

# Air pollution, racial disparities, and COVID-19 mortality

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**Air Quality and COVID-19: Connections, Health Impacts, and Racial Disparities**

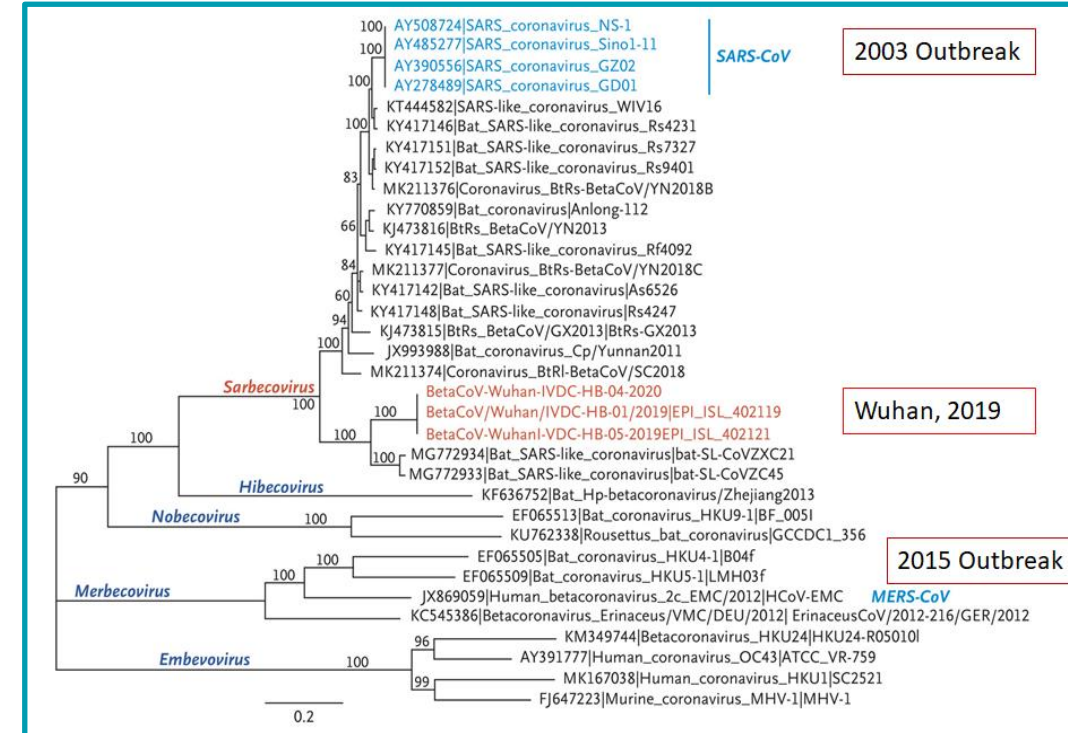
*American Lung Association Webinar, July 15, 2020*



