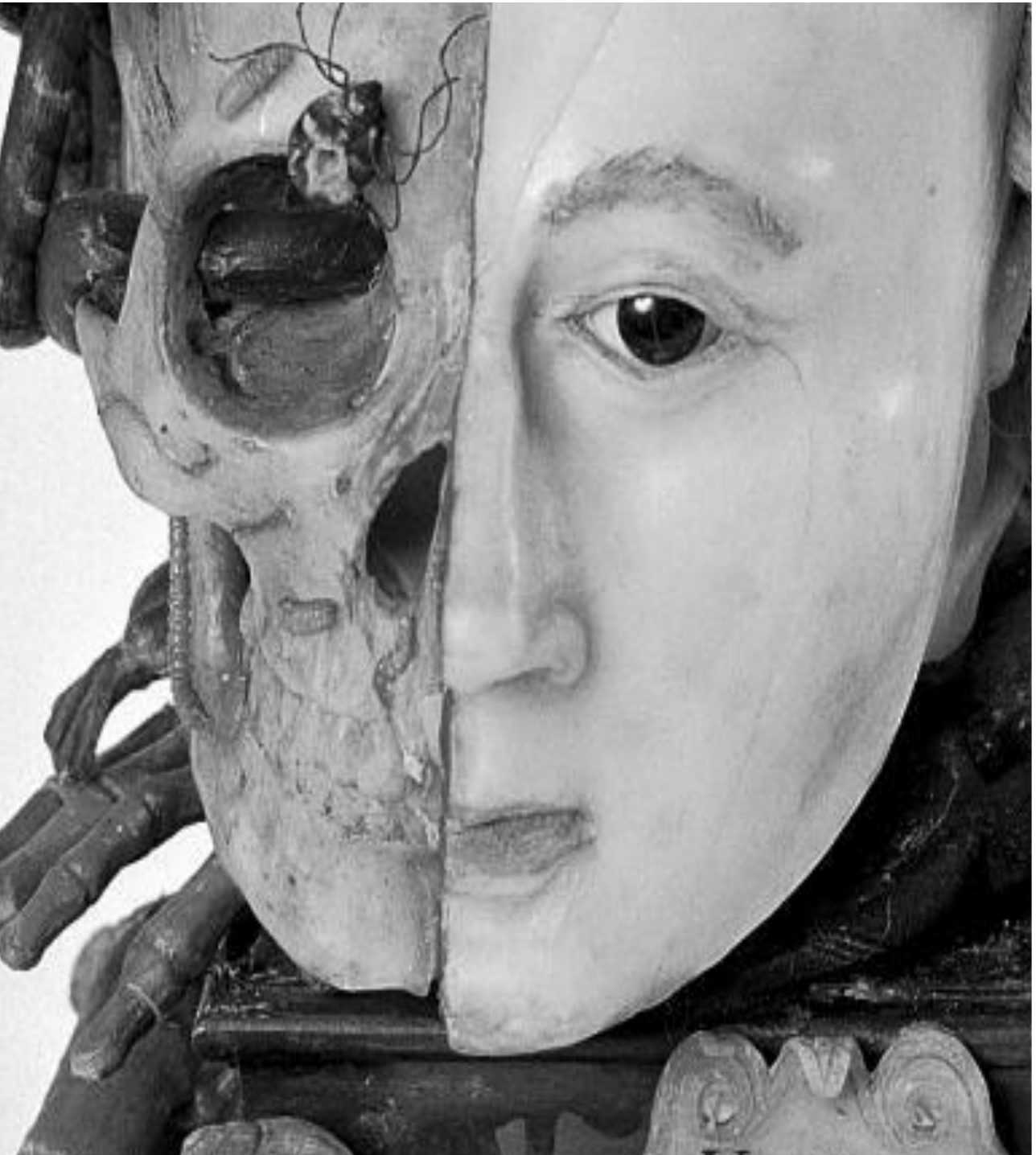

THE GREAT LEAP

Online Lecture Series:
The Epidemiological Transition

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cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

GREATLEAP

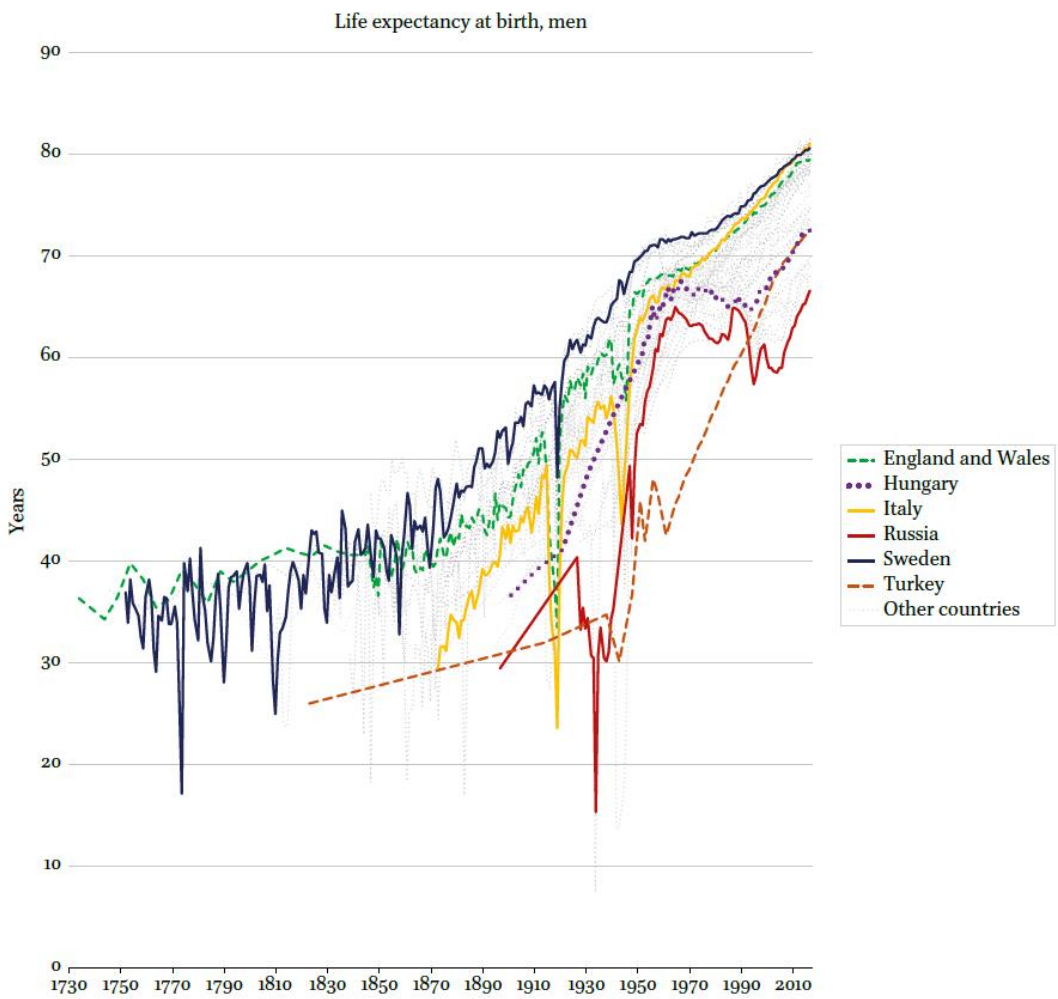
Outline of the lecture

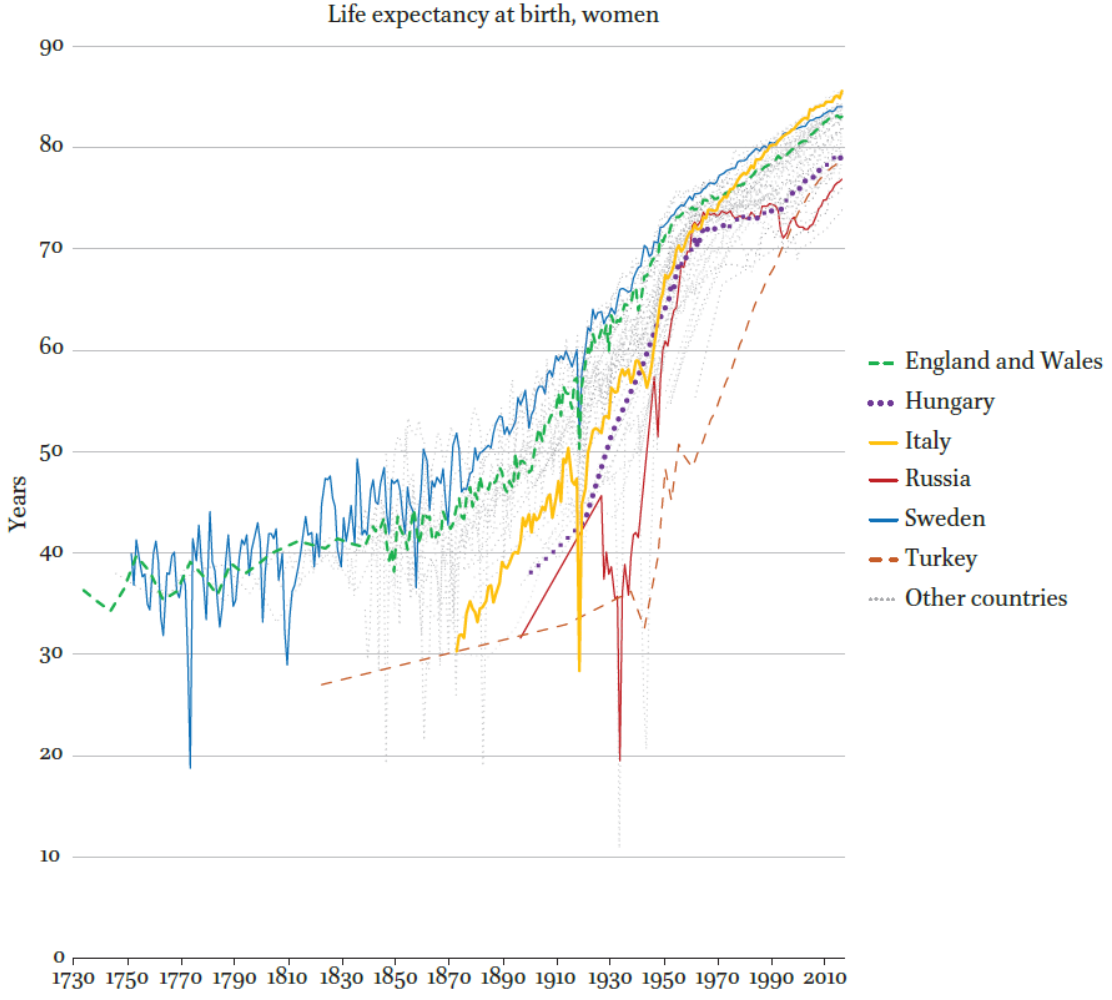
1. Definition of the epidemiological transition theory (ETT)
2. Historical context of ETT (Omran, 1971)
3. Criticisms: weaknesses, updates and adaptations of ETT
4. Data and indicators to study ETT
5. ETT in a global historical perspective
6. Determinants of the ETT transition (the McKeown debate)

1. DEFINITION OF EPIDEMIOLOGICAL TRANSITION

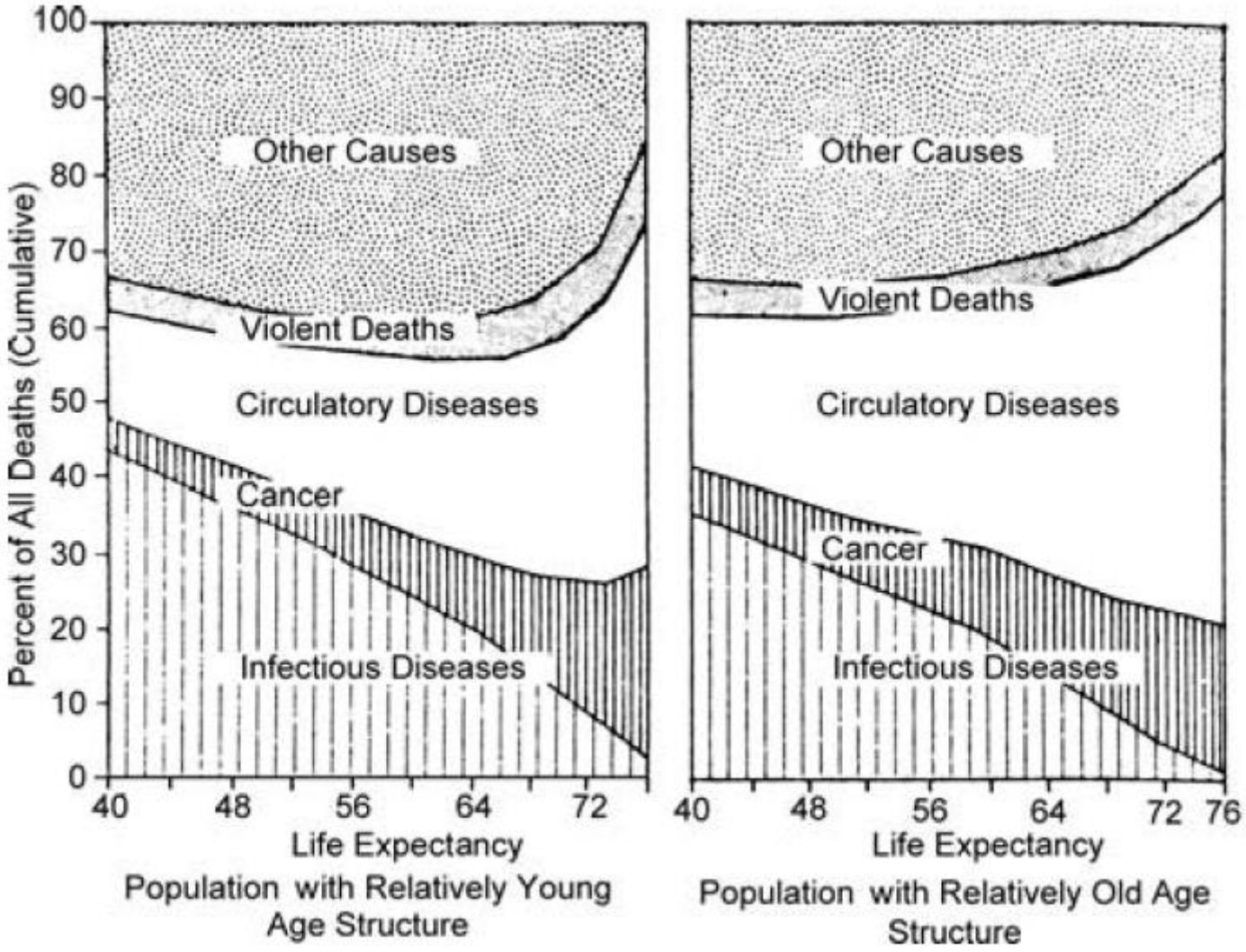
Theory developed by Abdel Omran in 3 articles:

- A.R. Omran (1971). The epidemiologic transition: A theory of the epidemiology of population change. *Milbank Memorial Fund Quarterly* 49: 509-538.
- A.R. Omran (1983). The epidemiologic transition theory: A preliminary update. *Journal of Tropical Pediatrics* 39: 305-316
- A.R. Omran (1998). The epidemiologic transition theory revisited thirty years later. *World Health Statistics Quarterly* 53 (2,3,4): 99-119.



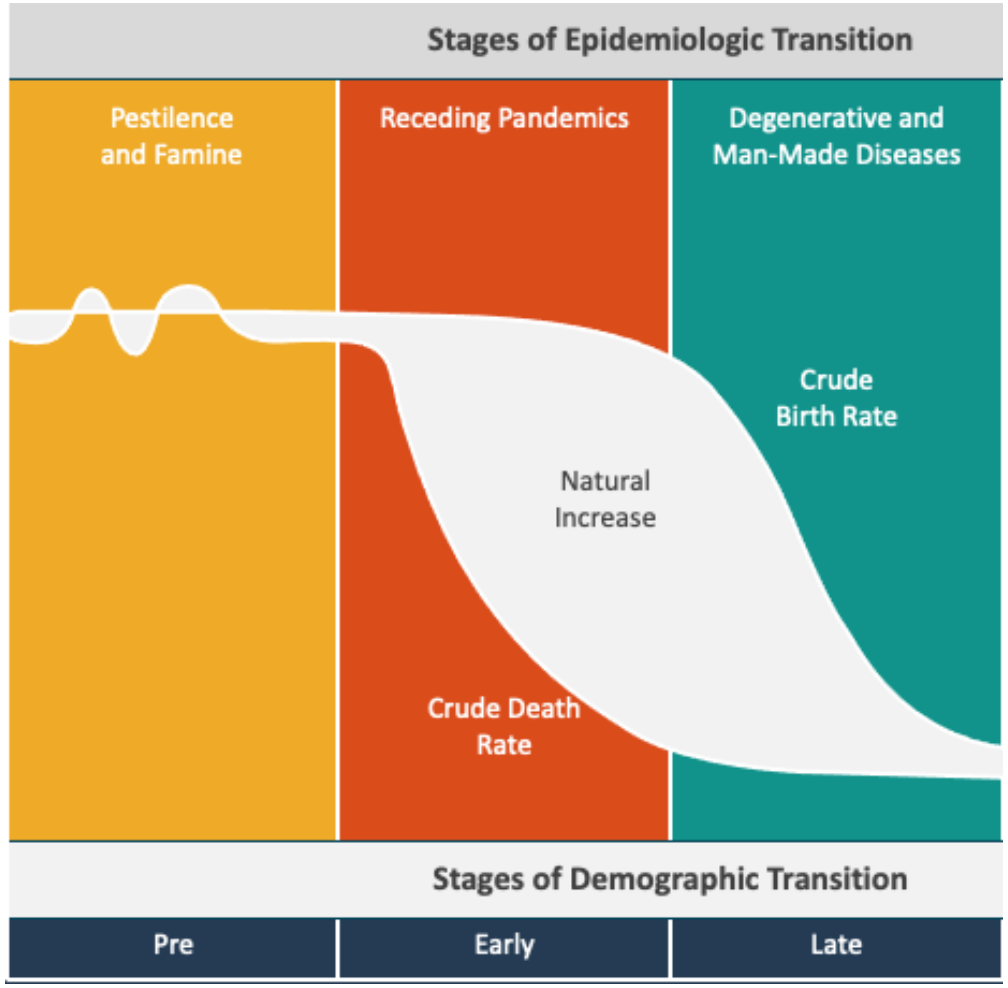


J.P.Mackenbach (2020). *A History of Population Health. Rise and Fall of Disease in Europe*, 4, 341.



