Inequality in Health

Lecture X: Pandemics

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Outline

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Recap of Last Lecture

Recap of Last Lecture

- Early environment and parental investments in early stages of life are among the most important predictors of skills and **ability** in later life.
- Cunha et al. (2010) develop a theoretical investment model.
- Investing in disadvantaged children is justifiable not only on equity, but also on economic efficiency grounds.
- They analyze the process of **skill formation**, distinguishing between **cognitive** and **noncognitive** skills.
- Postulate that both types of skills play an important part on outcomes and success in life.
- Empirical evidence shows that parents partly compensate for adverse health shocks.

Introduction

Introduction

- COVID-19 pandemic: > 88m confirmed cases, > 1.89m deaths in 2020
- Not only health but also economic consequences:
  - Direct: via morbidity & mortality
  - Indirect:
    - via preventive measures (NPIs) such as school closures, lockdowns, travel restrictions
    - Crowd-out in health care

$\Rightarrow$ Reduction in labour supply/demand, production, consumption; increase in unemployment, public spending

- Within- and between-country heterogeneity in morbidity & mortality
- Severe short-term consequences, long-term effects still unknown

$\Rightarrow$ Important to learn from previous pandemics!

Pandemics and Socioeconomic Inequality

HIV Infections, U.S. 2014/2018

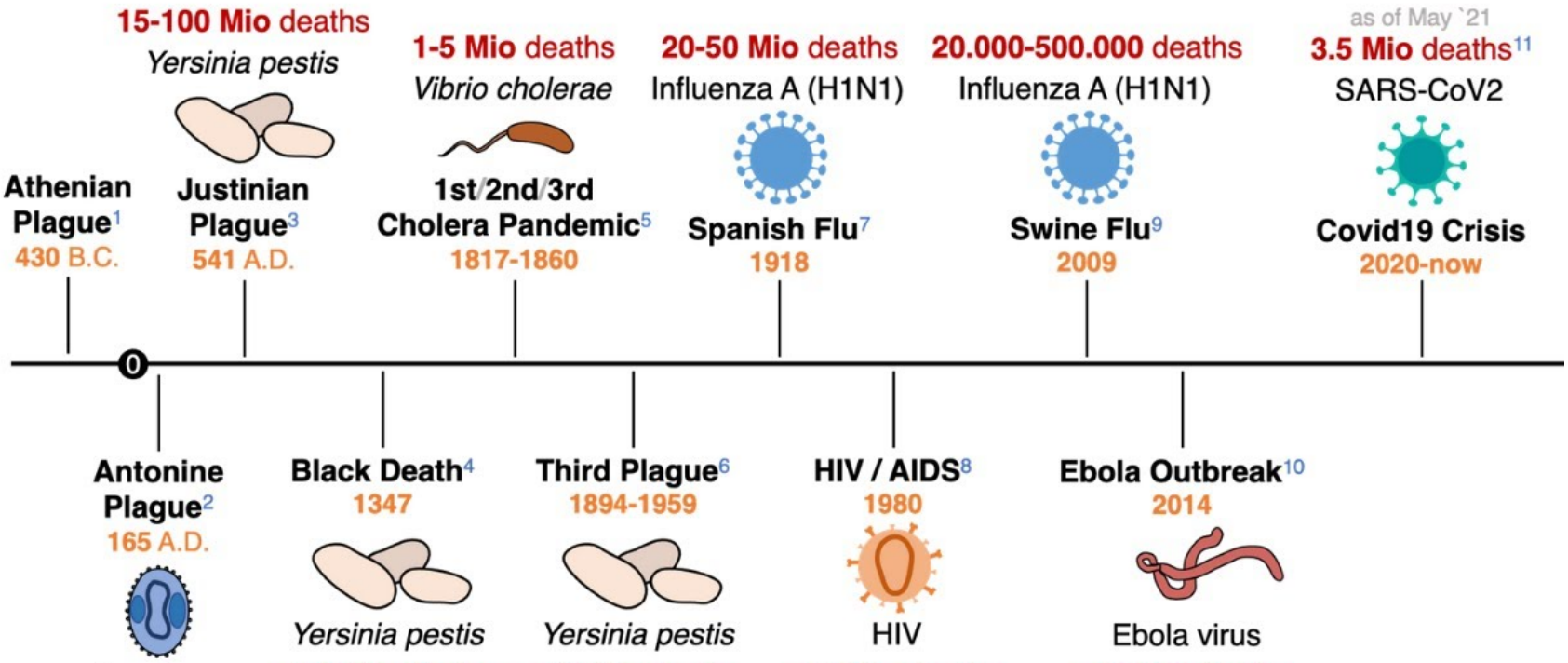


Figure 1. Major Pandemics in History

Source: *Henrik's lab*.

The Plague/Black Death

- **Plague**: first known pandemic (before 1,000 BC in Eurasia)
- **Black Death**: Pandemic in Eurasia & parts of Africa, 1347-1351
- 75-200m deaths, Europe's population reduced by 30-60%
- Cities and large towns more severely affected than rural areas
- Rather small SES inequality in mortality, even monarchs affected (e.g., Alfonso XI, king of Castile and León)

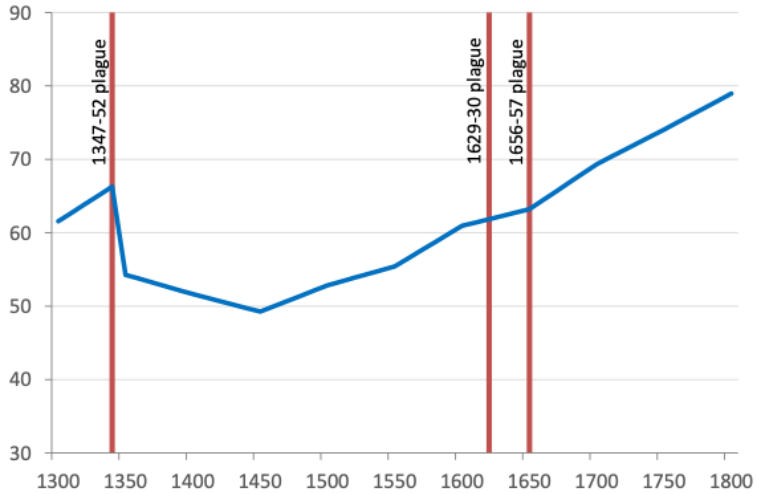


Figure 2. Share of wealth of richest 10 % in Italy. Source: Alfani (2022)

AIDS/HIV

- AIDS: acquired immunodeficiency syndrome
- Worldwide pandemic since 1980s
- > 35m deaths in total, about 1.7m infections in 2019
- Highest prevalence in Sub-Saharan Africa
- Intergenerational impact possibly huge Bell et al. (2006).
  - Consider intergenerational transmission of human capital.