# What is COVID-19?

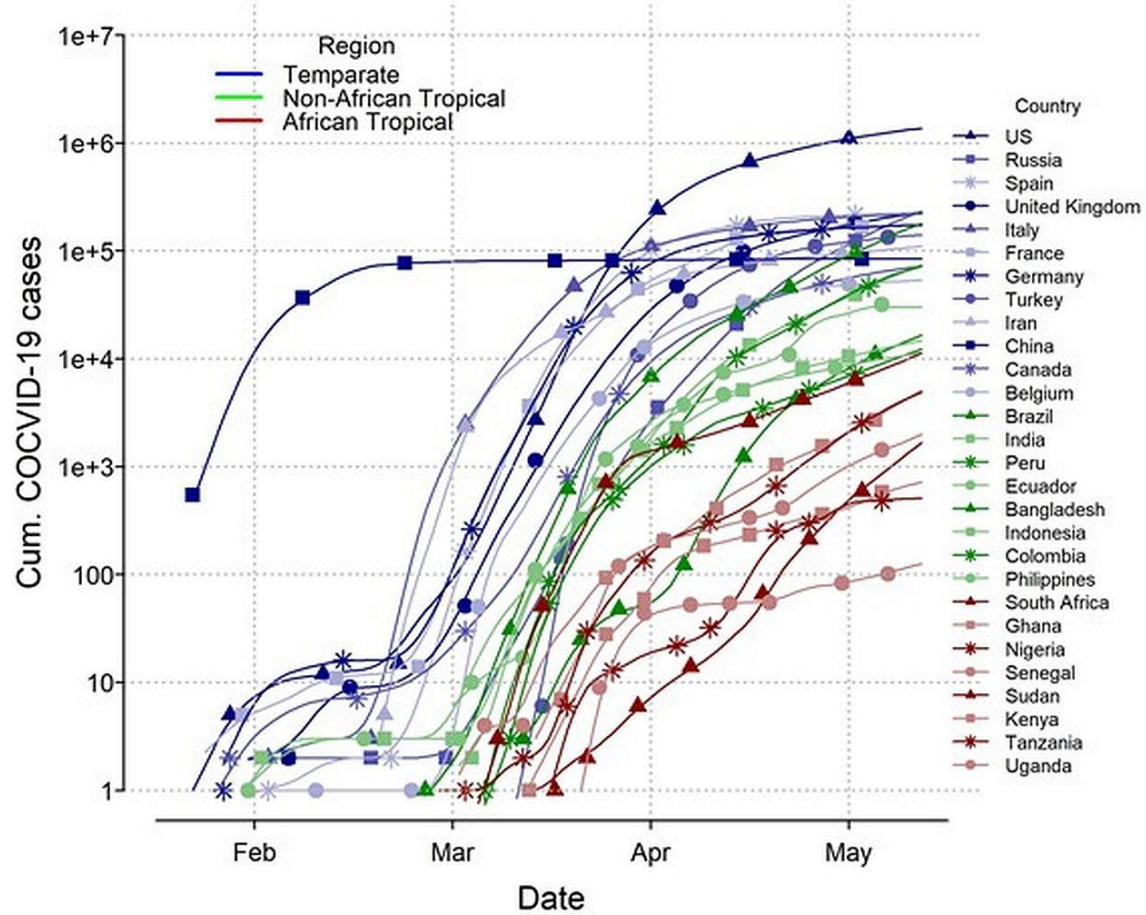
- Coronaviruses (CoV) are a large family of viruses:
  - [Middle East Respiratory Syndrome \(MERS-CoV\)](#)
  - [Severe Acute Respiratory Syndrome \(SARS-CoV\)](#)
- Transmitted between animals and people.
- Wide range of disease symptoms:
  - Elevated inflammatory response
  - Respiratory symptoms
  - Fever, cough
  - Shortness of breath
  - Pneumonia, renal failure and even death.