A.R. Omran (1971). The Epidemiologic Transition: A Theory of the Epidemiology of Population Change. *Milbank Memorial Fund Quarterly* 49: 518.

Stages of the epidemiological transition



Stage 1. The age of pestilence and famine

- Mortality is high and fluctuating. Malthusian positive checks: epidemics, war, famine. Mortality variation (peaks) greater than variations in fertility
- Life expectancy at birth is low and variable (20- 40 years)
- Pop. growth was cyclical

Stage 2. The age of receding pandemics

- Mortality declines progressively, the rate of decline accelerates as epidemic peaks become less frequent and eventually disappear
- Life expectancy at birth increases steadily from 30 to 50 years' (55 years in the 1983 update)
- During the latter part of this phase, fertility starts to decline Population growth is sustained and begins to describe an exponential curve (Omran 1983)

Stage 3. The age of degenerative and man-made diseases

- Mortality continues to decline and become stable at a relatively low level.
- Life expectancy at birth rises gradually until it exceeds 50 (70 years in the updated version (Omran 1983).
- During this phase fertility becomes the main factor in population growth

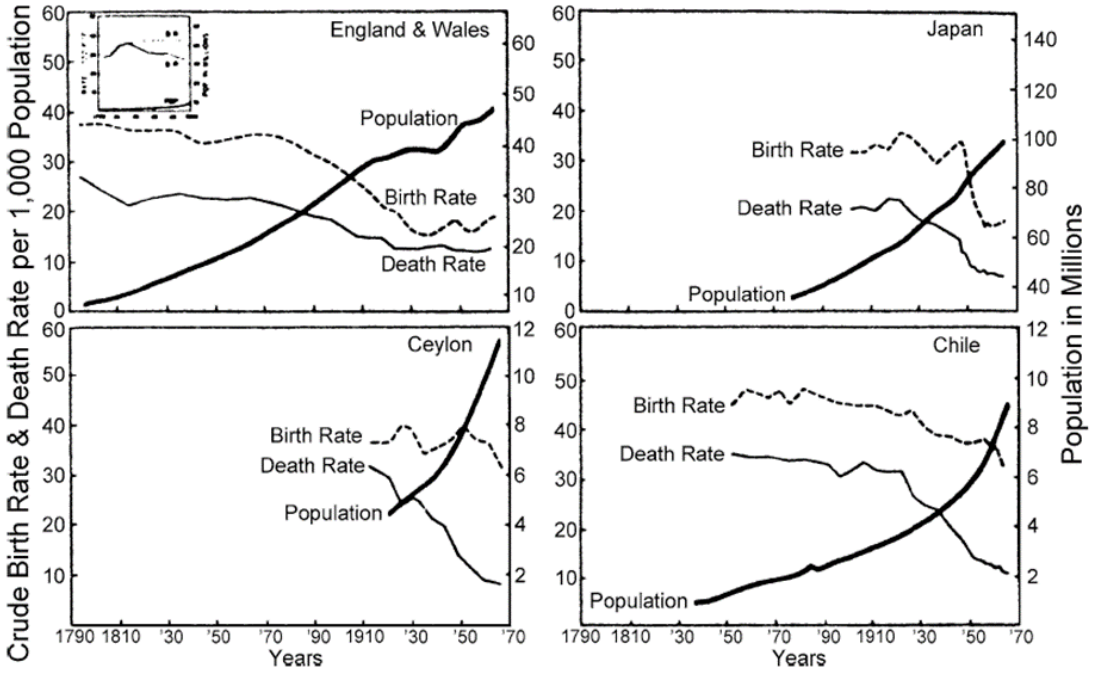
Models of the epidemiological transition

"the demographic transition failed to account for the different types of transition occurring in the developing countries"

variations between countries in pattern, pace, determinants and consequences of pop change

Omran differentiates 3 basic models:

- **Classical model (Western model**): slow transition, over 2 centuries, completed, strong pop. growth.
- **Accelerated model (semi-Western model)** (Japan, Eastern Europe): late start, shorter and faster transition, steep pop.growth
- **Delayed model** (most developing countries 1971!): late start of mortality decline, but fertility remains high (slow decline), ongoing transition, exponential pop.growth

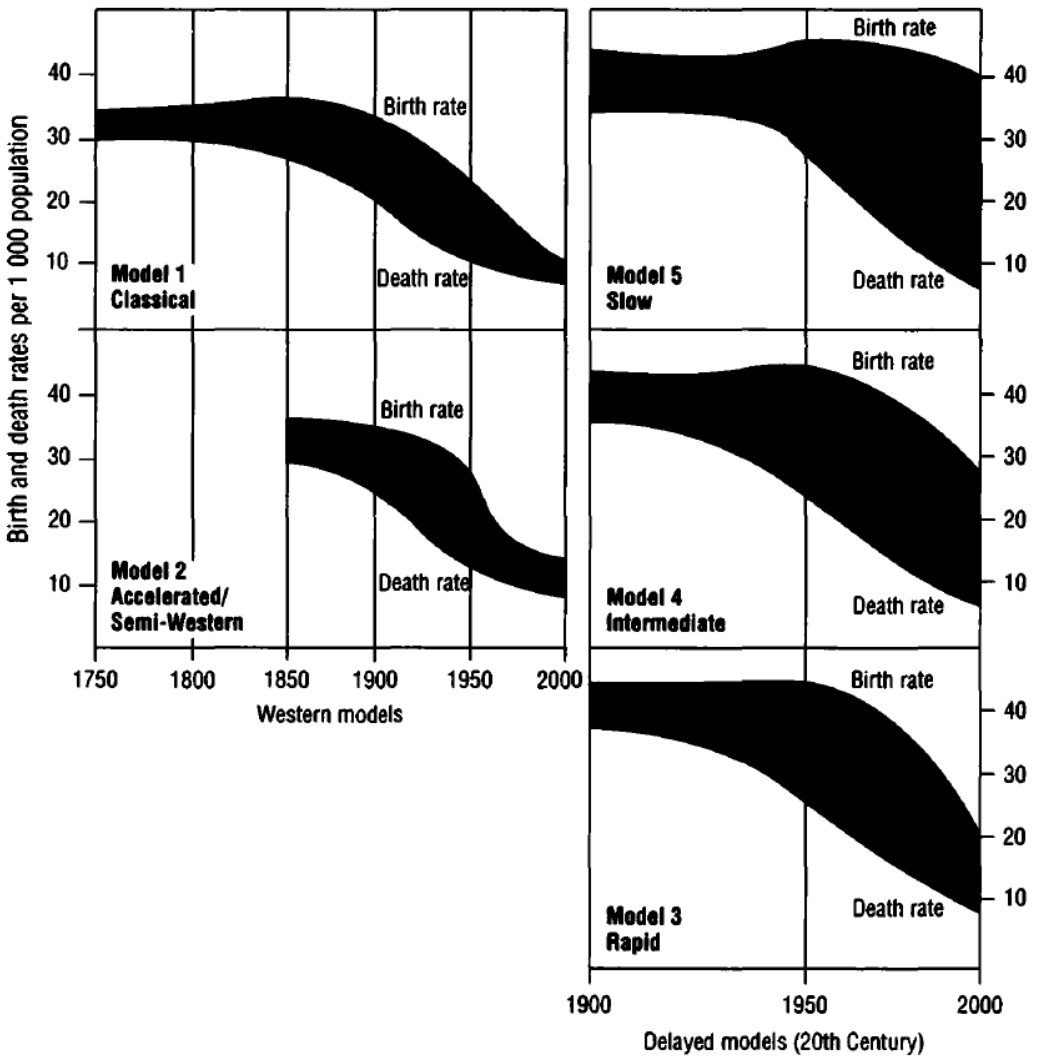


A.R. Omran (1971). The Epidemiologic Transition: A Theory of the Epidemiology of Population Change. *Milbank Memorial Fund Quarterly* 49: 517.

- 1983 update: fourth model: transitional model (Singapore, Hong Kong)

- 1998 update: **five-stage model** transitional model split into three variants:
  - **Slow transitional variant**: rapid fertility decline (e.g. Korea, Taiwan)
  - **Intermediate transitional variant**: gradual fertility decline (e.g. Mexico, Egypt)
  - **Rapid transitional variant:** slow or no fertility decline (e.g. Yemen, Bolivia)

Fig. 7
Models of the epidemiologic transition



A.R. Omran (1998). The epidemiologic transition theory revisited thirty years later. *World Health Statistics Quarterly*, 53 (2,3,4): 112.

2. HISTORICAL CONTEXT OF THE EPIDEMIOLOGICAL TRANSITION THEORY

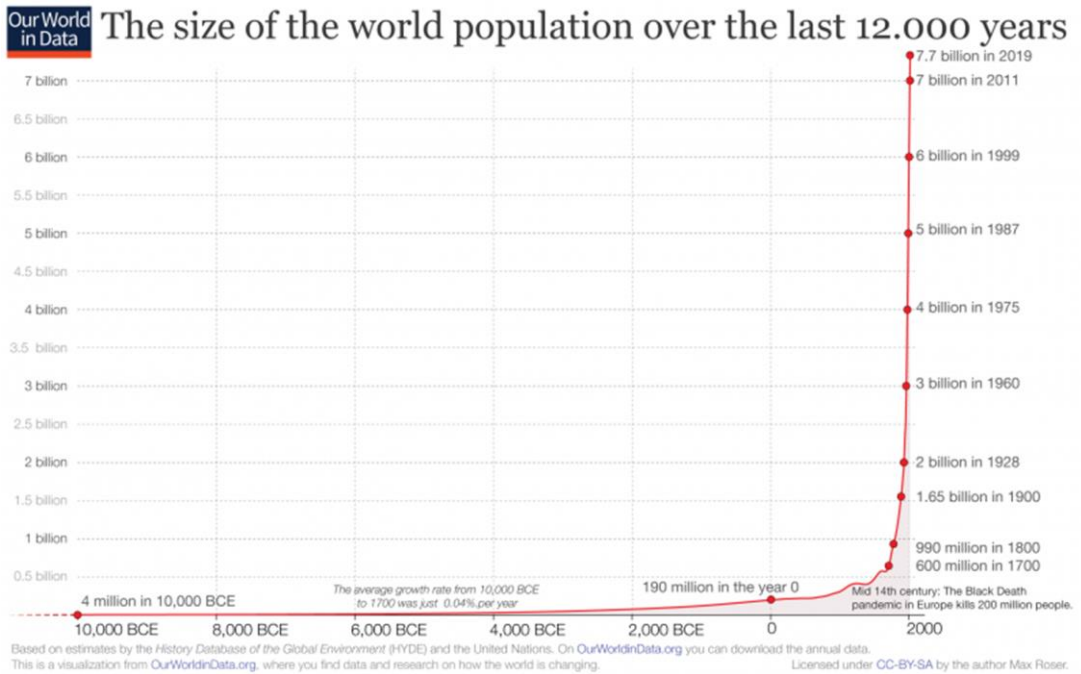
Ongoing discussions 1960-70s

- Demographic transition theory (Thompson 1929, Davis 1946, Notestein 1953)
  - Most high-income countries: demographic transition (nearly) completed
  - Middle and low-income countries: ongoing transitions,
- Problems of exponential population growth: The Limits to Growth (Club of Rome 1972)

Interventions

- Increasing number of birth control and vaccination programs supported by international organizations in developing countries. Vaccination much more successful
- African and Asian countries: 'Development is the best contraceptive' (World Population Conference Bucharest 1974)
  - DT successful in many countries in SE Asia (newly industrialized countries)
  - However, also eco. developing countries (e.g. Brazil 1980s) without a strong decline in birth rate (no secularization)
- Importance of cultural factors (religion, education/knowledge)

Discussions on pathways towards low mortality and low fertility



Omran's agenda (Weisz and Olszynko-Gryn, 2009)

- **Omran was not directly concerned with the rise of chronic disease**, but more about "the ways communities respond to overpopulation on the basis of cultural and social values and how they might be nudged into behaving differently through international interventions based in health services"
- ETT was "**part of a broader effort to reorient American and international health institutions towards the pervasive population control agenda of the 1960s and 1970s**. The theory was integral to the WHO's then controversial efforts to align family planning with health services".
- Stress the importance of motivation for decline, not economic development alone

Abdel Rahim Omran (1925-1999)

° Cairo; graduated as Doctor of Medicine from **Cairo University**

Married Khairia F. Omran (born Yousef Fawzy), also MD

1956: Master of Public Health; 1959: Doctor of Public Health at **Columbia University**

1959-63: started his career as a lecturer at Cairo University

1966: Associate Professor of Epidemiology at the **University of North Carolina** at Chapel Hill.

1969: Associate Director of the Carolina Population Center (CPC) and coordinator of the WHO Health and Fertility Studies at the Center

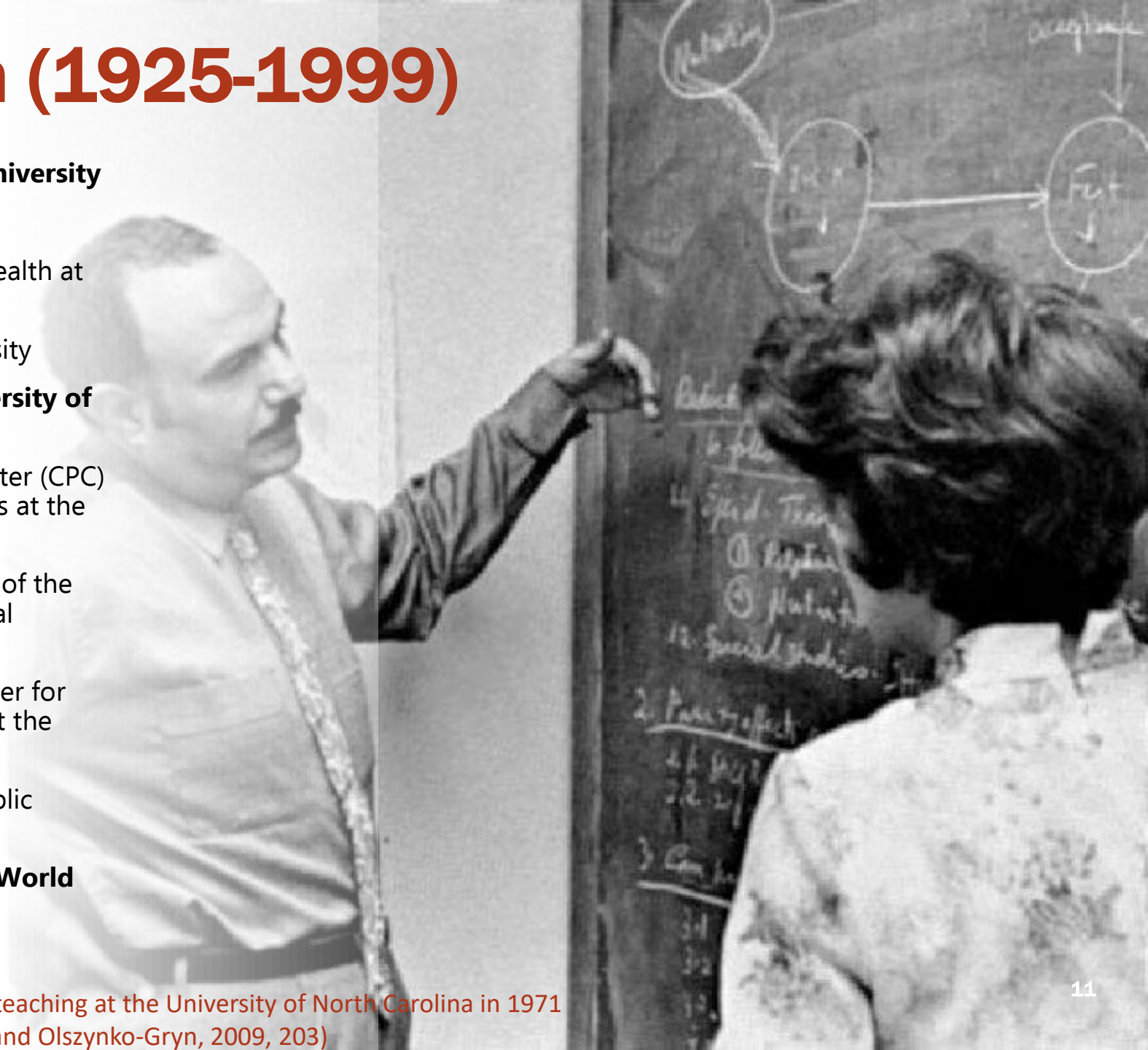
1971: Professor of Public Health at Chapel Hill, Director of the WHO International Reference Center for Epidemiological Studies in Human Reproduction

1984: Director of Population and Health Studies at Center for International Development and Conflict Management at the **University of Maryland**

Ended his career at the Department of International Public Health at **George Washington University.**

* Consultant for the **Ford Foundation, WHO, UNFPA, World Bank**, and various governments around the world