New HIV Infections

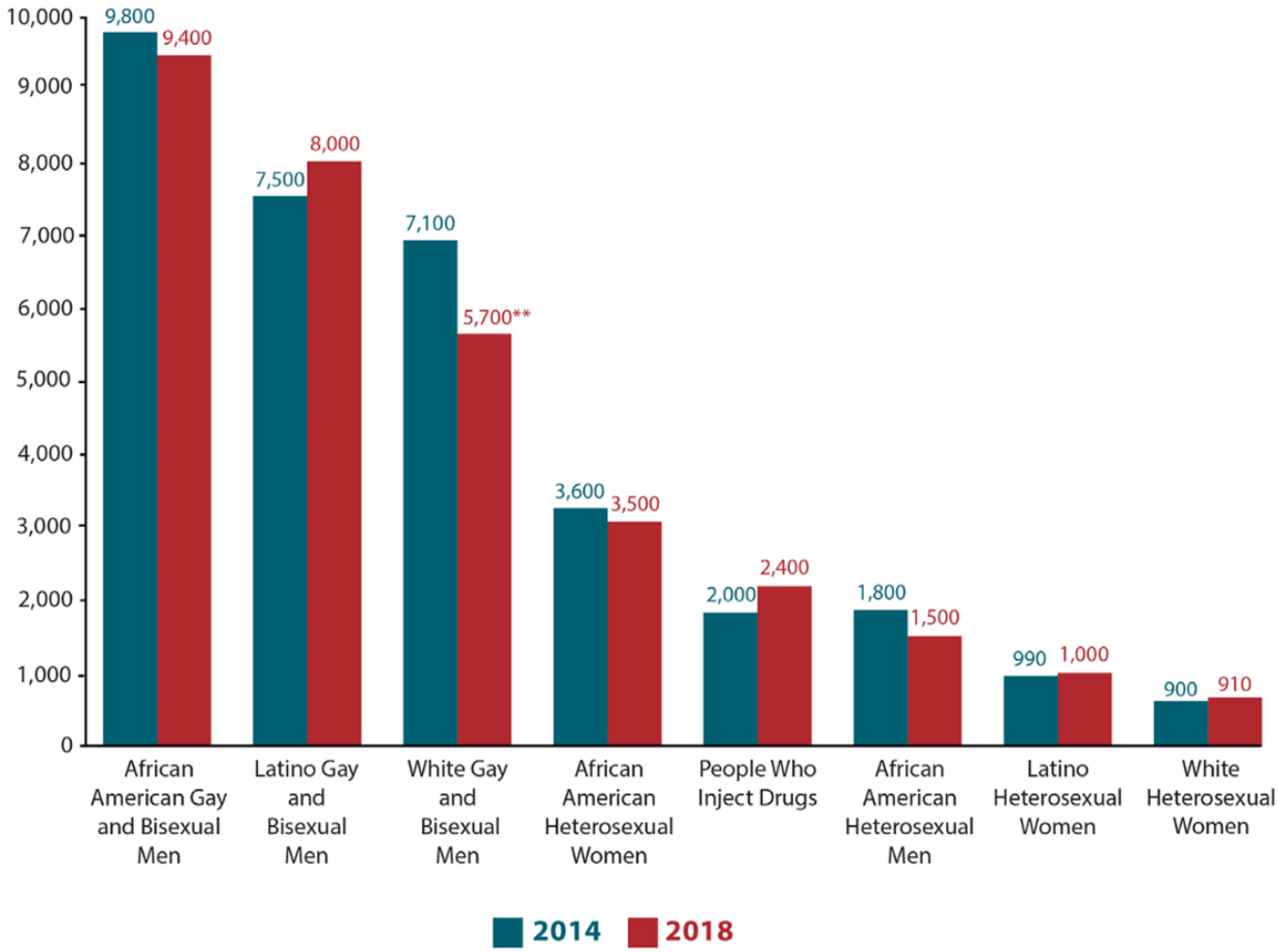


Figure 3. HIV Infections by Demographic, United States.

Source: CDC, hiv.gov

SARS

- SARS: severe acute respiratory syndrome
- First pandemic in 21st century (2002/2003)
- Mainly in southeast Asia (PR China, Taiwan, Singapore, Vietnam) but also Canada and U.S.
- 8,096 confirmed infections, 774 confirmed deaths
- SES gradient in SARS incidence (Bucchianeri, 2010), positive correlation between air pollution and case fatality Cui et al. (2003)

The 1918-1920 Influenza Pandemic

Background

- Influenza pandemic caused by H1N1 influenza A virus
- Worldwide pandemic, February 1918 – April 1920
- Between 20m and 100m deaths
- Three (four) waves, second wave most deadly.
- Geographic origin unknown
  - Kansas, France or China?
- Uncensored newspaper reports during WWI in neutral Spain gave impression of severe exposure
- **Preventive measures**: social distancing, school closures, face masks
- Young adults especially affected (unlike most influenza outbreaks).