## Phylogeny

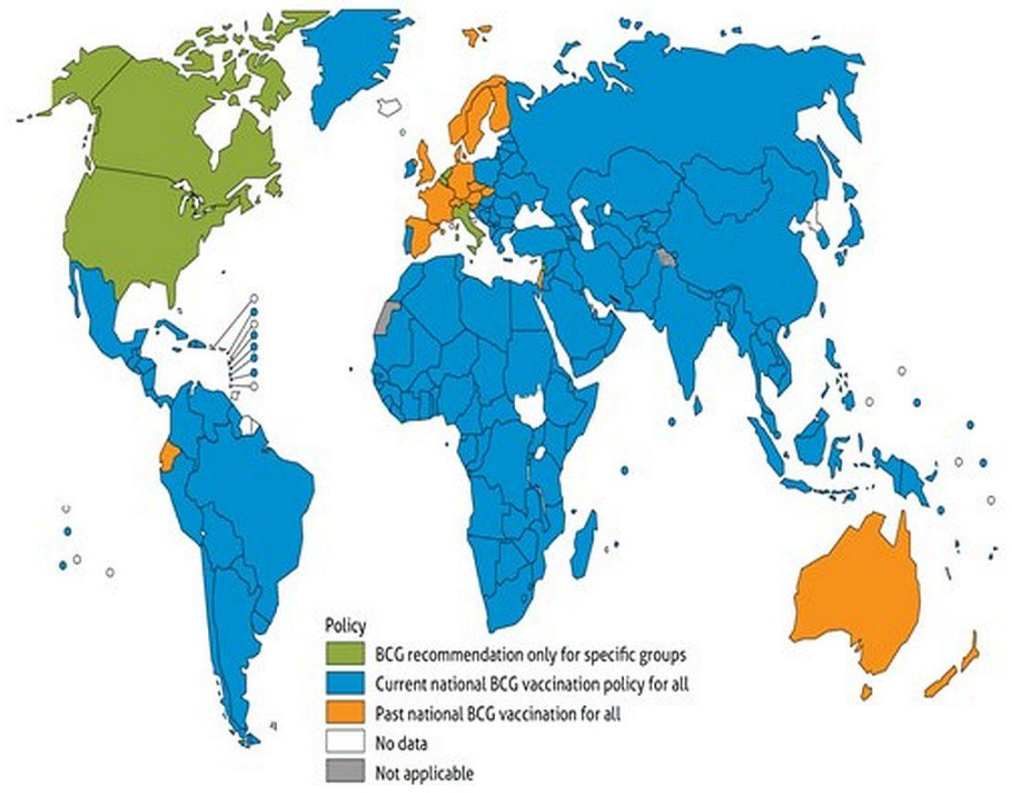


# Global Prevalence & Trends

A.



B.



Bacillus Calmette-Guérin (BCG) vaccination coverage map by country (<http://www.bcgatlas.org/index.php>)

Johns Hopkins University COVID-19 Case Tracker: <https://coronavirus.jhu.edu>  
 (Accessed on July 11, 2020)

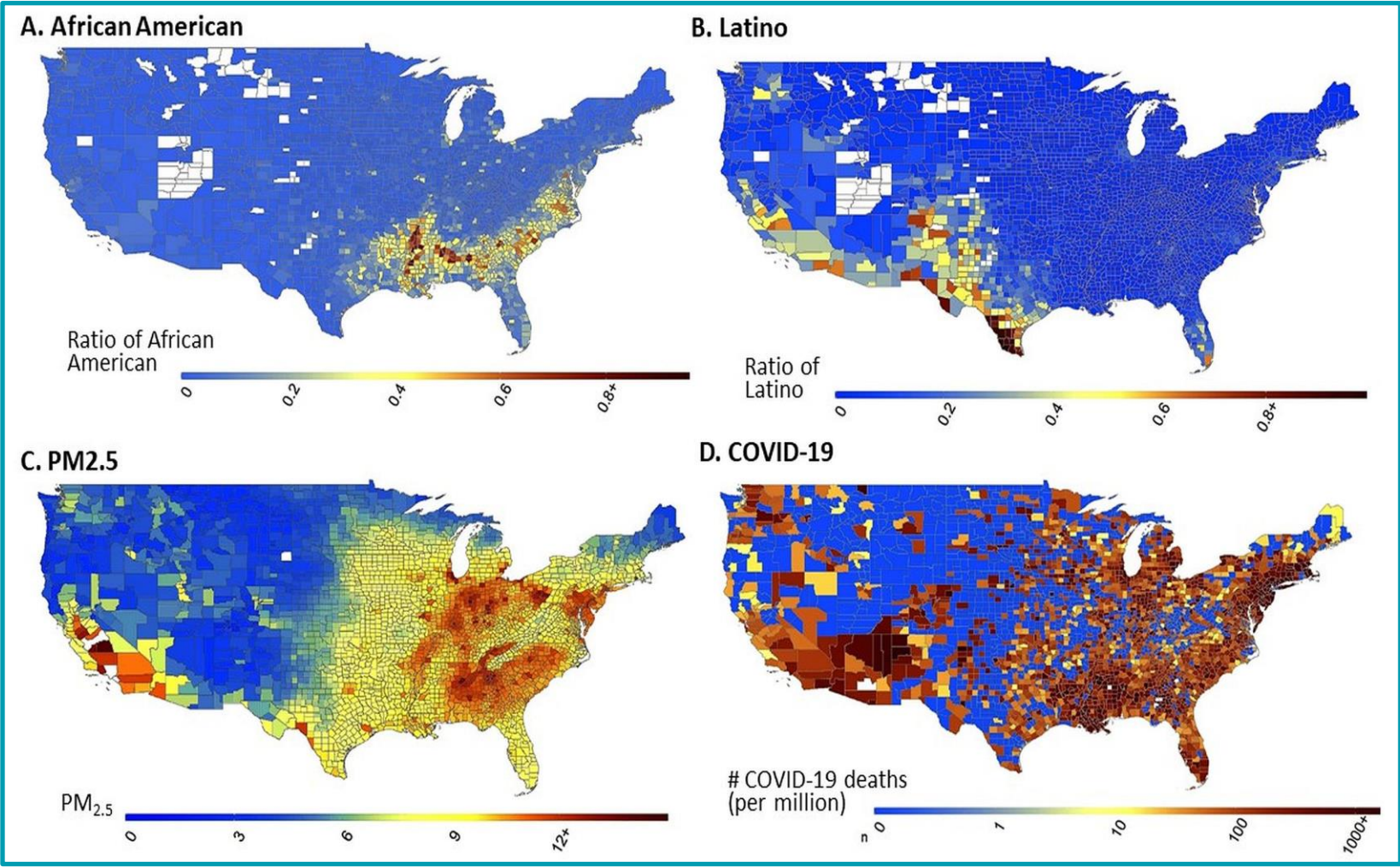
# Global variation in COVID-19 prevalence and mortality