* Fieldwork



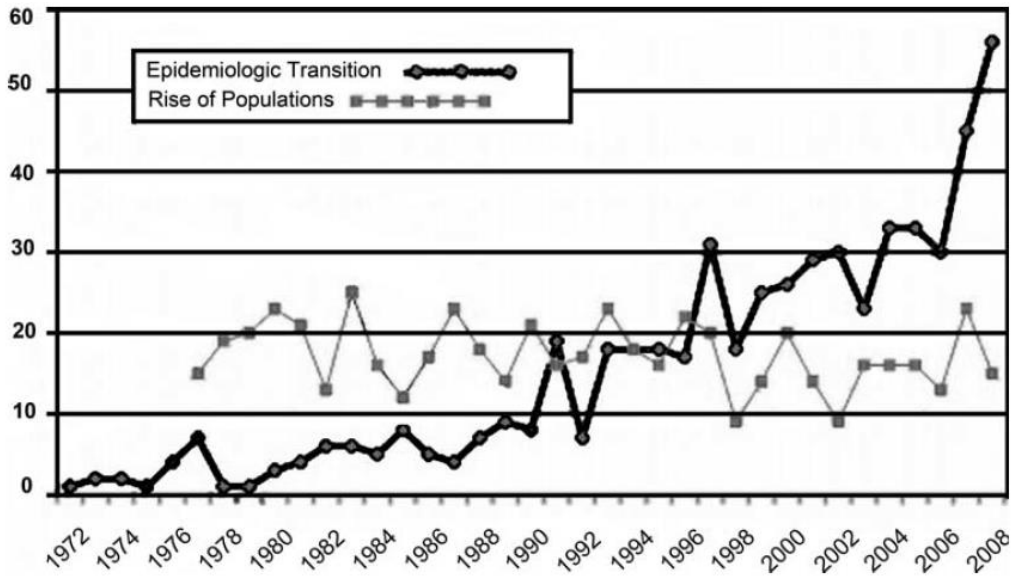
Omran teaching at the University of North Carolina in 1971
(Weisz and Olszynko-Gryn, 2009, 203)

Bibliography of Abdel Omran

- Most famous for his epidemiological transition theory (1971, update 1983, 1998). Also case studies for North Carolina, US and the Americas

- Substantial body of work (ca. 150 edited books, chapters, articles, reports and conference papers) on family planning, abortion, and reproduction. Impact of religion (Islam)

Reception of ETT



Number of citations of Omran and McKewon in WoS (Weisz and Gryn, 2009, 321)

- 1970-1990: Little interest, even in the field of epidemiology
- 1990s: increasing attention in (Historical) Demography (questions about the validity of DTT; **novelty causes of death**) and other disciplines such as PH (international health issues; resurgence of non-communicable diseases) **comprehensive theory**
- 2024: Google Scholar ca. 7400 citations. Very popular, but also severely criticised (but less controversial than Mc Keown's work)

3. CRITICISMS: WEAKNESSES, UPDATES, ADAPTATIONS

(1) Omran's agenda
(2) Labelling of phases
(3) Periodization
(4) Focus on mortality and not on other health outcomes
(5) Limited attention to social differences
(6) Oversimplification

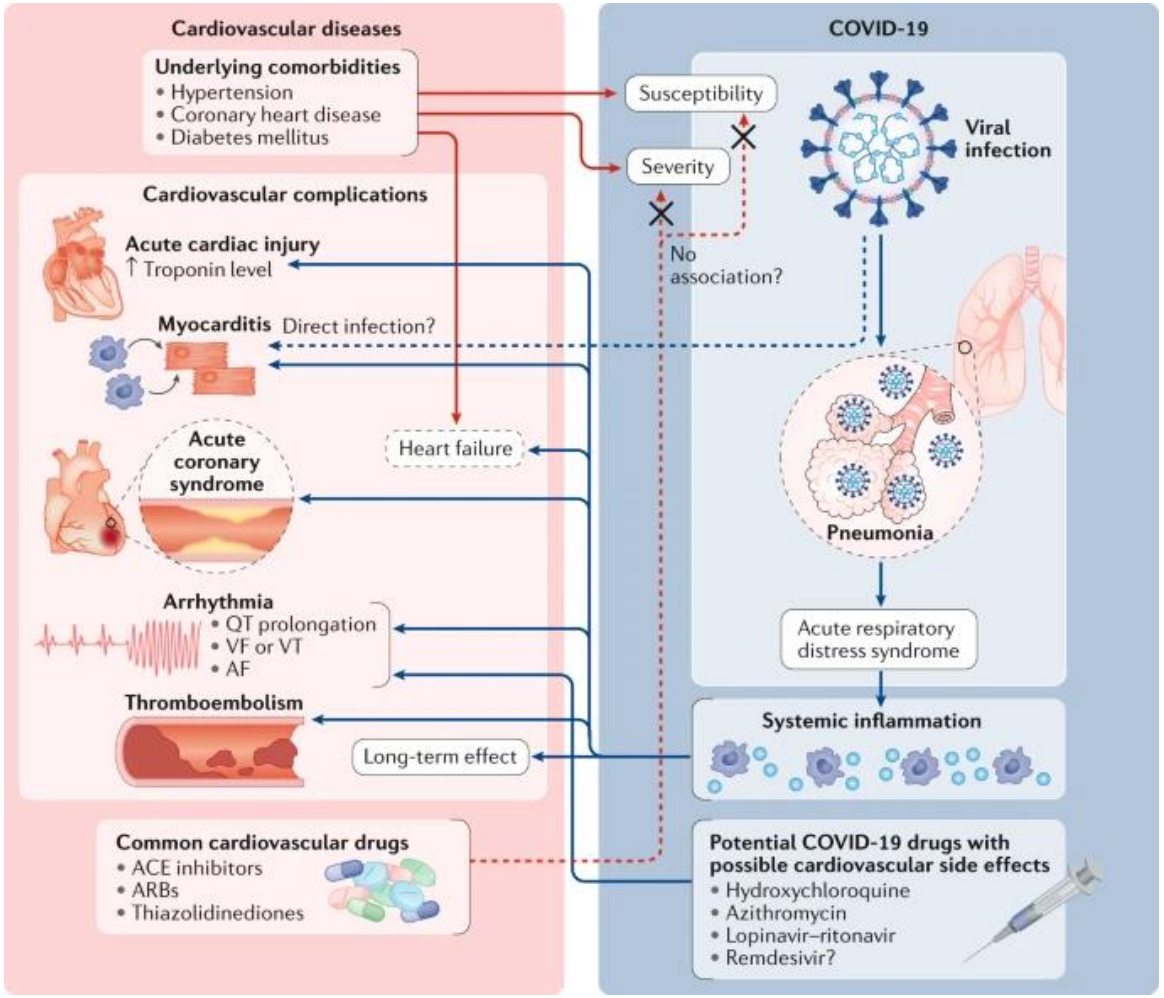
3.2. Labelling

Labelling of phases (causes of death, diseases) not adequate: shift from ‘pandemics’ of infectious diseases to ‘degenerative and man-made diseases’

- Phase of ‘receding pandemics’: cholera and influenza were pandemic diseases, but many infectious diseases responsible for declining mortality (TB, pneumonia, malaria) were **endemic**
- Phase of ‘degenerative and man-made diseases’. CVD and cancers are not only caused by ‘degeneration’ but also by exogenous factors (environmental, SE factors, lifestyle) like infectious diseases in the past. Many causes are ‘**man-made**’ (e.g. smoking), but that also applies to the living conditions and habits which promote the transmission of many **infectious diseases**

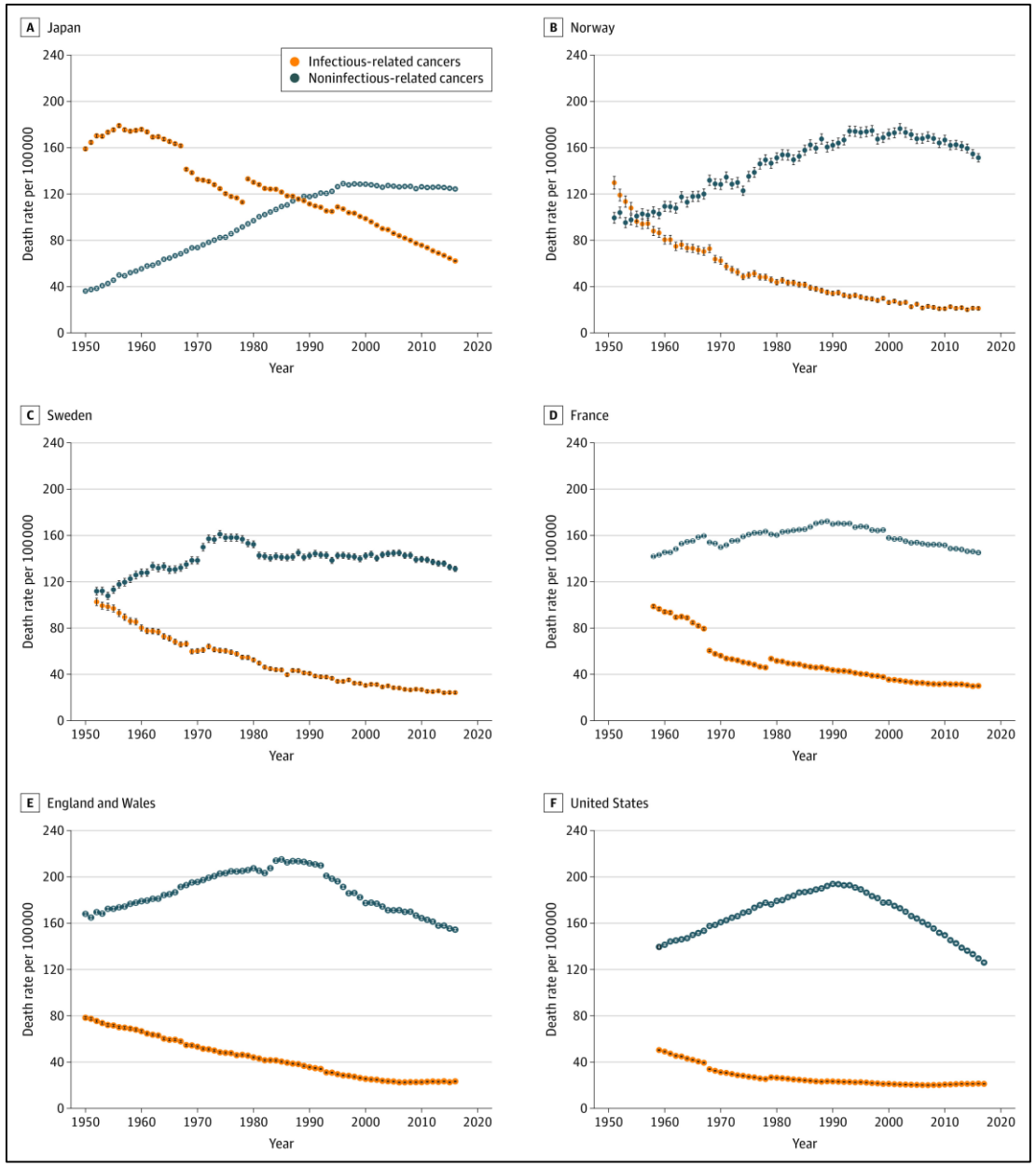
WHO – Global Burden of Disease Studies (1996-) use three other umbrella terms: ‘communicable, maternal, neonatal and nutritional diseases’, ‘non-communicable diseases’ and ‘injuries’

- **False dichotomy:** interactions between diseases (Mercer 2018). Many micro-organisms have now been confirmed as the underlying cause of ‘degenerative’ deaths, and vice versa: e.g. the relation between CVD and contagious diseases (COVID-19), infectious cancers (cancer transition),...



Cancer transition

- Coined by Gersten and Wilmoth (2002) in an article on Japan
- Omran's theory is overly simplified because it overlooks the fact that infection is often an important cause of cancer
- As nations develop, they move **from** a situation where **infectious-related cancers** are prominent **to** one where **non-infectious-related cancers** dominate (Knaul et al. 2012, Bray et al. 2012, Fidler et al. 2018)



Age-Standardized Death Rates for Infectious- vs Noninfectious-Related Cancers in Japan, Select European Nations, and the US (Gersten and Barbieri, 2021)

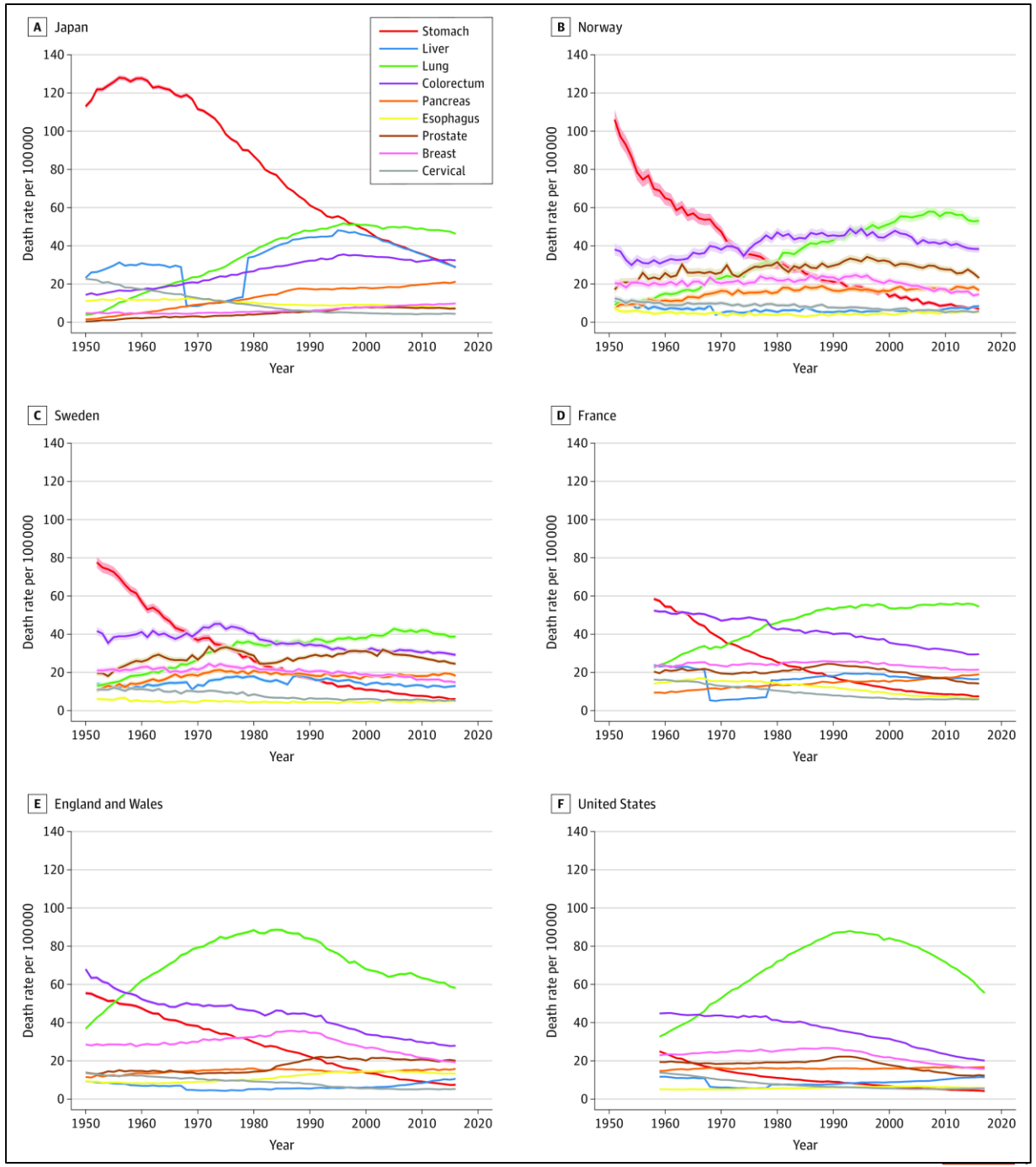
Cancer mortality patterns parallel the epidemiological transition

	Before: infectious disease	After: noninfectious disease
Epidemiological transition	Malaria	Cancer
	Tuberculosis	Heart disease
	Smallpox	Stroke
Cancer transition (and risk factor)	Stomach (*Helicobacter pylori*)	Lung, pancreas (smoking)
	Liver (hepatitis B and C viruses)	Breast (hormonal and physical activity)
	Cervical cancer (human papillomavirus)	Colorectum (Western lifestyle)

O. Gersten, M. Barbieri (2021). Evaluation of the Cancer Transition Theory in the US, Select European Nations, and Japan by Investigating Mortality of Infectious- and Noninfectious-Related Cancers,1950-2018, *JAMA Netw Open.* 4 (4): e215322.

But before 1950?

- Few data by cancer (type)
- Diagnostic methods?



Age-Standardized Death Rates for the Most Common Cancers in Japan, Select European Nations, and the US (Gersten and Barbieri, 2021)

3.3. Focus on mortality

Focus on mortality, largely ignoring **other health outcomes** (morbidity, anthropometrics,...)

- '**Health transition**' coined by Julio Frenk et al. (1991), 'Elements for a Theory of the Health Transition', *Health Transition Review* 1, 1.

Health transition includes changes in morbidity (disease) in addition to cause of death mortality, but also society's responses to health problems (e.g. expansion of health care services). For Omran a health transition was part of the epidemiological transition, not vice versa.

But (historical) data?

