluxes from the ocean to the atmosphere. These frontal passages also cool the GoM surface waters due to mixing with lower temperature subsurface waters. During summer, tropical cyclones crossing the GoM can dramatically affect circulation and coastal upwelling.

Corona Virus Evaluation (Part 9)

5million Covid-19 Deaths 10/29/21

55% of global coronavirus deaths occurred in Countries/States bordering World's largest Seas

1) Deadly Seas in descending order:

Mediterranean, Gulf of Mexico, Arabian, Black, South China, Baltic, Caribbean, North, Japan/East China.

These brackish Seas all are home to major oil and gas industry facilities on and offshore. Some of these are heavily polluted with coal-powered electrical generation, diesel transportation, pesticide spraying and runoff…

2) 81% of global coronavirus deaths occurred in the countries bordering World's largest Seas above plus countries bordering the heavier brackish Atlantic, Pacific and Indian Oceans (US Pacific Coast, US Atlantic Coast, both South American Coasts, all South African Coasts)

3) An additional 4% of global coronavirus deaths occurred in the US Great Lakes Region, heavily polluted, but world's largest body of fresh water.

Major World Sea	Covid-19 Deaths 10/29/21	% of World's Deaths
Arabian Sea	484,413	9.7
Gulf of Mexico	487,761	9.7
Mediterranean Sea	492,534	9.8
Black Sea	454,023	9.1
South China Sea	276,967	5.5
Baltic Sea	207,880	4.2
Caribbean Sea	190,930	3.8
North Sea	190,188	3.8
East China + Japan	26,569	0.5
Total for Border Countries	2,741,058	55% of World's Deaths

5,003,852 global coronavirus deaths through 10/29/21 per Worldometer.

Black Sea and Mediterranean Seas both include Deaths in Turkey. Total deaths are corrected to not double-count.

Covid-19 Deaths in Countries Bordering Seas		
Sea Region	Deaths	% World
World Seas	2,741,058	54.8%
So America*	1,049,885	21.0%
So Africa	89,151	1.8%
US Pacific Coast	86,542	1.7%
US Atlantic Coast	111,306	2.2%
US Great Lakes**	194,725	3.9%
29-Oct-21	4,272,667	85.4%
Global total	5,003,852	
* less Caribbean Countries		
** largest world fresh water		

4,272,667 deaths in countries/States bordering large water bodies on October 29, 2021 accounting for 85% of world's 5,003,852 coronavirus deaths.

US Pacific Coast includes California, Oregon, Washington.

US Atlantic Coast includes Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina.

Great Lakes		
State	Deaths	Death Rate
New York	57,370	2,949
Pennsylvania	32,188	2,514
Ohio	25,282	2,163
Indiana	16,976	2,522
Illinois	28,901	2,281
Michigan	24,027	2,406
Ontario	9,981	727
	194,725	

Following Slides Illustrate Polluted Environment in Great Lakes Region per LADCO

The Great Lakes have a dominant influence on the climate, weather, and air quality in the LADCO region.

The air quality issues in the LADCO region result from interaction between man-made and natural emissions sources; local, regional, and transported pollution; and regional climate and weather (meteorology).

Ground-level ozone pollution occurs in and near urban areas and the lakeshore during the summer months. Ozone is a secondary pollutant that is formed in presence of sunlight from reactions of nitrogen oxides (combustion by-product) and volatile organic compounds (fuels, industrial sources, solvents, and trees/plants). Unique weather of Lake Michigan shoreline exacerbates ozone concentrations in region.

Air quality issues in region result from emissions sources in and near region and complex meteorology surrounding Great Lakes. Major man-made emissions sources of air pollution in the region include:

i. Electricity generation, metals production, and other heavy industry are major sources of CO, CO_2, NOx, SO_2, methane, and air toxics

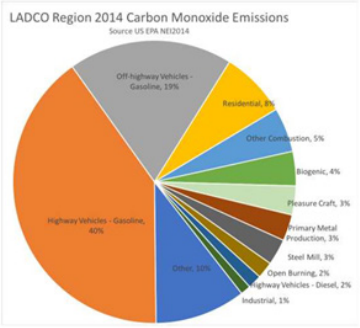
ii. Interstates and urban roadways are major sources of VOC, NOx, CO, CO_2, and particles

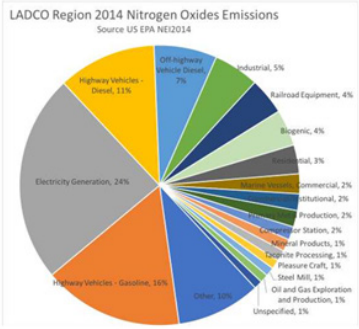
iii. Intermodal transportation (road-rail-marine) terminals are major sources of NOx, CO, CO_2, particles

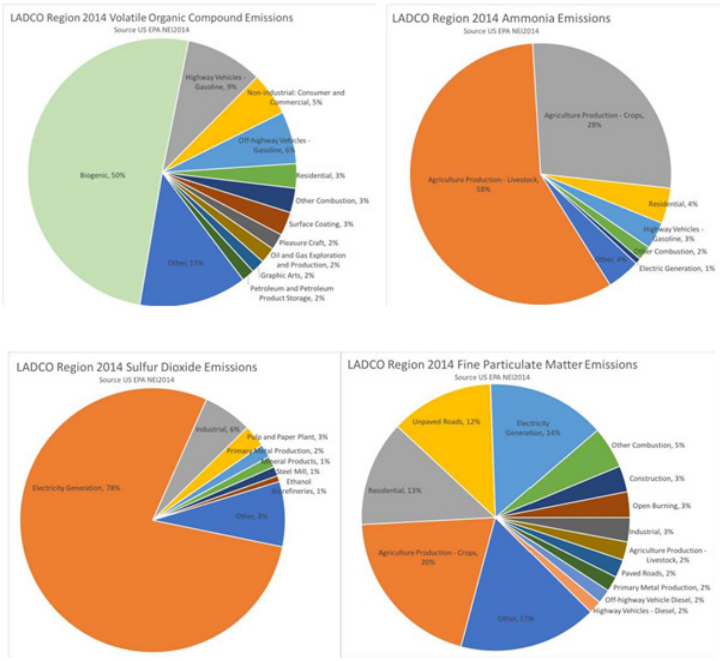
iv. Dense urban areas contain many smaller to medium sources of VOC, NOx, CO, methane, air toxics

v. Agricultural areas are major sources of NH_3, methane, particles

vi. Natural sources of air pollution in the region include wildfires (NOx, CO, CO_2, particles), vegetation (VOC), and soils (NO).







Great Facts About the Five Great Lakes by Kim Ann Zimmermann June 29, 2017

The Great Lakes-Superior, Huron, Michigan, Ontario and Erie-make up the largest body of fresh water on Earth, accounting for one-fifth of the freshwater surface on the planet at 6 quadrillion gallons. The area of all the Great Lakes is 95,160 square miles (246,463 square kilometers) and span 750 miles (1,200 km) from west to east. The square mileage is larger than the state of Texas.

The lakes, called "the nation's fourth seacoast," are on the U.S. and Canadian border, touching Ontario in Canada and Michigan, Wisconsin, Minnesota, Illinois, Indiana, Ohio, Pennsylvania and New York in the United States. As of 2017, more than 30 million people live in the Great Lakes basin, according to the Environmental Protection Agency (EPA). This equates to 10 percent U.S. residents and 30 percent Canadian residents. More than 3,500 species of plants and animals inhabit the Great Lakes basin, as well, including 170-plus species of fish.

Today, the Great Lakes are popular recreation spots for boating, fishing and other recreational activities, and still serve as an important mode of transportation of goods, but they have not always been in their current form. About 14,000 years ago, the Great Lakes area was covered with a glacier that was more than a half-mile (1km) thick. As the glacier melted, it slowly moved toward Canada and left behind a series of large depressions that filled with water. These formed the basic shape of the Great Lakes, and about 10,000 years ago the Great Lakes took the form that is familiar today.

Great Lakes Water Issues: Pollution & Invasive Species

Elizabeth Friedl has a Master's in Zoology from North Carolina State, one in GIS from Florida State University, and a bachelor's in biology from Eastern Michigan University. She has taught college level Physical Science and Biology.

Making up the largest freshwater system on Earth, the Great Lakes are an impressive feature. But there are also great issues: those of pollution and invasive species.

Pollution in the Great Lakes

Because the lakes are so extensive, border so many states (two countries!), and provide recreation, commerce, and industry to so many, pollution is a major issue. Water wasn't always seen as a precious resource to protect. Until early 1970s both industry and individuals would dump waste into Great Lakes thinking it would be diluted without any harm.

This led to large-scale pollution in lakes, from point source pollution (pollution from a specific location such as a sewage drainpipe) and non-point source pollution (runoff pollution that comes from many different sources and includes soil, litter etc). When a company that is placed along the shore of one of the Great Lakes dumps its waste into the water, this is point source. But runoff of land fertilizers and chemicals creates non-point source pollution, which is much harder to control.

Many grassroots groups and legislative changes have helped to clean up the Great Lakes, and will also help prevent future pollution from occurring. For example, after a study determined an abnormally high level of phosphorous in the lakes, the U.S. and Canada signed the

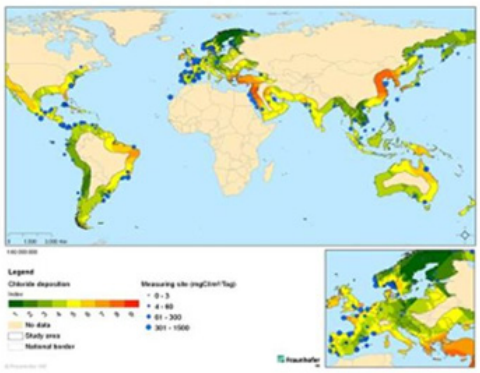
Great Lakes Water Quality Agreement (GLWQA) in 1972 and again in 1978 to combat pollution, specifically 'persistent organic pollutants' (a collection of synthetic chemical pollutants related to industry), pollution related to non-point sources, and air pollution.

Invasive Species

More than 180 aquatic species have been introduced into the Great Lakes. Fortunately, most of them either did not establish populations or are barely noticeable in the ecosystem. A small fraction of these non-native species have become invasive, which means that they have established abundant populations that have negative consequences for the existing ecosystem. Invasive species frequently have strong negative impacts on fish populations and the fisheries they support. Sea lamprey, alewife, dreissenid mussels, round gobies, and the spiny water flea are all examples of invasive species that have affected or are affecting Great Lakes fisheries. Along with overfishing and pollution, invasive species are responsible for the loss of 18 fish species in at least one Great Lake. Because of the damage that these harmful invaders pose to fisheries, the Great Lakes Fishery Commission believes that preventing the introduction and establishment of non-native aquatic species is essential for the long-term sustainability of the fishery. This means closing vectors of introduction that include illegal transport of invasive species, discharge of ballast water through shipping, inadvertent introduction by boats, and release of live bait, as well as eventually separating the Mississippi River and Great Lakes basins through their artificial connection at Chicago.

Ships, through the discharge of ballast, is also a critical invasive species vector. Ships use ballast to stabilize a trans-oceanic or interlake voyage. When the ballast is discharged to take on cargo (the cargo then serves as ballast), organisms picked up with the ballast water in the originating port can be introduced to the ecosystem to which the ballast is discharged. The commission believes ballast regulations and practices should be harmonized between Canada and the United States, should apply nationally, and should apply to foreign as well as domestic ships. Four species of Invasive carps, bighead carp, silver carp, black carp, and grass carp are some undesirable invasive fishes that Great Lakes fishery managers are seeking to prevent from establishment. The commission will continue to be vigilant at the policy level and facilitate cooperative action from fishery managers to prevent establishment of harmful invaders into the future. Meanwhile, the commission will continue to effectively control the invasive sea lamprey.

Most salty regions in the world



The "most salty regions in the world" include the South China Sea, the Seas of Japan and East China, the Black Sea, the Baltic Sea, the North Sea, the Gulf of Mexico, the Caribbean Sea, the US Pacific and Atlantic Coasts, the South American Pacific and Atlantic Coasts.

Apparently Africa was not included in the evaluation that led to this map. The next three Charts show that South Africa experiences similar corrosion inland as the rest of the other salty water coastal areas.

The first atmospheric corrosion map of South Africa, produced by Callaghan in 1991, has become outdated, because it primarily focuses on the corrosivity of coastal environments, with little differentiation given concerning South Africa's inland locations. To address this problem, a study was undertaken to develop a new corrosion map of the country, with the emphasis placed on providing greater detail concerning South Africa's inland regions. Here we present this new corrosion map of South Africa's macro atmosphere, based on 12-month corrosion rates of mild steel at more than 100 sites throughout the country. Assimilations and statistical analyses of the data (published, unpublished and new) show that the variability in the corrosion rate of mild steel decreases significantly moving inland. Accordingly, the average first-year corrosion rate of mild steel at the inland sites (at all corrosion monitoring spots located more than 30 km away from the ocean) measured 21 [+ or -] 12 [micro]m/a [95% CI: 18-23 [micro]m/a]. The minimum inland figure was about 1.3 [micro]m/a (recorded at Droerivier in the Central Karoo) and the maxima were approximately 51 [micro]m/a and 50 [micro]m/a in the industrial hearts of Germiston (Gauteng) and Sasolburg (Free State), respectively. The variability in the corrosion rate of mild steel also decreased by as much as 80% between 150 m and 1000 m from the coastline. Moreover, the impact of changing altitude on the corrosivity of the environment was confirmed, particularly along the coastal regions. Significance:

i. A new corrosion map of South Africa's inland and coastal regions is presented.

ii. The map facilitates the identification of South Africa's least to most corrosive environments; enabling the selection of more appropriate corrosion protection solutions for general, business, mining and industrial installations.

iii. In identifying South Africa's least corrosive areas, the use of more environmentally friendly corrosion protection procedures is potentially encouraged.

Can South Africa's Coastal Infrastructure Survive Corrosion?

Simon Norton, International Zinc Association 04.21.20

South Africa has a coastline of more than 2,850 kilometres and an extensive, complex and vastly expensive infrastructure has developed along the coast over the past 100 years.

This ranges from luxury houses at coastal holiday resorts and quaint villages, to rail and industrial infrastructure in the form of warehouses, cranes, electrical pylons and structural steel. The bulk of this hugely costly infrastructure is concentrated up the west coast at Saldanha Bay, around Cape Town, along the Garden Route, at smaller cities such Port Elizabeth and East London, around the Durban metropolis and at the Richards Bay coal terminal.

Billions of Rands have been invested at the coast over the past 50 years in structural steel, power line masts, roofing, water treatment plants, wastewater process units, cladding of factory structures, luxurious housing with architecturally designed features and expensive roof sheeting. Can these assets and investments actually stay the course and last long enough to ensure a good return on investment for home and business owners and municipalities?

In truth, South Africa's coastal infrastructure is a mix of good and bad design and in some cases poor steel protection. Consulting engineers and designers seem to need intensive education on the important role that zinc hot dip galvanised steel can play in ensuring a long life (30+ years) for exposed structural steel and other steel fixtures.

In South Africa with our long and very corrosive coastline, it is absolutely vital that civil engineers, consulting engineers and architects utilise hot dip galvanized steel structures and even galvanized reinforcing steel in concrete structures exposed to coast salt spray and sea spray.

It's the chlorides in sea spray and sea mist that corrode steel the most and put South Africa's coastal infrastructure most at risk and we have to inform and impress on design engineers how critical it is to use galvanized steel as well as aluzinc and galvanised roof sheeting to keep the chlorides out.

There is no need for coastal steel infrastructure to be damaged by chloride corrosion and seawater corrosion if the right tools are used to design structures, roofing or steel items. The South African Bureau of Standards (SABS) offers a range of very useful standards for working with hot-dip galvanizing of steel.

The most effective way to protect coastal infrastructure is to use what we call a DUPLEX COATING SYSTEM, where the steel is first hot-dip galvanized to SANS 121 and then overcoated with multiple layers of organic paint. This not only offers effective corrosion protection in highly corrosive coastal environments but also offers the designer the choice to choose an aesthetically attractive paint color.

It is very difficult to quantify the risk that South African coastal infrastructure faces and to highlight the magnitude of the risk.

However, the fall in the quantity of zinc imported into South Africa between 2015 and 2018, by nearly 54,000 metrictons, speaks volumes…

Reflections from Part 9 5M Data Analysis

Over 80% of the world's coronavirus deaths have occurred in salty coastal regions adjacent to the world's Oceans and large Seas across the world. Throughout this evaluation from Part 1 through Part 8, these same areas have been shown to be heavily polluted from oil and gas industry operations, from coal-powered electrical generating plants, from diesel transportation on land and sea, and from pesticide spraying and runoff.

These areas are all subject to corrosion from the salty waters and acid rain is a well know result of these operations.

It must be concluded that the coronavirus thrives in a deadly manner in aqueous, salty, acidic, polluted atmospheres subject to seasonal temperature inversions.

However, no public literature seems to be available from the world "experts" addressing this.

4million Covid-19 Deaths Surrounding Brackish Waters

About Halloween, the world reached 5 million covid-19 deaths per all coronavirus death trackers. 4 million of these deaths occurred in Countries or States directly bordering the world's brackish Seas and Oceans.

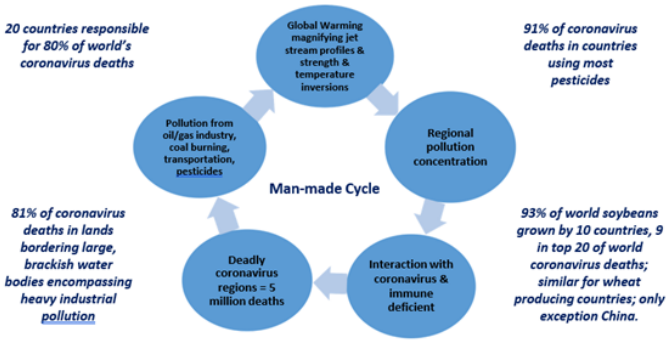
Here is the data:

i. World Brackish Seas: Mediterranean Sea-493,000; Gulf of Mexico 488,000; Arabian Sea 484,000; Black Sea 454,000; South China Sea 277,000; Baltic Sea 208,000; Caribbean Sea 191,000; North Sea 190,000; East China + Japan Seas 27,000.

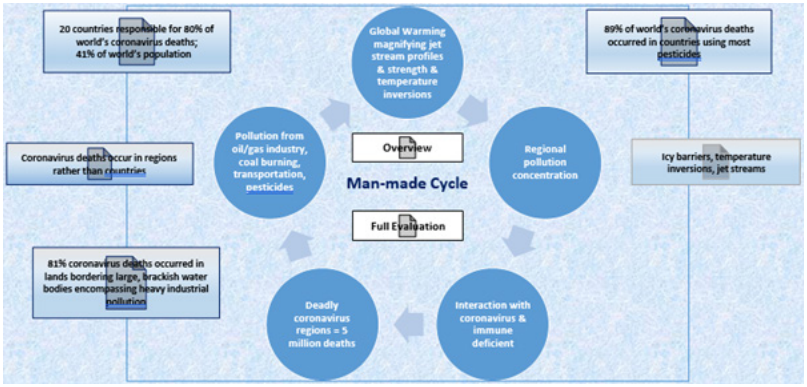
ii. World's Oceans: US Pacific Coast 87,000; US Atlantic Coast 111,000; South American Pacific and Atlantic Coasts (less Caribbean countries) 1,050,000; South African Coasts 89,000. Total=4.1 million covid-19 deaths on the lands directly abutting the world's brackish waters. In addition 195,000 deaths occurred in the US States directly abutting the Great Lakes, another 4% of the world's covid-19 deaths. This brings total covid-19 deaths on lands directly abutting Seas to 85% of the world's coronavirus deaths.

What do these lands abutting Seas have in common? Research shows that these aqueous regions are home to the oil and gas industries, large electrical generation, substantial diesel transportation and auto traffic, often massive pesticide runoff. Obviously this means heavy pollution. The world galvanizing associations show these lands as the saltiest on earth. Because of the CO_2 generation, these lands are subject to acid rains. These lands also undergo significant seasonal temperature inversions.

This pollution has been determined to be the cause of global warming, which exasperates the polar-equator temperature profiles generating powerful jet streams, which in turn are the source of temperature inversions around the world. Research has shown during covid-19 death periods in these various regions, that the deaths only occur on the tropical side of the jet streams and always under temperature inversion conditions.



Corona Virus Evaluation (Part 10)



5million World Coronavirus Deaths Reached on October 29, 2021

Massive amount of world data tracked which has provided many key learnings that should be pondered and addressed before the next virus, likely to occur prior to 2030.

Overview of Website

Logo: Data Analysis -Ponder Facts

a) Politically world divided into 220 countries/territories; data so tracked by coronavirus meters.

b) Covid-19 deaths don't recognize country boundaries; deaths occur regionally in identifiable patterns.

c) Multiple ways of defining regions.

i. Continents.

ii. Lands surrounding major bodies of water, particularly brackish.

iii. Well-known pollution sources; refineries, coal burning, transportation, pesticide spraying.

iv. Predominant topography and geography: mountain valleys, seacoasts, polar regions

d) Other integral factors involved in causing covid-19 deaths.

i. Seasonal temperature inversions, known to concentrate pollutants and facilitate drift.

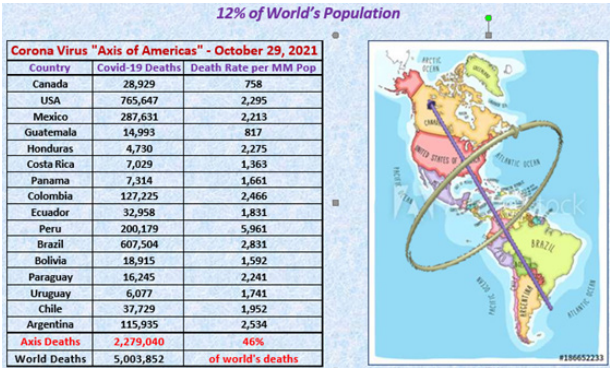
ii. Intensity and profiles of jet streams, affected by global warming, on temperature inversions produced.