Great Influenza Pandemic – Overall Mortality

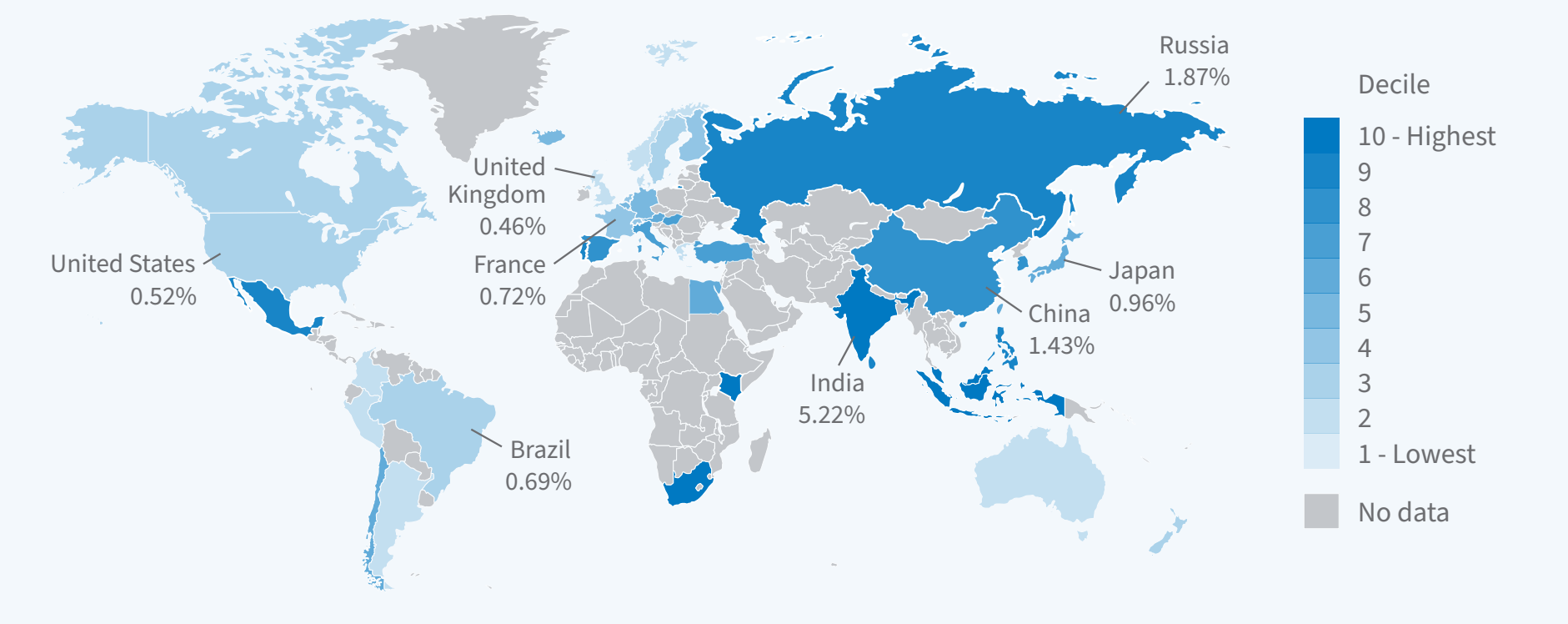


Figure 4. Death Rates During the Great Influenza Pandemic

Source: Maas (2020)

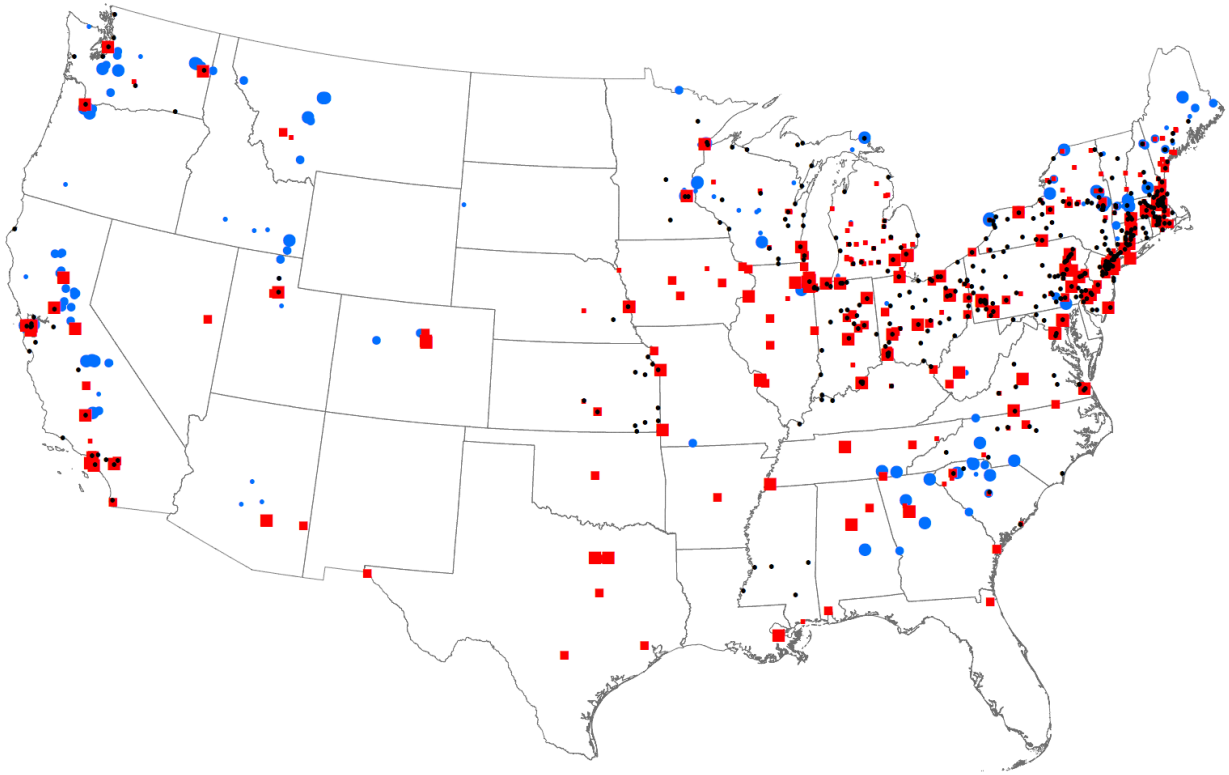
Clay et al. (2019)