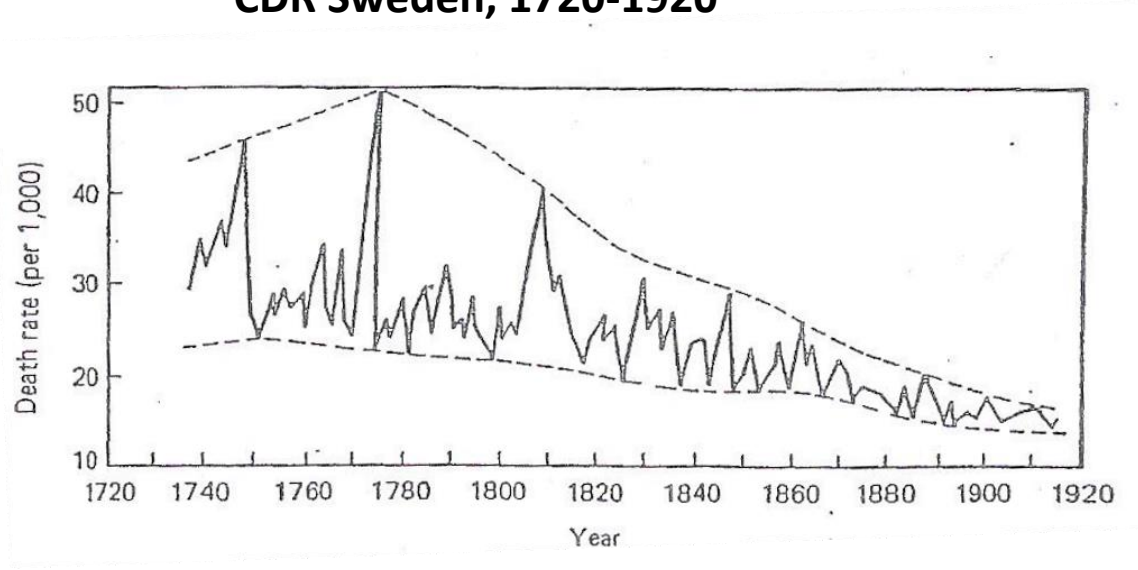
But mixing up the dependent variable (i.e. changes in population health) with the independent variable (i.e. what society does to improve population health)

3.4. Periodization

Start of the epidemiological transition

- Omran does not give a starting point for the first stage 'age of pestilence and famine' (= premodern times) (Wolleswinkel 1998)
- The second phase of 'receding pandemics' is not clearly defined (=19th century). In Western Europe the decline of infectious disease (e.g. plague) mortality started much earlier than in the 19th century (Mackenbach 2020)

CDR Sweden, 1720-1920



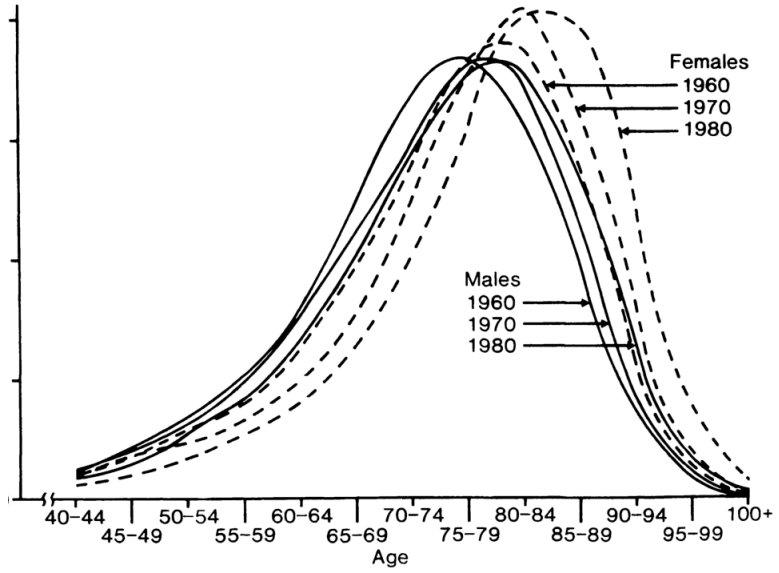
End of the epidemiological transition

Omran assumed a stable state of mortality and fertility by 1971

Fourth stage of the epidemiological transition identified afterwards

- '**Age of delayed degenerative diseases**' (Olshansky and Ault 1986): *But* really a new stage in the same transition? Strong decline in mortality of ischaemic heart disease in many high-income countries in 1970s.
- '**Hybristic phase**' (Rogers and Hackenberg 1987): mortality dominated by destructive life-styles among younger people; (external) causes missing in ETT: accidents, alcoholism, suicide, homicide, Aids...

Percentage of distribution of deaths from cerebrovascular disease for the U .S . population at ages 40 and over, by sex (I9 6 0 , 1970, 1980).



S. Olshansky, A. Ault (1986). The fourth stage of the epidemiologic transition: the age of delayed degenerative diseases. *Milbank Memorial Fund Quarterly*, 64(3):355-391.

Fifth stage of the epidemiological transition

- '**Emergence of new infectious diseases**' such as AIDS, legionnaire's diseases, old diseases (TB) increased strongly (TB) (globalization, antibiotic resistance) (Olshansky, Carnes, Rogers and Smith L. 1998)
- '**The age of aspired quality of life with paradoxical longevity'** (Omran 1998)

For some scholars, this is more than a new stage, but an entirely new ('third') epidemiological transition

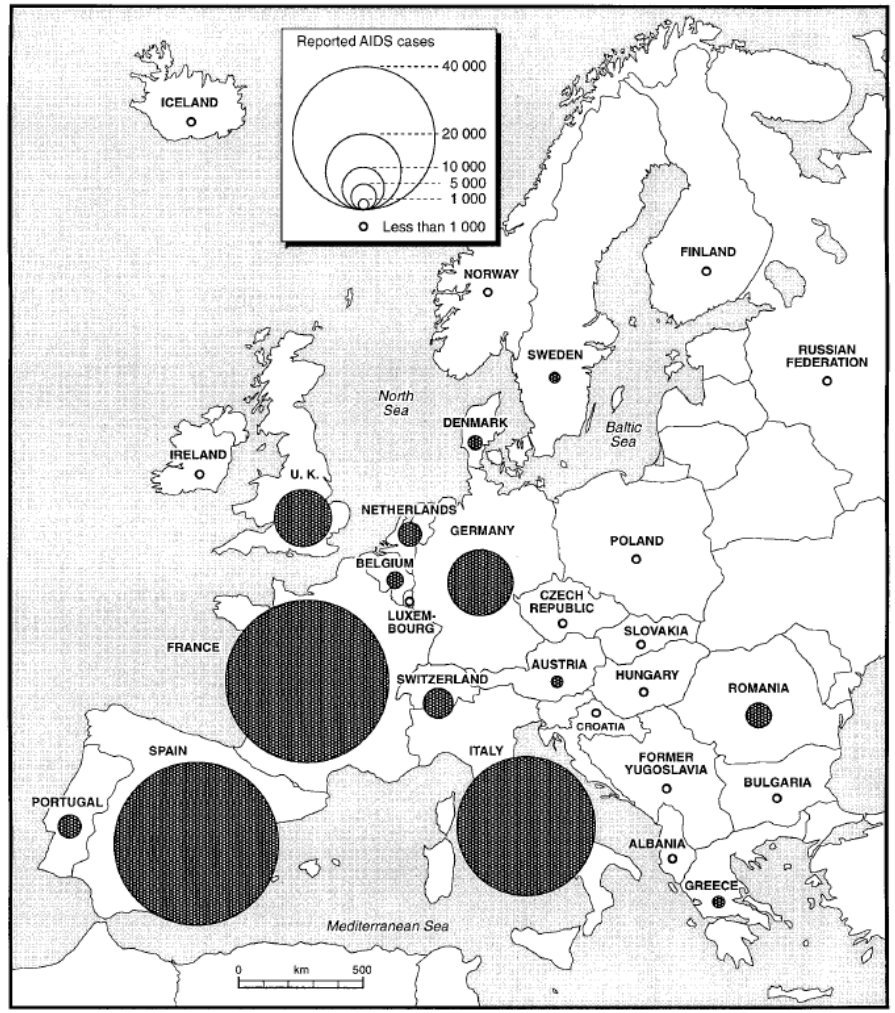


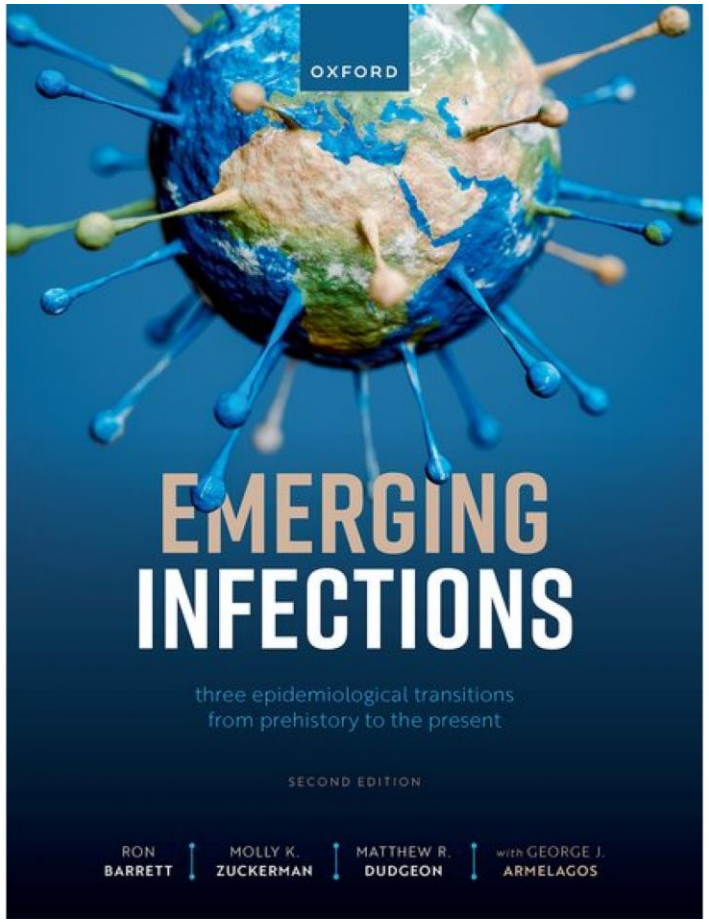
Fig. 4. Cumulative AIDS cases recorded in sample European countries to 31st December 1996. Source: data from European Centre for the Epidemiological Monitoring of AIDS, 1997a.

(Very) long term anthropological perspective

Three epidemiological transitions since prehistory

- **1st ET Neolithicum** (ca. 10,000 years ago): shift from hunter-gathers (foraging) to an agricultural economy (farming) was marked by the emergence of infectious diseases (instead of physical injuries)
- **2nd ET**: Omran's transition
- **3nd ET since late 20th century**: new, emerging infectious diseases (eg HIV, ebola, corona) and a reemergence of infectious diseases (e.g. TB)

  But are these really 'new'?

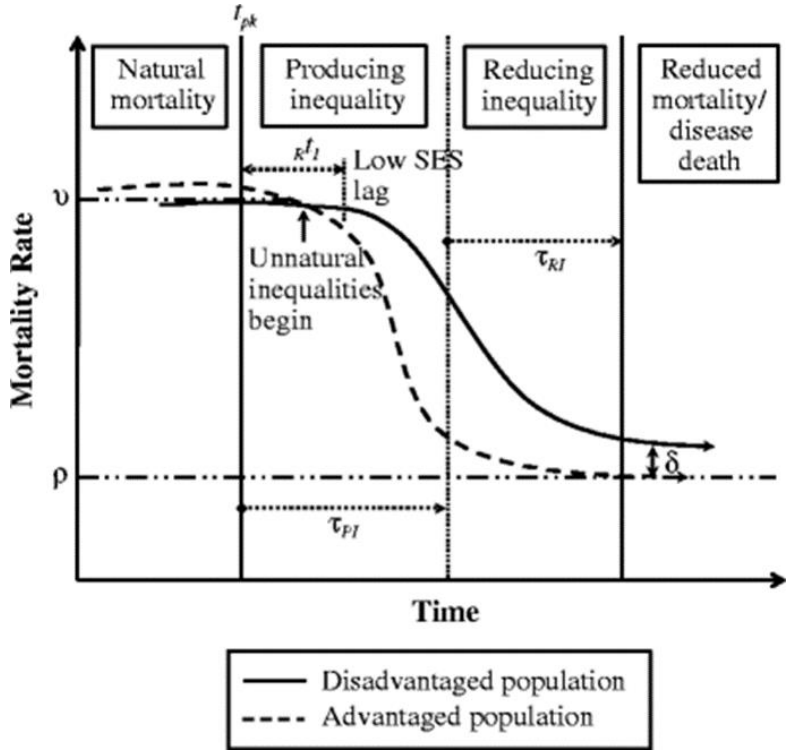


R. Barrett, M. Zuckerman, M. R. Dudgeon, G. J. **Armelagos (2024)**

3.5. Limited attention to social differences

ETT assumes populations to be homogeneous whereas they are heterogeneous

- **Omran 1998**: attention to ethnic differences (Afro-American, indigenous), social differences (e.g. infectious diseases are highly prevalent among the poor whereas non-communicable diseases are prevalent among the rich).
- **Clouston, Link et al. 2016**: **Extended Fundamental Cause Theory** (combination of ETT and FCT; SES is a fundamental cause of mortality inequalities)
    - Phase 1: no knowledge about the disease, mortality inequalities minimal
    - Phase 2: unequal diffusion of knowledge, increasing mortality inequalities
    - Phase 3: inequalities decline, as access to knowledge increases across pop.
    - Phase 4: disease is eliminated due to effective prevention and treatment



3.6 Over-schematization

- Omran assumed a linear progression of ET for all countries: similar continuous progressions (onset, speed)

- **Many exceptions to the expected pattern** (Caselli et al. 2002): temporary reversals of mortality decline, absence of a rise of non-communicable disease mortality
  e.g. Eastern Europe 1990s

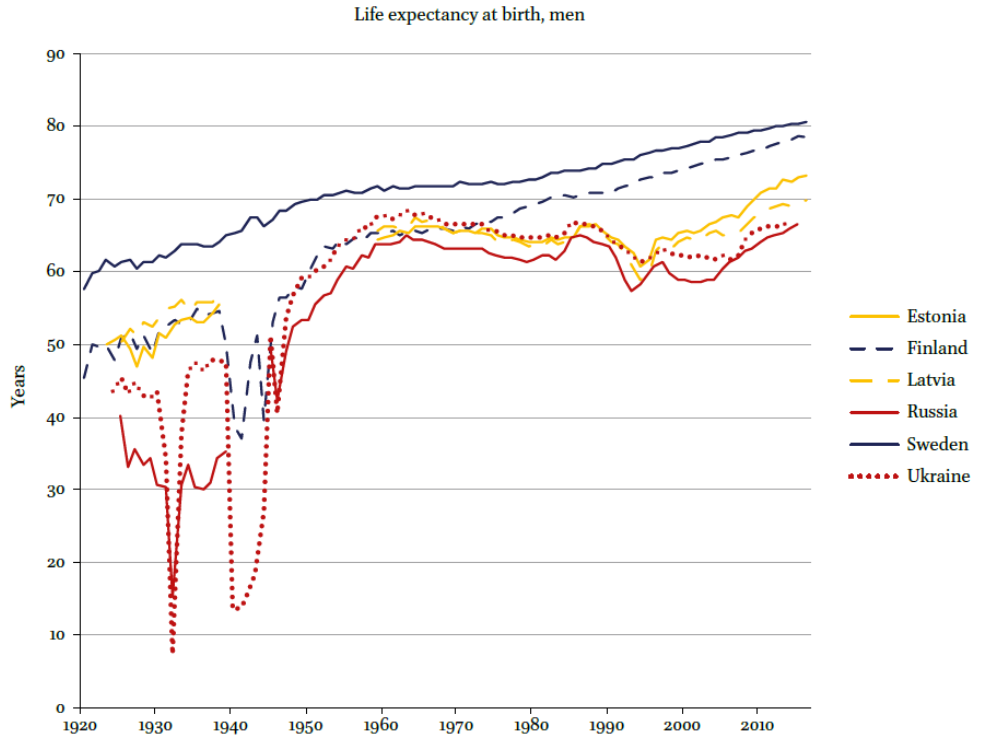


FIGURE 7 Trends in life expectancy in Northern and Eastern Europe, 1920–2015

J.P.Mackenbach (2020). *A History of Population Health. Rise and Fall of Disease in Europe*, 79.