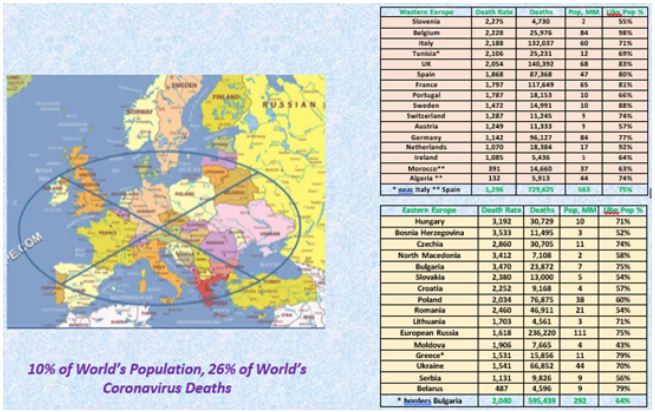
iii. World population explosion over past 230 years

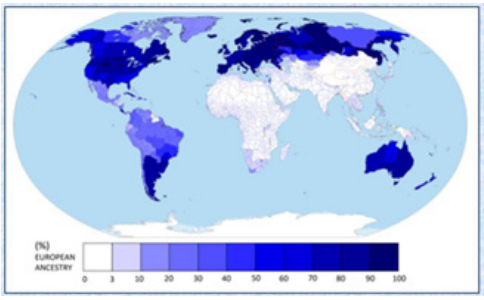
84 of 222 Countries with more than 4,000 Corona Virus Deaths on 10/29/21.										
	Pop, MM	Acc Pop	% of Pop	Urban %	Country	Deaths	Case Rate	Death Rate	Acc Deaths	% of Deaths
1	332	332	4%	83%	USA	765,647	140,196	2,295	765,647	15%
2	213	545	7%	87%	Brazil	607,504	101,572	2,831	1,373,151	27%
3	1,385	1,930	25%	35%	India	457,773	24,507	327	1,830,924	37%
4	130	2,060	26%	80%	Mexico	287,631	29,056	2,213	2,118,555	42%
5	111	2,171	28%	75%	European Russia	236,220	57,750	1,618	2,354,775	47%
6	33	2,204	28%	79%	Peru	200,179	65,489	5,961	2,554,954	51%
7	274	2,478	32%	56%	Indonesia	143,361	15,299	517	2,698,315	54%
8	68	2,546	33%	83%	UK	140,392	131,357	2,054	2,838,707	57%
9	60	2,606	33%	71%	Italy	132,037	78,923	2,188	2,970,744	59%
10	51	2,657	34%	80%	Colombia	127,225	96,850	2,466	3,097,969	62%
11	84	2,741	35%	76%	Iran	125,998	69,186	1,475	3,223,967	64%

12	65	2,806	36%	81%	France	117,649	109,268	1,797	3,341,616	67%
13	45	2,851	37%	93%	Argentina	115,935	115,585	2,534	3,457,551	69%
14	84	2,935	38%	77%	Germany	96,127	54,233	1,142	3,553,678	71%
15	60	2,995	38%	66%	South Africa	89,151	48,658	1,479	3,642,829	73%
16	47	3,042	39%	80%	Spain	87,368	107,124	1,868	3,730,197	75%
17	38	3,080	39%	60%	Poland	76,875	79,602	2,034	3,807,072	76%
18	84	3,164	41%	75%	Turkey	70,207	90,361	821	3,877,279	77%
19	44	3,208	41%	70%	Ukraine	66,852	66,350	1,541	3,944,131	79%
20	21	3,229	41%	54%	Romania	46,911	85,406	2,460	3,991,042	80%
Global Population		7,800	million		Global deaths	5,003,852			10/29/2021	

Region	Ave Death Rate	Deaths	MM pop	% Urban pop
So Amer	2,871	1,177,110	410	78%
No Amer	2,056	1,114,279	542	73%
East Eur	2,040	595,439	292	64%
West Eur	1,296	729,625	563	75%
ME/SW Asia	374	842,204	2,249	59%
	1099	4,458,657	4,056	
October 29, 2021 total deaths		5,003,852	7,800	
		89%	52%	







Map is from Brilliantmaps.com and labeled "The European Diaspora". European emigration defined as emigration waves from the European continent to other continents. Origins of various European diasporas can be traced to people who left European nation states or stateless ethnic communities on European continent.
e.g, Argentina: 38,416,407
Mexico: 59,000,000
Brazil: 91,051,646
United States: 234,370,202

Countries of European Diaspora (less Australia) responsible for 72% of world's coronavirus deaths and account for only 22% of world's population.

Australia's population density is only 3 people per square kilometer vs Italy at 206 and Spain at 91.

Major World Sea	Covid-19 Deaths 10/29/21	% of World's Deaths
Arabian Sea	484,413	9.7
Gulf of Mexico	487,761	9.7
Mediterranean Sea	492,534	9.8
Black Sea	454,023	9.1
South China Sea	276,967	5.5
Baltic Sea	207,880	4.2
Caribbean Sea	190,930	3.8
North Sea	190,188	3.8
East China + Japan	26,569	0.5
Total for Border Countries	2,741,058	55% of World's Deaths

5,003,852 global coronavirus deaths through 10/29/21 per Worldometer.

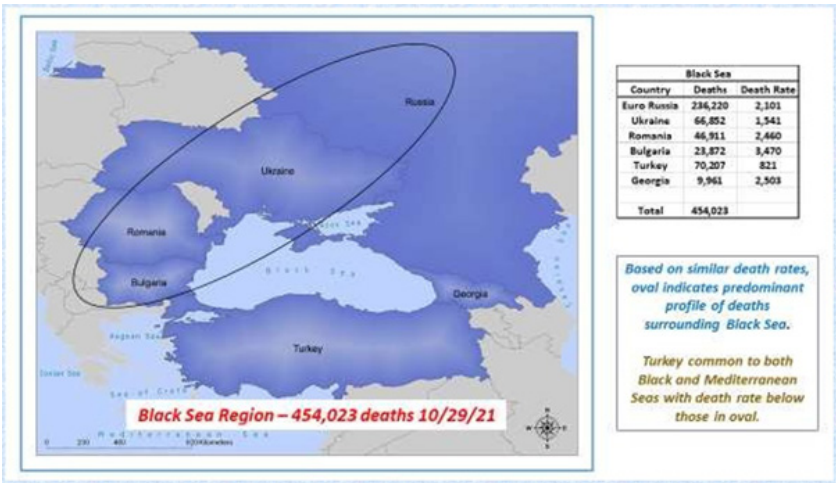
Black Sea and Mediterranean Seas both include Deaths in Turkey. Total deaths are corrected to not double-count.

Covid-19 Deaths in Countries Bordering Seas		
Sea Region	Deaths	% World
World Seas	2,741,058	54.8%
So America*	1,049,885	21.0%
So Africa	89,151	1.8%
US Pacific Coast	86,542	1.7%
US Atlantic Coast	111,306	2.2%
US Great Lakes**	194,725	3.9%
29-Oct-21	4,272,667	85.4%
Global total	5,003,852	
* less Caribbean Countries ** largest world fresh water		

4,272,667 deaths in countries/States bordering large water bodies on October 29, 2021 accounting for 85% of world's 5,003,852 coronavirus deaths.

US Pacific Coast includes California, Oregon, Washington.

US Atlantic Coast includes Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina.



Black Sea		
Country	Deaths	Death Rate
Euro Russia	236,220	2,101
Ukraine	66,852	1,541
Romania	46,911	2,460
Bulgaria	23,872	3,470
Turkey	70,207	821
Georgia	9,961	2,503
Total	454,023	

Based on similar death rates, oval indicates predominant profile of deaths surrounding Black Sea.

Turkey common to both Black and Mediterranean Seas with death rate below those in oval.

Mediterranean Sea Region – 492,534 deaths 10/29/21

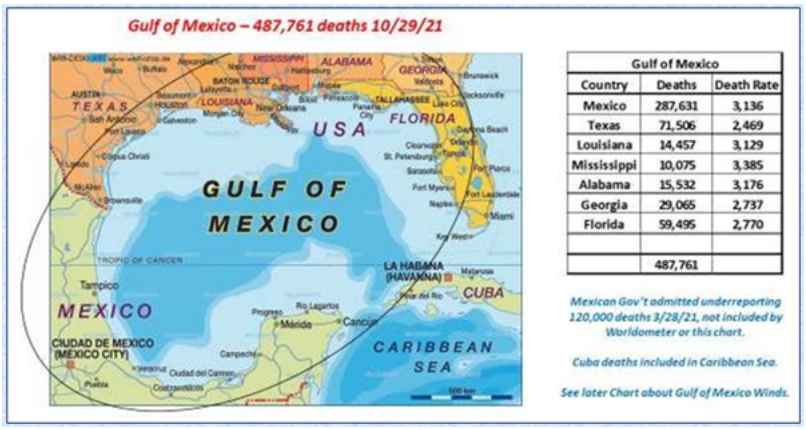
Mediterranean Sea		
Country	Deaths	Death Rate
Turkey	70,207	821
Greece	15,856	1,531
Italy	132,017	2,188
France	117,649	1,797
Spain	87,368	1,868
Morocco	14,600	391
Algeria	5,933	132
Tunisia	25,231	2,106
Libya	5,078	726
Egypt	18,535	177
	492,534	

Based on similar death rates, oval indicates predominant profile of deaths surrounding Mediterranean. Northern African countries have significant deaths, but much lower death rates, except Tunisia.

Turkey common to both Black Sea and Mediterranean Sea with death rate lower than countries in oval.

South China Sea Region - 276,967 Deaths 10/29/21

South China Sea		
Country	Deaths	Death Rate
Vietnam	21,966	223
Cambodia	2,773	164
Thailand	19,070	272
Myanmar	18,644	340
Malaysia	28,532	876
Indonesia	143,361	517
Philippines	42,621	382
	276,967	

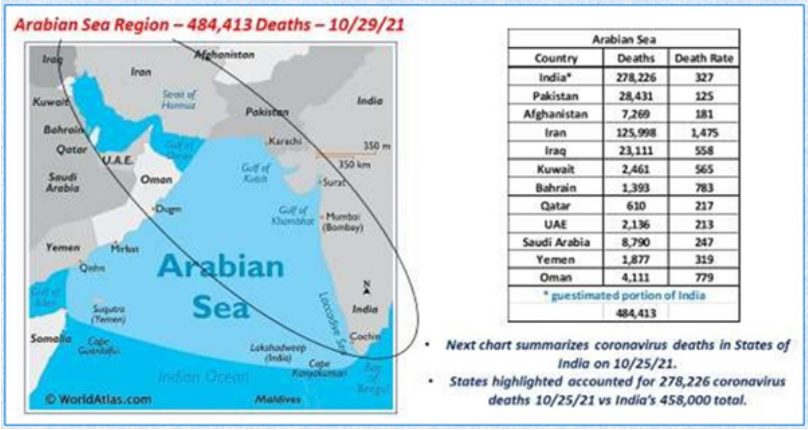


Gulf of Mexico		
Country	Deaths	Death Rate
Mexico	287,631	3,136
Texas	71,506	2,469
Louisiana	14,457	3,129
Mississippi	10,075	3,385
Alabama	15,532	3,176
Georgia	29,065	2,737
Florida	59,495	2,770
	487,761	

Mexican Gov't admitted underreporting 120,000 deaths 3/28/21, not included by Worldometer or this chart.

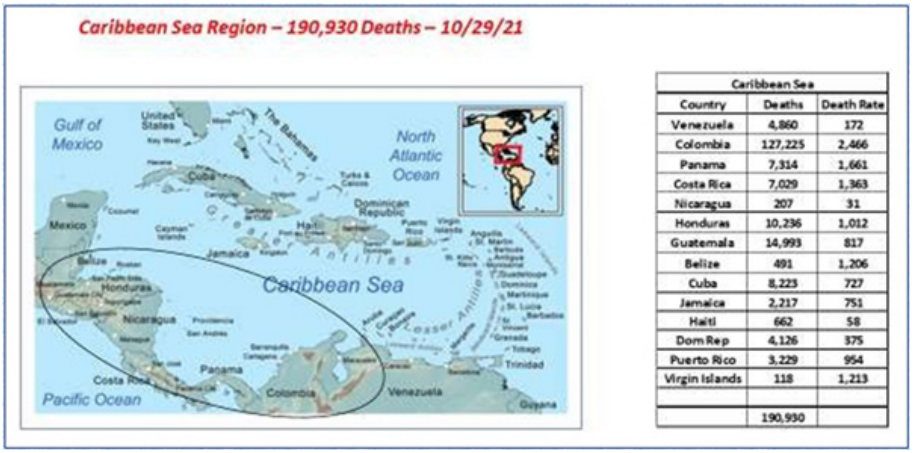
Cuba deaths included in Caribbean Sea.

See later Chart about Gulf of Mexico Winds.



Arabian Sea		
Country	Deaths	Death Rate
India*	278,226	327
Pakistan	28,431	125
Afghanistan	7,269	181
Iran	125,998	1,475
Iraq	23,111	558
Kuwait	2,461	565
Bahrain	1,393	783
Qatar	610	217
UAE	2,136	213
Saudi Arabia	8,790	247
Yemen	1,877	319
Oman	4,111	779
* guestimated portion of India		
	484,413	

- *Next chart summarizes coronavirus deaths in States of India on 10/25/21.*
- *States highlighted accounted for 278,226 coronavirus deaths 10/25/21 vs India's 458,000 total.*



Caribbean Sea		
Country	Deaths	Death Rate
Venezuela	4,860	172
Colombia	127,225	2,466
Panama	7,314	1,661
Costa Rica	7,029	1,363
Nicaragua	207	31
Honduras	10,236	1,012
Guatemala	14,993	817
Belize	491	1,206
Cuba	8,223	727
Jamaica	2,217	751
Haiti	662	58
Dom Rep	4,126	375
Puerto Rico	3,229	954
Virgin Islands	118	1,213
	190,930	

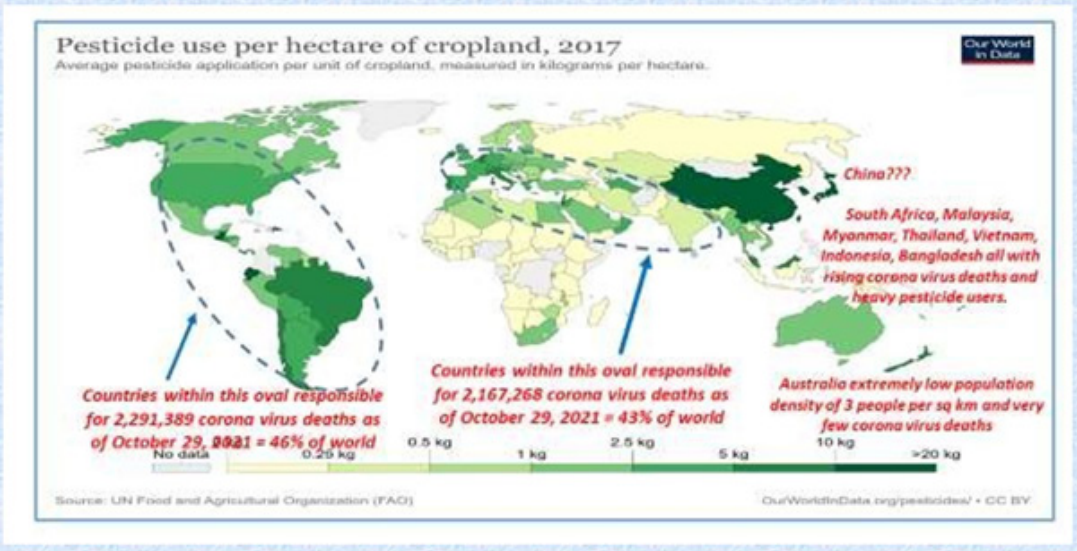
Baltic Sea is 142,857 square miles with an average depth 57 feet.

Baltic Sea		
Country	Deaths	Death Rate
Estonia	1,610	1,213
Latvia	3,499	1,883
Lithuania	6,111	2,288
Belarus	4,745	502
Poland	76,875	2,034
Germany	96,127	1,142
Denmark	2,738	470
Sweden	14,991	1,472
Finland	1,184	213
	207,880	

North Sea		
Country	Deaths	Death Rate
Netherlands	18,384	1,070
Belgium	25,976	2,228
UK	140,392	2,054
Ireland	5,436	1,085
	190,188	

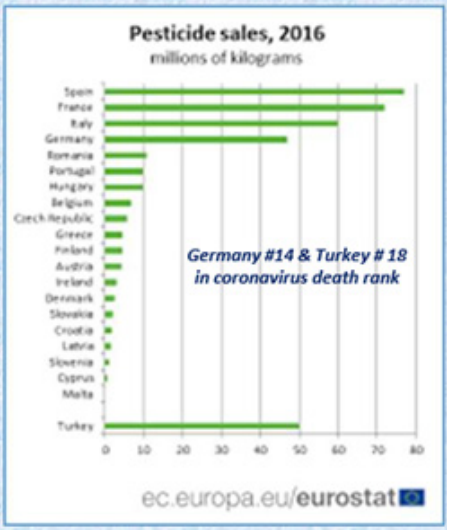
North Sea is 220,077 square miles with an average depth of 295 feet.

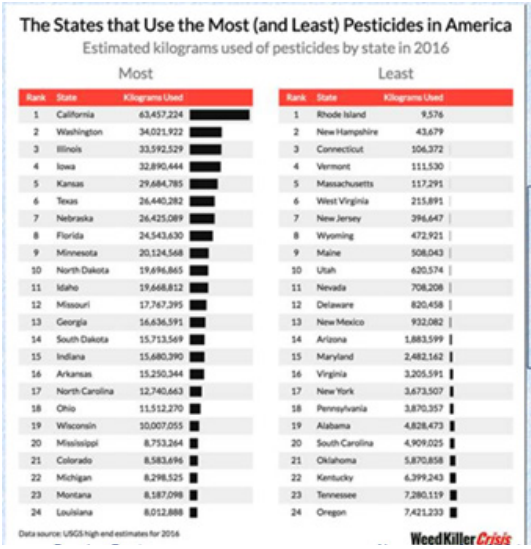
Great Lakes		
State	Deaths	Death Rate
New York	57,370	2,949
Pennsylvania	32,188	2,514
Ohio	25,282	2,163
Indiana	16,976	2,522
Illinois	28,901	2,281
Michigan	24,027	2,406
Ontario	9,981	727
	194,725	



World Atlas April 25, 2017

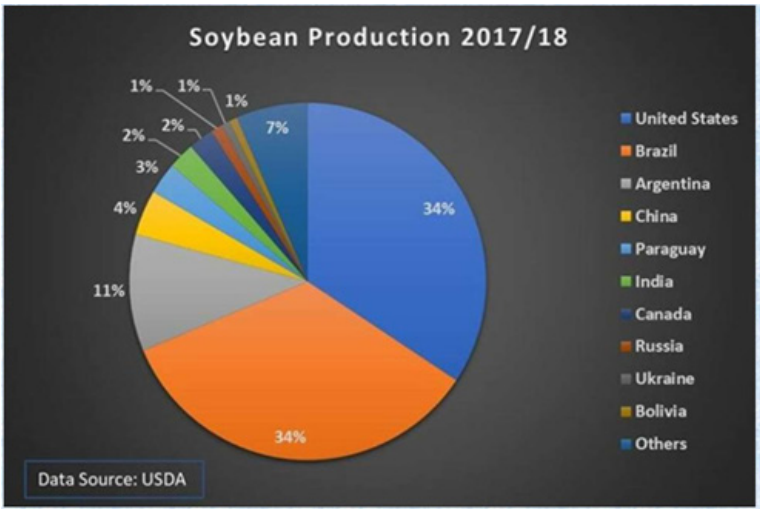
World Rank Pesticide Consumption	Country	Annual Pesticide Consumption millions of kg	Coronavirus Death Rank
1	China	1,806	79
2	USA	386	1
3	Argentina	265	13
4	Thailand	87	35
5	Brazil	76	2
6	Italy	63	9
7	France	62	12
8	Canada	54	26
9	Japan	52	40
10	India	40	3





Reviewing corona virus death data in US showed that 65% occurred in States with refineries or directly in refinery regions; e.g. New York vs New Jersey. Searching had identified pesticide spraying during periods of temperature inversions as a significant problem.

Table shows pesticide consumption for each US State. The fruit, vegetable, corn, wheat producers are the States that consume the most pesticides.



Coronavirus Death Rank
1
2
13
79
42
3
26
5
19
36

Note that Belgium, the country with highest death rate of 786, has direct border with Germany having death rate of only 98 (May 17, 2020 data).

How could this possibly be?

Plateaus of the Ardennes and High Fens separate Belgium from Germany

The blue line separates the geographic regions with low CV deaths from those of high CV deaths.
The regions north & east of the blue line have death rates of 10-20% of those to the south & west of the blue line.

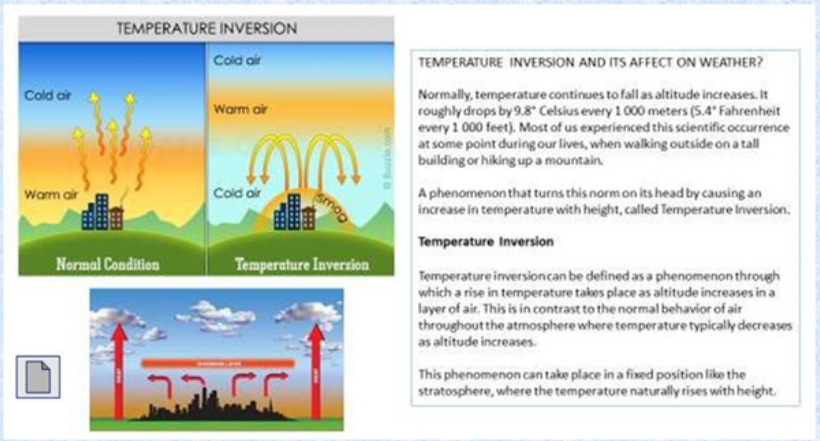
Late May to mid-June 2020, continued to explore why/how areas of high corona virus death rates existed and spread to other countries. Concept of icy, cold regions seemed difficult to defend at this time in 2020.