- Climate hypothesis
  - seasonality/climate: tropical, temperate zones
- Genetic hypothesis
  - racial differences in ACE-2 gene polymorphisms
- Evolutionary and natural selection hypothesis
  - Th1/Th2 cytokine responses to infections
- Trained immunity hypothesis
  - Bacillus Calmette-Guérin (BCG) vaccination
  - Cytokine storm

Mersha *et al.* (under review)



# U.S. map for COVID-19 epidemic: racial and PM2.5 variations



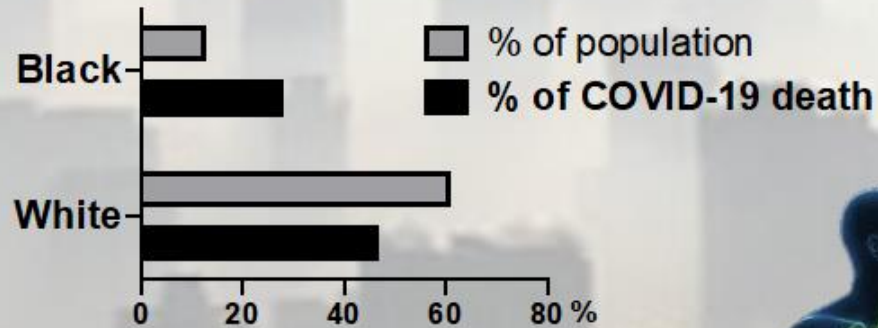
Johns Hopkins University COVID-19 Case Tracker: <https://coronavirus.jhu.edu>  
(Accessed on July 11, 2020)



# Air pollution, racial disparities, and COVID-19 death

## Racial minority populations

- Live in densely populated cities & neighborhoods
- Live near highways/polluting industries
- They are hospitalized and die from COVID-19 more than whites.