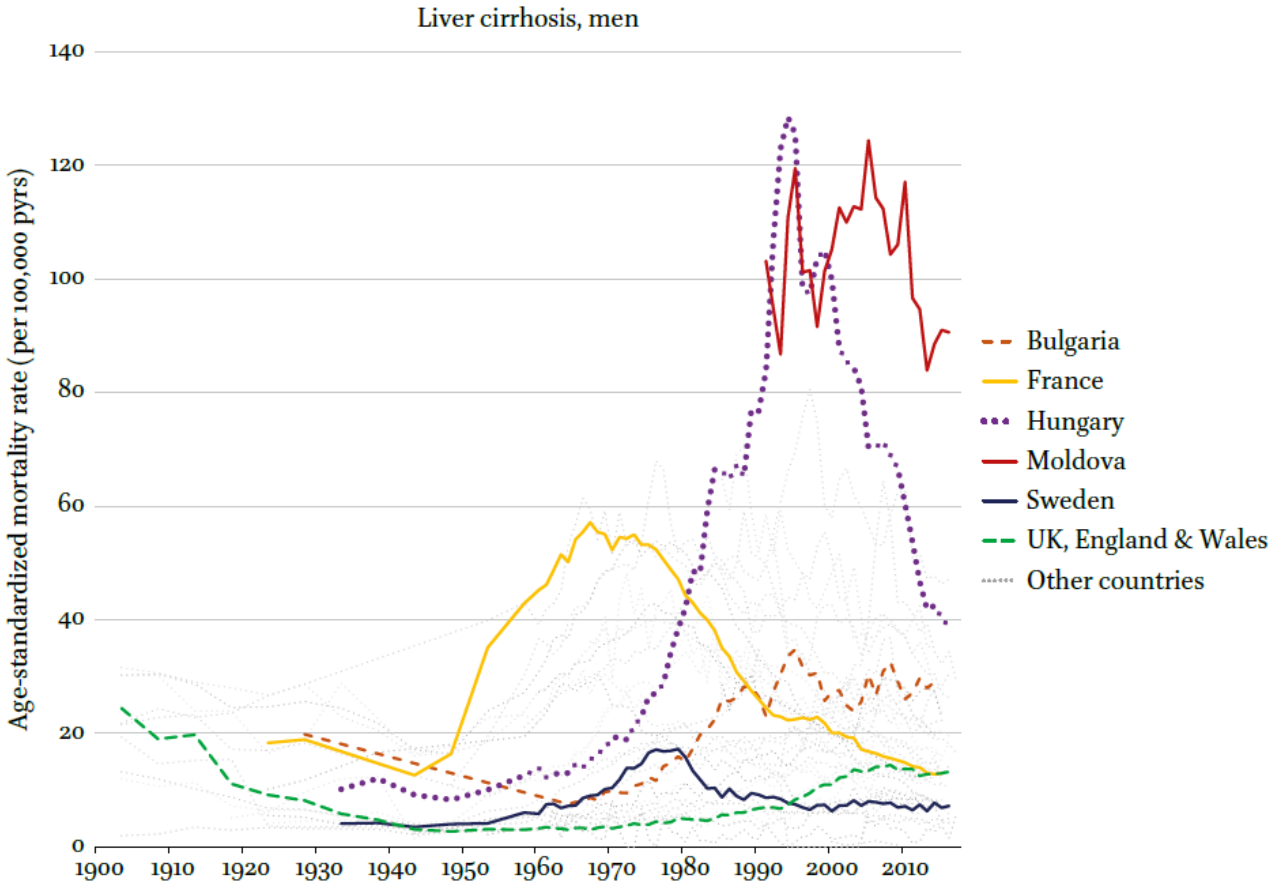


FIGURE 28 Trends in liver cirrhosis mortality in Europe, 1900–2015

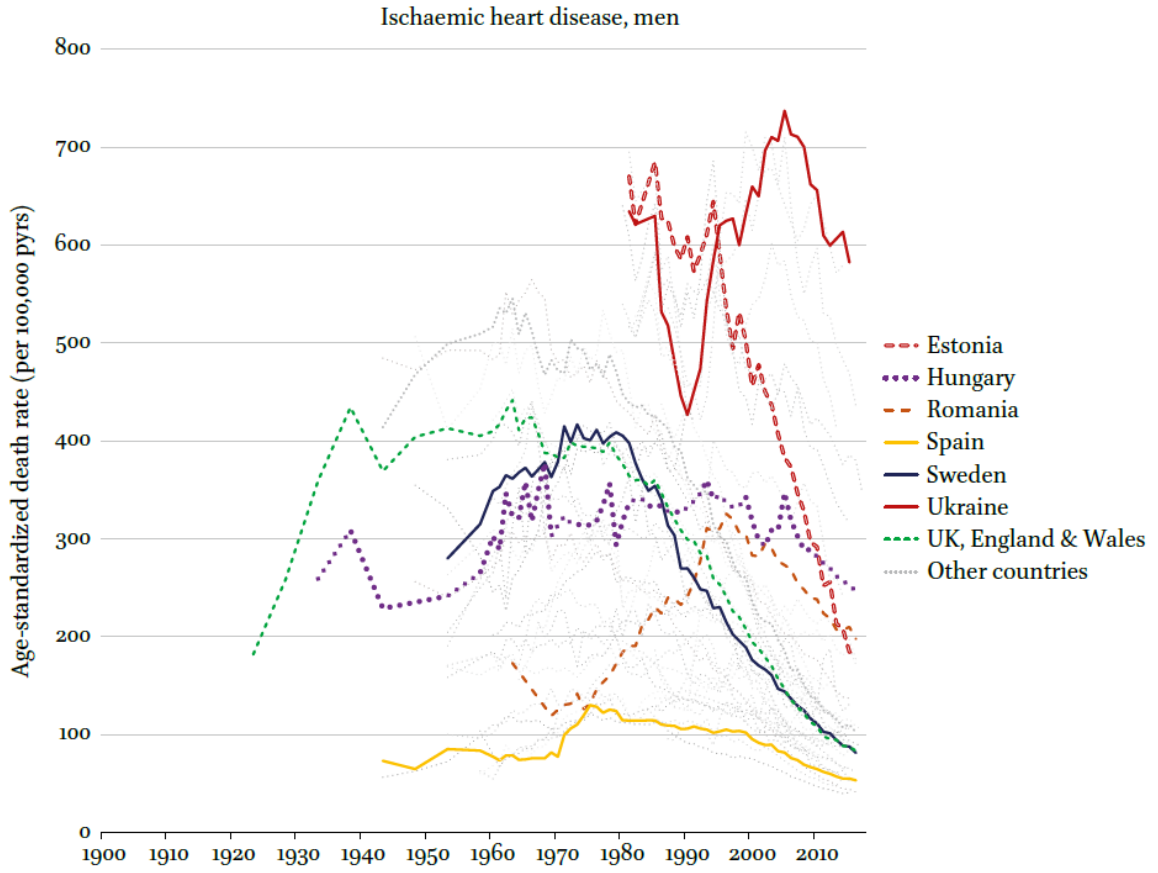


FIGURE 22 Trends in ischaemic heart disease mortality in Europe, 1900–2015

J.P.Mackenbach (2020). *A History of Population Health. Rise and Fall of Disease in Europe*, 221, 254.

Epidemiological transition 2.0 (J.P. Mackenbach, 2020)

- Most diseases follow a pattern of ‘rise-and-fall’. Trends in population health are the result of many superimposed disease-specific trends.

- Three large trends (mainly NW Europe):
    1. Health problems of pre-industrial societies (before 1800)
    2. Health problems of industrializing societies (1800-1950)
    3. Health problems of affluent societies (after 1950)

Group	Health problem	Rise and fall?	Start of rise[a]	Start of fall[b]
Health problems of pre-industrial societies	War	Rise and fall	(before 4300 BCE)	16th century[c]
	Homicide	Fall only	N/A	16th-17th century
	Famine	Rise and fall	(6500 BCE[d])	18th century
	Plague[e]	Rise and fall	1347	17th century
	Smallpox	Rise and fall	6th century	18th century
	Typhus	Rise and fall	Late 15th century	17th century?
	Malaria	Rise and fall	16th century	18th century
Health problems of industrializing societies	Cholera	Rise and fall	1829-1837	1846-1860
	Intestinal infections[f]	Rise and fall	(6500 BCE[d])	Mid-19th century
	Tuberculosis	Rise and fall	18th century	Mid-19th century
	Syphilis	Rise and fall	Late 15th century	Early 20th century
	Childhood infections[g]	Rise and fall	18th century	Late 19th century
	Pneumonia	Fall only	N/A	Early 20th century
	Influenza	Rise and fall	16th century	1918-1919
	Puerperal fever	Rise and fall	18th century	Mid-19th century
	Infant mortality	Fall only	N/A	Late 18th – late 19th century
	Still-births	Fall only	N/A	1940s
	Pellagra[h]	Rise and fall	18th century	Late 19th century
	Rickets	Rise and fall	17th century	Late 19th century
	Goitre	Fall only	N/A	1920s
	Peptic ulcer	Rise and fall	Late 19th century	1930s-1940s
	Appendicitis	Rise and fall	Late 19th century	1930s-1940s
	Pneumoconiosis	Rise and fall	19th century	Early 20th century
	Mesothelioma	Rise only	1970s	N/A
	Stomach cancer	Rise and fall	19th century?	Early 20th century

Group	Health problem	Rise and fall?	Start of rise[a]	Start of fall[b]
Health problems of affluent societies	Ischaemic heart disease	Rise and fall	Early 20th century	1970s
	Cerebrovascular disease[i]	Rise and fall	Early 20th century	1970s
	Diabetes mellitus type II	Rise only	Mid-20th century	N/A
	Colorectal cancer	Rise and fall	Early 20th century?	1970s
	Breast cancer	Rise and fall	Late 19th century?	1980s
	Prostate cancer	Rise and fall	First half 20th century?	1980s-1990s
	Lung cancer	Rise and fall	1930s	1970s-1980s[j]
	Liver cirrhosis[k]	Rise and fall	1950s	1970s-2000s
	Dementia[l]	Rise only	1970s	N/A
	Depression	Unknown	N/A	N/A
	Road traffic injuries	Rise and fall	Early 20th century	1970s
	Suicide	Rise and fall	18th century	1920s-1980s
	AIDS	Rise and fall	Early 1980s	Mid-1990s

4. DATA & INDICATORS

Aggregate country-level datasets

- WHO Mortality Database (COD 1945 onwards, multiple indicators) https://platform.who.int/mortality/themes/theme-details/MDB
- Human cause-of-death data series (recent period) https://www.mortality.org/Data/HCD
- Book by Michael Alderson, International Mortality Statistics, 1981 (back matter, COD 1901-1975, W countries) https://link.springer.com/book/10.1007/978-1-349-03855-8

Comparisons across time and space

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Comparisons across time and space

- https://ourworldindata.org (interactive tables, maps and graphs (log scale!), ; mainly WHO data; limited number of indicators)
- Book by J.P. Mackenbach, A History of Population Health. The Rise and Fall of Disease in Europe, 2020 (graphs in book and appendix) https://brill.com/display/title/57111

Challenges of comparative approach

- Completeness of (cause-of-death) data

Countries are only included in the WHO Mortality Database if over 65% of deaths have a registered cause

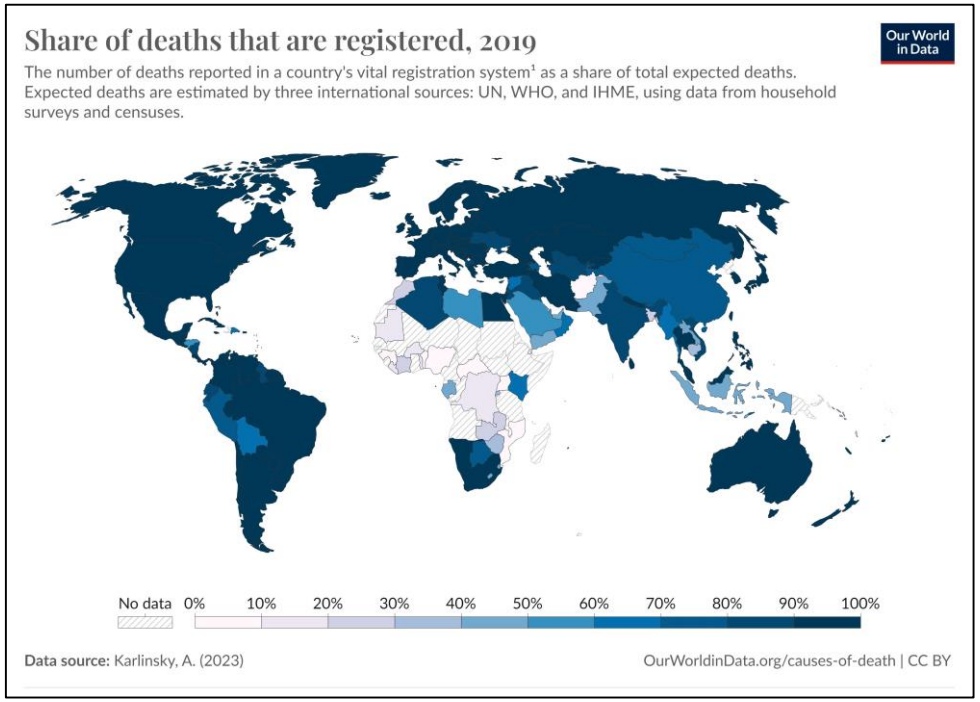
- Confidentiality of registration of causes
- Changes in codification and categorization (ICD changes)

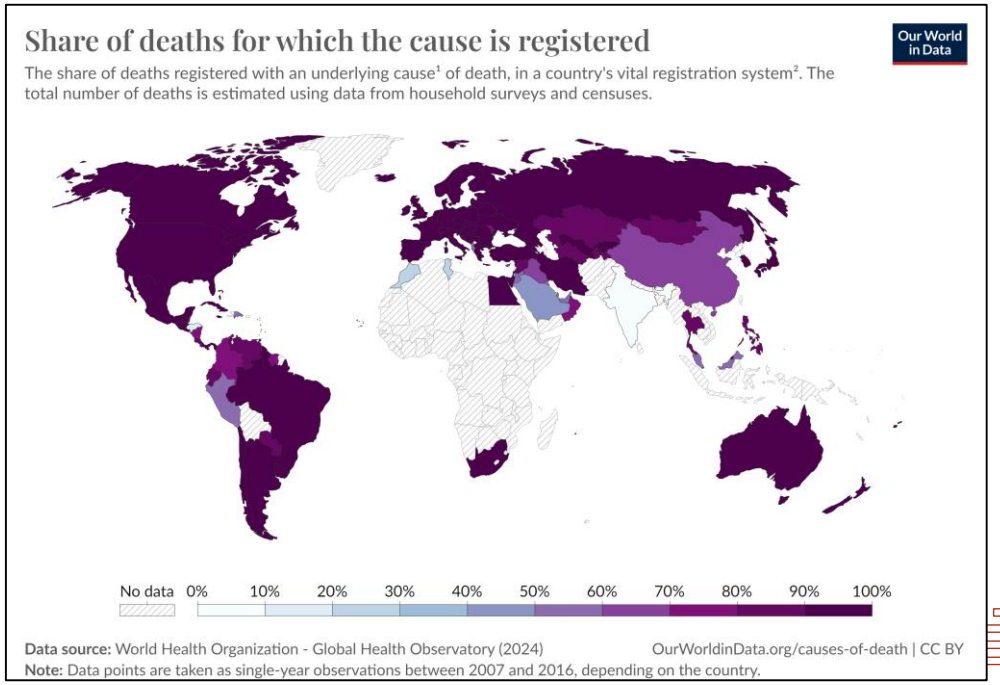
WHO https://www.who.int/data/data-collection-tools/who-mortality-database (ICD 7-10)

I.M. Moriyama, R.M. Loy, A. Robb-Smith. History of the Statistical Classification of Diseases and Causes of Death, 2011.

Alderson, International Mortality Statistics 1981 (chapter: alignment of revisions of ICD)

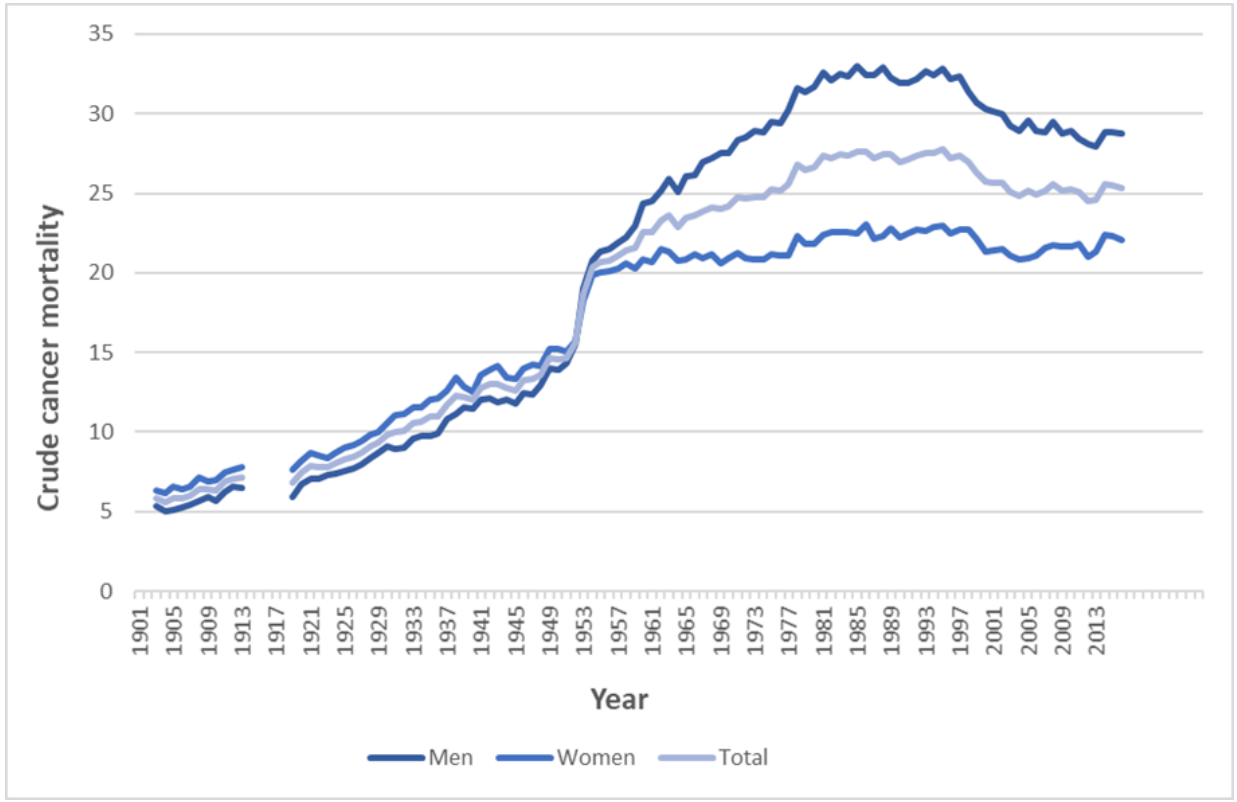
- Differences in medical knowledge (diagnostics)



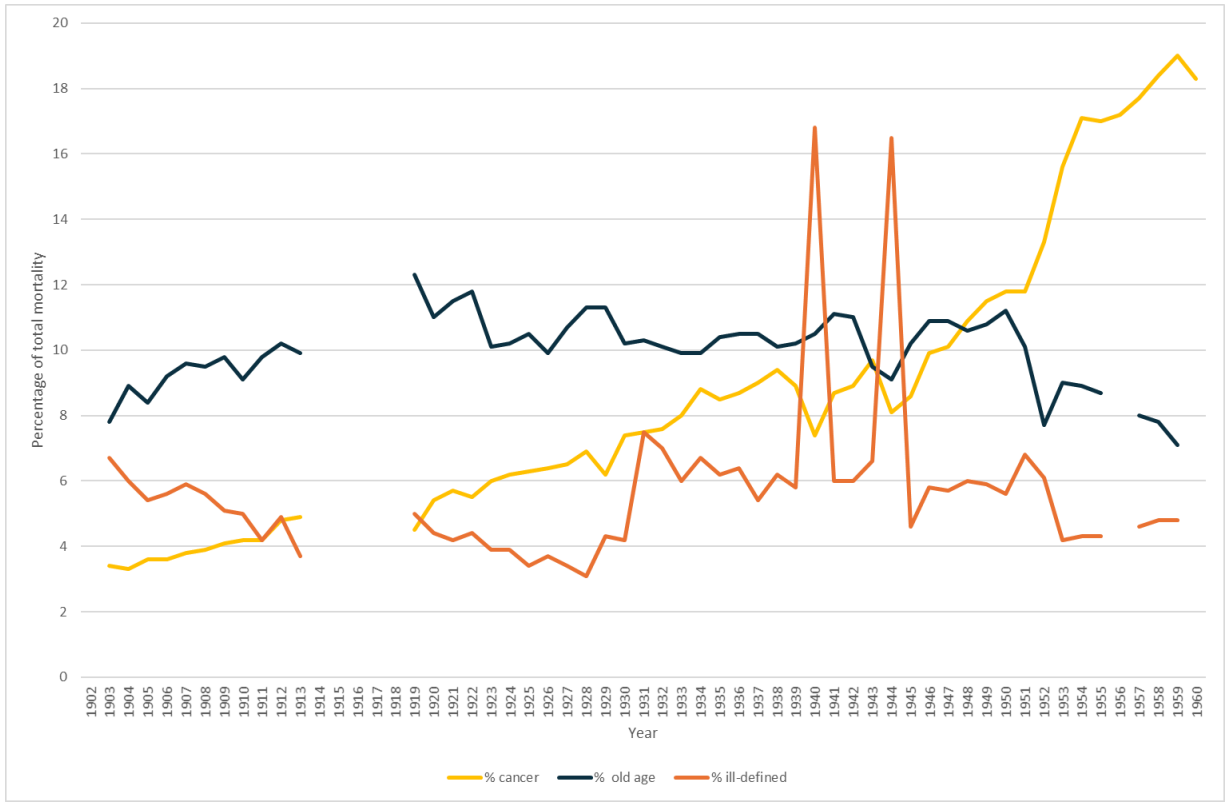


GREATLEAP

Crude cancer mortality by sex (per 10.000 persons), Belgium, 1903-2016



Percentage of COD-categories cancer, old age and ill-defined diseases in total mortality, Belgium, 1903-1960



Sources: Mouvement de la Population (1903-1953), WHO (1954-2015)

Cause-of-death indicators

- Absolute number of deaths by cause (ICD)
- Percentage of deaths by cause in total deaths (influenced by (ICD) changes in other causes!)
- Crude death rates (age structure!)
- Age-standardized mortality ratios (SMR)
- Age-specific mortality rates

!