Considered personal experience on DuPont Chambers Works during periods with "temperature inversions". These conditions prevented dissipation of toxic plumes from plant stacks into atmosphere, and resulted in plumes actually descending to ground level. Manufacturing operations had to be stopped to protect workers. State of technology 1940s to 1970s.

EPA has promulgated air quality standards discussing accumulation of toxic particulate matter in 2.5 and 10 micron range as a result of "temperature inversions". Smog one term used to describe type of air quality that occurs. PM2.5, PM10 used in the nomenclature on air quality standards. Air Quality Index (AQI) is monitored in all major areas of the world.

Searching Google for "temperature inversions" in Torino Valley of Northern Italy, found they typically occur in January-February. This was timing of beginning of corona virus deaths in northern Italy – Milan, Turin – the Torino Valley of the Alps. Searched Google for primary air flow between Italy and France, which led to existence of traffic tunnels through the Alps from Italy to France.

Searching Google for interactions with polluted air with corona virus provided information that corona virus attached to PM2.5 aerosols remaining airborne and at this micron size readily goes to lungs. Further half-life of corona virus shown to be 86 hours at high humidity conditions. Also evidence that corona virus remains airborne in air conditioning systems in hospitals. Churches, ships, all closed buildings potentially subject to this.



The Full 20 Month Coronavirus World Death Evaluation

A. Abstract

i. Part 1-recognition that world regions independently experienced coronavirus deaths in identifiable patterns, principally impacted by major pollution sources and exasperated by seasonal temperature inversions.

ii. Part 2-Considered differences of Western World vs Eastern World do to wide difference in deaths.

iii. Part 3-Recognized that majority of deaths were occurring in humid sub-tropical climates.

iv. Part 4-With abrupt increase in South American deaths, focused on role of pesticides on creating deaths.

v. Part 5-Evaluated whether other world regions were similar in characteristics as their deaths increased to those in Parts 1 through 4.

vi. Part 6-Realized that coronavirus deaths regions were being controlled by the world's jet streams.

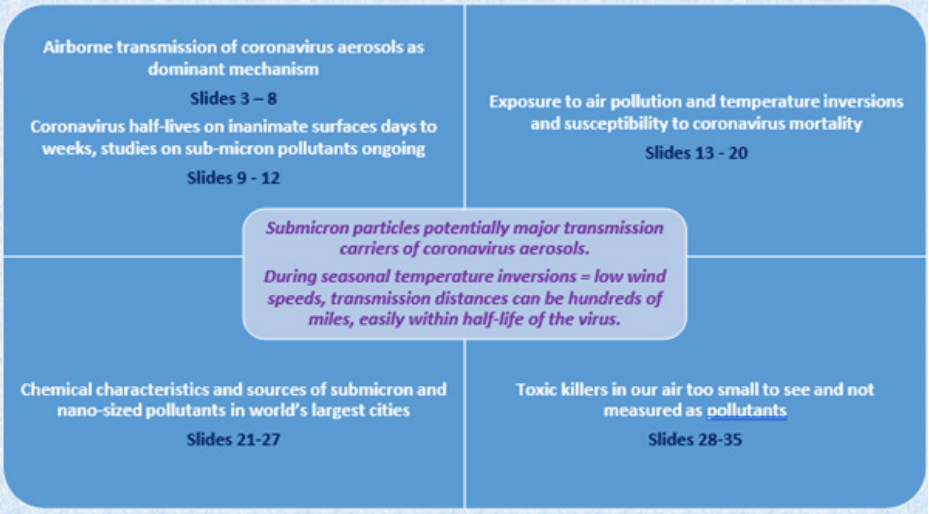
vii. Part 7-Updated world coronavirus death statistics for the predominant deadly regions.

viii. Part 8-Realized that the world's largest brackish Seas, encompassing major pollution sources, accounted for 55% of world's coronavirus deaths.

ix. Part 9-Extended evaluation to world's brackish Oceans to findings for brackish Seas, accounting for 85% of world's coronavirus deaths.

Corona Virus Evaluation (Part 11)

Influence of Sub-Micron and Nano-Sized Pollutant Particles on the Transmission of Coronavirus Over Long Distances



Airborne Transmission of Respiratory Viruses

Chia C Wang

HTTPS://ORCID.ORG/0000-0003-3214-9937

Kimberly A Prather

HTTPS://ORCID.ORG/0000-0003-3048-9890

Josué Sznitman

HTTPS://ORCID.ORG/0000-0001-8217-3842

Jose L Jimenez

HTTPS://ORCID.ORG/0000-0001-6203-1847

Seema S Lakdawala

HTTPS://ORCID.ORG/0000-0002-7679-2150

Zeynep Tufekci

HTTPS://ORCID.ORG/0000-0002-7806-0025

Linsey C Marr

Mechanisms of Airborne Transmission

The COVID-19 pandemic has highlighted controversies and unknowns about how respiratory pathogens spread between hosts. Traditionally, it was thought that respiratory pathogens spread between people through large droplets produced in coughs and through contact with contaminated surfaces (fomites). However, several respiratory pathogens are known to spread through small respiratory aerosols, which can float and travel in air flows, infecting people who inhale them at short and long distances from the infected person. Wang et al. review recent advances in understanding airborne transmission gained from studying the spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections and other respiratory pathogens. The authors suggest that airborne transmission may be the dominant form of transmission for several respiratory pathogens, including SARS-CoV-2, and that further understanding of the mechanisms underlying infection from the airborne route will better inform mitigation measures. -GKA

Structured Abstract

Background:

Exposure to droplets produced in the coughs and sneezes of infected individuals or contact with droplet- contaminated surfaces (fomites) have been widely perceived as the dominant transmission modes for respiratory pathogens. Airborne transmission is traditionally defined as involving the inhalation of infectious aerosols or "droplet nuclei" smaller than 5μm and mainly at a distance of >1 to 2 m away from the infected individual, and such transmission has been thought to be relevant only for "unusual" diseases. However, there is robust evidence supporting the airborne transmission of many respiratory viruses, including severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East respiratory syndrome (MERS)-CoV, influenza virus, human rhinovirus, and respiratory syncytial virus (RSV). The limitations of traditional views of droplet, fomite, and airborne transmission were illuminated during the COVID-19 pandemic. Droplet and fomite transmission of SARS-CoV-2 alone cannot account for the numerous superspreading events and differences in transmission between indoor and outdoor environments observed during the COVID-19 pandemic. Controversy surrounding how COVID-19 is transmitted and what interventions are needed to control the pandemic has revealed a critical need to better understand the airborne transmission pathway of respiratory viruses, which will allow for better-informed strategies to mitigate the transmission of respiratory infections.

Advances:

Respiratory droplets and aerosols can be generated by various expiratory activities. Advances in aerosol measurement techniques, such as aerodynamic and scanning mobility particle sizing, have shown that the majority of exhaled aerosols are smaller than 5μm, and a large fraction are <1μm for most respiratory activities, including those produced during breathing, talking, and coughing. Exhaled aerosols occur in multiple size modes that are associated with different generation sites and production mechanisms in the respiratory tract. Although 5μm has been used historically to distinguish aerosols from droplets, the size distinction between aerosols and droplets should be 100μm, which represents the largest particle size that can remain suspended in still air for more than 5s from a height of 1.5m, typically reach a distance of 1 to 2m from the emitter (depending on the velocity of airflow carrying the aerosols), and can be inhaled. Aerosols produced by an infected individual may contain infectious viruses, and studies have shown that viruses are enriched in small aerosols (<5μm). The transport of virus-laden aerosols is affected by the physicochemical properties of aerosols themselves and environmental factors, including temperature, relative humidity, ultraviolet radiation, airflow, and ventilation.

Once inhaled, virus-laden aerosols can deposit in different parts of the respiratory tract. Larger aerosols tend to be deposited in the upper airway; however, smaller aerosols, although they can also be deposited there, can penetrate deep into the alveolar region of the lungs. The strong effect of ventilation on transmission, the distinct difference between indoor and outdoor transmission, well-documented long-range transmission, the observed transmission of SARS-CoV-2 despite the use of masks and eye protection, the high frequency of indoor superspreading events of SARS-CoV-2, animal experiments, and airflow simulations provide strong and unequivocal evidence for airborne transmission. Fomite transmission of SARS-CoV-2 has been found to be far less efficient, and droplets are only dominant when individuals are within 0.2m of each other when talking. Although both aerosols and droplets can be produced by infected individuals during expiratory activities, droplets fall quickly to the ground or surfaces within seconds, leaving an enrichment of aerosols over droplets. The airborne pathway likely contributes to the spread of other respiratory viruses whose transmission was previously characterized as droplet driven. The World Health Organization (WHO) and the US Centers for Disease Control and Prevention (CDC) have officially acknowledged the inhalation of virus-laden aerosols as a main transmission mode in spreading COVID-19 at both short and long ranges in 2021.

Outlook:

Airborne transmission of pathogens has been vastly underappreciated, mostly because of an insufficient understanding about the airborne behavior of aerosols and at least partially because of the misattribution of anecdotal observations. Given the lack of evidence for droplet and fomite transmission and the increasingly strong evidence for aerosols in transmitting numerous respiratory viruses, we must acknowledge that airborne transmission is much more prevalent than previously recognized. Given all that we have learned about SARS-CoV-2 infection, the aerosol transmission pathway needs to be reevaluated for all respiratory infectious diseases. Additional precautionary measures must be implemented for mitigating aerosol transmission at both short and long ranges, with particular attention to ventilation, airflows, air filtration, UV disinfection, and mask fit. These interventions are critical tools for ending the current pandemic and preventing future outbreaks.

Abstract

The COVID-19 pandemic has revealed critical knowledge gaps in our understanding of and a need to update the traditional view of transmission pathways for respiratory viruses. The long-standing definitions of droplet and airborne transmission do not account for the

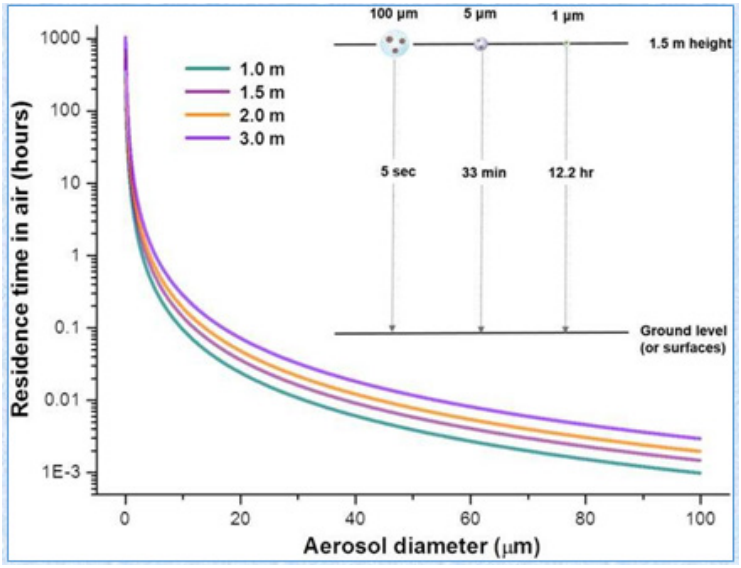
mechanisms by which virus-laden respiratory droplets and aerosols travel through the air and lead to infection. In this Review, we discuss current evidence regarding the transmission of respiratory viruses by aerosols-how they are generated, transported, and deposited, as well as the factors affecting the relative contributions of droplet-spray deposition versus aerosol inhalation as modes of transmission. Improved understanding of aerosol transmission brought about by studies of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection requires a reevaluation of the major transmission pathways for other respiratory viruses, which will allow better-informed controls to reduce airborne transmission.

The residence time of virus-laden aerosols in air is crucial in determining their range of spread. In the absence of other forces, the residence time of an aerosol of a specific size is related to its terminal settling velocity, Up, resulting from a balance between the viscous drag force and the gravitational force, as described by Stokes' law for small particles subject to laminar flow (115, 116).

$$U_p = d_p^2 g \rho_p C_c 18\eta$$

where dp is the diameter of the aerosol particle, g is gravitational acceleration, ρ_p is the density of the aerosol particle, C_c is the Cunningham slip correction factor accounting for the reduced air resistance caused by slippage when the particle size becomes comparable to the mean free path of gas molecules, and η is the dynamic viscosity of air. The settling time for aerosols of a specific size to reach the ground can thus be estimated on the basis of an assumption that the surrounding air is at rest (Figure 3). In still air, a 5-μm aerosol takes 33 min to settle to the ground from a height of 1.5m, whereas a 1-μm aerosol can remain suspended in air for >12 hours (116).

However, in most realistic environments, the velocity of the surrounding airflow should be taken into consideration. Additionally, when respiratory aerosols are exhaled, these particles are contained in an exhaled humid plume with its own speed and trajectory, which also play a role in determining the final reachable distance and direction (86). The distance that virus-laden aerosols travel depends on aerosol size, initial velocity of the flow carrying them, and other environmental conditions, such as outdoor wind speed or indoor air currents induced by natural ventilation or heating, ventilation, and air conditioning (HVAC) systems (117, 118). The concentration of exhaled aerosols is highest close to the source (i.e., the infectious individual) and decreases with distance as the respiratory plume mixes with ambient air (50, 119).



Stability and Infectivity of Coronaviruses in Inanimate Environments

Shi-Yan Ren, Wen-Biao Wang, Ya-Guang Hao, Hao-Ran Zhang, Zhi-Chao Wang, Ye-Lin Chen, and Rong-Ding Gao

Abstract

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a highly contagious virus that can transmit through respiratory droplets, aerosols, or contacts. Frequent touching of contaminated surfaces in public areas is therefore a potential route of SARS-CoV-2

transmission. The inanimate surfaces have often been described as a source of nosocomial infections. However, summaries on the transmissibility of coronaviruses from contaminated surfaces to induce the coronavirus disease 2019 are rare at present. This review aims to summarize data on the persistence of different coronaviruses on inanimate surfaces. The literature was systematically searched on Medline without language restrictions. All reports with experimental evidence on the duration persistence of coronaviruses on any type of surface were included. Most viruses from the respiratory tract, such as coronaviruses, influenza, SARS-CoV, or rhinovirus, can persist on surfaces for a few days. Persistence time on inanimate surfaces varied from minutes to up to one month, depending on the environmental conditions. SARS-CoV-2 can be sustained in air in closed unventilated buses for at least 30 min without losing infectivity. The most common coronaviruses may well survive or persist on surfaces for up to one month. Viruses in respiratory or fecal specimens can maintain infectivity for quite a long time at room temperature. Absorbent materials like cotton are safer than unabsorbent materials for protection from virus infection. The risk of transmission via touching contaminated paper is low. Preventive strategies such as washing hands and wearing masks are critical to the control of coronavirus disease 2019.

Keywords: Severe acute respiratory syndrome coronavirus 2, Coronavirus disease 2019, Inanimate surface, Infectivity, Survival, Transmission

Air samples collected from patient wards and swab samples from frequently touched surfaces in wards and nurse stations were positive by PCR, indicating that the aerosols bearing SARS-CoV-2 could exist in the air temporarily, especially in poorly ventilated areas, such as buses [23] and wards [18]. The half-life of coronaviruses in aerosols was reported to be 86 h at 80% humidity in the environment [26].

Survival of SARS-CoV in liquid: Water, Urine, and Sewage

The survival time of SARS-CoV is impacted by viral stains, the types of solutions it stayed in, temperature, and viral titers. It could survive for 14 d at 4°C, 2 d at 20°C in dechlorinated tap water or domestic sewage, and 14 d at 20°C in BPS. The SARS-CoV strain P9 was isolated from a pharyngeal swab of SARS patients [26]. In testing conditions, it could survive in serum, 1:20 diluted sputum, and feces for at least 4d (96h), and in urine for at least 3 d (72h) with a low level of infectivity [26]. SARS-CoV P9 infectivity at RT persisted for 60h after exposure, started to drop after 72h, and was almost detectable after 120h [26]. It stayed stable at 4°C, 20°C and at 37°C for at least 2h with infectivity in cells. A short time exposure can inactivate complement at 56°C, and antibody at 67°C, which is not enough to eliminate SARS-CoV infectivity; the conditions for SARS-CoV to become non-infectious should be at 56°C for 90min, 67°C for 60min, and 75°C for 30min, respectively [26]. Another study shows that coronaviruses remain infective at 4°C for several months, and at 60°C for many years [36] but are inactivated at 56°C within 10-15min, and at 37°C after several days [36].

SARS-CoV GVU6109 (106 TCID50/mL) can remain infectious in respiratory specimens for >7 d at RT, for > 20 d at 4°C [35], and for 4 d in diarrheal stool samples at pH 9 at RT [35]. SARS-CoV HKU 39849 is relatively more stable than HuCoV 229E or OC43 and some other viral respiratory pathogens such as RSV. It is stable for 3 wk at RT in a liquid environment and after being dried on plastic, and its viability can be retained from 5d to 2wk at 22-25°C at a relative humidity (RH) of 40-50% [37], which is like air conditioned indoor environments. It is easily killed at 56°C for 15 min [37]. High RH of > 95% and at 28°C or 33°C did not significantly affect the infectivity of SARS-CoV HKU 39849. Increasing the temperature to 38 °C can suppress the virus. The viral viability was rapidly lost (3 log10) at 38°C and a RH of > 95% [37] (Table11). At 25°C, the time required for a 99% reduction in reagent-grade water was 22d for transmissible gastroenteritis virus (TGEV) and 17d for mouse hepatitis virus (MHV). In pasteurized settled sewage, a shorter time (9d for TGEV and 7d for MHV) was needed for a 99% reduction. These data suggest that contaminated water is a potential vehicle for human exposure [36].

Temperature and humidity impact the persistence time of viruses

Persistence of most bacteria, fungi, and viruses (e.g., SARS-CoV) on surfaces depends on environmental conditions [37], such as air temperature and RH [39], inoculums, and the materials that they stayed on. Low temperature, high inoculums, and proper RH are associated with longer persistence time for most viruses. The role of the environment on the survival of viruses in the air may be more complex and significant [40]. RH impacts the survival time of viruses, and the relationship between the inactivation of RH and temperature was not monotony. The temperature impacts the survival of the virus more significantly than that of RH. In all water types tested (reagent-grade water, lake water and settled sewage), the titer of infectious virus declined more rapidly at 25°C than at 4°C [36]. A high RH of > 95% and temperature of 28°C or 33°C did not significantly affect the infectivity of SARS-CoV HKU 39849. Increasing the temperature to 38°C disfavors the virus, with the virus rapidly losing viability (3log10) at 38 °C and RH of > 95% (Table11) [37]. A high temperature (e.g., 30°C or 40°C) reduced the persistence duration of highly pathogenic MERS-CoV, TGEV, and MHV. The persistence of SARS-CoV was longer with higher inocula. HCoV-229E at RT persists longer at RH 50% than at RH 30%.

The survival of airborne HuCoV 229E was investigated under different conditions of temperature and RH. At 20°C, at 50% RH, aerosolized HuCoV-229E was found to survive best with a half-life of 67.33±8.24h, with nearly 20% infectious virus detectable at 6d, while at 30% RH the virus half-life was 26.76±6.21h. At high 80% RH, the half-life was only about 3h, and no virus in aerosols could be detected after 24h. At 6°C, in either 50% or 30% RH conditions, the survival of HuCoV-229E was significantly enhanced, with the decay pattern

essentially similar to that seen at 20±1°C. At 6°C in 80% RH, however, the HuCoV-229E half-life increased to 86.01±5.28h, nearly 30 times that found at 20°C and 80% RH [40].

Table 1
Survival time of coronaviruses on different materials of inanimate surfaces

Surface	Virus	Strain	Inoculum	Temperature	Time	Ref.
Cartridge brass	HuCoV	229E	103		5 min	
Brasses 70% copper			103		< 60 min	
Silicon rubber				RT 21 °C	3 d	
Metal	SARS-CoV	P9	105	RT	5 d	[26]
Stainless steel	HCoV	229E	103	RT 21 °C	≥ 5 d	[33,34]
Cupper	HCoV	229E	103	RT 21 °C	< 5 min	[33]
MERS-CoV	HCoV-EMC2012		105	4 °C	≥ 28 d	[41]
MERS-CoV	HCoV-EMC2012		105	20 °C	48 h	[41]
MERS-CoV	HCoV-EMC2012		105	30 °C	8-24 h	[41]
Aluminum	HCoV	229E OC43	5 × 103	21 °C	2-8 h	[34]
PTFE	HCoV	229E	103	21 °C	5 d	[33]
PVC	HCoV	229E	103	21 °C	5 d	[33]
Glass	SARS-CoV	P9	105	RT	4 d	[26]
Glass	HCoV	229E	103	21 °C	5 d	[33]
Ceramic tiles	HCoV	229E	103	21 °C	5 d	[33]
Wood	SARS-CoV	P9	105	RT	4 d	[26]
Glove latex	HCoV	229E OC43	5 × 103	21 °C	≤ 8 h	
Silicon rubber	HCoV	229E	103	21 °C	5 d	[33]
Plastic	HCoV	229E	107	RT	2-6 d	[2]
	SARS-CoV	P9	105	RT	4 d	[26]
	SARS-CoV	HKU39849	105	22-25 °C	5 d-2 wk	[37]
	SARS-CoV	FFM1	107	RT	6-9 d	[2]
	MERS-CoV	Isolate		20	48 h	[41]
	HCoV	EMC 2012	105	30	8-24 h	[41]

Air Pollution and COVID-19: The Role of Particulate Matter in the Spread and Increase of COVID-19's Morbidity and Mortality

Silvia Comunian, Dario Dongo, Chiara Milani*, Paola Palestini (2020) Int J Environ Res Public Health 17(12): 4487.