- Clay, Lewis, and Severnini (2019) explore determinants of Spanish flu mortality in the U.S.
- 438 U.S. cities considered, annual mortality data
- Three factors evaluated:
  - Pre-pandemic **health** and **poverty**
  - Air pollution
  - Timing of onset and proximity to **military bases**
- Results:
  - Positive significant relationship between high pre-pandemic infant mortality and Spanish flu deaths
  - Higher mortality in areas with higher air pollution
  - No significant relationship between excess mortality and proximity to WWI bases

Clay, Lewis, and Severnini (2019) - Data

- Data on 438 U.S. cities with at least 10,000 residents in 1920
- Data sources:
  - All-cause deaths in 1915-1925 from U.S. Mortality Statistics
  - Pre-pandemic demographic and economic characteristics from 1910 census of population and manufacturing
  - Proximity to military bases obtained from U.S. War Department
  - Coal-fired generating capacity from U.S. Department of Agriculture

Clay et al. (2019) – Data



Notes: This figure maps the 438 cities in our sample (small black asterisks) as well as the coal-fired power plants (red squares) and hydroelectric dams (blue circles) in 1915 by terciles of electricity generating capacity (larger symbols represent higher terciles of capacity).

Figure 5. Source: Clay et al. (2019)

Clay et al. (2019) – Econometric Approach

Two-step procedure:

1. Determine excess mortality for city c via

$$M_{ct} = \alpha_c + \beta_c t + e_{ct},$$

where

M_{ct} mortality rate for city c in year t (excluding 1918)
α_c city-specific intercept
β_c city-specific time trend

2. Regress excess mortality on factors X_c:

$$\Delta M_c = \gamma_0 + \sum_j \gamma_j X_c^j + \varepsilon_c$$

with

ΔM_c excess mortality in city c: $M_{c,1918} - \widehat{M_{c,1918}}$

Clay et al. (2019) – Results

	Dependent variable: Excess Mortality in 1918				
	(1)	(2)	(3)	(4)	(5)
% urban residents in 1910					
High vs. low	-7.556**	-12.37***	-6.937*	-14.03***	-18.46***
	[3.420]	[3.434]	[4.104]	[4.825]	[4.176]
	(3.400)	*(3.414)*	*(4.080)*	*(4.798)*	*(4.123)*
Middle vs. low	-7.725**	-5.649	-6.522*	-8.484**	-8.181**
	[3.501]	[3.572]	[3.845]	[3.890]	[3.464]
	(3.481)	*(3.552)*	*(3.823)*	*(3.868)*	*(3.420)*
Infant mortality, 1915-1916					
High vs. low	31.35***				20.96***
	[3.408]				[4.033]
	(3.389)				*(3.982)*
Middle vs. low	13.88***				7.782**
	[3.063]				[3.156]
	(3.046)				*(3.116)*
% illiterate in 1910					
High vs. low		33.09***			21.26***
		[3.461]			[3.993]
		(3.442)			*(3.942)*
Middle vs. low		19.35***			11.41***
		[3.345]			[3.693]
		(3.326)			*(3.646)*
Proximity to WWI base					
High vs. low			7.078*		5.225
			[4.088]		[3.825]
			(4.065)		*(3.776)*
Middle vs. low			2.223		1.012
			[3.608]		[3.456]
			(3.588)		*(3.413)*
Coal capacity					
High vs. low				15.89***	9.116**
				[4.991]	[4.472]
				(4.962)	*(4.416)*
Middle vs. low				7.230*	3.778
				[3.706]	[3.428]
				(3.685)	*(3.384)*
Observations	438	438	438	438	438

Figure 6. Source: Clay et al. (2019)

Replication for Sweden – Karlsson et al. (2022)

Table 1. Joint determinants of excess mortality 1918/19.

	All		Urban		Rural	
	(1)	(2)	(3)	(4)	(5)	(6)
Urban parish	-18.450**	-17.206**				
	(7.162)	(8.037)				
Proportion age 0-20	-19.132	80.639	491.881*	564.377*	-52.575	5.077
	(67.014)	(66.578)	(257.896)	(324.837)	(70.274)	(71.713)
Proportion age 41-64	-217.637***	-105.140	-506.174	-601.016	-217.192**	-158.773*
	(82.959)	(85.492)	(361.469)	(474.169)	(88.502)	(90.973)
Proportion age 65+	-106.642	-40.007	370.814	297.590	-234.669***	-167.138**
	(65.959)	(68.482)	(252.221)	(310.123)	(67.706)	(73.914)
(Log) population density	5.999***	6.002**	8.729	-3.829	7.698***	6.449**
	(1.848)	(2.388)	(8.032)	(12.537)	(2.165)	(2.715)
(Log) household size	0.413	5.148	-5.830	-15.236	-23.039*	-21.835*
	(12.043)	(11.773)	(19.705)	(24.819)	(13.619)	(12.593)
HISCO category 12	-86.612	62.927	183.839	490.038	-676.536***	-636.347**
	(201.118)	(215.720)	(619.250)	(804.385)	(240.215)	(253.570)
HISCO category 34	-46.786	-257.714*	-202.853	-430.400	141.959	193.580
	(121.738)	(146.708)	(261.098)	(472.048)	(172.665)	(180.501)
HISCO category 5	-15.826	62.029	207.513	215.652	-105.515	-26.534
	(56.852)	(55.115)	(134.545)	(210.302)	(73.636)	(71.560)
HISCO category 6	4.130	-15.838	-236.396**	-282.390	46.875*	13.652
	(25.122)	(26.819)	(114.138)	(178.477)	(26.568)	(27.392)
Number of poor per 1000	-0.070	-0.055	-0.087	0.016	-0.012	-0.102
	(0.065)	(0.068)	(0.113)	(0.164)	(0.088)	(0.089)
IMR medium	-2.927	-3.568	-13.657*	-4.649	-6.145**	-6.726**
	(2.728)	(2.561)	(7.008)	(9.810)	(2.845)	(2.760)
IMR high	-9.538***	-11.563***	-4.023	-0.051	-14.687***	-15.062***
	(2.911)	(2.836)	(9.838)	(13.594)	(2.957)	(2.988)

Replication for Sweden – Ctd

Table 2. Joint determinants of excess mortality 1918/19.