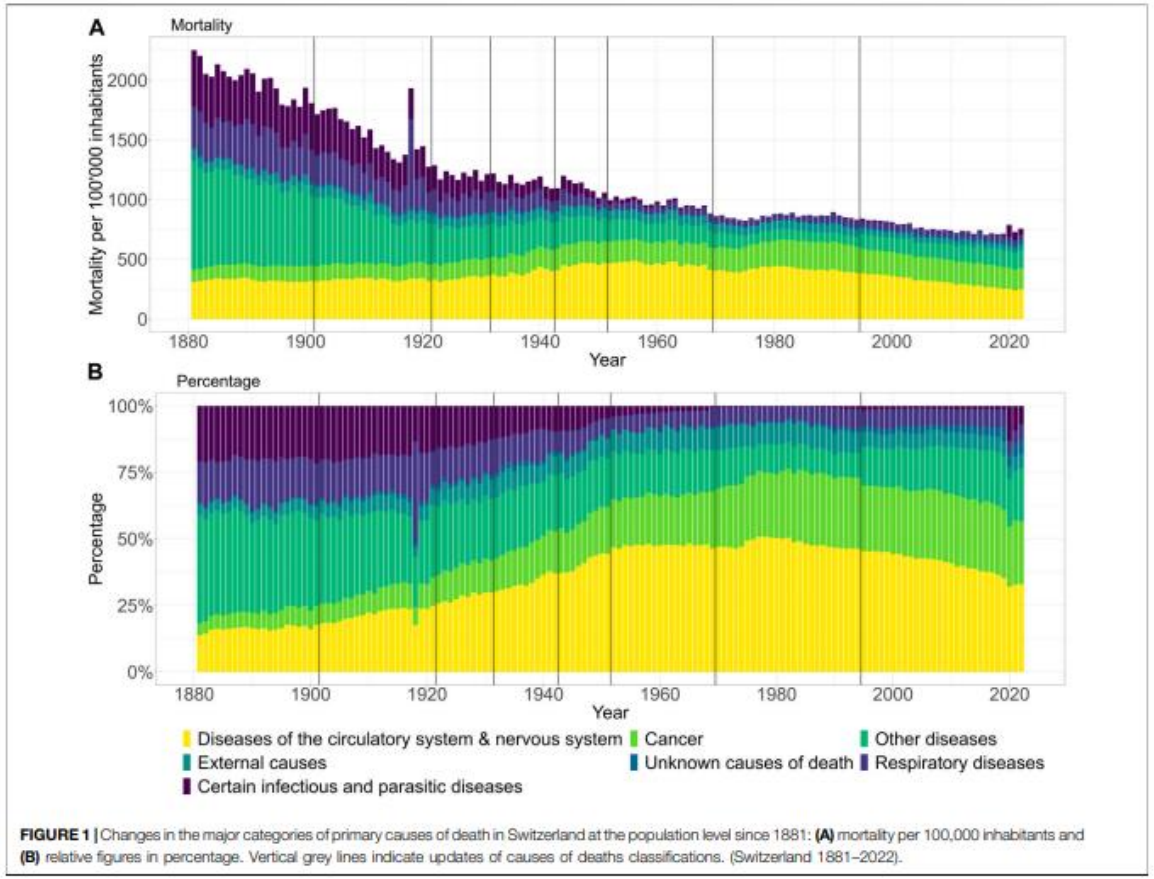
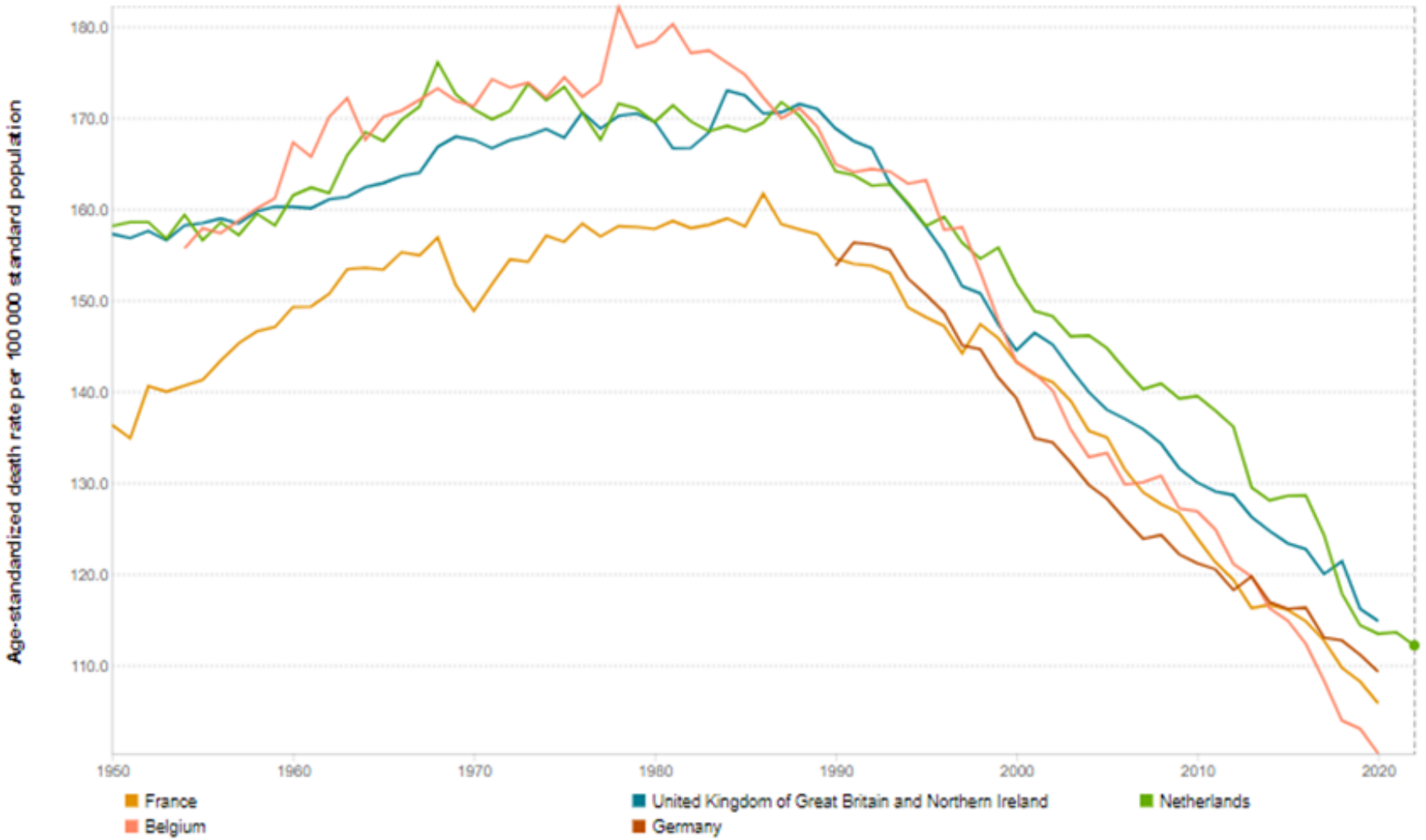


FIGURE 1 | Changes in the major categories of primary causes of death in Switzerland at the population level since 1881: **(A)** mortality per 100,000 inhabitants and **(B)** relative figures in percentage. Vertical grey lines indicate updates of causes of deaths classifications. (Switzerland 1881–2022).

K. Matthes, K. Staub (2024). The Need to Analyse Historical Mortality Data to Understand the Causes of Today's Health Inequalities International Journal Public Health, 69

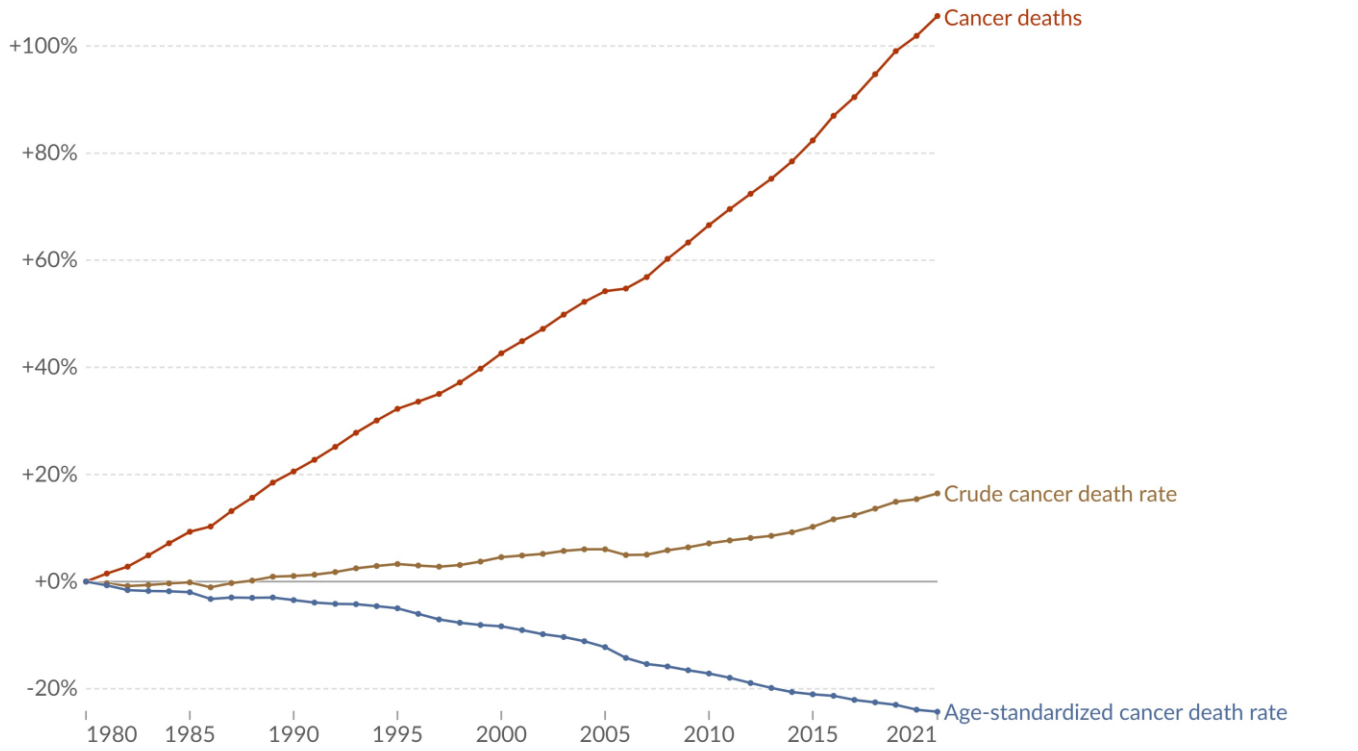
Age-standardized cancer mortality (per 10.000 persons), 1950-2022



Source: WHO dataset

Change in three measures of cancer mortality, World

The change in the estimated number of deaths, crude death rate[1], and age-standardized[2] death rate from all cancers[3] over time.



Data source: IHME, Global Burden of Disease (2024)

OurWorldinData.org/cancer | CC BY

1. Crude death rate: The crude death rate is the total number of deaths in a population per year, without taking into account the age structure of the population or other factors. This means it can be affected by changes in the age of the population. For example, the crude death rate tends to increase as the population gets older, without other changes. The crude death rate differs from the age-standardized death rate, which adjusts for age differences. Read more: How does age standardization make health metrics comparable?

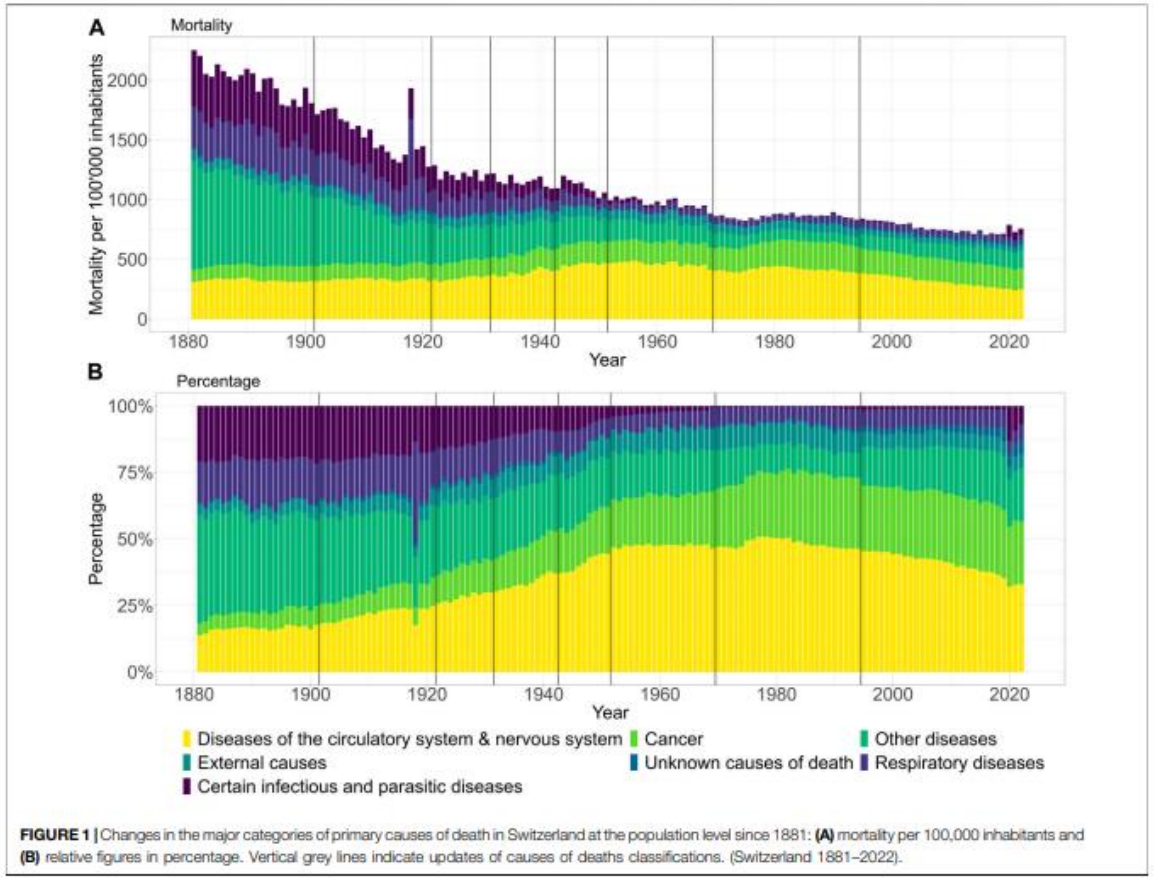
2. Age standardization: Age standardization is an adjustment that makes it possible to compare populations with different age structures, by standardizing them to a common reference population. Read more: How does age standardization make health metrics comparable?

Cause-of-death indicators

- Absolute number of deaths by cause (ICD)
- Percentage of deaths by cause in total deaths (influenced by (ICD) changes in other causes!)
- Crude death rates (age structure!)
- Age-standardized mortality ratios (SMR)
- Age-specific mortality rates

Recent periods:

- Health-adjusted life years indicators (DALY), YPLL,...
- Morbidity indicators (prevalence and Incidence of disease)
- Etc.