Abstract

Sars-Cov-2 virus (COVID-19) is a member of the coronavirus family and is responsible for the pandemic recently declared by the World Health Organization. A positive correlation has been observed between the spread of the virus and air pollution, one of the greatest challenges of our millennium. COVID-19 could have an air transmission and atmospheric particulate matter (PM) could create a suitable environment for transporting the virus at greater distances than those considered for close contact. Moreover, PM induces inflammation in lung cells and exposure to PM could increase the susceptibility and severity of the COVID-19 patient symptoms. The new coronavirus has been shown to trigger an inflammatory storm that would be sustained in the case of pre-exposure to polluting agents. In this review, we highlight the potential role of PM in the spread of COVID-19, focusing on Italian cities whose PM daily concentrations were found to be higher than the annual average allowed during the months preceding the epidemic. Furthermore, we analyze the positive correlation between the virus spread, PM, and angiotensin-converting enzyme 2 (ACE2), a receptor involved in the entry of the virus into pulmonary cells and inflammation.

Keywords: COVID-19, particulate matter, ACE2, inflammation, oxidative stress'

Introduction

On 11 March 2020, the World Health Organization (WHO) declared the coronavirus pandemic: the Sars-Cov-2 virus (COVID-19) is a threat to the population's health. Air pollution is also one of the greatest challenges of our millennium, and some early studies have highlighted a positive correlation between air pollution and the spread of the virus. Therefore, it is crucial to define which role the atmospheric particulate plays in the spread, morbidity, and mortality of the virus.

In this context, two hypotheses should be highlighted. First, COVID-19, similarly to other viruses, could also have an airborne transmission, and particulate matter (PM) could act as a carrier through the aerosol, conveying the virus and increasing its spread. Secondly, PM could instead have induced damage to the lung cells, increasing the inflammation state [1]. This rise of inflammation may increase the mortality rate and the severity of expression of the disease in the most polluted areas. The virus binds to the angiotensin-converting enzyme 2 (ACE2) receptor to enter the cell; ACE2 generates an anti-inflammatory peptide and is overexpressed to play its role in the case of inflammation from PM exposure, thus increasing the probability of COVID-19 entering the cells [2]. These hypotheses, which are not mutually exclusive, are an important starting point for future analyses aimed at explaining the positive correlation between the spread of COVID-19 and air pollution.

Airborne Transmission: Comparison between Sars-Cov-1 and Sars-Cov-2

Pathogens can reach the organism through various transmission mechanisms: ingestion (via the fecal-oral route), inhalation, inocu-

lation, contact, iatrogenic transmission, and coupling. The most common route of transmission is the expulsion of pathogens through the respiratory system by infected subjects and the penetration into the receptive host by inhalation. The saliva droplets from the infected subject are usually large and, because of their weight, travel short distances before falling to the ground. In this case, the transmission is defined as transmission by close contact. This transmission is different from what occurs in the aerosol, which is a suspension of solid or liquid particles within a gas phase. The diameter of these particles is normally between 0.001 and 100 micrometers; thus, they are very small particles that sediment slowly and are easily conveyed by air currents (in this case, the transmission is called long distance transmission). As small viral particles are suspended in the aerosol, they can be transported by particles such as in the case of the avian flu virus that was found in large concentrations in the air after the dust storms that occurred in Asia even at a long distance from the outbreaks of origin [3]. The new coronavirus Sars-Cov-2 (COVID-19) emerged in late 2019 in the city of Wuhan in China and is now causing a global pandemic owing to its rapid spread. It is thus necessary to understand how the transmission takes place to limit its further diffusion. COVID-19, as the Sars-cov-1 virus, is mainly transmitted by inhalation of droplets, and with a smaller percentage by fecal-oral route, direct contact, and through pregnancy. Airborne transmission by aerosols in long distances has been proposed only as a possibility to be verified by Zhou Wang [4,5], assisted by a committee of experts who have addressed the epidemic of coronavirus pneumonia (COVID-19) in the city of Wuhan.

COVID-19 belongs to the coronavirus (CoV) family, a large family of respiratory viruses that can cause mild to severe diseases, from the common cold to respiratory syndromes such as MERS (Middle East respiratory syndrome) and SARS (severe acute respiratory syndrome). The name coronavirus derives from the proteins that outline a crown shape and that are present on the surface of the virus. In 2003, SARS caused a minor, but equally significant epidemic, after which numerous studies were conducted about the route of transmission of the virus. The spread of the virus was analyzed in closed environments such as in aircraft cabins. It was observed that SARS has three prevalent transmission routes: it spreads 21% by aerosol (long distance), 29% by close contact between individuals (droplets), and 50% by contact with surfaces (fomite route) [6].

A recent analysis proposed in The New England Journal of Medicine by van Doremalen and collaborators [7] investigates the stability of the new virus in aerosol and on surfaces by comparing it with Sars-Cov-1. The surfaces analyzed are plastic, stainless steel, copper, and cardboard. COVID-19 persists more on plastic and steel, while copper and cardboard are more inhospitable to the virus. From the results obtained, it is observed that COVID-19 remains in the aerosol for 3h, slowly reducing the infectious capacity such as Sars-Cov-1. The half-life of Sars-Cov-2 and Sars-Cov-1 is similar in aerosol, with an average of about 1.1-1.2h, indicating that the epidemiological differences between the two are probably owing to other factors. The virus persists on surfaces for days and in aerosol for hours [7].

Many studies highlight the association between airborne infections and ventilation systems in buildings, as in the case of other viruses such as measles, avian, and SARS. SARS spread in 17 major cities in 2003. In a city environment, people normally spend about 90% of their time indoors. A low ventilation rate, particularly in hospitals, increases the probability of virus contraction. In a building, the air circulates from one environment to another with turbulent flow that favors the establishment of microenvironments in which pathogens proliferate. Viruses are transported by the aerosol at a certain distance that depends on the design of the buildings in which they circulate. In this regard, a multidisciplinary study is needed to analyze this effect and determine the correct ventilation rate to be applied in closed environments to decrease the probability of spreading these viral pathogens [8]. This phenomenon has been analyzed in a Hong Kong hospital during the 2003 epidemic. In this analysis, it is observed that the droplets are moist, but begin to evaporate after release by decreasing their size and may become small enough to circulate in the air. In the Hong Kong hospital, the distribution of air was analyzed, and it was shown that an unbalanced air diffuser distribution led to the spread of the Sars-Cov-1 virus in the 8 A department, where a greater incidence of the number of infections occurred [9].

A similar study was conducted in Amoy Garderns, a group of residential buildings in Hong Kong that recorded an outbreak of SARS in 2003. The investigators analyzed the ventilation system and the air transmission of the virus, focusing on the residence buildings with the most elevated number of infections. This analysis further confirms the need for reviewing the internal air quality and ventilation designs in buildings, offices, homes, hotels, and hospitals [10]. The transmission modes of Sars-Cov-1 and COVID-19 are very similar, as COVID-19 also persists in the air, and thus it can be assumed that it is also transported at greater distances than those observed in close contact infection. Despite the similarities between the new and previous viruses, why has the new coronavirus displayed a higher spread rate in some areas?

Air Pollution is Present in the Aerosol

The air is composed of 78% nitrogen, 21% oxygen, and 1% other gases. Man is introducing into the air new components that can be harmful to the environment and human health. Air pollution is the result of the presence of gas and contaminating particles in the atmosphere. The gases include carbon monoxide (CO), nitrogen oxides (NO_x), ozone (O3), sulfur dioxides (SO2), ammonia (NH3), and volatile organic compounds (VOCs), as well as some gaseous forms of metals. Particulate matter (PM) instead includes a mixture of compounds

that can be grouped into five major categories: sulphates, nitrates, elemental carbon, organic carbon, and crustal materials (such as earth and ash). PM, as defined by the Environmental Protection Agency (EPA), is a term that indicates the set of particles dispersed in the air for enough time to be diffused and transported. There are many sources of these particles. PM is classified as PM10 and PM2.5 based on a diameter of less than 10 micrometers or 2.5 micrometers, respectively [11].

PM are inhalable corpuscles that cause various damage to human health owing to their small size. Their toxicity is then increased as they can adsorb other substances such as Polycyclic Aromatic Hydrocarbons (PAHs) and heavy metals. Hydrocarbons derive from oil and are higher in concentration during winter [12]. PAHs are hydrocarbons made up of two or more joined aromatic rings. Metals, on the other hand, are natural constituents of the earth's crust. Metals that are toxic and tend to accumulate are mercury, chromium, cadmium, arsenic, lead, and uranium [13]. Air pollution is a global public health emergency that affects people of all ages in every part of the world. Nowadays, addressing ambient air pollution is the priority of the government, and the WHO issues air quality guidelines to defend the population in general, and the most vulnerable in particular [14].

Numerous epidemiological studies have shown the effects of air pollution on respiratory and cardiovascular systems. Short-term exposure to air pollution at higher levels reduces life expectancy by aggravating pre-existing respiratory and cardiovascular diseases [15]. Cardiovascular effects induced by PM are linked to particles' deposition in the lungs, to their translocation through the air-blood barrier to extra-pulmonary sites, and to the resulting systemic inflammation [16,17]. Particles' deposition rates are strictly linked to the particle size-smaller particles have the highest deposition efficiency. Numerous studies also highlight correlations between the effect of PM and male infertility [18] as well as neurodegenerative diseases [19-21].

In Lombardy (North of Italy), diesel combustion and solid biomass burning are responsible for 15% and 50% of the primary fine particles production, respectively [22]. Diesel exhaust is a complex mixture of solid, condensed (or liquid), and gaseous corpuscular fractions [23]. The solid fraction is represented by diesel exhaust particles (DEPs), with a bio-persistent core of about 10-30nm in diameter [24]. These primary particles, composed of elemental carbon, can then agglomerate into larger soot aggregates with mean diameters of 60-100nm [23]. The DEP surface can adsorb more than 300 chemical compounds, which include PAHs, aliphatic hydrocarbons, quinones, transition metals, and others [25]. Moreover, biomass burning (BB)-derived particles are obtained as a result of inefficient combustion that generates a multitude of partially oxidized organic chemicals, many of which have been associated with adverse health impacts [22]. However, DEP has been shown to be even more toxic than BB [26].

These particles are included in PM2.5 fraction, are less than 0.1 micrometers in size, and thus can be classified as ultrafine particles (UFPs). UFPs can show worse and different toxicity profiles in comparison with those of larger particles with the same composition, as their specific interaction with lung cells and their capability to translocate across the alveolar epithelial barrier [27]. Nonetheless, it cannot be excluded that systemic toxicity may be mediated also by PM or UFPs associated water-soluble components and/or biochemical mediators released in the lung and then translocated in blood circulation. WHO has also indicated air pollution as responsible for a great risk for environment and health. Even more harmful to health is indoor air pollution in large urban areas. It is thus essential to have correct ventilation systems in closed environments as the particulate matter in the aerosol can also host pathogens such as viruses and bacteria, which can thus be easily transmitted.

Association between Short-Term Exposure to Air Pollution and COVID-19 Hospital Admission/ Mortality During Warm Seasons

Babak Khorsandi, Kiarash Farzad, Hannaneh Tahriri, Reza Maknoon. Free PMC article

Abstract

COVID-19 is a new viral infection that is usually accompanied by respiratory complications. Air pollution has been linked to cardiorespiratory-related diseases and even premature mortality. The short-term exposure to air pollution may aggravate pulmonary symptoms in COVID-19 patients. The relationship between the short-term exposure to air pollution and hospital admission and mortality resulting from COVID-19 will be examined in Tehran, Iran, during the spring and summer of 2020. The statistics of PM2.5, PM10, and 8-h maximum ozone (O_3) concentrations, meteorological conditions, and COVID-19 hospital admissions/mortality were analyzed. The cross- correlation and temporal relationship between the daily concentration of the aforementioned pollutants (as well as the meteorological conditions) and the COVID-19 hospital admissions/mortality rate was calculated for each month. The concentration of PM2.5, PM10, and 8-h maximum O3, along with temperature, increased in the summer. The hospital admissions and mortality associated with COVID-19 decreased from the first peak in the spring and then increased to its second peak in the summer. The short-term exposure to ambient PM2.5, PM10, O3, and elevated temperatures is associated with higher rates of COVID-19-related hospital admissions/mortality throughout the summer. Among these variables, the correlation with O3 was statistically significant in more summer months. The short- term exposure to air pollution (especially O3) may increase the susceptibility of the population infected with COVID-19 and, therefore, increases the rate of hospital admissions and mortality even during the warm seasons.

Keywords: Air pollution; COVID-19; Ozone; Short-term exposure; Tehran.

Impact of the Inversion and Air Pollution on the Number of Patients with Covid-19 in the Metropolitan City of Tehran

Ghasem Keikhosravi , Seyedeh Fatemeh Fadavi , Free PMC article

Abstract

There is a downward curve between increasing inversion altitude and the number of coronavirus patients during all periods. As temperature inversion altitude increases, the pollutants are dispersed in a greater thickness of the atmosphere and the concentration of the pollutants decreases on the earth's surface. At the same time, the number of patients with Covid-19 reduces. Although investigation of the effect of severity of pollutants on the number of coronavirus patients showed poor significance level during the periods, a decreasing and increasing relationship was shown. In 1- and 9-14-day periods, the correlation coefficient was negative. As a result, the effect of the severity of pollutants and Covid-19 is not observed on 1- and 9-14-day periods. Conversely, during 2-8-day periods, a positive correlation coefficient was observed. Therefore, the time between infection with the virus and the onset of symptoms of this disease is between 2 and 8 days, in which the 3-day period showed the highest correlation. Considering the relationship between inversion altitude, the severity of pollutants and the number of patients during 2-5-day periods, it can be concluded that in the metropolitan city of Tehran, the maximum infection of this virus and the onset of symptoms is between 2 and 5days.

Keywords: Concentration of pollutant; Correlation coefficient; Covid-19; P-value; Temperature inversion.

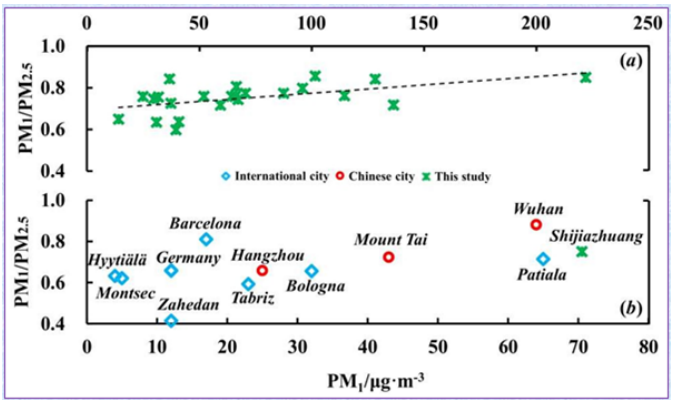
Chemical Characteristics and Sources of Submicron Particles in a City with Heavy Pollution in China

by Jianlei Lang *ORCID,Shengyue Li,Shuiyuan Cheng,Ying Zhou,Dongsheng Chen,Yanyun Zhang,Hanyu Zhang, Haiyan Wang (2018) Key Laboratory of Beijing on Regional Air Pollution Control, College of Environmental & Energy Engineering, Beijing University of Technology, Beijing 100124, China.

Abstract

Submicron particle (PM1) pollution has received increased attention in recent years; however, few studies have focused on such pollution in the city of Shijiazhuang (SJZ), which is one of the most polluted cities in the world. In this study, we conducted an intensive simultaneous sampling of PM1 and PM2.5 in autumn 2016, in order to explore pollution characteristics and sources in SJZ. The results showed that the average mass concentrations of PM1 and PM2.5 were 70.51μg/m3 and 91.68μg/m3, respectively, and the average ratio of PM1/PM2.5 was 0.75. Secondary inorganic aerosol (SIA) was the dominant component in PM1 (35.9%) and PM2.5 (32.3%). An analysis of haze episodes found that SIA had a significant influence on PM1 pollution, NH4+ promoted the formation of pollution, and SO42-and NO3-presented different chemical mechanisms. Additionally, the results of source apportionment implied that secondary source, biomass burning and coal combustion, traffic, industry, and dust were the major pollution sources for SJZ, accounting for 45.4%, 18.9%, 15.7%, 10.3%, and 9.8% of PM1, respectively, and for 42.4%, 18.8%, 12.2%, 10.2%, and 16.4% of PM2.5, respectively. Southern Hebei, mid- eastern Shanxi, and northern Henan were the major contribution regions during the study period. Three transport pathways of pollutants were put forward, including airflows from Shanxi with secondary source, airflows from the central Beijng-Tianjin-Hebei region with fossil fuel burning source, and airflows from the southern North China Plain with biomass burning source. The systematic analysis of PM1 could provide scientific support for the creation of an air pollution mitigation policy in SJZ and similar regions. View Full-Text.

Keywords: PM1; PM2.5; chemical characteristics; source apportionment; haze pollution; Shijiazhuang



Pollution from Nanomaterials, Wikipedia

Part of a series of articles on the Impact of nanotechnology Health and safety

The International Organization for Standardization defines Engineered Nanomaterials, or ENMS, as materials with external dimensions between 1 and 100nm, the nanoscale, or having an internal surface structure at these dimensions [1]. Nanoparticles can be both incidental and engineered. Incidental nanoparticles include particles from dust storms, volcanic eruptions, forest fires, and ocean water evaporation. Engineered nanoparticles (EMMs) are nanoparticles that are made for use in cosmetics or pharmaceuticals like ZnO and Ti O_2. They are also found from sources such as cigarette smoke and building demolition [2]. Engineered nanoparticles have become increasingly important for many applications in consumer and industrial products, which has resulted in an increased presence in the environment. This proliferation has instigated a growing body of research into the effects of nanoparticles in the environment.

Nanoparticle Sources

Products containing nanoparticles such as cosmetics, coatings, paints, and catalytic additives can release nanoparticles into the environment in different ways. There are three main ways that nanoparticles enter the environment. The first is emission during the production of raw materials such as mining and refining operations. The second is emission during use, like cosmetics or sunblock getting washed into the environment. The third is emission after disposal of nanoparticle products or use during waste treatment, like nanoparticles in sewage and wastewater streams [3].

The first emission scenario, causing 2% of emissions, results from the production of materials. Studies of a precious metals refinery found that the mining and refining of metals releases a significant amount of nanoparticles into the air. Further analysis showed concentration levels of silver nanoparticles far higher than OSHA standards in the air despite operational ventilation [4]. Wind speed can also cause nanoparticles generated in mining or related activities to spread further and have increased penetration power. A high wind speed can cause aerosolized particles to penetrate enclosures at a much higher rate than particles not exposed to wind [5]. Construction also generates nanoparticles during the manufacture and use of materials. The release of nanoscale materials can occur during the evacuation of waste from cleanout operations, losses during spray drying, filter residuals, and emissions from filters [6]. Pump sprays and propellants on average can emit 1.1x10^8 and 8.6x10^9 particles/g [7].

A significant amount of nanoparticles are also released during the handling of dry powders, even when contained in fume hoods. Particles on construction sites can have prolonged exposure to the atmosphere and thus are more likely to enter the environment. Nanoparticles in concrete construction and recycling introduce a new hazard during the demolition process, which can pose even higher environmental exposure risks. Concrete modified with nanoparticles is almost impossible to separate from conventional concrete, so the release may be uncontrollable if demolished using conventional means. Even normal abrasion and deterioration of buildings can release nanoparticles into the environment on a long-term basis [6]. Normal weathering can release 10 to 10^5mg/m^2 fragments containing nanomaterials [7]. Another emission scenario is release during use. Sunscreens can release a significant amount of TiO_2 nanoparticles into surface waters. Testing of the Old Danube Lake indicated that there were significant concentrations of nanoparticles from cosmetics in the water. Conservative estimates calculate that there were approximately 27.2 micrograms/L of TiO_2, if TiO_2 was distributed throughout the entire 3.5*10^6 M^3 volume of the lake [8].

Although TiO_2 is generally considered as weakly soluble, these nanoparticles undergo weathering and transformation under conditions in acidic soils with high proportions of organic and inorganic acids. There are observable differences in particle morphology between manufactured and natural TiO_2 nanoparticles, though differences may attenuate over time due to weathering. However, these processes

are likely to take decades [9]. Copper and zinc oxide nanoparticles that get into water can additionally act as chemosensitizers in sea urchin embryos [10]. It is predicted that exposure through sunscreen is probably the most important route for animals in aquatic systems to get exposure to harmful metal particles [11]. ZnOs from sunblock and other applications like paints, optoelectronics, and pharmaceuticals are entering the environment at an increasing rate. Their effects can be genotoxic, mutagenic, and cytotoxic [12].

Nanoparticles can be transported through different mediums depending on their type. Emissions patterns have found that TiO_2 NPs accumulate in sludge-treated soils. This means that the dominating emission pathway is through wastewater. ZnO generally collects in natural and urban soil as well as landfills. Silver nanoparticles from production and mining operations generally enter landfills and wastewater. Comparing different reservoirs by how readily Nanoparticles pollute them, ~63-91% of NPs accumulate in landfills, 8-28% in soils, aquatic environments receive ~7%, and air around 1.5% [3].

Exposure Toxicity

Knowledge of the effects of industrial nanoparticles (NPs) released into the environment remains limited. Effects vary widely over aquatic and terrestrial environments as well as types of organisms [13]. The characteristics of the nanoparticle itself plays a wide variety of roles including size, charge, composition, surface chemistry, etc. [14]. Nanoparticles released into the environment can potentially interact with pre-existing contaminants, leading to cascading biological effects that are currently poorly understood [15].