- Racial disparities in housing, employment and access to health care are contributing to **increased COVID-19 mortality.**

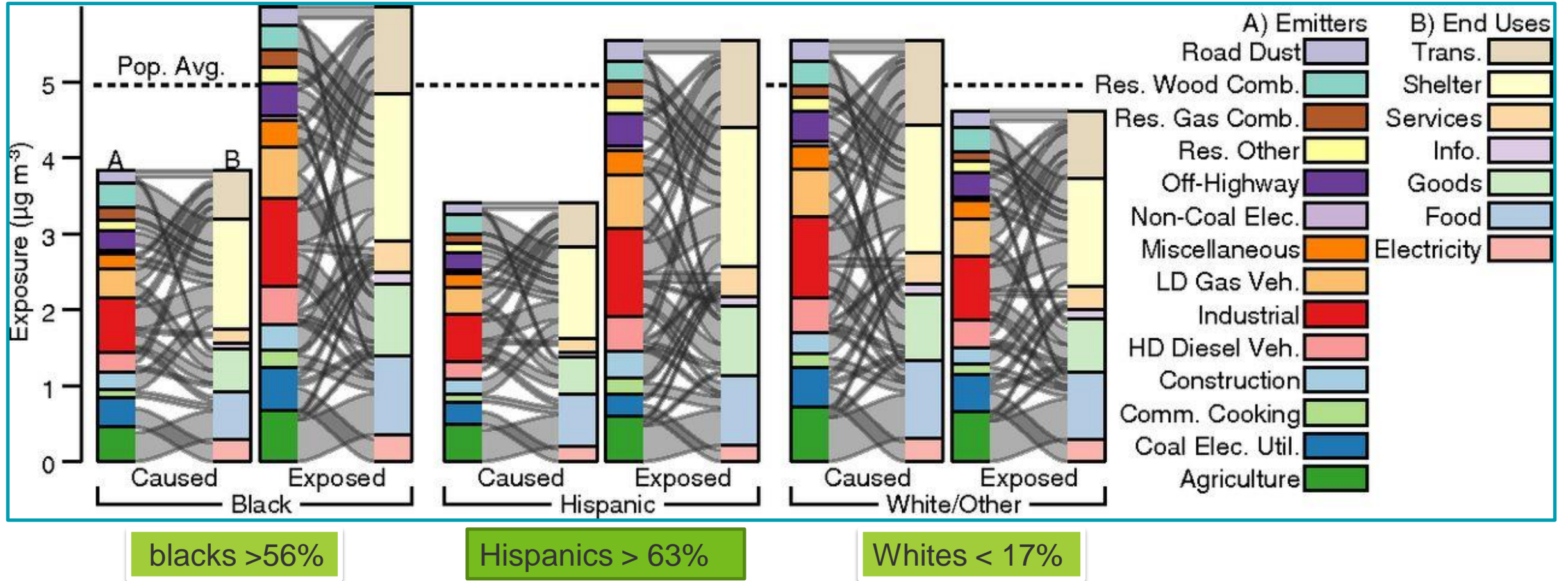


## COVID-19 risk factors

- Age (older than 65; live in a nursing home)
- Sex (male)
- Obesity (BMI >30)
- Diabetes
- Heart conditions
- Hypertension
- Immuno-compromised
  - Cancer
- Kidney disease
- Liver disease
- Chronic lung disease
  - COPD (smoking)
  - Severe asthma
- Racial minorities are more likely to suffer from these comorbidities
- **Genetic variability**



# Average PM 2.5 inequality by racial groups



PNAS March 26, 2019 116 (13) 6001-6006

# Health status measures in US racial/ethnic groups

	White	African Americans	Hispanic	Asian
Cause of Death	<b>Age-adjusted Death rates (per 100,000)</b>			
Heart disease	165.5	203.1	113.9	85.0
Coronary heart disease	101.2	114.8	75.3	55.3
Stroke	35.4	50.9	30.2	28.5
Cancer	170.9	194.2	115.2	102.6
Diabetes mellitus	18.6	38.2	25.1	15.1
COPD	41.8	24.7	15.6	10.3
Asthma	8.2	22.3	7.8	-
Pneumonia/Influenza	15.1	16.3	12.8	12.9
HIV infection	0.9	8.6	2.0	0.3
Infant mortality (/1000)	5.1	11.1	5.0	4.1
Life expectancy at birth	78.9	75.1	81.6	85
HIV mortality (/1000)	18	21	14	
<b>COVID-19 mortality</b>	<b>30.2</b>	<b>70.0</b>	<b>34</b>	<b>29</b>

