Racial Disparities and Comorbidities of COVID-19 Mortality

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COVID-19 is the 3rd leading cause of death after heart disease and cancer in the United States.
Global prevalence, death & trends of COVID-19

Total cases 80,316,555  Total deaths 1,770,695  Recovered 50,582,478

Why global variations in COVID-19? Plausible Hypothesis

- Climate hypothesis
  - seasonality/climate: tropical, temperate zones
- Neighborhood/environment risk factor hypothesis - PM2.5
- Comorbidity hypothesis
- Genetic hypothesis
  - racial differences in ACE-2 (and other genes) polymorphisms
- Evolutionary and natural selection hypothesis
  - Th1/Th2 cytokine responses to infections
- Trained immunity hypothesis
  - Bacillus Calmette-Guérin (BCG) vaccination
- Age hypothesis
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Example:
Living in high altitudes (less prone to hypoxia) appears to reduce transmission and death rates from COVID-19.
COVID-19 Pandemic: A paradox?

- Total population: 1.3B
- COVID-19 deaths: 100k
- COVID-19 Cases: 2,074,387
- Mortality rate in Africa: 2.5%
- Western countries: 8-10%
- 17% world population but ~3.6% of total global cases

**Prediction:** 70 million infection and more than 3 million death

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Average PM 2.5 inequality by racial groups

blacks >56%
Hispanics > 63%
Whites < 17%

PNAS March 26, 2019 116 (13) 6001-6006
COVID-19 patients in Illinois: zip code level

Data
- Zip-code level data (503 zip codes)
  - income, education, race
  - 91,907 confirmed cases

Results
Cluster 1 (More COVID-19 Cases):
  - Higher confirmed cases
  - Higher % Blacks and lower % Whites
  - Higher % food stamp recipients

Cluster 2 (Lower COVID-19 Cases):
  - Lower confirmed cases
  - Higher % whites and lower % blacks
  - Lower % food stamp recipients

- Zip-code classify racial groups better than county
Target high risk neighborhoods **NOT** just high-risk individuals
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Social determinants of health domains may contribute to disease burden with COVID-19

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Genetic Hypothesis

ACE2 and TMPRSS2 are the major portals of entry that allow SAR-CoV2 entry at epithelial barriers.

- ACE-2 is an Entry Receptor for SARS-CoV-2

https://www.rndsystems.com/resources/articles/ace-2-sars-receptor-identified
Genome-wide association study of COVID-19

GWAS Data:

**Italy**
- 835 patients
- 1255 controls

**Spain**
- 775 patients
- 950 controls

Higher risk in blood group A than in other blood groups

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Evolutionary adaptation

Exposure of Africans to fatal parasitic infections could have primed African immune systems to fight COVID-19.

Pre-existing immunity

Maria Yazdanbakhsh et al. Science 2002;296:490-494
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Vaccination coverage:

Bacillus Calmette-Guérin (BCG) vaccination coverage
(http://www.bcgatlas.org/index.php)

Distribution of COVID-19

COVID-19 worldwide distribution (as of 12/01/20)
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Age hypothesis: COVID-19 in children vs adults:

- Presence of comorbidities in adults.
- Inherent biological differences in immunological responses to CoV
  - Progressive deterioration of the immune system with aging
  - Expression and affinity of ACE2 increase with age


Opportunities to Improve Health Disparities

Approaches:
- Individual level
- Neighborhood/community level
- National level
  - Example: outdoor air conditions are often not within the control of individuals.
COVID-19 disparities (high in minorities) reinforces known health disparities

- Underprivileged/minority populations are more likely:
  - to live in areas with higher exposure to **air pollution** (highways & industries)
  - to be obese and/or suffer from comorbidities (diabetes, cardiovascular diseases…)
  - to get infected and hospitalized with life threatening COVID19.

- Solution: Multilevel interventions!

- I believe health disparities are preventable or (at least) modifiable.