Several scientific studies have indicated that nanoparticles can cause a series of adverse physiological and cellular effects on plants including root length inhibition, biomass reduction, altered transpiration rate, developmental delay, chlorophyll synthesis disruption, cell membrane damage, and chromosomal aberration [16]. Though genetic damage induced by metal nanoparticles in plants has been documented, the mechanism of that damage, its severity, and whether the damage is reversible remain active areas of study [17]. Studies of CeO_2 nanoparticles were shown to greatly diminish nitrogen fixation in the root nodules of soybean plants, leading to stunted growth. Positive charges on nanoparticles were shown to destroy the membrane lipid bilayers in animal cells and interfere with overall cellular structure. For animals, it has been shown that nanoparticles can provoke inflammation, oxidative stress, and modification of mitochondrial distribution. These effects were dose-dependent and varied by nanoparticle type [14]. Present research indicates that biomagnification of nanoparticles through trophic levels is highly dependent upon the type of nanoparticles and biota in question. While some instances of bioaccumulation of nanoparticles exist, there is no general consensus [14,18].

Nanotechnologies » Level 3 » Question 5

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What are the uses of nanoparticles in consumer products?

Inhaled nanoparticles may represent a potential health risk. Aerosols in workplace environments may be derived from a wide variety of sources, depending on the type of activity and processes taking place. Nanoparticle aerosols arising from mechanical processes (e.g. the breaking or fracture of solid or liquid material) are unlikely to be formed. Grinding and surface finishing typically releases micrometre and submicrometre particles, possibly down to 100 nm but rarely below this. Most plasma and laser deposition and aerosol processes are performed in evacuated or at least closed reaction chambers. Therefore exposure to nanoparticles is more likely to happen after the manufacturing process itself, except in those cases of failures during the processing (Luther 2004). In processes involving high pressure (e.g. supercritical fluid techniques), or with high energy mechanical forces, particle release could occur in the case of failure of sealing of the reactor or the mills. Nanoparticles exhibit increased diffusivity with decreasing size and therefore show delayed sedimentation in the earth's gravitational field, which translates into potentially increased lifetimes for nanoparticulate impurities at low concentration. In the presence of larger microparticles, as with the wide size distribution in aerosols such as smoke, the highly diffusive character of nanoparticles may lead to faster agglomeration or impaction on the larger particles. Furthermore, many particles, including metallic particles, are highly pyrophoric and there is a considerable risk of dust explosions.

The Toxic Killers in our Air too Small to See

By Tim Smedley, 15th November 2019, author of Clearing The Air, published by Bloomsbury.

Current pollution meters don't count the very smallest pollutants -nanoparticles.

Recent research suggests these tiny toxic substances could be a major cause of illness and death.

After years of headlines about air pollution, we've been misled on a few things about the world's biggest environmental health problem. For example, we're told that "PM2.5"-solid pollution particles measuring 2.5 micrometres or less -can pass through our lungs and into

our blood stream. But, in fact, the vast majority of them can't. We've also been told NO_x gases -including nitrogen dioxide -are the biggest threat to health within cities. However, NOx is responsible for just 14% of deaths attributed to air pollution in Europe. The biggest killer of all never makes the headlines, isn't regulated, and is barely talked about beyond niche scientific circles (despite their best efforts to change that narrative): it's nanoparticles.

PM2.5 may be too small to see, being roughly 30 times smaller than the width of a human hair. But it's a relative heavyweight. PM2.5 stomps in at 2,500 nanometres (nm), while nanoparticles are 100nm or below. PM2.5 and PM10 (10,000nm) are killers in their own right, typically causing lung and respiratory conditions. Yet nanoparticles can reach, and wreak havoc in, any organ in the body. And because government authorities monitor PM2.5 by mass (million of nanoparticles may not even register a measurement by microgram) -their reports underrepresent the true risks. The science of why we should be concerned about the total number of particles that we breathe in, not just their mass, has been known for some time. In 2003, Surbjit Kaur was a young researcher finishing her Masters at Imperial College London, when her supervisor suggested she join the Dapple experiment (the Dispersion of Air Pollution and its Penetration into the Local Environment). Kaur designed a personal exposure study, with a team of six volunteers "dressed up like Christmas trees" with various different air pollution sensors, and asked them to travel a set route in central London every day for four weeks. The volunteers "were a combination of friends and people in the department" says Kaur, who has since left science and now works as a management consultant. "But I couldn't really ask people to do this if I wasn't doing it myself." She joined them out on the roadside, which centered around Marylebone Road, a major seven-lane highway and home to the Madame Tussauds waxwork museum, and its lengthy queues waiting outside. "We went out there knowing that we were going to get ill because of that constant exposure. We began to feel quite grotty after a while."

The equipment draped over the volunteers and inside backpacks measured the standard air pollutants, PM2.5 and CO (carbon monoxide). But Kaur also included a brand-new piece of kit that had only just come on the market: a 'P-Trak' nanoparticle counter. "We needed to get all sorts of approvals to use them [in the field work] because they looked a bit like Geiger-counters and there were concerns that the public might panic," she laughs. The device could count nanoparticles right down to 2nm (many times smaller than a human blood cell) by sucking in air, spraying alcohol onto the surface of the particles to make them visible and individually counting by laser beam. Influenced by work emerging from University of Rochester, New York, and the National Public Health Institute, Finland, Kaur had a hunch that counting these "ultrafine particles" could add some interesting data. She wasn't wrong.

"I expected a certain level of variation [in particle number]", she says, "but the level of fluctuation really surprised me… The volume of cars that went past had very little impact on people's exposure to PM2.5. But it had a massive impact on ultrafines." As the volunteers pounded the pavements, they were exposed to a minimum of 36,000 particles at a time, up to a maximum of 130,000. When they took the same route by bicycle (tricky, but not impossible, with all the equipment), the maximums and minimums went up by another 20,000. However, the highest averages were recorded inside the cars and buses: the closer to the source of the pollution, the exhaust pipes spewing out the fumes, the higher the total number of nanoparticles. The difference between walking by the kerbside of the road, and by the building side, on the same pavement-just a few short steps-was an average of 82,000 particles versus 69,000. The same readings registered no change in PM2.5.

Around 2006, just as Kaur was stepping away from science-her findings having made no difference to how government authorities measured air pollution exposure-a doctoral student at the University of Cambridge picked up the baton. Prashant Kumar had already studied PM2.5 and PM10 for his Masters at the Indian Institute of Technology (IIT) in Delhi. But upon arriving in England for his PhD, "in discussions with my supervisors we found there as very little, or almost nothing, done on the understanding [of nanoparticles]: their measurements, the concentrations in different environments. So I took up that topic as a challenge." His subsequent flurry of papers published from 2008 onwards have become seminal work on nanoparticle exposure, and led to his professorship at the University of Surrey.

A cloud of a billion 10nm particles has the same mass as just one PM10 particle, but a combined surface area a million times larger.

"The first study I carried out in 2008 was an exploratory analysis," recalls Kumar. "When the exhaust fumes come out of vehicles, they come out as gases and cool into smaller [nano] particles. Then they start to accumulate to make bigger particles. From the tailpipe you can get 10-to-the-power-of-six (one million) particles per centimetre cubed of air. On the road 100,000, by the roadside 10,000." His studies found that up to 90% of all particles by busy roads are nanoparticles below 100nm. This is a problem for our health, explains Kumar, "because the smaller particles you have, you have a greater surface area. A greater surface area means more [potential] toxicity, as they are in touch with a greater surface area inside your body."

To visualise this, imagine footballs versus golf balls. A football (or soccer ball, for North American readers) has a circumference of 70cm (28in) and a surface area of around 1,500cm2 (91.5in2). A golf ball is obviously much smaller, with a circumference of about 13cm (5.2in), making its surface area 54cm2(3.3in2). By volume, you could fit 156 golf balls into the same space as a football, but the total surface area of all those golf balls would be 8,453cm2 -a substantial 6.9 square metres more than the football. On a nano-scale, that difference

is amplified. A cloud of a billion 10nm particles has the same mass as just one PM10 particle, but a combined surface area a million times larger. And that surface area comes coated with toxic, unburnt fuel from vehicle exhausts. Another of Professor Kumar's studies looked at the exposure of children being pushed in prams along the roadside of a small town. "We found that you get a high exposure when waiting at traffic lights, and children get a much higher exposure compared to adults… In some cases it was 20-30% higher exposure [at pram height compared to adult height]. Because their immune system is still developing, they are more vulnerable to the health impact." The Californian Children's Health Study, for example, finds that children growing up within half a kilometre of a busy road suffer a significant loss in lung capacity. Nanoparticles can also pass through the walls of the lungs and into the bloodstream, in a way that larger PM2.5s cannot. Once in the bloodstream they cause the same inflammation damage they inflict on the lungs, except now they can reach any organ or artery in the body. Until recently it wasn't known exactly what size of particle could make it through, and which remained stuck in the lungs or upper airways.

First, the Edinburgh team got mice to breathe in the gold nanoparticles; next, it was the human volunteers' turn.

That final piece of the jigsaw was put in place by a team led by Professor David Newby at the University of Edinburgh in 2017. *Jen Raftis, et al.,* who was part of the research team, says: "There were various ideas about how we could show these nanoparticles [in the blood], various imaging techniques. But no imaging technique really has that kind of resolution. So we decided to use gold." A machine borrowed from the Netherlands used electrodes to scatter gold into nanoparticles right down to 2nm in size. First, the Edinburgh team got mice to breathe in the gold nanoparticles; next, it was the human volunteers' turn. "We used gold because we know it is really safe", explains Raftis, reassuringly. "It is used clinically because it is inert, it doesn't react to things or cause oxidative stress in the body." It is also easy to detect, unlike carbon particles which are effectively camouflaged within our carbon-based bodies.

The volunteers gave blood and urine samples 15 minutes and 24 hours after they inhaled the particles. Lo and behold, there was gold in them there samples. The team discovered a 30nm cut-off point; anything below that could be found swimming around in the bloodstream, but anything above that failed to get past the lungs. "Obviously with humans we couldn't perform a biopsy, but with the mice we did", says Raftis. "We found the biggest accumulations [of particles] in the lungs primarily, but the liver next, because your liver is where the blood passes through first… the pore size in the kidney is 5nm, so nothing bigger than that would pass through the kidney… There could be accumulations in other parts of the body as well, because pore sizes across the body differ." Gold was still present in the urine of the volunteers three months later.

David Newby, funded by the British Heart Foundation, then took the study further. Again, it had been theorized-but not proven-that nanoparticle build-up in the arteries could lead to strokes and heart disease. He approached hospital patients who were due to undergo surgery to remove a fat deposit (known as a 'plaque') from an artery. If they breathed in gold nanoparticles, would these be found on the plaque removed during surgery a day later? "Yes, we found gold in the plaque," says Raftis, still excited by the finding. "It was indicative that air pollution particles of this size and structure can be delivered to a plaque within 24 hours of inhaling them. That's quite a big risk for patients with heart disease… as air pollution is a whole of life exposure. We just did a one-off experiment, but this is happening every single day."

Think of a plaque as the scene of a car crash, and the artery as a road; nanoparticles are more cars piling up behind it, causing a bigger blockage. The nanoparticles can also be the cause of the crash, inflaming the artery with toxic chemicals stuck to their surface (Newby's predecessor Professor Ken Donaldson had highlighted the toxicity of nanoparticles back in the 1990s). The Global Burden of Diseases study estimates that air pollution could account for 21% of all deaths due to stroke and 24% of deaths from ischaemic heart disease. Traffic fumes had long been considered the smoking gun, but the bullet had proved elusive. Now, many think that the bullet is nanoparticles.

A low PM2.5 reading on government website or mobile phone app can therefore give a false impression of clean air when it is, in fact, swirling with particles entering our arteries.

Most countries including the US and the EU have legal limits for the most harmful air pollutants, including PM2.5, NOx, carbon monoxide and sulphur dioxide. But no similar regulatory limits exist for nanoparticles. The typical rebuttal is that "PM2.5 includes everything down to 1nm", which technically it does, but as we have seen, literally millions of nanoparticles still give a low PM2.5 reading. A low PM2.5 reading on government website or mobile phone app can therefore give a false impression of clean air when it is, in fact, swirling with particles entering our arteries.

A 2018 report on ultrafine particles below 100nm for the UK Department for Environment, Food and Rural Affairs (Defra), found that because "there are currently no emissions ceilings or emission reduction targets set on [nanoparticles]… there are no guidelines or common sources of emission factors of [nanoparticles] to enable inventories to be developed." The one regulation that does exist, the Euro 6 vehicle emissions test, includes a particle number limit, and measures down to 23 nm. But that means, says the Defra report, "more than 30% of [nanoparticles] in urban environments may not be included", and covers only a fraction of those below the 30 nm threshold identify

by the Edinburgh gold study. Perhaps the only good news is that while particle number doesn't correlate well with particle mass (PM2.5) measurements, it does tend to correlate with NOx readings. Like nanoparticles, NO_2 is highest closest to its source, and then quickly dissipates. NO_2 even reacts with other gases in the air to form some of the nanoparticles. So tackling NO_2 can often work as a proxy to reduce nanoparticles. "They do correlate well," says Kumar, "because they are coming from the same source."

The solution for NOx and nanoparticles are also the same: replacing combustion with electrification. Electric cars still kick up road dust, but they emit no combustion-derived nanoparticles or NOx; and while power stations are needed to take the electricity, we spend far more time standing by roads than we do standing by power station chimneys (although this is all the more reason to rapidly move to 100% renewable energy). True zero-emissions transport, such as walking and cycling, are even better. The quicker we can make this transition, the more lives will be saved. In the interim, we also need to reduce our exposure by physically separating people from combustion-based traffic, via segregated cycle lanes, and green barriers-trees, hedges and climbing plants-in between pavements and roads.

I stopped burning candles in my house. I don't use or have a log burner at home, even though I like them... I always have the extraction on when I cook food -Jen Raftis.

Kaur still finds her own habits influenced by her nanoparticle research, over a decade later. "My friends find it hilarious that I'm hugging the building side when I walk along a pavement!" she laughs. "Wherever possible I cut through the park or I take the side roads." In Edinburgh, Raftis goes a step further. "I stopped burning candles in my house. I don't use or have a log burner at home, even though I like them... I always have the extraction on when I cook food. I don't go for runs along roads, I always run in a park. I don't drive and don't think I consciously could do unless it was an electric car." She cycles, despite the proximity to high particle counts, because "even if you cycle in heavy traffic you are offsetting the exposure to air pollution with exercise."

I ask her if emissions regulation and policy should shift more towards nanoparticle exposure. She is not a policy person, she tells me, but quickly adds: "I just don't know why they haven't. I mean, you feel like you are researching and researching and producing data and nothing gets done about it, only lip service. I feel it has to move along with the technology. PM2.5 is [just] what the monitors measure." Within the same town or city, our daily exposure to air pollution can differ greatly by person, by mode of transport, by the routes we take. Most cities or countries measure this with a handful of stationary monitoring stations, which can only test the air immediately next to them. We don't, however, spend our lives standing still. "I still find it fascinating", says Kaur, speaking to me from her Thames-side offices, overlooking the London Mayor's office. "If you are introducing air pollution policy for the wellbeing of humans, and you base that guidance on data that isn't relevant, are you really helping people or are you actually hindering?"

Reflection on Above Slides

1. I made a comment in Part 1 of my evaluation May 2020 that I thought the science of coronavirus transmission was incorrect based on my data analysis and in subsequent email exchanges advised that a new textbook was needed and another course for epidemiology students. The August 2021 paper on "Airborne transmission of respiratory viruses" confirms this.

2. In Part 8 of my evaluation a few months ago, when I confirmed that all the Countries/States directly abutting the World Seas accounted for 55% of the world's deaths, I added that the data indicated that the susceptibility zone from the Seas might be up to 1,000 miles. In my Part 1, I included a summary of a Chinese paper that stated the half-life of the coronavirus at humidity was 86 hours. This paper is included in this Part 11. The Iranian paper included in this Part 11 found a positive factor of susceptibility between days 2 and 8. I'm an old engineer with vast experience in pollution. The corporation I worked for 50 years had a masters in polluting; so I had plenty of opportunity to learn.

3. I learned a long time ago that pollutants travel maximum distance with winds at 4 mph. Low winds are normal under temperature inversions. Now let's combine these facts. 86 hours (3.6 days) x 4 mph = 344 miles; that's for the half-life of the virus. 8 days x 24 hrs x 4 mph = 768 miles. So my observation in Part 8 is consistent. Micron sized particles with coronavirus encapsulated by absorption/adsorption/chemistry can travel under temperature conversions easily 350-750 miles and infect people far from the source.

Corona Virus Evaluation (Part 12)

EDCs vs LGBTQ

Simultaneous Exponential Growth of Both

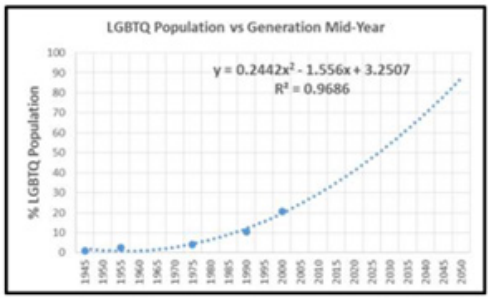
Table below is chart 36 later in this PowerPoint package

Americans' Self Identification as LGBT, by Generation

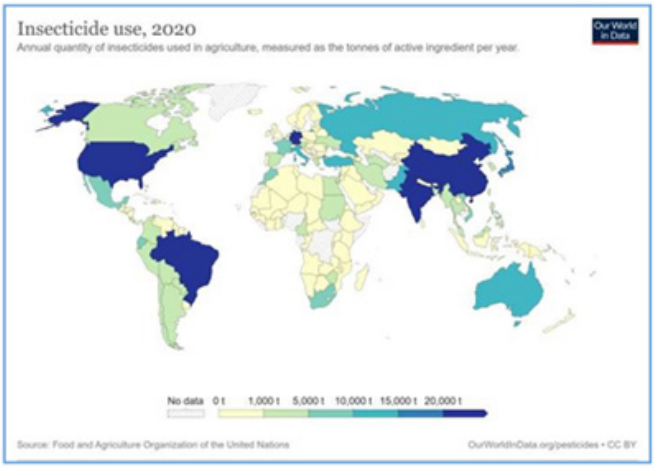
	LGBT %	Straight/Heterosexual %	No response %
Generation Z (born 1997-2003)	20.8	75.7	3.5
Millennials (born 1981-1996)	10.5	82.5	7.1
Generation X (born 1965-1980)	4.2	89.3	6.5
Baby boomers (born 1946-1964)	2.6	90.7	6.8
Traditionalists (born before 1946)	0.8	92.2	7.1

GALLUP, 2021

Below is an Excel graph created from the table showing trendline & correlation



2021 Gallop determined that generation with birth midpoint year of 2000 acknowledged 20.8% LGBTQ population. Graph indicates in 2045, US generation with birth midpoint year of 2027 will acknowledge 50% LGBTQ population. 2045 is 100 years after end of WWII and beginning of pesticide worldwide use.



The countries in dark blue each have over 7% LGBTQ overall population and are exhibiting harassment activities to cover up the fact that the governments, industries and supporting scientists are jointly responsible for the exponential growth of the LGBTQ population in each successive generation by allowing the extensive proliferation of endocrine disruption pesticides for past four generations.

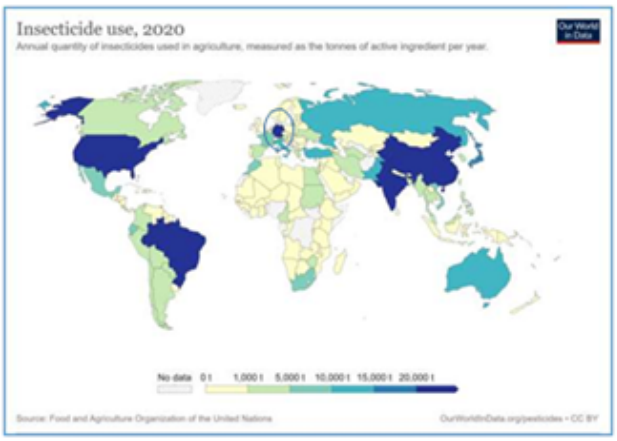
LGBTQ Populations in Heaviest Pesticide Consuming Countries (per chart 3 map)

Asexual, lesbian, gay, bisexual, and trans (ALGBT) individuals face worse life conditions and violence rates than their heterosexual cisgender counterparts. Brazil is often highlighted for having one of the highest rates of hate-related homicides against ALGBTs in the world. However, to date, Brazil's ALGBT population has not been investigated with a representative sample, and basic information such as population size or sociodemographic characteristics are mostly based in non-systematic data. We aimed to assess the proportion of asexual, lesbian, gay, bisexual, trans and non-binary adults in Brazil, their sociodemographic characteristics, and self-reported violence rates. In 2018, a sample (n=6000) of the Brazilian adult population answered a face-to-face survey assessing sociodemographic characteristics, gender identity, sexual orientation, and self-reported psychological, physical, verbal, and sexual violence. Among Brazilian adults, 12.04% are ALGBT: 5.76% asexual, 0.93% lesbian, 1.37% gay, 2.12% bisexual, 0.68 trans, and 1.18% non-binary.

Multinational research firm Ipsos released report on LGBT+ Pride 2021 Global Survey conducted between 23 April and 7 May 2021. The survey was conducted as a 27-market survey conducted by Ipsos on its global advisor platform through interview on a sample of 500 individuals in India. The report shows that 3% of the Indian population identify as homosexual (Including gay and lesbian), 9% identify as bisexual, 1% identify as pansexual, and 2% identify as asexual. 59% identified as not heterosexual (excluding 'do not know', and 'prefer not to answer'). 3+9+1+2=15%.