	All		Urban		Rural	
	(1)	(2)	(3)	(4)	(5)	(6)
Hospital	0.454	1.378	-0.926	-1.347	14.271	18.069
	(6.642)	(6.467)	(9.921)	(12.140)	(19.842)	(15.005)
Health care expenditures	4.192	5.902*	1.607	1.540	1.772	2.842
	(2.710)	(3.165)	(5.735)	(9.020)	(5.586)	(5.302)
Midwife density medium	1.914	3.451	2.789	18.238	0.689	2.850
	(2.695)	(2.786)	(7.878)	(13.848)	(2.887)	(3.096)
Midwife density high	-4.056	-2.015	-9.641	-0.050	-5.115	1.014
	(3.055)	(3.428)	(11.763)	(12.707)	(3.220)	(3.894)
Train station in parish	4.259	1.234	8.767	0.795	3.191	1.796
	(3.056)	(3.062)	(9.487)	(10.599)	(3.619)	(3.456)
Distance to nearest train station	0.807***	0.600**	-1.753	-1.919	0.886**	0.802**
	(0.308)	(0.296)	(1.546)	(1.933)	(0.349)	(0.330)
Distance to nearest train station (sq.)	-0.022***	-0.019***	0.055	0.041	-0.024***	-0.021***
	(0.006)	(0.006)	(0.042)	(0.062)	(0.006)	(0.006)
Military camp	-6.789	-5.366	-22.955	-17.896	28.668	27.485
	(6.083)	(6.190)	(18.702)	(22.955)	(17.475)	(17.572)
Distance to nearest camp	-0.030	-0.025	-0.698	-0.952	-0.065	-0.102
	(0.116)	(0.118)	(0.847)	(1.050)	(0.119)	(0.118)
Distance to nearest camp (sq.)	0.001	0.001	0.005	0.011	0.001	0.001*
	(0.001)	(0.001)	(0.007)	(0.009)	(0.001)	(0.001)
Rain levels Sep. 1918	-7.450***	-11.330***	0.650	-22.266*	-8.410***	-6.555
	(2.554)	(4.019)	(6.389)	(12.536)	(2.945)	(5.065)
Rain levels Oct. 1918	2.279	1.667	3.277	0.694	4.586	-3.923
	(5.656)	(11.644)	(12.488)	(33.580)	(6.423)	(13.624)
Total pollution (per area)			-6.878	-3.451		
			(6.383)	(7.661)		
N	2,417	2,417	101	101	2,316	2,316

Clay et al. (2019) – Conclusions

- Low levels of health and poverty contributed to pandemic severity
- Results correspond to previous studies finding poor individuals to be disproportionately affected
- Air pollution positively related to mortality
- Limitations:
  - No causal interpretation
  - Excess mortality instead of cause-specific mortality used
  - Local public interventions not taken into account

Galletta and Giommoni (2022)

- Galletta and Giommoni (2022) estimate the effect of the Spanish flu on income inequality in Italy
- Digitized historical administrative records on Italian taxpayer incomes are used
- They implement a OLS strategy using ill WWI soldiers returning to their hometown as proxy for influenza severity
- Results:
  - Higher income inequality after 5 years in more affected municipalities
  - Effect mostly explained by reduction in income share by poorer people

Galletta and Giommoni (2022) - Data

- Data on around 2,000 Italian municipalities
- Data sources:
  - Influenza and general mortality data from Italian national statistical office
  - Income declaration data issued by Italian tax authority
  - WWI casualties
  - Decennial censuses 1901 and 1911

Galletta and Giommoni (2022) – Econometric Approach

- Estimation strategy

$$I_{idp} = \beta \text{Victims}_{idp} + \gamma \mathbf{X}_{idp} + \eta_{idp}$$

with

I_{idp} income inequality in municipality i, district d, province p,

Victims_{idp} soldiers returning to hometowns from war frontline who die due to disease complication

$\mathbf{X}$ set of fixed effects and controls

- Identifying assumptions:
  - Victims_{idp} correlated with number of deaths due to influenza
  - Conditional exogeneity of proportion of ill soldiers returning to hometown