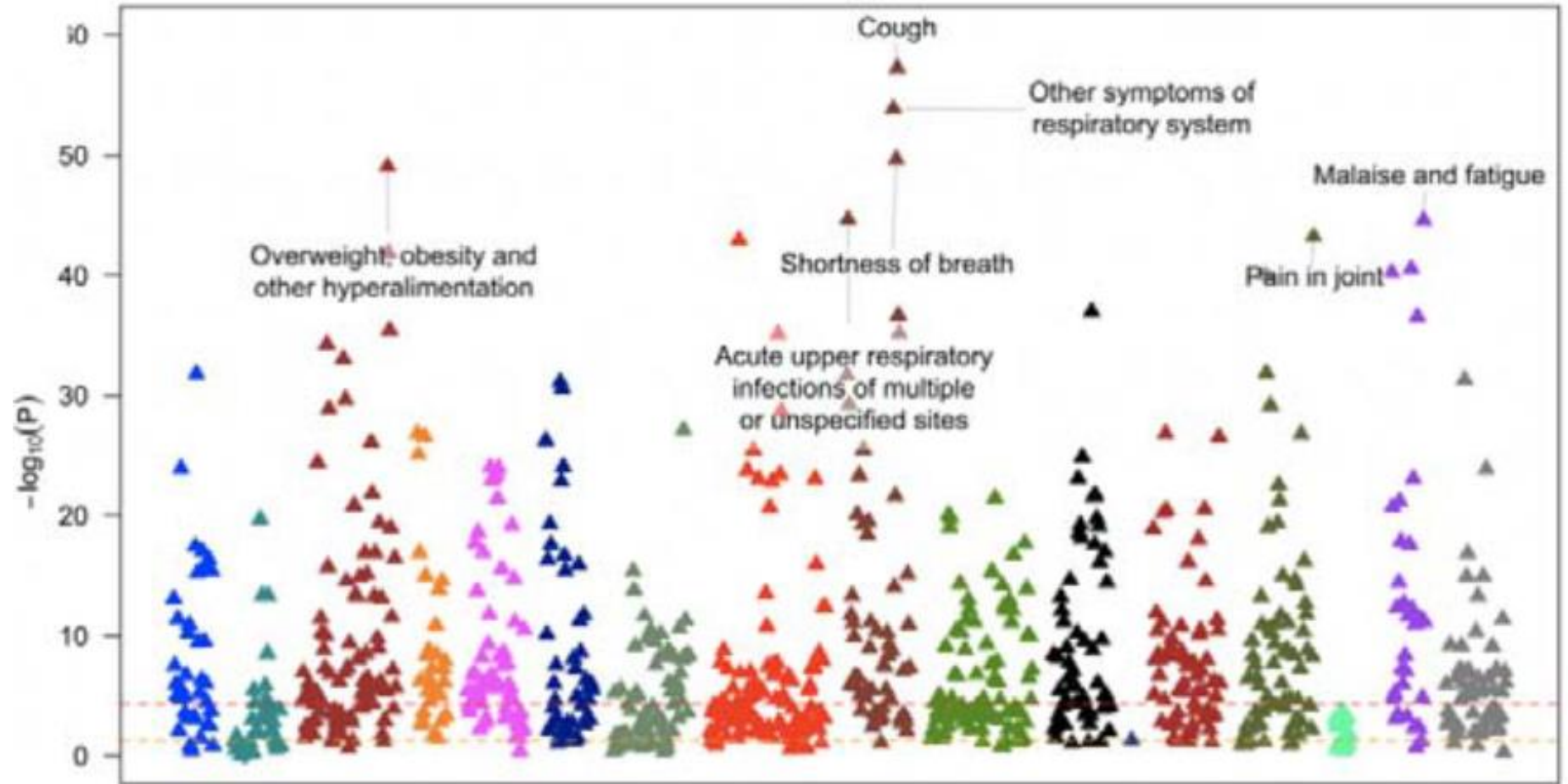
<https://www.apmresearchlab.org/covid/deaths-by-race> (COVID-19 data, July 7, 2020)