China has the world's largest Lesbian, Gay, Bisexual, and Transgender (LGBT) population. Among 29,125 participants, 2066 (7.1%) identified as lesbian, 9491 (32.6%) as gay, 3441 (11.8%) as bisexual, 3195 (11.0%) as transgender, and 10,932 (37.5%) as heterosexual. Heterosexual people were generally friendly towards the LGBT community with a mean score of 21.9 (SD=2.7, total scale score=100) and

the grand averaged score of self-perceived discrimination by LGBT participants was 49.9 (SD=2.5). Self-perceived discrimination from family and social services is particularly severe. The published article starting on chart 34 discusses the Gallop study on LGBTQ population in the US, which has doubled in past decade.



Circle on map in nothern Europe is highlighting the heavy insecticide using country of The Netherlands.

In 2020, around 83 percent of respondents in the Netherlands considered themselves to be heterosexual, that is to say, only attracted to the opposite sex. There has been a decreasing trend in the this time range following a high of 90 percent in 2014.

The Ipsos LGBT+ Pride 2023 survey finds that **an average of 9% of adults in 30 countries identify as LGBT+,** with sharp generational differences.

Preliminary Conclusion

A 2021 Gallop poll study showed that the LGBTQ population in the US has increased from an acknowledged 1% for the generation pre-end of WWII to 20.5% for the generation with birth dates of 19972003. It is obvious that this growth is exponential and that there is very likely a scientific explanation. Pesticides are Endocrine Disruption Chemicals (EDCs) and were introduced worldwide just after WWII. World is now in the fifth generation of exposure to pesticides and data is strongly emphasizing that the sexual evolution of humanity is being affected by this exposure. EDCs affect fertility and sexual selection during pregnancy and puberty and are well known for this effect in wildlife. The trend line from a plot of the Gallop poll data indicates that in 2045 (100 years after end of WWII) 50% of the US children born in the decade of 2020-2030 will acknowledge being LGBTQ.

On June 19, 2023 a Letter to Editor was published by OS Publishers, an open scientific journal, focusing on this observation. Peer review by an editorial board was required. Universally religious of various denominations and other peoples living in bubbles are blindly blaming the LGBTQ community for moral depravity, which is incorrect. These LGBTQ folks have evolved from successive generational exposure to pesticides. Continued exponential growth of their population from this cause is probably unstoppable. Even if all pesticides were banned today, it is uncertain that the sexual evolution of humanity, which is well underway, could reverse itself.

Worldwide Pesticide Usage and its Impacts on Ecosystem

Anket Sharma, SN Applied Sciences volume 1, Article number: 1446 (2019) Cite this article.

Abstract

Pesticides are extensively used in modern agriculture and are an effective and economical way to enhance the yield quality and quantity, thus ensuring food security for the ever- growing population around the globe. Approximately, 2 million tonnes of pesticides are utilized annually worldwide, where China is the major contributing country, followed by the USA and Argentina, which is increasing rapidly. However, by the year 2020, the global pesticide usage has been estimated to increase up to 3.5 million tonnes. Although pesticides are beneficial for crop production point of view, extensive use of pesticides can possess serious consequences because of their bio-magnification and persistent nature. Diverse pesticides directly or indirectly polluted air, water, soil and overall ecosystem which cause serious health hazard for living being. In the present manuscript, an attempt has been made to critically review the global usage of different pesticides and their major adverse impacts on ecosystem, which will provide guidance for a wide range of researchers in this area.

Introduction

Pesticides are the chemicals (natural or synthetic) employed in various agricultural practices to control pests, weeds and diseases in plants. Pesticides include a wide range of herbicides, insecticides, fungicides, rodenticides, nematicides, etc. In the process of agricultural development, pesticides became a vital tool for plant protection and for enhancing crop yield. Approximately, 45% of the annual food production is lost due to pest infestation; therefore, effective pest management by using wide range of pesticides is required to confront pests and to increase the crop production [1]. However, in the last half of the nineteenth century, robust growth in the world economy including both industrial and agricultural sectors has led to the progressive mount in the generation and utilization of agriculture-based chemicals

which often induce calamitous effects on the environment. Injudicious use of pesticides and other persistent organic pollutants in agricultural soils have devastated future repercussions. The persistent and ubiquitous nature of various agriculture-based pesticides and other organic pollutants has posed havoc to the mankind due to their bioaccumulation properties and high toxicity [2]. These pesticides are known to hinder the normal functioning of endocrine and reproductive systems in living organisms [3]. Certain pesticides like Dichloro Diphenyl Trichloroethane (DDT), chlordane, aldrin, dieldrin, endrin, mirex, heptachlor and hexachlorobenzene impart deleterious effects on human health and environment [4].

There may be other alternatives available to control crop loss due to pest attack which may include the application of various biopesticides. Developing some pest-resistant crop varieties using transgenic approaches is also one method to avoid pesticide use. But application of chemical pesticides is still preferred the most over all other alternatives to protect crops from yield loss. Presently, throughout the globe approximately 2 million tonnes of pesticides are utilized, out of which 47.5% are herbicides, 29.5% are insecticides, 17.5% are fungicides and 5.5% are other pesticides [5]. The top ten pesticide consuming countries in the world are China, the USA, Argentina, Thailand, Brazil, Italy, France, Canada, Japan and India [6]. Moreover, it has been estimated that by the year 2020, the global pesticide usage will increase up to 3.5 million tonnes [7].

Pesticides are applied to increase crop productivity; however, in due course of time, they get accumulated in plant parts, water, soil, air and biota. Extensive use of pesticides contaminates soil and water, remain in the crops and finally enter food chain, thereby posing threat to the human beings [8, 9]. The commercial use of pesticides in agriculture produces vapors of pesticides that have the ability to become air pollutant [10]. The release of pesticides into the air largely depends upon the physical and chemical properties of the active compound, application procedure and changing environment conditions [11,12]. Further, the volatilization of water adds pesticides into the air. The pesticides get dispersed and transported from one site to other in the form of degraded products [13]. Pesticides used in agriculture are synthetic in origin and get absorbed in the soil through surface runoff from treated plants. The nature of organic compound, cropping practices, irrigation techniques and climatic factors influence the dissolution of pesticides in soil [14]. The residues of these organochlorine compounds further pollute the groundwater through leaching and in turn affect the quality of agricultural crops. Pesticides get accumulated in soils directly by its application in agriculture and domestic purposes or indirectly by deposition of airborne contaminants previously coming from different sites or areas. Soil serve as storage compartments due to high affinity of organic chemicals with soil [15]. The deposition of organic chemicals or pesticides in soil directly exposes soil organisms and also increases the risk for other higher organisms through diet and can severely affect soil ecosystem, water bodies, plants and human health [16-19]. Keeping in mind the extensive use of pesticides throughout the globe, the present review gives an overview about the application of pesticides in the world and their various impacts on the ecosystem.

In Africa, lack of knowledge about the usage of pesticides has also led to the usage of those pesticides which fall under WHO risk classification system. According to Pesticide Risk Reduction Program (PRRP), [26], in Ethiopia alone, out of 302 registered pesticides, 160 contained active ingredients which were classified as WHO class II chemicals (moderately hazardous). Case studies of other African countries also showed the usage of pesticides which were hazardous according to the WHO risk classification system. A study by Obopile et al. [27] in Botswana showed that over 50% of farmers use malathion and cypermethrin as pesticides and these are WHO class II chemicals. The same study also pointed that in Botswana, methomyl is used by 7.1% of farmers, demeton-S-methyl is used by 2.7% farmers, and dichlorvos is used by 1.8% farmers, and all these chemicals are classified under WHO class Ib pesticides (highly hazardous). A similar study conducted by Oluwole and Cheke [28] in Nigeria established that maximum farmers (78%) use monocrotophos which comes under WHO class Ib chemicals. Other pesticides that were reported included atrazine and metolachlor which fall under WHO class III chemicals (slightly hazardous), and lindane, copper sulfate and paraquat which are WHO class II chemicals. Nyirenda et al [29]. reported the usage of monocrotophos (Ib) by 41% farmers in Zambia, while in Malawi, parathion, a WHO class Ia pesticide (extremely hazardous), is used by over 25% of farmers. Other commonly used active ingredients in pesticides include glyphosate (III), malathion (III), chlorpyrifos (II), cypermethrin (II), deltamethrin (II), dimethoate (II), endosulfan (II), fenitrothion (II) and profenofos (II). These mentioned pesticides are frequently used in Benin, Ethiopia, Ghana and Senegal [30]. The common risk linked with pesticide usage is the resistance of the pests that leads to destruction of the crops despite appropriate application. It has been reported in western part of Africa that the use of pyrethroids has caused resistance in tomato bollworm (*Heliothis armigera Hübner, et al.,)* and diamondblack moth (*Plutella xylostella L, et al.,*) [23, 31]. Also, resistance to pyrethroids and organophosphates was seen in an aphid (*Aphis gossypii Glover, et al.,*), while a whitefly (*Bemisia tabaci Gennadius, et al.,*) has been reported to develop resistance against pyrethroids, organophosphates and neonicotinoids [32, 33].

Pesticide usage in Asia

The use of pesticides in agriculture is increasing rapidly in developing countries, especially in Southeast Asia [34, 35]. WHO has reported that approximately 20% of pesticides are used in developing countries with increasing rate of usage. An annual increase in import of pesticides is reported as 61% for Cambodia, 55% for Laos and 10% for Vietnam [36]. The manufacturing of pesticides in India started in 1952, with the production of benzene hexachloride, followed by DDT. The synthesis of pesticides increased enormously. In 1958, India

manufactured over 5000 metric tonnes of pesticides which increased to 85,000 metric tonnes in the mid-1990s with the registration of 145 pesticides and the major pesticides produced are insecticides [37]. India is one of the major pesticides producing countries in Asia with annual production of 90,000 tonnes, and it stands at twelfth position in the world in the manufacturing of pesticides [38]. In the past, India used and exported organochlorine pesticides on large scale including DDTs and HCHs [39]. Similarly, in Pakistan, the pesticides usage started in 1954 with the import of 250 metric tonnes [40]. The pesticides consumption in Pakistan increased to 78,132 tonnes per annum in 2003 [38, 41]. During Green Revolution period, thousands of tonnes of pesticides had been imported from Europe and the USA to control crop pest infections, locust control and suppression of malaria in Pakistan [42]. Use of pesticides in Bangladesh was low until 1970. The pesticide usage increased tremendously from 2200 million tonnes in 1980-1982 to 6500 million tonnes in 1992-1994 [43]. In Nepal, the first reported use of pesticides was DDT in 1956, which was followed by other organochlorines, organophosphates, carbamates and synthetic pyrethroids. It has been reported by plant protection division of department of agriculture, approximately 55.8 metric tonnes of pesticides is used annually in Nepal [44]. In Sri Lanka, the pesticides are mainly used in agriculture sector. DDT was the first pesticide used in Sri Lanka after World War II for malaria eradication. Pesticides were introduced in Thailand and Vietnam in mid-1950s. In Vietnam, the use of pesticides accelerated in mid-1980s during economic liberalization. The use of pesticides in agriculture increased from 20 to 30 million kg, and it further increased to 77 million kg in 2007 [45]. In China, pesticide production started in 1950 with the manufacturing of DDT. China has become the largest pesticide manufacturing country during past 50 years of development. In China, pesticides are mainly used for rice production. The consumption of pesticides in China has increased from 76 million tonnes in 1991 to 146 million tonnes in 2006. Japan is one of the largest pesticide consumers in the world and has biggest pesticide market in Asia [46]. Table 2 shows the consumption of different pesticides in the Asian countries.

World Population by Region											
#	Region	Population (2020)	Yearly Change	Net Change	Density (P/Km^2)	Land Area (Km^2)	Migrants (net)	Fert. Rate	Med. Age	Urban Pop %	World Share
1	Asia	4,641,054,775	0.86%	39,683,577	150	31,033,131	-1,729,112	2.2	32	0%	59.50%
2	Africa	1,340,598,147	2.49%	32,533,952	45	29,648,481	-463,024	4.4	20	0%	17.20%
3	Europe	747,636,026	0.06%	453,275	34	22,134,900	1,361,011	1.6	43	0%	9.60%
4	Latin America and the Caribbean	653,962,331	0.90%	5,841,374	32	20,139,378	-521,499	2	31	0%	8.40%
5	Northern America	368,869,647	0.62%	2,268,683	20	18,651,660	1,196,400	1.8	39	0%	4.70%
6	Oceania	42,677,813	1.31%	549,778	5	8,486,460	156,226	2.4	33	0%	0.50%

Table 1: Pesticide usage in African countries in the years 2010 and 2014, index on the basis of their area. From: Worldwide pesticide usage and its impacts on ecosystem.

S. no.	African countries	Area (km)^2	Quantity of pesticide used in 2010 (kg/ha)	Quantity of pesticide used in 2014 (kg/ha)
1	Congo	2,345,00	3.61	3.03
2	Sudan	1,886,08	0.09	0.25
3	Cameroon	475,442	1.22	NA
4	Zimbabwe	390,757	NA	0.53
5	Malawi	118,484	0.15	0.6
6	Togo	56,785	0.09	0.25
7	Rwanda	28,338	0.69	1.47
8	Burundi	27,834	0.19	NA
9	Mauritius	2,040	28.17	27.19

Table 2: Annual pesticide consumption in different Asian countries [47] From: Worldwide pesticide usage and its impacts on ecosystem.

S. no.	Country	Tonnes pesticides used
1	China	1,807,000
2	India	56,120
3	Malaysia	49,199

4	Pakistan	27,885
5	Thailand	21,800
6	Vietnam	19,154
7	South Korea	19,788
8	Bangladesh	15,833
9	Myanmar	5583
10	Nepal	454
11	Bhutan	12

Table 3: Pesticide usage in European countries - years 2010 and 2014, index on basis of their area. Source: Worldwide pesticide usage and its impacts on ecosystem.

S. no.	European countries	Area (km)^2	Quantity of pesticide used in 2010 (kg/ha)	Quantity of pesticide used in 2014 (kg/ha)
1	France	551,394	1.17	3.9
2	Spain	498,468	2.77	3.35
3	Sweden	449,964	0.68	0.72
4	Germany	357,168	3.39	3.8
5	Italy	301,318	7.34	6.45
6	Greece	131,940	1.51	2.58
7	Portugal	91,568	7.4	6.84
8	Austria	83,858	2.53	2.39
9	Czech Republic	78,866	1.59	1.45
10	Ireland	70,273	2.5	2.84
11	Denmark	44,493	1.61	0.71
12	Netherlands	41,198	9.05	9.86
13	Belgium	30,510	5.43	7.73

NIH Public Access Author Manuscript Rev Environ Health. Author manuscript; available in PMC 2010

September 27. Published in final edited form as: Rev Environ Health. 2009; 24(4): 303-309.

Pesticides Use and Exposure Extensive Worldwide

Introduction

Worldwide it is estimated that approximately 1.8 billion people engage in agriculture and most use pesticides to protect the food and commercial products that they produce. Others use pesticides occupationally for public health programs, and in commercial applications, while many others use pesticides for lawn and garden applications and in and around the home [1, 2]. Pesticides are defined as "chemical substances used to prevent, destroy, repel or mitigate any pest ranging from insects (i.e., insecticides), rodents (i.e., rodenticides) and weeds (herbicides) to microorganisms (i.e., algicides, fungicides or bactericides)" [1, 3]. Over 1 billion pounds of pesticides are used in the United State (US) each year and approximately 5.6 billion pounds are used worldwide [1]. In many developing countries programs to control exposures are limited or non-existent. As a consequence; it has been estimated that as many as 25 million agricultural workers worldwide experience unintentional pesticide poisonings each year [4]. In a large prospective study of pesticide users in the United States, the Agricultural Health Study, it was estimated that 16% of the cohort had at least one pesticide poisoning or an unusually high pesticide exposure episode in their lifetime [5]. Although attempts to reduce pesticide use through organic agricultural practices and the use of other technologies to control pests continue, exposure to pesticides occupationally, through home and garden use, through termite control or indirectly through spray drifts and through residues in household dust, and in food and water are common [6]. The US Department of Agriculture has estimated that 50 million people in the United States obtain their drinking water from groundwater that is potentially contaminated by pesticides and other agricultural chemicals [7, 8]. Children from 3-6 years old received most of their dermal and non-dietary oral doses from playing with toys and while playing on carpets which contributed the largest portion of their exposure [9-12].

Previous Hazard Assessment Inadequate

Pesticides are commonly referred to by the functional class of the active ingredient and the type of organism that they are designed

to control (e.g. organophosphate insecticides, thiocarbamate herbicides, thiazine herbicides). Nearly all commercial formulations of pesticides are complex mixtures of active and other ingredients. These "other ingredients" include a wide variety of substances added to increase the efficacy of the product in a cost-effective manner. Information regarding these other compounds is considered proprietary business information and is not publicly available [6]. The health effect of a commercial pesticide product may be a consequence of the active ingredient, the other ingredients in the formulation, or both. Toxicological testing, unfortunately, is usually restricted to the active ingredient. Epidemiological surveillance of the health effects of pesticides identifies adverse effects of the combined ingredients. Disparity between epidemiological evaluations of President's Cancer Panel - October 21, 2008 NIH Public Access Author Manuscript Rev Environ Health. Author manuscript; available in PMC 2010 September 27.

Published in final edited form as: Rev Environ Health. 2009; 24(4): 303-309. NIH-PA Author Manuscript NIH-PA Author Manuscript NIH-PA Author Manuscript pesticides and toxicological evaluations may, in part, be due to this difference in scientific focus. The International Agency for Research on Cancer (IARC), a component of the World Health Organization, and its monograph series on the Evaluation of Carcinogenic Risks to Humans is widely used to identify environmental carcinogens and to help guide government policy in protecting people from the risk of cancer due to dietary, environmental and occupational carcinogens. Currently, lARC classifies two pesticides as human carcinogens namely, the arsenical insecticides and 2,3,7,8 Tetrachlorodibenzo-p-dioxin (TCDD, a contaminant of the phenoxy herbicide 2,4,5-T) [13]. However, IARC also states that "occupational exposures in spraying and application of non-arsenical insecticides" as a group are "probable human carcinogens". This group of non-arsenical chemicals is used world-wide and includes scores of active ingredients in hundreds of different commercial formulations. Most of the pesticides on the market today are considered non-genotoxic. IARC characterizes most previous epidemiology studies as inadequate to assess human carcinogenicity because of small sample size, limited follow-up, or a retrospective design with poor exposure assessment.

In United States before a pesticide can be marketed or sold, Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) requires the EPA to ensure that when used according to label instructions, the pesticide can be used with a reasonable certainty it will not harm health or the environment. To achieve this, the EPA assesses carcinogenic risk by relying primarily on animal genotoxicity studies and/or short-term mutagenicity assays. This is based on our understanding that genotoxicity and mutagenicity play a major role in carcinogenesis [6]. Of particular concern is the situation that arises when a pesticide is determined to be noncarcinogenic based on genotoxicity/mutagenicity assays (thus labeled by the US EPA as "Not Likely to Be Carcinogenic in Humans" or "Evidence of Non-Carcinogenicity for Humans" [14], yet cancer incidence has been found to be increased in epidemiologic studies [15]. Recently, the Agricultural Health Study has produced some evidence of increased incidence of cancer of the prostate, lung, colon, pancreas, bladder, leukemia, and multiple myeloma with increasing lifetime exposure to certain pesticides [16-31].

Use of in-vitro and in-vivo toxicological testing has undoubtedly kept many dangerous pesticides destined for agricultural, commerce, public health and household use off the market. Accumulating experience suggests that post-market epidemiological surveillance of pesticide safety is essential to ensure public health [6]. Post-market surveillance has revealed that as many as 25 million agricultural workers worldwide experience unintentional pesticide poisoning each year [32] and it has also been suggested that pesticides on the market currently may cause cancer in humans [16-32]. The epidemiologic evaluation of individual pesticides for human carcinogenicity has been hampered by inadequate exposure assessment. Early occupational epidemiological studies inferred pesticide exposures from occupational or industrial classifications of work histories [14-32]. Exposure assessment methods have progressed from using crude surrogates, such as farming or living on a farm, to identifying specific chemicals that may contribute to disease risk. Additionally, information on determinants of exposure, such as application methods, use of personal protective equipment, and attitudes regarding safe work practices can be collected by questionnaire or personal interview. Exposure estimates can be further improved through the use of integrated metrics such as exposure algorithms that have been used in the Agricultural Health Study [14,32,38]. Pesticide exposure assessments are more accurate and precise when information is collected prior to disease onset, because most exposure cannot be assessed Alavanja Page 2 Rev Environ Health. Author manuscript; available in PMC 2010 September 27. NIH-PA Author Manuscript NIH-PA Author Manuscript NIH-PA Author Manuscript accurately [32]. Time since application and disease can influence recall of exposure as well as interpretation. The primary' goal of exposure estimation in epidemiology is to correctly rank individuals with regard to exposure level in the study population [32]. To reduce exposure misclassification, it is critical to separate the non-exposed from the low-exposed, moderately exposed, and highly exposed individuals. Workers in developing countries and migrant seasonal workers.

Populations Disproportionately by Affected by Agriculturally Related Work Cancers

Workers with occupational exposures to pesticides on average have significantly exposure than the rest of the population. In the United States pesticides with the highest acute toxicity are now known as "restricted use pesticides" and can only be sold to individuals with certification in safe handling of these chemicals. Applicators who apply these pesticides generally required to obtain formal instruction in the safe use, handling and storage of these chemicals. Workers in developing countries and migrant or seasonal agricultural workers in the United States rarely have adequate training in the use of "restricted use pesticides". These populations are probably disproportionately

affected by the adverse health effects of these pesticides. These populations are difficult to study epidemiologically because cancer tends to take 10-20 years to develop in an individual exposed to a biologically sufficient dose [33]. Further studying the association of exposures in transient seasonal agricultural workers and their families [34-37] with cancer has rarely been possible. Innovative study designs coupled with modern technology may allow us to conduct studies of cancer risk among seasonal workers in the future; however studies with adequate statistical power and rigorous exposure assessment have yet to be fully developed.