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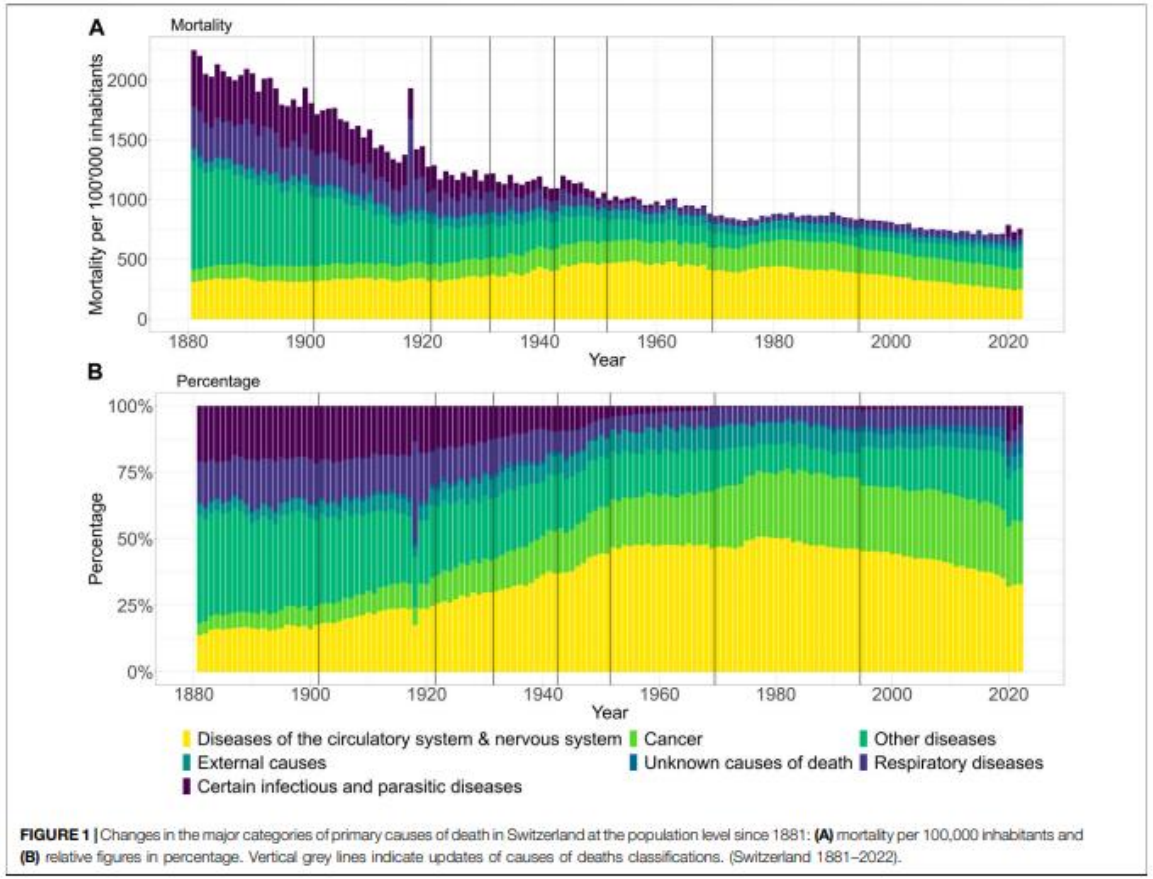
Cause-of-death indicators

When comparing, watch out for

! ICD changes

! 'Garbage categories' Ill-defined, AND other (unknown) causes (symptoms) e.g. old age/cancer

! Co-morbidities and related causes (limited medical knowledge). Check contemporary knowledge (medical journals, dictionaries etc.) e.g. flu-related deaths: broader grouping (flu, but also other respiratory diseases such as bronchitis, pneumonia, etc.)



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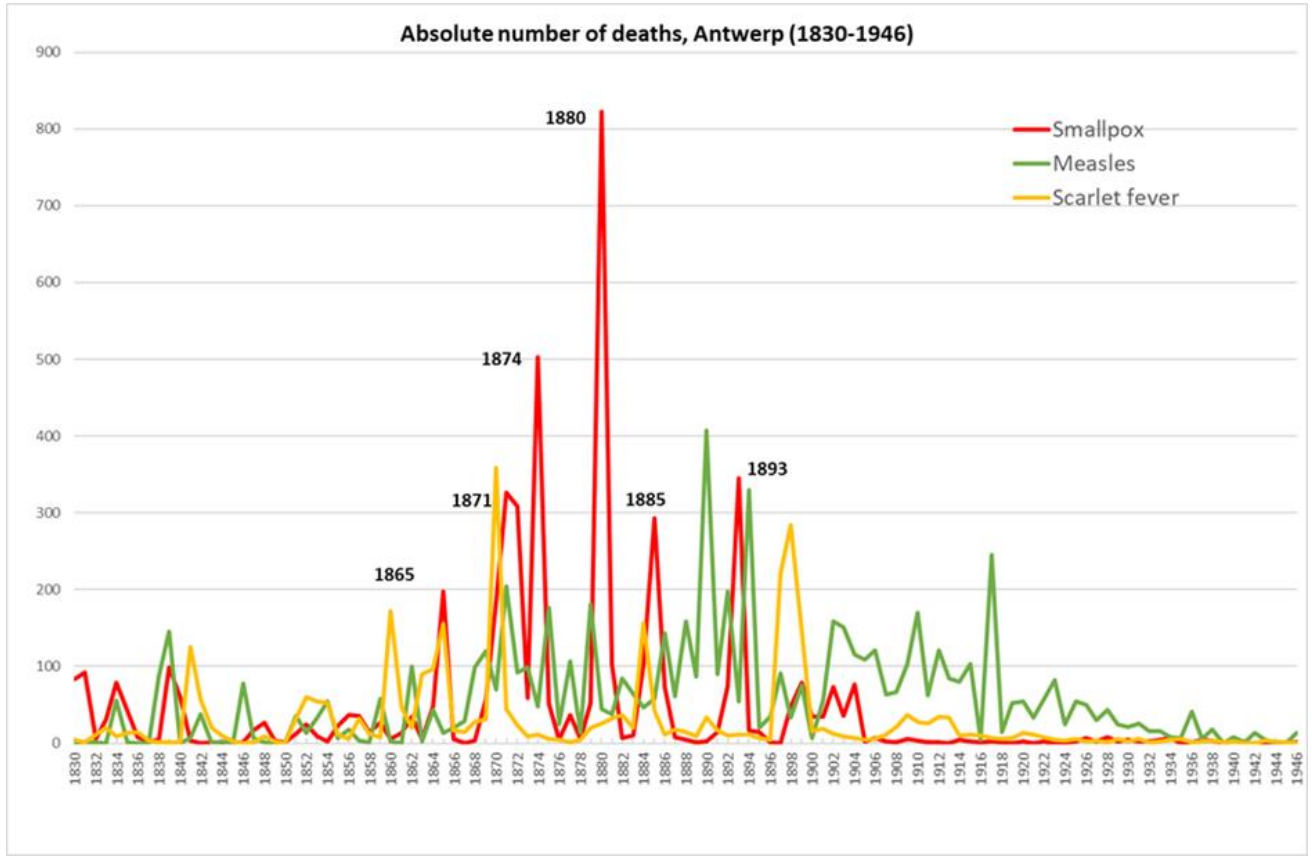
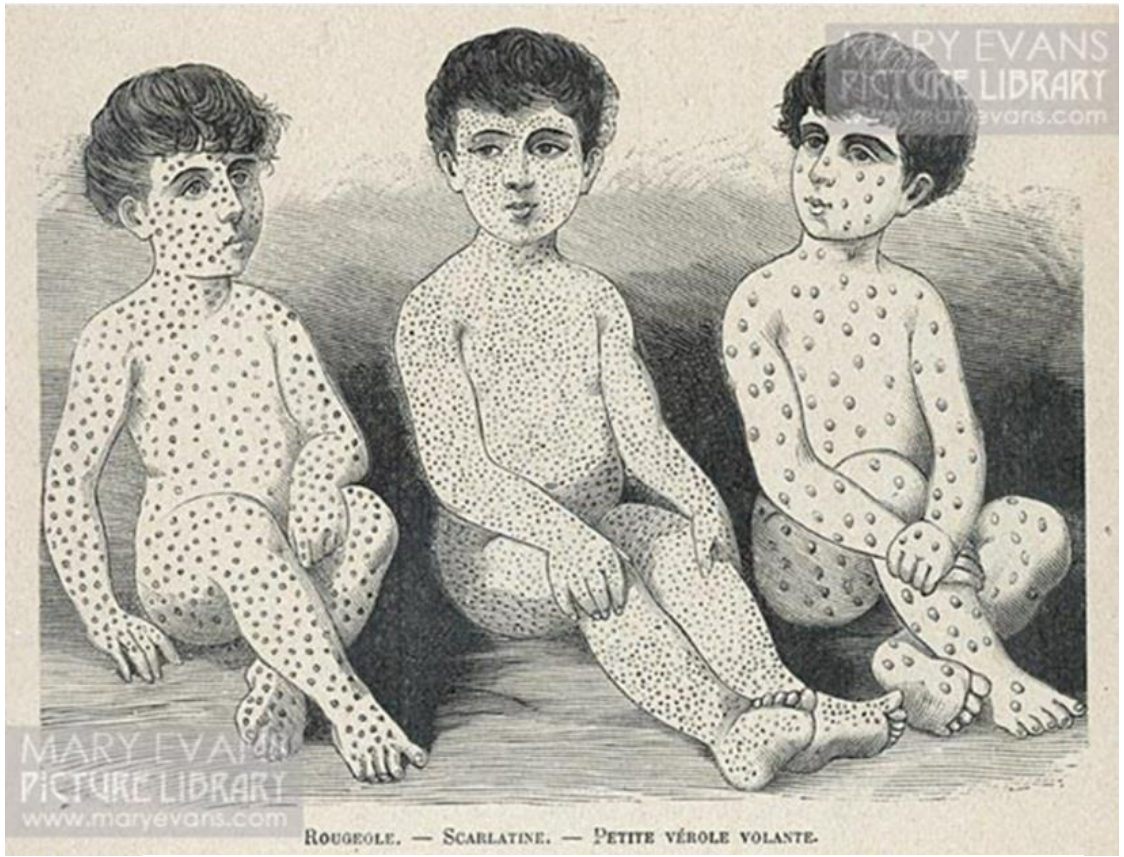
K. Matthes, K. Staub (2024). Int J Public Health.



UGent Queteletcenter, SOS Antwerp dataset



Symptoms of measles, scarlet fever and smallpox (1880)

Mary Evans Picture Library

5. EPIDEMIOLOGICAL TRANSITION IN GLOBAL HISTORICAL PERSPECTIVE

- Countries in Europe began the earliest mortality transitions and started from higher levels of life expectancy at birth
- Countries in Africa and Asia generally began transitions later from lower levels

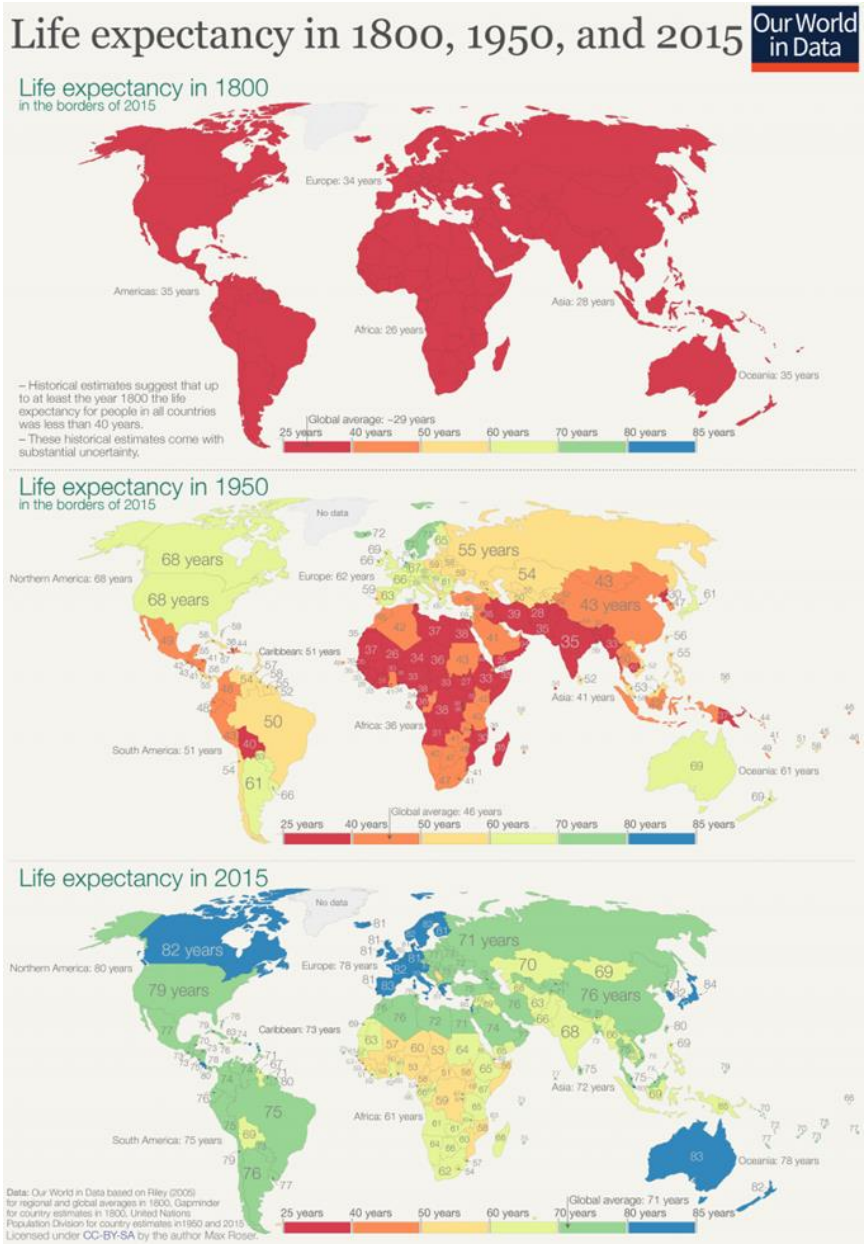
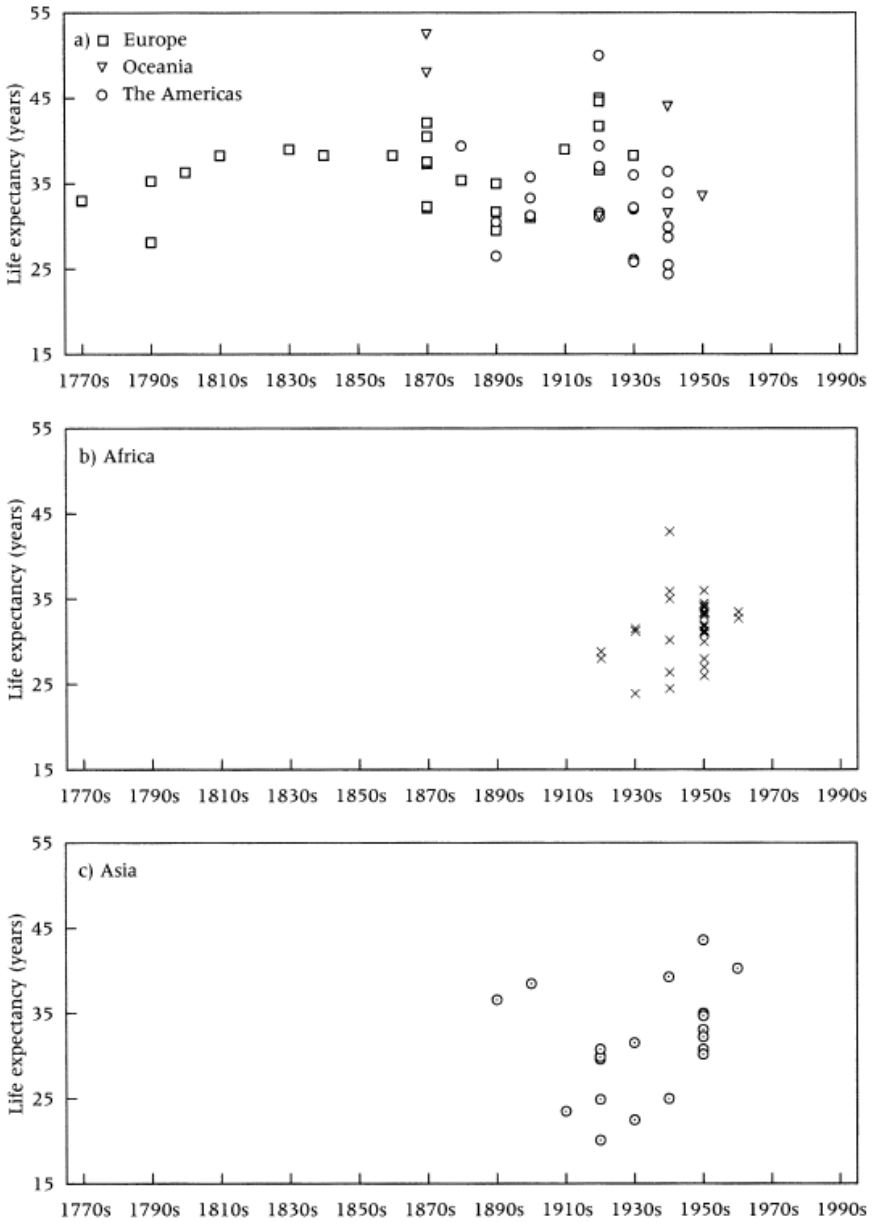


FIGURE 2 Timing and level of life expectancy at the initiation of health transitions (plotted by period of initiation)



NOTES: In 2a there are two data points for Europe in the 1920s at 41.7. In 2b there are two data points in the 1930s at 23.9. In 2c there are two data points in the 1920s at 24.9.
SOURCES: See the bibliography at «www.lifetable.de/RileyBib.htm».