# Phenome-wide association study of COVID-19 using EHR data

## PheWAS Data:

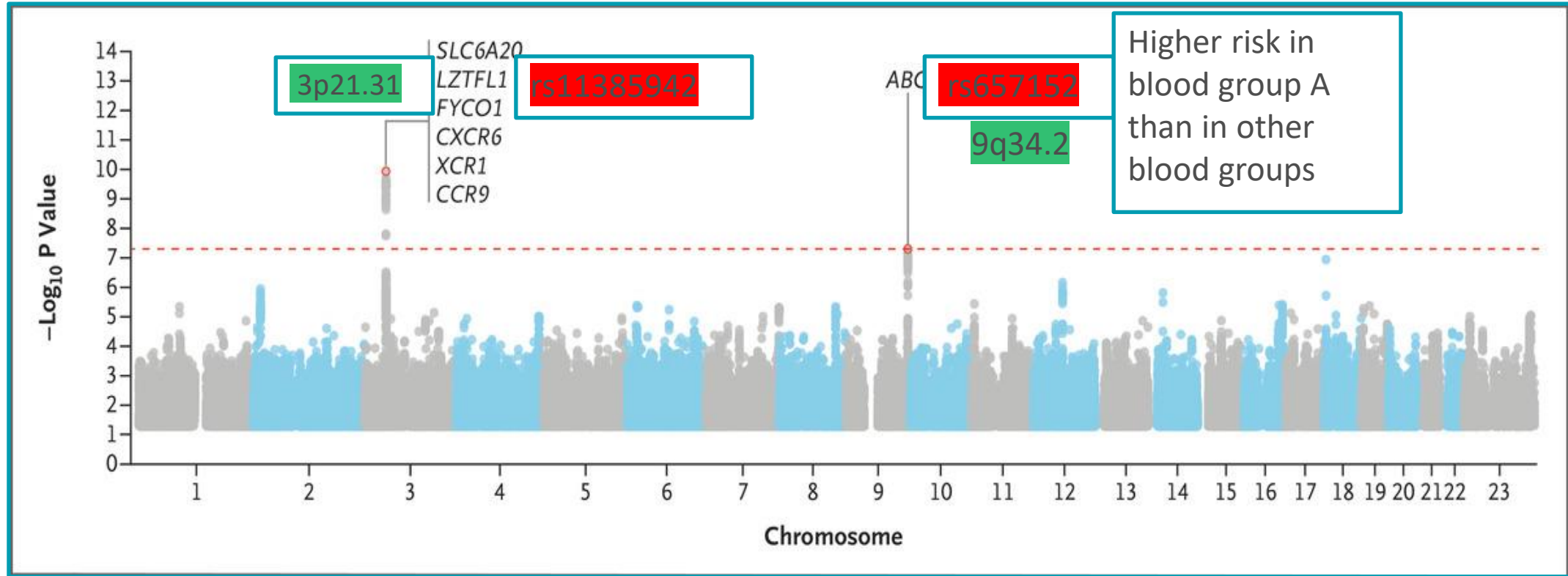
- 5,698 COVID-19 patients
- 7,211 controls



medRxiv preprint doi: <https://doi.org/10.1101/2020.06.29.20141564>

# Genome-wide association study of COVID-19

Sample size: Italy (835 patients, 1255 control) and Spain (775 patients and 950 control)



They are still underpowered, and also do not directly address functional variants

N Engl J Med 2020. DOI: 10.1056/NEJMoa2020283

# Summary

- No evidence so far for SNPs in ACE-2 gene linked with African ancestry
- Link between air pollution and COVID-19:
  - ✓ High COVID-19 risks with higher #s of minorities:
    - > live in zip codes close to highways, industry
    - > low income, poor housing and worse pollution
    - > compromised respiratory, cardiac and other systems
    - > worse COVID-19 outcome.