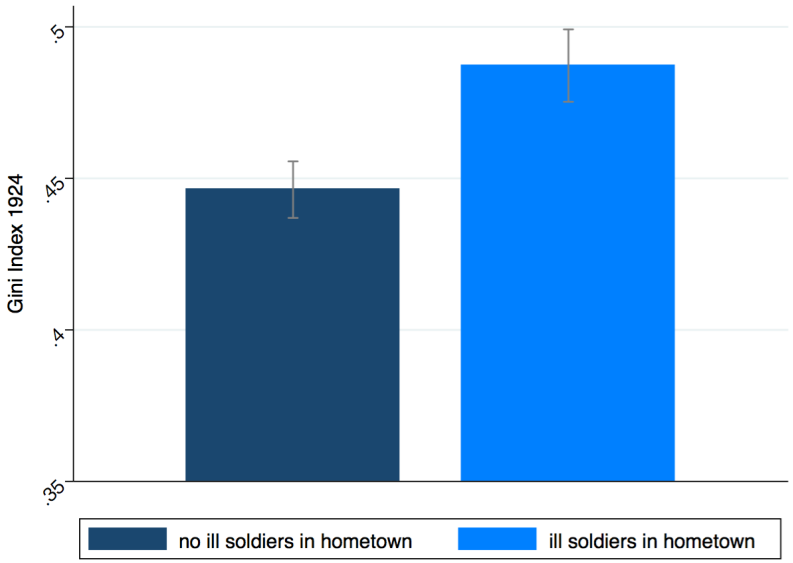
Galletta and Giommoni (2022) - Results

	(1)	(2)	(3)	(4)
Panel A: Municipal Gini index (log)				
Victims WWI - illness (hometown)	0.027***	0.021**	0.021**	0.020**
	(0.010)	(0.009)	(0.009)	(0.008)
N	1804	1804	1804	1804
R^2	0.004	0.225	0.276	0.279
Panel B: Income share of top 20%				
Victims WWI - illness (hometown)	0.006	0.003	0.004	0.003
	(0.004)	(0.004)	(0.004)	(0.004)
N	1774	1774	1774	1774
R^2	0.001	0.152	0.222	0.225
Panel C: Income share of bottom 20%				
Victims WWI - illness (hometown)	-0.002**	-0.002*	-0.002*	-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)
N	1774	1774	1774	1774
R^2	0.004	0.199	0.258	0.262
Province FE	No	Yes	No	No
Geography FE	No	Yes	Yes	Yes
N contributors quartile FE	No	Yes	Yes	Yes
District FE	No	No	Yes	Yes
Municipal controls	No	No	No	Yes

Figure 7. Source: Galletta and Giommoni (2020)

Galletta and Giommoni (2022) – Results

(A) Gini index in 1924



(B) Gini index in 2018

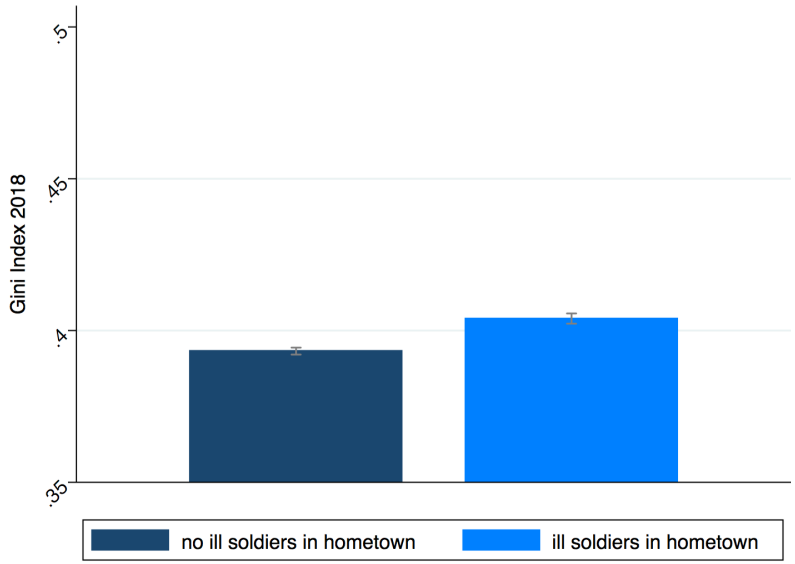


Figure 8. Source: Galletta and Giommoni (2020)

Galletta and Giommoni (2022) – Conclusions

- The authors find a one standard-deviation increase in pandemic exposure measure to increase inequality in 1924 by 2-3.4%
- Effect mostly driven by bottom of income distribution, no effect on top 20% of income distribution
- Long-run effects even after 100 years visible
- One of the first studies on causal effect of pandemics on local income inequality

Further Studies

- Using Swedish data, Karlsson et al. (2014) find significant increases in poorhouse rates and negative effects on capital returns but no impact on incomes
- Percoco (2016) finds the Spanish flu to have caused an average reduction of 0.3-0.4 years of schooling for Italian children born in 1918-1920
- Guimbeau et al. (2020) identify significant increases in infant mortality and still births due to the Spanish flu in Brazil as well as adverse long-run effects on female literacy and inpatient hospital admissions
- For the U.S., Beach et al. (2020) find robust evidence for in utero exposure to the Spanish flu to have reduced high school graduation rates

COVID-19

How it Started...