Prospective Cohort Studies: Some Improvements in Design

In order to mitigate the limitations of previous epidemiological efforts scientists at the National Cancer Institute in collaboration with other federal agencies (i.e., NIEHS, USEPA, and NIOSH), designed and initiated the previously-mentioned prospective study known as the Agricultural Health Study (AHS) of occupationally exposed pesticide applicators in two important agricultural states (i.e., Iowa and North Carolina) [38]. Both farmers and commercial pesticide applicators and the non-occupationally exposed spouses of farmer applicators constitute the study population of 89,658 participants. A more complete discussion the AHS is contained in the report by *Dr. Laura Beane-Freeman* (this issue). In summary, thirty heavily used pesticides have been evaluated by the Agricultural Health Study as of September, 2008 [14-31]. Because the observed exposure- response associations for many of these pesticides were not hypothesized a priori and because of the limited study of their biological plausibility, study findings should be interpreted with caution. Nonetheless the results are provocative. Twelve of the thirty pesticides used by millions of people worldwide were observed to show an increased risk of some cancer with increasing use of the pesticide based on limited numbers. Significant associations were observed for prostate, lung, bladder, pancreas, and colon cancer as well as for, leukemia and multiple myeloma. The pesticides observed to show significant positive effects included herbicides, insecticides and chemical fumigants. While a wide variety of chemical were involved, not all chemicals from the same chemical class showed significant associations with cancer. The AHS is evaluating the consistency of these findings by re-evaluating the links between pesticides and cancer and by assessing the mode of action of these pesticides. Studies with a prospective design and comprehensive exposure assessment can provide valuable information concerning the potential link between pesticides and cancers. However, it is essential that an independent panel of experts such as those convened by IARC or the USEPA make a determination about the adequacy of evidence regarding the human carcinogenicity of a particular pesticide.

Can Non-Genotoxic Chemicals be Human Carcinogens?

The majority of pesticides observed to show a significant exposure-response association with a particular cancer in recent epidemiological studies were not observed to be genotoxic in the standard battery of laboratory test currently used in pre- market screening of commercial products [14,32]. This perplexing observation may suggest recent epidemiological findings are erroneous. Alternatively, it may indicate although the existing battery of tests used for regulatory purposes have successfully kept a large number of genotoxic human carcinogens out of the market place; some non-genotoxic human carcinogens have passed through the existing screening procedures [14]. ALTERNATIVE BIOLOGICAL MECHANISMS Several alternative mechanisms are being explored within the AHS and other studies: Epigenetic mechanism Epigenetic events are responsible for both normal and vital processes that keep cells working in a healthy state and also for abnormal and pathological processes associated with cancer development. Epigenetic events include heritable alterations in gene and chromatin expression without accompanying changes or mutations in the DNA sequence. Knowledge of epigenetic mechanisms within the cells is developing rapidly and holds great promise for research related to cancer etiology, prevention, early diagnosis and treatment. Although other mechanisms are being explored, three major mechanisms seem to account for the major vital epigenetic cellular control measures within the cell including: DNA methylation, covalent post- translational modifications of historic proteins, and RNA-mediated gene silencing. Once epigenetic patterns of DNA methylation and histone acetylation have been established, they are propagated over many cell generations. Disruption of one of these two epigenetic mechanisms will automatically affect the other and this close communication seems to be at work in both the normal and the diseased cell [38-41]. Current research suggests that aberrant epigenetic changes such as those discussed above can promote tumor development. Better understanding of the environmental and the endogenous factors that trigger these epigenetic changes is vitally needed. Environmental pollutants such as pesticides, metals (arsenic, nickel, cadmium), aflatoxin, ionizing radiation, tobacco smoke, and different infectious agents are suspected to have a potential effect on DNA rnethylation, chromatin organization and function, and histone as carriers of specific epigenetic information. Growing evidence suggests that the deregulation of epigenetic information in somatic cells caused by environmental pollutants can alter gene expression in a heritable manner, leading to malignant transformations [39-42].

Gene-Environment Interaction

Prostate cancer is significantly more frequent in farm populations compared to the general population [14]. In the AHS, we observed a significant elevation in risk among men with a family history of prostate cancer [42] that used chlorpyrifos, fonofos, phorate, coumaphos, pymethrin, and butylate, suggesting genetic susceptibility among these subjects. To better understand this observation, we have launched a nested case-control study within the AHS cohort. Buccal cell DNA will be used to determine if selected pathways could help explain the

observation by means of a gene- environment interaction. By using the latest biotechnology available, we will explore a large number of pathways including metabolic, hormone regulatory, lipid metabolism, telomere regulatory and others.

Telomere Length

Since some leukemia's and lymphomas are often preceded by chromosome instability, several studies are evaluating the length of the chromosome telomeres in relation to environmental exposures and cancer risk. Telomeres shorten with age and with exposure to some exogenous agents. Telomere length controls the stability of the chromosome and shortening the telomere after exposure to selected pesticides may explain, in part, the epidemiological associations observed between selected pesticides and cancer risk [14].

Conclusion

Exposure to pesticides is very common world-wide. Currently, only two pesticides, arsenical insecticides and TCOD (a dioxin) have been designated by IARC as known human carcinogens, but many others with world-wide use are suspected human carcinogens. Few pesticides on the market today are directly genotoxic and their role in human carcinogenesis will be questioned as long as the epidemiologic data are limited and alternative non-genotoxic mechanisms are not established. Rapid progress in our understanding of non-genotoxic carcinogenic mechanisms is being made in the biomedical research arena. While no one study can provide all the evidence needed to evaluate the carcinogenicity of pesticides as human carcinogens, prospective cohort studies with comprehensive exposure assessment are likely to greatly increase our understanding. A prospective cohort study also allows for pertinent biological specimens to be collected at appropriate periods of time to examine the biological plausibility of the epidemiological observations. The design strengths of prospective studies should help increase our scientific understanding of the links between pesticide exposure and cancer and other diseases. Better scientific understanding coupled with effective public health programs should greatly reduce the human disease burden currently caused by pesticide exposures.

Are EDCs Blurring Issues of Gender? Ernie Hood

Although scientists have postulated a wide range of adverse human health effects of exposure to Endocrine-Disrupting Chemicals (EDCs), the nexus of the debate is the concern that prenatal and childhood exposure to EDCs may be responsible for a variety of abnormalities in human sexuality, gender development and behaviors, reproductive capabilities, and sex ratios. Scientists today are asking hard questions about potential human effects: Do EDC exposures impair fertility in men or women? Can they cause sexual organ malformations, stunted reproductive development, or testicular or breast cancer? Do fetal exposures to EDCs alter sex phenotypes? Do they change later gender-related neurobiological characteristics and behaviors such as play activity and spatial ability? Could such exposures even be involved in the etiology of children born with ambiguous gender? EDCs include a spectrum of substances that can be loosely classified according to their known or suspected activity in relation to sex hormone receptors and pathways. The most-studied and best known are the environmental estrogens, which mimic estradiol and bind to estrogen receptors (ERs). ER agonists include the pesticide methoxychlor, certain polychlorinated biphenyls (PCBs), bisphenol A (BPA; a high production volume chemical used to make polycarbonate plastic), pharmaceutical estrogens such as Di Ethyl Stilbestrol (DES) and ethinyl estradiol, and phytoestrogens, which occur naturally in many plants, most notably in soybeans in the form of genistein and related substances. There are a few known ER antagonists, or antiestrogens. Antiandrogens, or Androgen Receptor (AR) antagonists, include the fungicide vinclozolin, the DDT metabolite p,ṕ-DDE, certain phthalates (a group of chemicals used to soften polyvinyl chloride plastics), and certain other PCBs. And there are other types of EDCs that affect particular endocrine targets. The various EDCs differ greatly in their potencies relative to natural hormones, and in their affinity for target receptors. Some have been shown to act via non-receptor-mediated mechanisms, for example by interfering with hormone synthesis. In many well-documented cases of high-level fetal exposures to known EDCs such as DES, certain PCBs, and DDT, the answer to the question of whether exposure is associated with gender-related effects is clearly yes. But high-level exposures such as these are relatively rare and isolated. The debate today centers on low-dose exposures-generally defined as doses that approximate environmentally relevant levels-and the idea that low-dose intrauterine exposure to some EDCs during certain critical windows of development can have profound, permanent impacts on subsequent fetal development and adult outcomes.

Critics of this idea maintain that thus far there is no credible evidence to suggest that low-dose exposures cause any adverse human health effects. But if low-dose exposures were confirmed to be the threat that proponents of the concept insist they are, public health would clearly be at risk, regulatory agencies' risk assessment approach would need to be revised, and certain common chemicals-including some that are massively produced and economically important-would likely disappear from the marketplace. In a June 2000 EHP review article on human health problems associated with EDCs, Stephen Safe, director of the Center for Environmental and Genetic Medicine at Texas A&M University, concluded that "the role of endocrine disruptors in human disease has not been fully resolved; however, at present the evidence is not compelling." Frederick vom Saal, a developmental biologist at the University of Missouri-Columbia, disagrees, particularly in light of the research that's been presented in the years since that review. "The jury is not out on human effects," he says. "In terms of the amount of information we have in animals and the amount of information we have in humans, clearly there is a huge difference, but that's

a lot different than saying the jury is out on whether EDCs influence humans." One thing both scientists might agree on, though, is that right now there are still more questions than answers.

A Delicate Process

The endocrine system, comprising the hypothalamus, pituitary, testes, ovaries, thyroid, adrenals, and pancreas, is one of the body's key communications networks. It regulates the function of specific tissues and organs by secreting hormones that act as precise chemical messengers. Development and regulation of the reproductive system is one of the major functions of the endocrine system. Sex determination and development begin early in gestation, with the differentiation of the embryonic gonad into either testes or ovaries. If the Sry gene is present on the Y chromosome, it will, when activated, trigger a complex cascade of hormonal events that ultimately results in the birth of a baby boy with all of the requisite male equipment in place and functioning properly. In the absence of the Sry gene, the end product of the process will be a baby girl. The female phenotype is considered to be the "default" pathway for mammalian reproductive development. Differentiation and development of the sexual organs continues throughout gestation under the guidance of the various sex hormones (such as estrogen and testosterone) produced by the endocrine system. For males and females alike, the entire process of reproductive development is exquisitely sensitive to minute changes in levels of the sex hormones, particularly during certain critical windows of development.

In papers published in the Journal of Animal Science throughout 1989, vom Saal demonstrated this sensitivity in a series of mouse experiments. These studies showed that in multiple-birth species it was possible for adjacently positioned male and female fetuses to transmit tiny amounts of hormones to each other, with pronounced phenotypic consequences. "We found that a difference of about a part per billion of testosterone and about twenty parts per trillion of estradiol [endogenous estrogen] actually predict entirely different brain structures, behavioral traits, enzyme levels, and receptor levels in tissues, hormonal levels in the blood—there is nothing you look for that . . . doesn't differ in these animals," says vom Saal. Such a delicately timed and precisely controlled process presents a myriad of opportunities for perturbation from exposure to EDCs. These chemicals mimic hormones, and can disrupt differentiation and development in a wide variety of ways, by duplicating, exaggerating, blocking, or altering hormonal responses. The developing fetus and early neonate may lack the protective metabolic mechanisms present in adults that help detoxify and break down chemicals, maintaining homeostasis in the system. Also, tissues are rapidly dividing and differentiating in the fetus, and such a high level of cell activity is vulnerable to disruption of normal development. With such small body mass in the fetus and child compared to an adult, exposure levels may be amplified in terms of relative dosages reaching target tissues. And sometimes, exogenous EDCs may show very low binding to plasma hormone-binding proteins and thus roam the body in an unbound state, with unknown effects. Much of what remains to be discovered about the impacts of EDC exposures on the fetus relates to a new concept called the developmental origins of health and disease (until recently known more commonly as the fetal basis of adult disease). "People are just now recognizing that this is indeed a possibility," says NIEHS scientist Retha Newbold, a pioneer in the study of endocrine disruption who has spent decades researching the effects of exogenous estrogens, particularly DES. "Developmental exposure to low doses of EDCs may not lead to malformation or to anything you can look at and immediately recognize as a problem," she says. "But it still could have long-term effects, such as alterations in metabolism, alterations causing cancer later on, or alterations causing infertility."

Evidence of Effects

Reproductive and developmental abnormalities linked to EDC exposures have now been documented in birds, frogs, seals, polar bears, marine mollusks, and dozens of other wildlife species. For example, alligators in Lake Apopka-one of Florida's most polluted lakes due to extensive farming activities around the lake, the presence of a sewage treatment facility, and a major 1980 spill of pesticides including DDT and DDE-have been shown to have been "feminized." That is, zoologist Louis J. Guillette, Jr., and colleagues first reported in the August 1994 EHP, the males have shortened penises and low levels of testosterone, while the females have excessive levels of estrogens. Sex reversal (in which an animal of one sex matures with the reproductive organs and capabilities of the other sex) and skewed sex ratios (in which there is an unusually greater proportion of one sex than the other) have been seen in several fish populations, particularly colonies living in close proximity to pulp and paper mills and sewage treatment plants. Other reports have shown reproductive effects among wildlife resulting from exposure to EDCs excreted into the water supply by women taking birth control pills. Many of the adverse outcomes seen in wildlife populations have been replicated in laboratory experiments, confirming the role of EDCs in their occurrence. Among the papers reporting such confirmation were a May 1997 article in EHP, in which Guillette, D. Andrew Crain, and colleagues replicated alterations in steroidogenesis (the production of sex hormones) in alligators. More recently, in the December 2004 issue of EHP, Jon Nash and colleagues showed that long-term laboratory exposure to environmental concentrations of the pharmaceutical ethinyl estradiol caused reproductive failure in zebrafish. According to a report on EDCs published in volume 75, issue 11/12 (2003) of Pure and Applied Chemistry by the Scientific Committee on Problems of the Environment/International Union of Pure and Applied Chemistry (SCOPE/IUPAC), more than 200 animal species are either known or suspected to have been affected by these chemicals. "The weight of evidence for endocrine disruption in wildlife is really overwhelming," says Joanna Burger, a professor of cell biology and neuroscience at Rutgers University who cochaired the SCOPE/IUPAC project.

The SCOPE/IUPAC report was less definitive on the extent of human effects of endocrine disruptors. "It is too early to reach firm conclusions about whether human populations are seriously at risk from potential exposures to [EDCs], and further vigilance is clearly required," the authors wrote. "However, it is somewhat reassuring that after substantial research in the past decade, there have been no conclusive findings of low-level environmental exposures to [EDCs] causing human disease." The report further notes, however, that "[c] hemical interferences with steroid biosynthesis and metabolism can produce adverse health effects, even though the inducing agent would not be detected as an [EDC] using receptor-based test systems. This is an important area of study because some examples of [endocrine disruption] occurring in animals derive from exposure to inhibitors of steroidogenic enzymes such as 5α-reductase and aromatase. Some such agents are known to be active in humans and are used successfully in the treatment of a range of human

hormonal conditions." The authors suggested that evaluation of such effects will require integrated screening that incorporates in vitro and in vivo technologies. A comprehensive report issued in 2002 by the World Health Organization's International Programme on Chemical Safety, titled Global Assessment of the State-of-the-Science of Endocrine Disruptors, reached similar conclusions. The report stated that "although it is clear that certain environmental chemicals can interfere with normal hormonal processes, there is weak evidence that human health has been adversely affected by exposure to endocrine-active chemicals. However, there is sufficient evidence to conclude that adverse endocrine- mediated effects have occurred in some wildlife species." Citing the fact that studies to date examining EDC-induced effects in humans have yielded inconsistent and inconclusive results, the group wrote that, although that explains their characterization of the evidence as weak, "[that] classification is not meant to downplay the potential effects of EDCs; rather, it highlights the need for more rigorous studies." The Global Assessment further states that the only evidence showing that humans are susceptible to EDCs is currently provided by studies of high exposure levels. There is, in fact, clear evidence that intrauterine EDC exposures can alter human reproductive tract development and physiology. The most thoroughly characterized example is DES, the synthetic estrogen prescribed to millions of pregnant women in the United States and elsewhere from the 1940s to the 1970s to prevent miscarriage. The drug is known to have caused a rare form of vaginal cancer in thousands of daughters of women who took DES, as well as a variety of adverse reproductive tract effects in both the daughters and sons of those women.

The Phthalate Connection

But reliable correlations between animal data and human outcomes have proven elusive, particularly when it comes to showing an association between human exposures to environmental EDCs at ambient levels (that is, unrelated to spills or other acute contamination events) and adverse health effects. That may be about to change for one class of chemicals-phthalates.

Phthalates are commonly used in a wide variety of consumer products such as solvents, soft plastics, and cosmetics. The National Health and Nutrition Examination Survey showed that the majority of the U.S. population carries a measurable body burden of several phthalates. There is an extensive body of literature regarding the effects of prenatal phthalate exposure in rodents. Those effects include an association between intrauterine exposure and abnormalities in male animals in a biomarker known as Anogenital Distance (AGD), or the distance between the rectum and the base of the penis. AGD has been shown to be a sensitive measure of prenatal antiandrogen exposure. This pattern of genital dysmorphology has come to be known as the "phthalate syndrome."

In the first study to look at the link between AGD and EDC exposure in humans, Shanna Swan, a professor of obstetrics and gynecology at the University of Rochester, and her colleagues collected data from 85 mother-son pairs participating in the Study for Future Families, a multicenter pregnancy cohort study. The mothers' urine was analyzed for the presence of several phthalate metabolites, and the infant boys, aged 2-36 months, were examined for genital developmental characteristics, including AGD, which was standardized for weight to develop an Anogenital Index (AGI). Although the researchers found no sign of frank genital malformations or disease, they did discover an association between elevated concentrations of four phthalate metabolites in the mothers and shorter-than-expected AGI in the infants, as reported in the August 2005 issue of EHP. And, importantly, shortened AGI was found in infants exposed prenatally to phthalate metabolites at concentrations comparable to those found in one-quarter of the U.S. female population. The boys with short AGI were also significantly more likely to have incomplete testicular descent (cryptorchidism). "We know that incomplete testicular descent is a risk factor for poorer semen quality, lower sperm counts, [impaired fertility], and testicular cancer," says Swan. Although it is obviously impossible to predict adult outcomes, she says these infants may be at risk of Testicular Dysgenesis Syndrome (TDS) in the future.

TDS is a concept put forth by Danish researcher Niels Skakkebæk and colleagues, in which four adverse male reproductive end points-impaired semen quality, cryptorchidism, hypospadias (abnormal location of the urethra), and testicular cancer-are risk factors for each other. Says Swan, "The idea is that the development of the testis is interrupted in fetal life, and that this has consequences in adult life, as well as at birth. That certainly is something we've seen in rodents, and this study is the first evidence we've seen of TDS in humans." Swan's study is among the first to combine a population-based, measurable, low-level EDC exposure, observed physiologic effects, and solid biological underpinnings. Even skeptic Safe says that this is the kind of study needed to begin to answer the many questions about EDCs and human health. "This looks to be a good approach, and suggests a correlation," he says. "Whether it's causal of anything and whether it holds up or not, I don't know. It needs to be repeated in different locations and with more and more integrated measurements." Swan plans

to do just that, as well as to follow up on her current pregnancy cohort by measuring gender role behaviors in both the male and female children, who are now between 2 and 5 years old.

The Phthalate Esters Panel of the American Chemistry Council, a trade organization based in Arlington, Virginia, maintains that "there is no well-established and credible evidence for adverse effects [due to phthalates] in humans at environmentally relevant doses," says panel manager Marian Stanley. With regard to Swan's study, Stanley says, "It correlated some effects in infant males with some lower-molecular-weight phthalates, particularly diethyl phthalate, for which effects in rodents occur only at very high doses, and which is not considered to pose reproductive or developmental concerns by reviewing government agencies. "Stanley also points to questions about the biomarker used in the study. "The measurement that was used is something that I think is still subject to debate. You see the AG distance in rodents, and while it is a marker of something, it is certainly not a biological effect," she says. "I think the study has been overinterpreted by lots of other people [besides] the authors of the study."

EDCs and Sex Ratios

Sex ratio-the proportion of male to female live births-is very constant on a worldwide basis, typically ranging from 102 to 108 male births for every 100 female births. In recent years, however, a number of reports have suggested that environmental and occupational exposures to EDCs may be altering the sex ratio within given human populations.In one such study, appearing in the July 2005 edition of Human Reproduction, a group of Swedish researchers analyzed blood and semen samples from 149 fishermen to investigate whether exposure to the persistent organochlorine pollutants CB-153 (a PCB) and p,ṕ-DDE affected the proportion of Y-and X-chromosome-bearing sperm. They discovered that elevated exposure levels of both chemicals were positively associated with a higher proportion of Y-chromosome sperm. The researchers conclude that their findings add to evidence that exposure to persistent organic pollutants may alter the offspring sex ratio, with the higher proportion of Y-chromosome sperm likely tending to lead to a higher proportion of male births.

A study appearing in the October 2005 issue of EHP takes an epidemiologic approach to the issue. Constanze Mackenzie, a member of the Faculty of Medicine at the University of Ottawa, and colleagues report a distinct skewing of the sex ratio within members of the Aamjiwnaang First Nation community near Sarnia, Ontario. They found a severe decline in the proportion of boys born among the Aamjiwnaang over the last five years, and a lesser though still significant decline over the past ten years. Although no causal factors were determined, the authors note that the community is located in immediate proximity to several large petrochemical, polymer, and chemical plants, and that previous studies-such as those following the 1976 industrial accident in Seveso, Italy-have shown that exposure to contaminants such as EDCs can impact sex ratios within small communities near such industrial facilities. The authors suggest that further assessment should be pursued to identify potential exposures among community members. [For more details on this study, see "Shift in Sex Ratio," p. A686 this issue.]