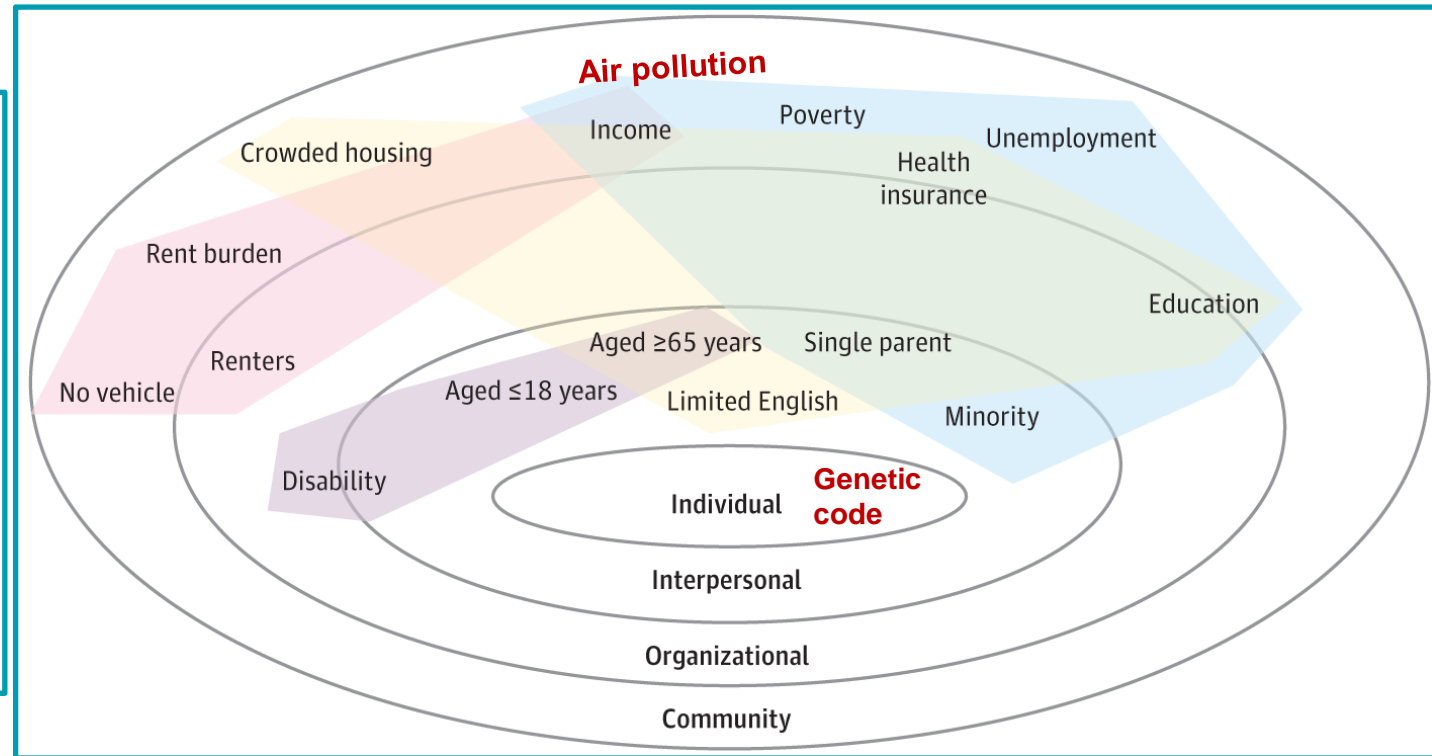
**Solution: Address racial disparities-- multilevel interventions!**



# Future direction

## Socio-environmental Determinants of COVID-19

**Risks of COVID-19 exposure are not evenly distributed. We need to address to socio-economical disparities**



# ***Prevention is better than cure***

- Case isolation and contact tracing
- Social distancing (6 ft)
- Limiting public interactions/gathering
- Maintain hand hygiene
- Avoid droplet Containment
- No vaccine at the moment, but research is in progress at a lightning speed!

# Acknowledgements

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