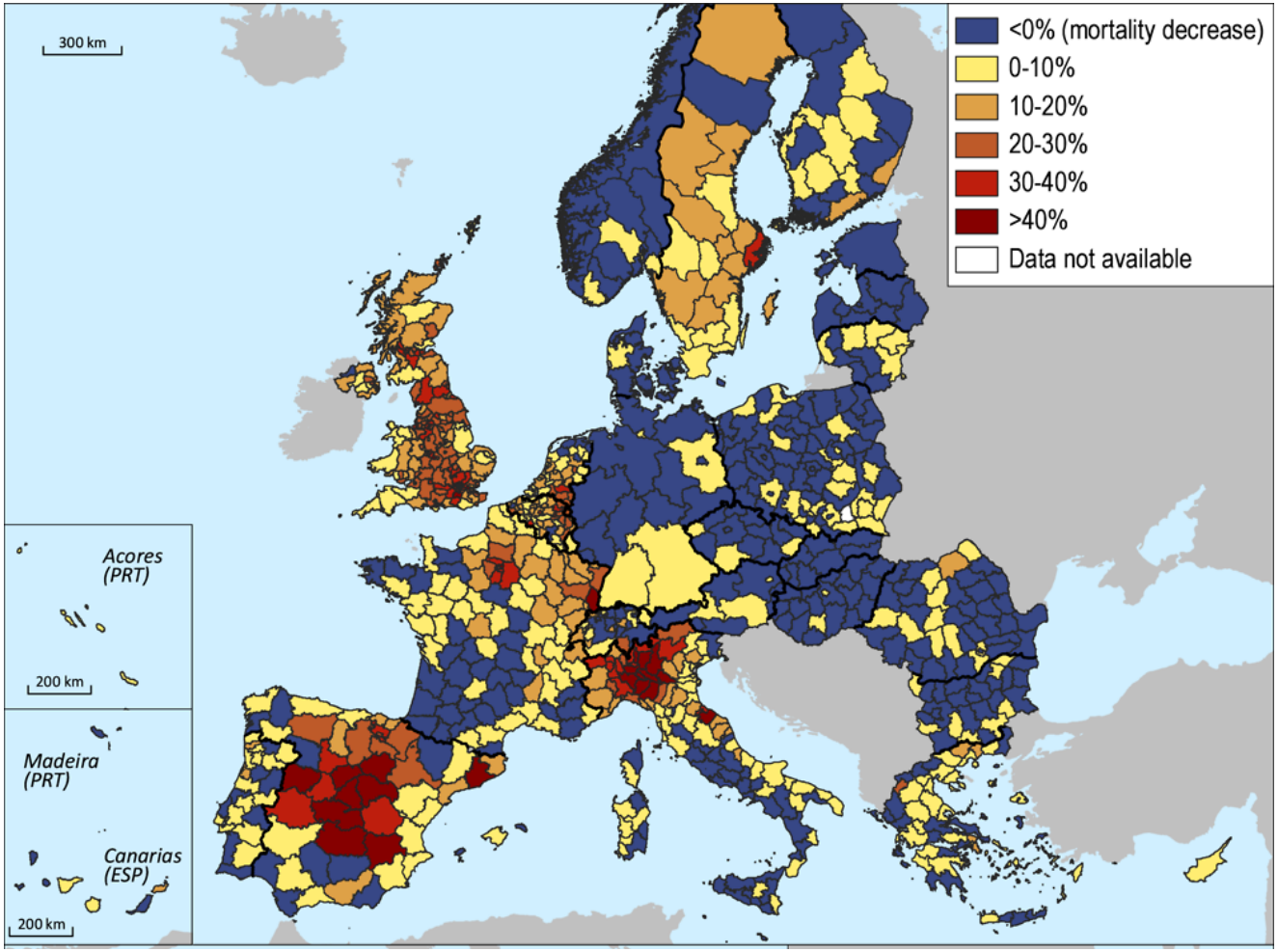


Figure 9. Excess Mortality, Feb-Jun 2020 Compared to 2018-19 Average

Source: OECD Regions and Cities at a Glance 2020

...How it's going

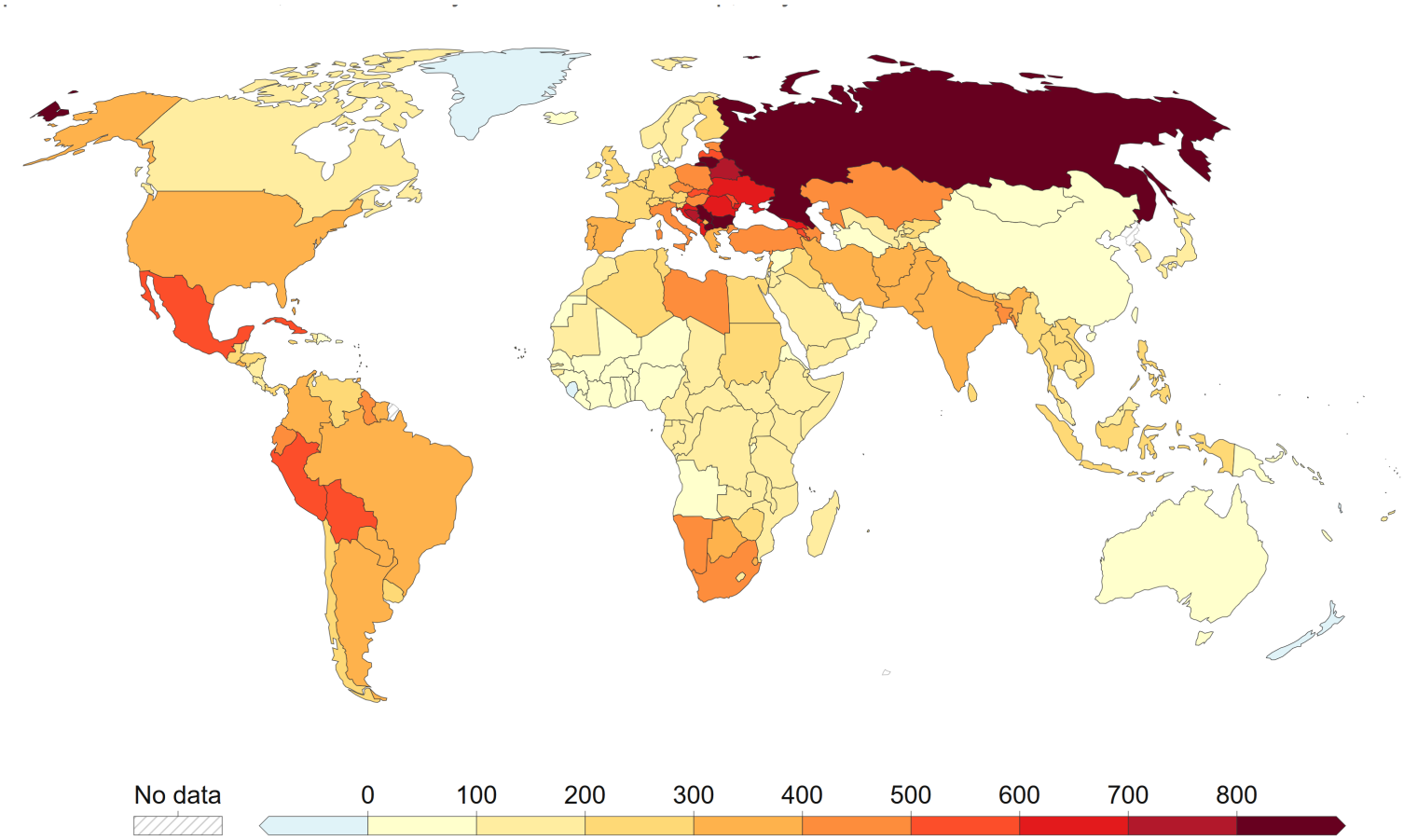


Figure 10. Cumulative Excess Deaths per 100,000 – December 2022.