How Low Do They Go?

When is a hypothesis no longer a hypothesis, but a validated scientific concept ready to drive regulatory and policy decision making? When it comes to the so-called "low-dose hypothesis" regarding the biological activity or adverse effects of low-dose exposures to EDCs, that is the key question. The issue has been debated for years, since vom Saal's group first published in the January 1997 issue of EHP their findings of enlarged prostate in male mice whose mothers had been fed low doses of BPA. Today, the controversy over whether vom Saal's findings have been sufficiently replicated, and whether the U.S. Environmental Protection Agency (EPA) should revise its risk assessment process to reflect the potential for adverse effects of low-dose EDCs, is still going strong. Some proponents of the low-dose hypothesis argue that the traditional toxicologic approach to risk assessment is an inappropriate method to assess EDCs. The current protocol assumes a linear dose-dependent response to chemical exposures, determines the lowest level at which there is an observed adverse effect, and then adds a safety factor to arrive at an official reference dose-the daily human intake assumed to be safe. Experimental work by vom Saal and others has postulated that EDCs exhibit a U-shaped dose-response curve, with biological activity stimulated at very low doses-often several orders of magnitude below current reference doses-as well as very high doses. Proponents also state that the process of endocrine disruption itself is inherently different from many other toxicologic processes, affecting a variety of highly sensitive pathways (especially in the fetus) via novel mechanisms of action, many of which are as yet poorly understood. Also, they say, endocrine-signaling pathways that mediate responses to EDCs have evolved to act as powerful amplifiers, resulting in large changes in cell function occurring in response to extremely small concentrations.

One chemical that has become a lightning rod in the debate is BPA. By vom Saal's count, there are now more than 100 published peer-reviewed studies showing significant biological effects of low doses of BPA (almost half published within the last two years) compared to 21 reporting no effect. He is convinced that widespread exposure to BPA poses a threat to human health. Not so, claims Steve Hentges, executive director of the Polycarbonate Business Unit of the American Plastics Council: "For our purposes, what we have to know is, does BPA cause health effects in humans at any relevant dose, particularly at the levels at which people are actually exposed? When you look at all of the evidence together, and in particular look at the comprehensive studies that are designed to look for health effects,

you don't find them." The industry group also believes that the weight of evidence does not support the concept of a low-dose effect for BPA. "And it's not just us saying that," says Hentges. "Indeed, every government body worldwide that's looked at it has reached effectively the same conclusion in terms of how they regulate BPA or consider regulating it." He acknowledges that there has been quite a bit of new research activity in this area within the past few years, but states that "even though new research has been conducted, we believe that the weight of evidence has not shifted." Where does the EPA stand on these issues? The agency's Office of Research and Development is in the midst of implementing a multiyear plan to set the EPA's agenda and goals in the area of EDC research. The plan is part of the agency's Endocrine Disruptors Research Program, a five- to ten- year research agenda it started in 2001 to look comprehensively at the science surrounding EDC exposures and effects. The integrated program was launched at about the same time that a congressional mandate, under the 1996 Food Quality Protection Act, directed the EPA to develop a screening and testing program for EDCs.

The EPA's stance is that the jury is still out on both the public health impacts of EDCs and the need to incorporate low-dose methodologies into the agency's risk assessment protocols. Elaine Francis, director of the Endocrine Disruptors Research Program, says the EPA needs to conduct a lot more research before any definitive public health statements can be made about this class of compounds. "When you look at such a diverse group of organisms that have been impacted in wildlife, and certainly laboratory rodent species," she says, "there is enough concern that we recognize the importance of developing a body of work in humans to try to characterize any impact [EDCs] might be having on humans." The agency is currently funding three research grants in the area of low-dose EDC exposures, partly in response to the conclusions reached in a 2000 peer review and subsequent report on the low-dose issue held by the National Toxicology Program at the EPA's request. In the 2001 Report of the Endocrine Disruptors Low-Dose Peer Review, that expert panel acknowledged that low-dose effects had been sufficiently documented at that point in time for the EPA to consider revisiting its current testing paradigm.

"The general consensus was that more work needed to be done in this area," says Francis. "Since that time, we would still agree that there has not been enough information to indicate that the existing approaches are ones that would not be valid for endocrine disruptors. But we left the door open that we would need to do more research, and the best we could do at this point is to support and promote research in that area, and we've done that." Vom Saal is of a different opinion: "In the risk assessment process for chemicals as currently conducted, the maximum tolerated dose is used as a reference, and a span of typically not more than fiftyfold in the dose range is the maximum that anyone ever uses in the studies. Studies [from the 1 January 2005 issue of Cancer Research and the April 2005 EHP show] literally millions of fold below that dose range in adverse effects . . . from BPA, and when you have that type of unbelievable discrepancy, for the EPA to come out as it recently did and state that it has no intention of testing low doses as part of the testing process [implies] that you no longer have a scientifically based process-it is an entirely politically driven process, because they are explicitly ignoring the scientific findings that are out there." From her perspective, Newbold feels that although there is no question that EDCs have low-dose effects, more research needs to be done to document adverse effects in humans. "We spend an awful lot of time arguing whether there are low-dose effects or not. That just infuriates me," she says. "There are low-dose effects. There have always been low-dose effects. The question is, are they adverse? We don't know, and we've got to design studies to get answers to that question." She adds, "In order to take this argument to a whole other level, we're going to have to have more epidemiology studies. I know it happens with mice, but I don't know what happens with humans."

Connecting the Gender Dots

It's premature to call it a theory; at this point, it barely qualifies as a hypothesis: some observers are putting forth the proposition that prenatal EDC exposures may affect gender identity-how a person identifies him- or herself, regardless of physical characteristics. This idea presupposes two basic concepts: first, that transgenderism (in which a person experiences "gender dysphoria," a strong feeling of having been born the wrong sex) is physiological in origin, most likely due to events during prenatal neurological development; second, that intrauterine EDC exposures can and do disrupt prenatal neurological development. A paper in the 2 November 1995 issue of Nature, among other reports, lends credence to the first concept. Jiang-Ning Zhou and colleagues at the Netherlands Institute for Brain Research studied heterosexual men and women, homosexual men, and male-to-female transsexuals. They reported finding a distinctly female brain structure in genetically male transsexuals (men who had gone through hormonal treatment and irreversible sexual reassignment surgery to become women). The volume of the central subdivision of the bed nucleus of the stria terminalis (BSTc), a sexually dimorphic brain area that is essential for sexual behavior, is larger in men than in women. Anatomical study results showed that BSTc volume did not differ significantly between heterosexual and homosexual men, and that BSTc volume was 44% larger in heterosexual men than heterosexual women. In the male-to-female transsexuals, BSTc volume was only 52% that of the reference males-a volume analogous to that seen in the women. The authors write that these findings "support the hypothesis that gender identity develops as a result of an interaction between the developing brain and sex hormones."

But a study by *Wilson C.J. Chung* and colleagues published in the 1 February 2002 Journal of Neuroscience complicates this picture. This group, also from the Netherlands Institute for Brain Research, reported that BSTc size differentiation between men and women became significant only in adulthood, implying that the phenomenon may be more effect than cause. The authors do point out, however, that the lack of marked sexual differentiation of the BSTc volume before birth and in childhood does not rule out early gonadal steroid effects on

BSTc functions. They point to earlier animal experiments showing that fetal or neonatal testosterone levels in humans may first affect synaptic density, neuronal activity, or neurochemical content during early BSTc development, and that "[c]hanges in these parameters could affect the development of gender identity but not immediately result in overt changes in the volume or neuronal number of the BSTc."

On the other side of the ledger, in the June 2002 edition of EHP Supplements, Bernard Weiss, a professor of environmental medicine and pediatrics at the University of Rochester, reviewed the existing literature on sexually dimorphic nonreproductive behaviors as indicators of endocrine disruption. Weiss made a strong evidence-based case that "gender-specific regional differentiation of the brain and, ultimately, its expression in behavior are guided by the gonadal hormones," and that the process is subject to interference by drugs and environmental contaminants. He points out that sex differences in performance and behavior are not-but should be-a recognized criterion in developmental neurotoxicity testing.

So who out there is connecting these dots?

Scott Kerlin is a Ph.D. social scientist at the University of British Columbia. He devotes considerable time to monitoring the international scientific literature on DES and other EDCs as well as to researching and writing about the long-term health effects of pre-natal DES exposure on males. He is himself the son of a woman given DES in pregnancy. Kerlin recently conducted a survey study of 500 members of the DES Sons International Network, an online resource for men who know or strongly suspect they were exposed to DES in utero. In a paper presented in August 2005 at the International Behavioral Development Symposium in Minot, North Dakota, he reports that more than 150 respondents identified themselves as having any of a variety of gender- related disorders. Kerlin does not claim that DES causes these gender disorders but feels that his results indicate that such outcomes should be included in research related to the potential effects of prenatal EDC exposures.

The Road Ahead

It's going to be very difficult to ever conclusively answer the basic question of whether low-level EDC exposures during development are causing deleterious reproductive or gender-related outcomes in humans. Scientists agree that one of the major challenges is to address the issue of mixtures. Typically, researchers look at the impact of one chemical at a time, but environmental exposures regularly involve an unpredictable mix of chemicals, with exposures varying widely in dose and duration. It is unlikely there will ever be a comprehensive understanding of how the many EDCs in mixtures interact with each other and with human physiology. Convincing epidemiologic evidence of adverse effects in humans is also difficult to come by, but will be necessary to translate scientific findings into concrete actions to protect public health. Swan's study, one of the first of its kind to appear thus far, may serve as a methodological model for future investigations of low-level EDC exposures.

Do we know enough now that steps should be taken in the policy and regulatory realm? Some observers, taking a precautionary approach, think that we do. For example, there are bills under consideration in the California and New York legislatures to restrict the use of certain phthalates in toys, child care products, and cosmetics, and a California bill would ban the use of BPA in products meant for use by children aged 3 years or younger. Also, the European Parliament voted in 2005 to ban the use of three phthalate plasticizers (DEHP, di-n-butyl phthalate, and benzyl butyl phthalate) in toys and child care items, and to prohibit the use of three others (diisononyl phthalate, diisodecyl phthalate, and di-n-octyl phthalate) in toys and child care items that children can put in their mouths. Theo Colborn, a professor of zoology at the University of Florida and author of the 1996 book Our Stolen Future, believes the time for action is now. "In the animals, it was at the population level that we really began to realize what was going on," she says. "If we're going to wait to see population effects for all of these concerns that we have in the human population, it's going to be too late." She points out that we're already into the fourth generation of individuals who have been exposed in utero to chemicals that had never been used before the mid-1930s or early 1940s.

Swan agrees that there is sufficient knowledge at this point to call EDC exposures a serious threat to public health. "I don't think it's necessarily a threat to individuals," she says, "but I think that as a population we are threatened. I'm not predicting the end of the species or anything like that, but I think the increasingly alarming trends that we're seeing, in terms of couples that can't conceive or couples whose babies have undescended testicles, and so on, can have an impact on the population as a whole." Other observers are not so sure. Harry Fisch, director of the Male Reproductive Center at Columbia University Medical Center, specializes in the diagnosis and treatment of male infertility. From his clinical perspective, other factors-including other exposures-are more important than EDCs. "The sky is not falling," he says. "A lot of times there's extrapolation from high-dose exposure to low-dose exposure. I think one of the biggest culprits for the abnormalities we see that's been totally ignored is [increased] parental age. Also, we need to look at things we're doing to ourselves before we start blaming low-level chemicals. For example, what does cigarette smoking do compared to Saran Wrap? What about the diets we eat, the high-fat intakes? Before we start blaming others, we need to look at ourselves to determine the impact of our lifestyles."

Although plastic wrap may not be responsible for human infertility, the scientific evidence fueling growing concerns about the effects of ambient environmental exposures to EDCs cannot simply be dismissed. "Vigilance is the key word here, because there are so many chemicals out there," says Burger. "Understanding the effects of chemicals is a three-pronged approach. It's being sure that we have wildlife

models and people who are watching wildlife populations to see quickly if something detrimental happens. It's having really good epidemiological studies and vigilance of people in various places. And it's backing those two up with laboratory science immediately when a problem turns up, to try to ascertain the cause quickly."

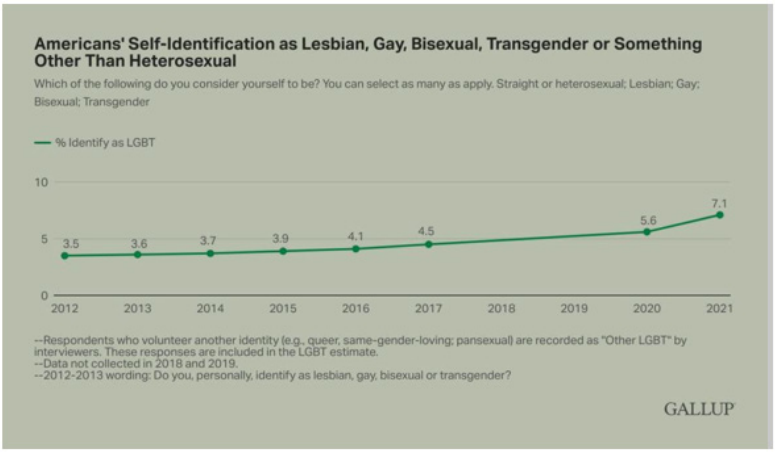
Photos not Copied for the Comments Below

Watching wildlife. Research has documented reproductive and developmental abnormalities linked to EDC exposures in wildlife species such as alligators and polar bears, although what these results mean for humans is still unknown. A question of Y. A Swedish study of fishermen exposed to CB-153 and p,p'-DDE associated elevated levels of these chemicals with a higher proportion of Y-chromosome sperm, suggesting that exposure to EDCs could skew the ratio of boys to girls.

Ubiquitous exposure, unknown consequences. Humans are exposed to EDCs through many routes including pharmaceuticals, air pollution, pesticides, and drinking water, but the effects of environmental exposure are largely unknown. Gender basis. In a study of the brain region known as the BSTc, which varies in size by sex, the volume of the BSTc for male-to-female transsexuals was analogous to that seen in women, leading the authors to speculate that the findings "support the hypothesis that gender identity develops as a result of an interaction between the developing brain and sex hormones."

WASHINGTON, D.C.--The percentage of U.S. adults who self-identify as lesbian, gay, bisexual, transgender or something other than heterosexual has increased to a new high of 7.1%, which is double the percentage from 2012, when Gallup first measured it. Gallup asks Americans whether they personally identify as straight or heterosexual, lesbian, gay, bisexual, or transgender as part of the demographic information it collects on all U.S. telephone surveys. Respondents can also volunteer any other sexual orientation or gender identity they prefer. In addition to the 7.1% of U.S. adults who consider themselves to be an LGBT identity, 86.3% say they are straight or heterosexual, and 6.6% do not offer an opinion. The results are based on aggregated 2021 data, encompassing interviews with more than 12,000 U.S. adults.

The increase in LGBT identification in recent years largely reflects the higher prevalence of such identities among the youngest U.S. adults compared with the older generations they are replacing in the U.S. adult population. Roughly 21% of Generation Z Americans who have reached adulthood those born between 1997 and 2003 identify as LGBT. That is nearly double the proportion of millennials who do so, while the gap widens even further when compared with older generations. Gen Z adults made up 7% of Gallup's 2017 national sample, but in 2021 accounted for 12% as more from that generation reached age 18 over the past four years. In contrast, the proportion of those born before 1946 has fallen from 11% in 2017 to 8%.



Americans' Self-Identification as LGBT, by Generation			
	LGBT %	Straight/Heterosexual %	No response %
Generation Z (born 1997-2003)	20.8	75.7	3.5
Millennials (born 1981-1996)	10.5	82.5	7.1
Generation X (born 1965-1980)	4.2	89.3	6.5
Baby boomers (born 1946-1964)	2.6	90.7	6.8
Traditionalists (born before 1946)	0.8	92.2	7.1

LGBT Identification Has Been Stable in Older Generations, Rising in Younger

Since Gallup began measuring LGBT identification in 2012, the percentage of traditionalists, baby boomers, and Generation X adults who identify as LGBT has held relatively steady. At the same time, there has been a modest uptick among millennials, from 5.8% in 2012 (when some members of the generation had not yet turned 18) to 7.8% in 2017 and 10.5% currently. The percentage of Gen Z who are LGBT has nearly doubled since 2017, when only the leading edge of that generation--those born between 1997 and 1999--had reached adulthood. At that time, 10.5% of the small slice of the generation who were adults identified as LGBT. Now a much greater proportion of Gen Z, but still not all of it, has become adults. The sharp increase in LGBT identification among this generation since 2017 indicates that the younger Gen Z members (those who have turned 18 since 2017) are more likely than the older members of the generation to identify as LGBT. Should that trend within Gen Z continue, the proportion of U.S. adults in that generation who say they are LGBT will grow even higher once all members of the generation reach adulthood.

Bisexual Identification Most Common Among LGBT Americans

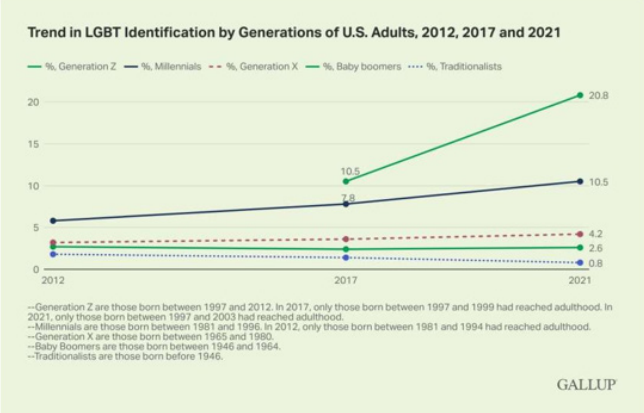
More than half of LGBT Americans, 57%, indicate they are bisexual. That percentage translates to 4.0% of all U.S. adults. Meanwhile, 21% of LGBT Americans say they are gay, 14% lesbian, 10% transgender and 4% something else. Each of these accounts for less than 2% of U.S. adults.

Americans' Self-Identified Sexual Orientation or Gender Identity

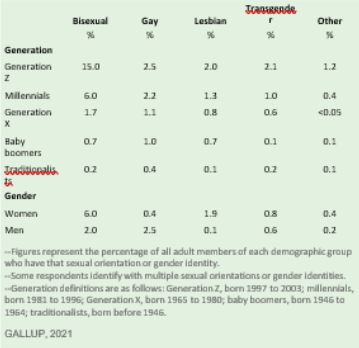
Which of the following do you consider yourself to be?
You can select as many as apply: Straight or heterosexual; Lesbian; Gay; Bisexual; Transgender.

	Among LGBT U.S. adults	Among all U.S. adults
	%	%
Lesbian	13.9	1.0
Gay	20.7	1.5
Bisexual	56.8	4.0
Transgender	10.0	0.7
Other (e.g., queer, same-gender-loving)	4.3	0.3

Percentages total more than 100% because respondents may choose more than one category.



Americans' Self-Identified Sexual Orientation and Gender Identity, by Generation and Gender



	Bisexual	Gay	Lesbian	Transgender	Other
	%	%	%	%	%
Generation					
Generation Z	15.0	2.5	2.0	2.1	1.2
Millennials	6.0	2.2	1.3	1.0	0.4
Generation X	1.7	1.1	0.8	0.6	<0.05
Baby boomers	0.7	1.0	0.7	0.1	0.1
Traditionalists	0.2	0.4	0.1	0.2	0.1
Gender					
Women	6.0	0.4	1.9	0.8	0.4
Men	2.0	2.5	0.1	0.6	0.2

--Figures represent the percentage of all adult members of each demographic group who have that sexual orientation or gender identity.
--Some respondents identify with multiple sexual orientations or gender identities.
--Generation definitions are as follows: Generation Z, born 1997 to 2003; millennials, born 1981 to 1996; Generation X, born 1965 to 1980; baby boomers, born 1946 to 1964; traditionalists, born before 1946.

GALLUP, 2021

Gen Z adults made up 7% of Gallup's 2017 national sample, but in 2021 accounted for 12% as more from that generation reached age 18 over the past four years. In contrast, the proportion of those born before 1946 has fallen from 11% in 2017 to 8%. Gallup's pre-2020 polling did not measure how many Americans identified with each LGBT category, separately. However, earlier data collected from other research institutions as well as Gallup's 2020 estimate have consistently found bisexual to be the most common LGBT identity. Prior Gallup analyses show bisexuals are much more likely to marry spouses or live with partners of a different sex than with spouses or partners who are the same sex as they are.

Nearly One in Six Generation Z Adults Identify as Bisexual

Bisexual is the most common LGBT status among Gen Z, millennials, and Gen X, while older Americans are about as likely to saythey are gay or lesbian as to say they are bisexual. Overall, 15% of Gen Z adults say they are bisexual, as do 6% of millennials and slightly less than 2% of Gen X. Women (6.0%) are much more likely than men (2.0%) to say they are bisexual. Men are more likely to identify as gay (2.5%) than as bisexual, while women are much more likely to identify as bisexual than as lesbian (1.9%).

Bottom Line

The proportion of U.S. adults who consider themselves to be lesbian, gay, bisexual or transgender has grown at a faster pace over the past year than in prior years. This is occurring as more of Gen Z is reaching adulthood. These young adults are coming of age, including coming to terms with their sexuality or gender identity, at a time when Americans increasingly accept gays, lesbians and transgender people, and LGBT individuals enjoy increasing legal protection against discrimination.

Given the large disparities in LGBT identification between younger and older generations of Americans, the proportion of all Americans who identify as LGBT can be expected to grow in the future as younger generations will constitute a larger share of the total U.S. adult population. With one in 10 millennials and one in five Gen Z members identifying as LGBT, the proportion of LGBT Americans should exceed 10% in the near future.