Source: Our World in Data

Spanish Flu vs. COVID-19 – Commonalities

- Virus inducing respiratory distress
- Highly contagious
- Similar transmission (respiratory droplets, aerosols)
- Limited scope for medical interventions

→ Use of non-pharmaceutical interventions

Spanish Flu vs. COVID-19 – Differences

- Higher life expectancy/better health care supply today than in 1918
- Quality of life today higher than in 1918
- Spanish flu breakout at end of WWI when most economies were disrupted
- Vulnerable populations:
  - COVID-19: very young children and very old adults
  - Spanish flu: young adults as well

Socioeconomic Gradient in Morbidity and Mortality

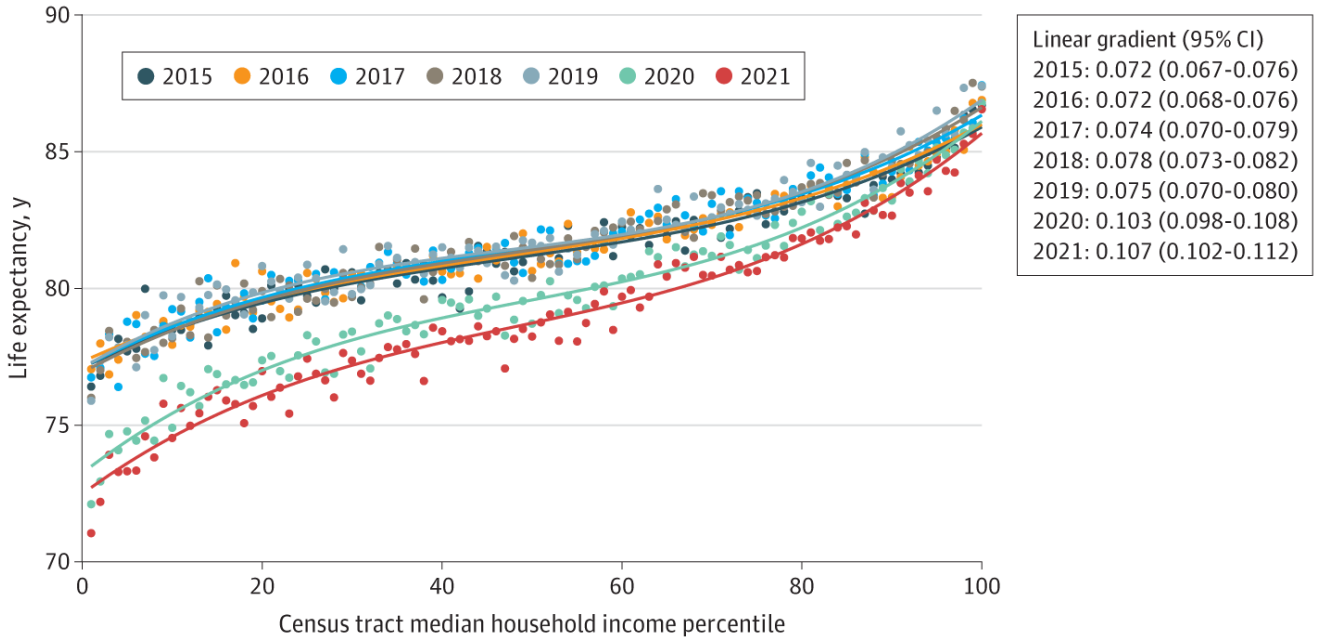


Figure 11. Source: Schwandt et al. (2022)

- Income gradient in mortality increased during the COVID-19 period.
- The life expectancy reduction is present in the whole income distribution but effects larger in the left tail.
- Bottom percentile lost 4.85 and top percentile 0.86 years of life expectancy in 2021.

Socioeconomic Gradient in Morbidity and Mortality

- Clouston et al. (2021) find high SES to be associated with earlier COVID-19 incidence but slower growth in incidence in U.S. counties.
- Madia et al. (2022) reports a socioeconomic gradient with respect to health and ethnicity in COVID-19 deaths.
- Brotherhood et al. (2022) find that poor are particularly vulnerable. DiD estimates following lockdowns found higher pandemic mortality and less social distancing in Brazilian favelas than the rest of the country.

Socioeconomic Effects of COVID-19

- For the Béland et al. (2020) find increases in unemployment in the short run – especially for younger and less-educated workers – but no impact on wages.
- Couch et al. (2020) implement a DiD strategy to find the racial gap in unemployment between black and white U.S. citizens to have increased at the beginning of the COVID-19 pandemic.
- Also using DiD, Gupta et al. (2020) show that about 60% of the short-term employment reduction in the U.S. was driven by state social distancing policies.

Education and COVID-19

- School closures were some of the most common pandemic responses.
- Those learning interruptions could have long-term consequences on inequality.
- Engzell et al. (2021) finds a 0.08 standard deviation reduction in learning due to 8-weeks school closures in The Netherlands. Effect stronger for less educated parental background.
- Jack et al. (2022) using data from the U.S found larger declines in school subjects pass rates in districts with remote learning in comparison with those that had in person courses. Effects are stronger in communities with higher percentages of blacks.

Summary and Conclusions

Summary and Conclusions

- Pandemics might cause economic downturns – either directly via increases in morbidity and mortality, or via preventive measures.
- However, pandemics can vary with respect to socioeconomic gradients in incidents:
  - AIDS/HIV pandemic especially in Sub-Saharan Africa; high-risk groups in developed countries
  - Small gradient in case of Black Death
- Spanish flu 1918-1920 most severe pandemic in past century with up to 100m deaths:
  - Evidence of SES gradient in mortality
  - Pandemic increasing socioeconomic inequality
  - quite similar to current COVID-19 pandemic
- First results for COVID-19 find low-SES groups to be especially vulnerable.

Literature I

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