TABLE 1 Health transition beginning periods and life expectancy levels by region, 119 countries

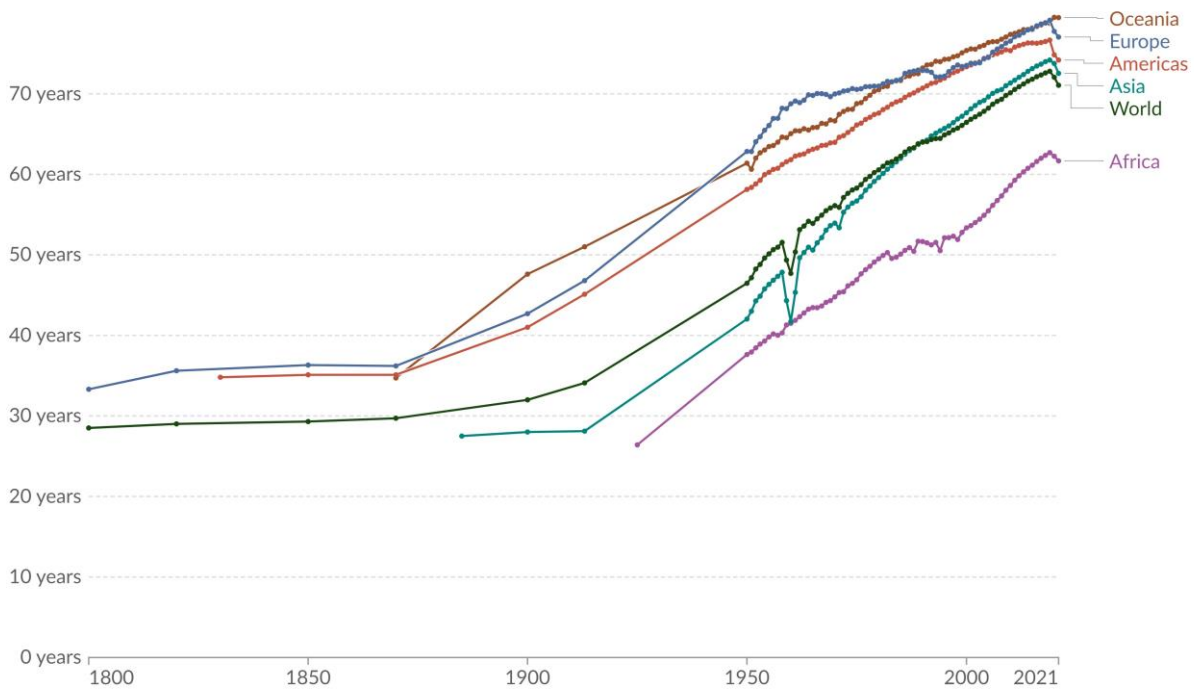
Region	Number of countries	Range of beginning periods	Average beginning level (years)
Africa	43	1920s–1960s	31.4
Americas	23	1830s–1940s	32.9
Asia	23	1890s–1960s	31.0
Europe	25	1770s–1930s	36.8
Oceania	5	1870s–1940s	41.4

James C. Riley (2005), The timing and pace of health transitions around the world, *Population and Development Review*, 31, 4 741-764.

Life expectancy

The period life expectancy[1] at birth, in a given year.

Our World in Data



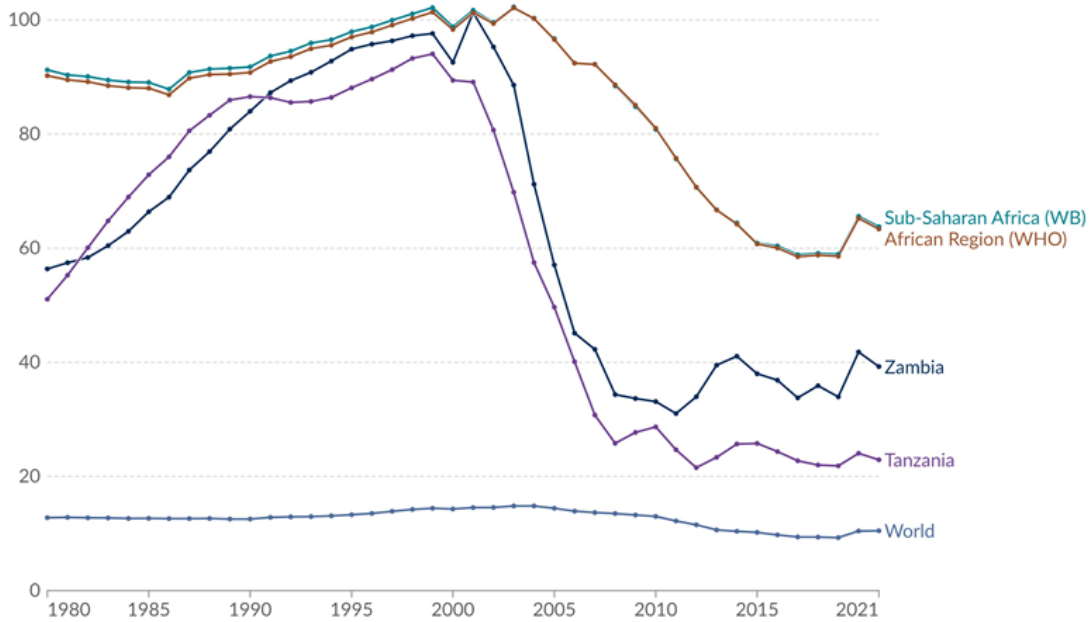
Data source: UN WPP (2022); HMD (2023); Zijdeman et al. (2015); Riley (2005)

OurWorldinData.org/life-expectancy | CC BY

Death rate from malaria

Estimated number of deaths from malaria[1] per 100,000 people.

Our World in Data



Data source: IHME, Global Burden of Disease (2024)

OurWorldinData.org/malaria | CC BY

Note: To allow for comparisons between countries and over time, this metric is age-standardized[2].

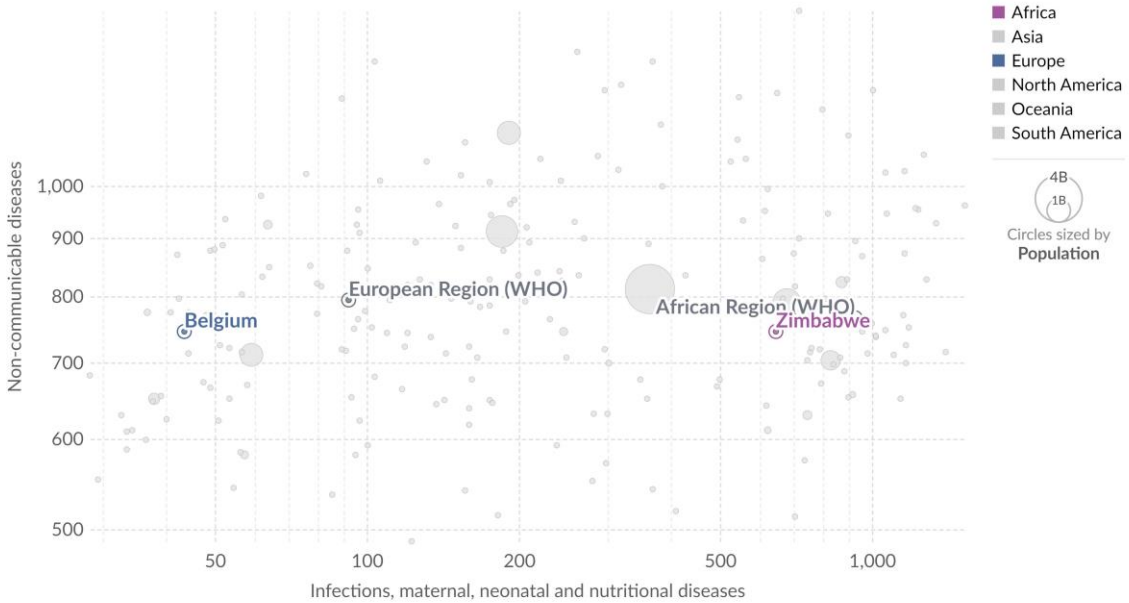
1. Malaria: Malaria is a life-threatening disease caused by parasites that are transmitted by female Anopheles mosquitoes. There are five parasite species that cause malaria in humans. Two of these species – P. falciparum and P. vivax – pose the greatest threat. The first symptoms – fever, headache and chills – usually appear 10 to 15 days after the infective mosquito bite and may be mild and difficult to recognize as malaria. Left untreated, P. falciparum malaria can progress to severe illness and death within 24 hours. Read more on our page on malaria.

2. Age standardization: Age standardization is an adjustment that makes it possible to compare populations with different age structures, by standardizing them to a common reference population. Read more: How does age standardization make health metrics comparable?

Death rate from communicable vs. non-communicable diseases, 1980

Our World in Data

The estimated annual death rate per 100,000 people. Death rates are compared between non-communicable diseases[1], versus infectious, maternal, neonatal and nutritional diseases combined.



Data source: IHME, Global Burden of Disease (2024) OurWorldinData.org/causes-of-death | CC BY

Note: To allow for comparisons between countries and over time, this metric is age-standardized[2].

1. Non-communicable diseases: Noncommunicable diseases (NCDs), also known as chronic diseases, tend to be of long duration and are the result of a combination of genetic, physiological, environmental and behavioural factors. The main types of NCD are cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes.

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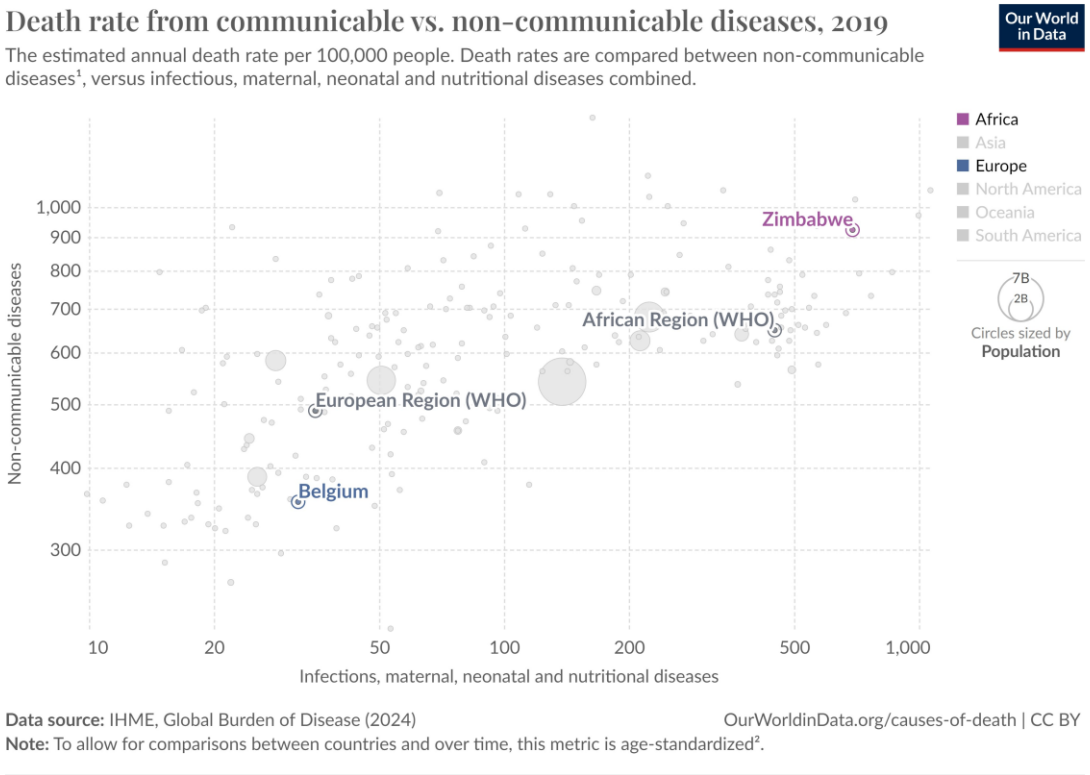
Double (triple) burden of disease



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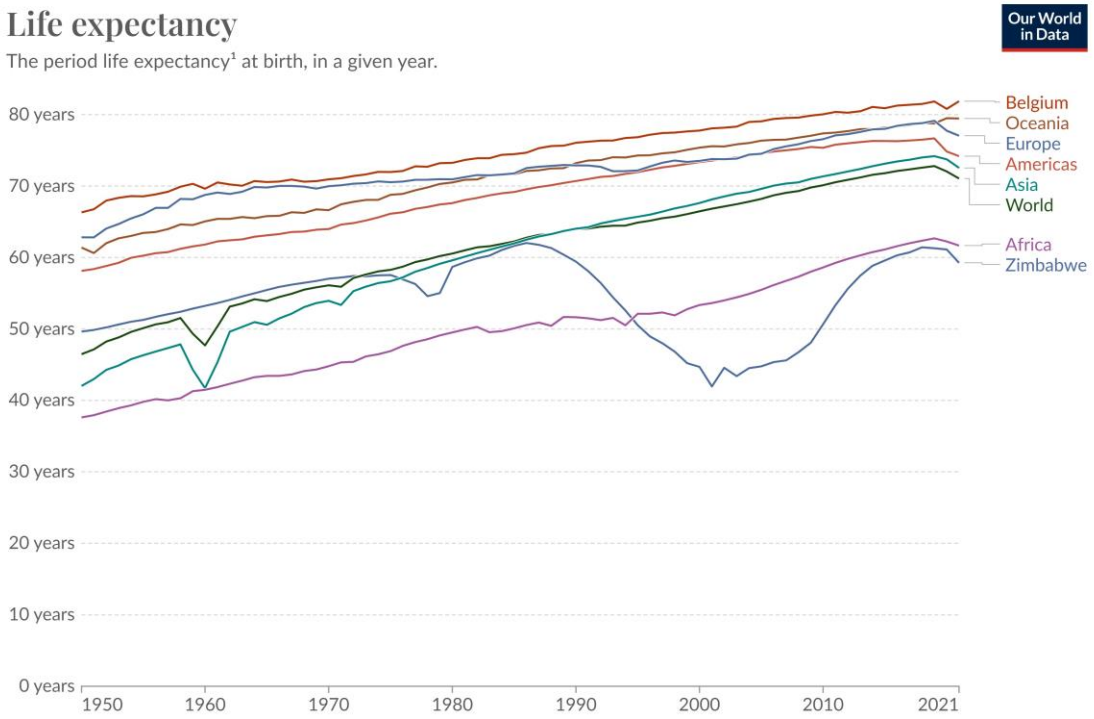
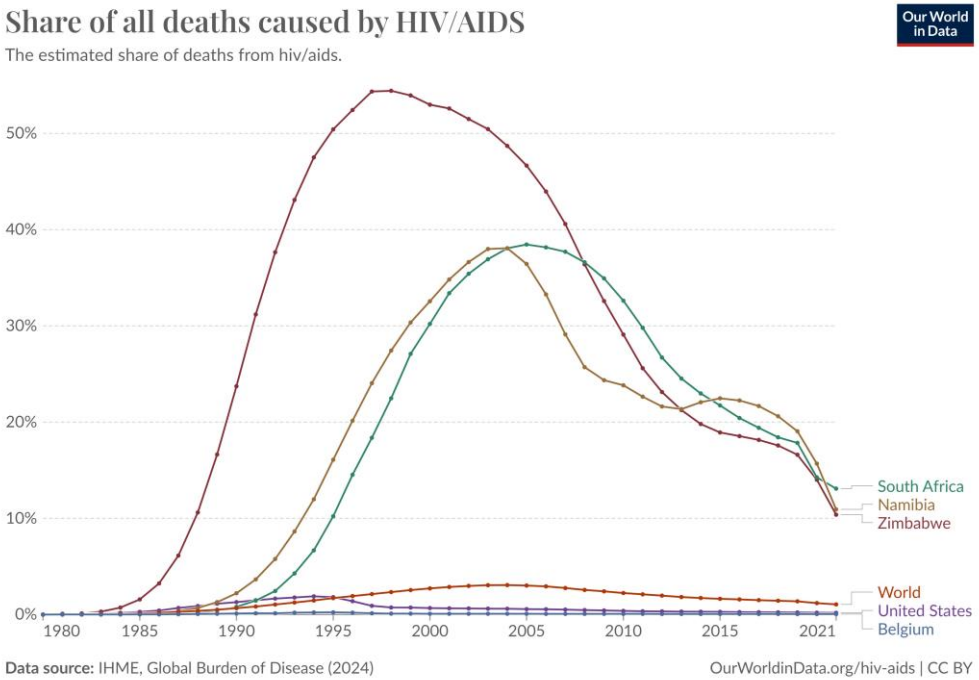
Specific situation of many low-income countries since 1980s

- **Coexistence** of high (yet often declining) mortality by communicable and (rising) non-communicable diseases.
- Triple burden (**new emerging diseases** such as HIV in the 1990s, COVID in 2020; re-emergence of old ones TB)
- Difficult to have a single unified theory of epidemiological transition: country-specific effects, varying patterns within countries

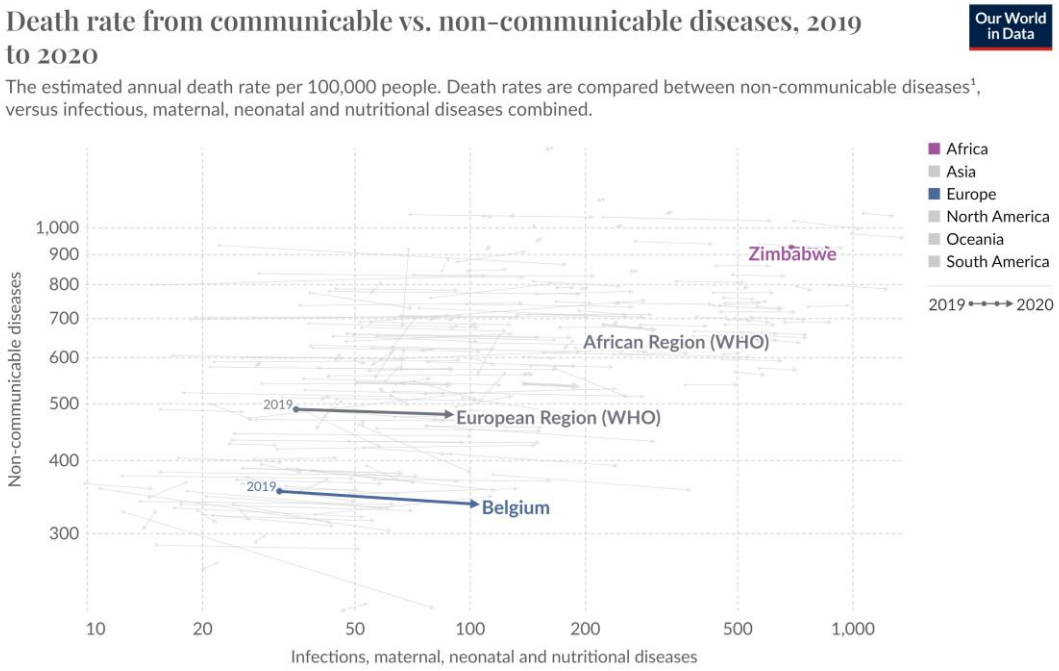
New emerging diseases: Aids



1. **Period life expectancy**: Period life expectancy is a metric that summarizes death rates across all age groups in one particular year. For a given year, it represents the average lifespan for a hypothetical group of people, if they experienced the same age-specific death rates throughout their whole lives as the age-specific death rates seen in that particular year. Learn more in our articles: "Life expectancy" – What does this actually mean? and Period versus cohort measures: what's the difference?



New, emerging diseases: COVID-19



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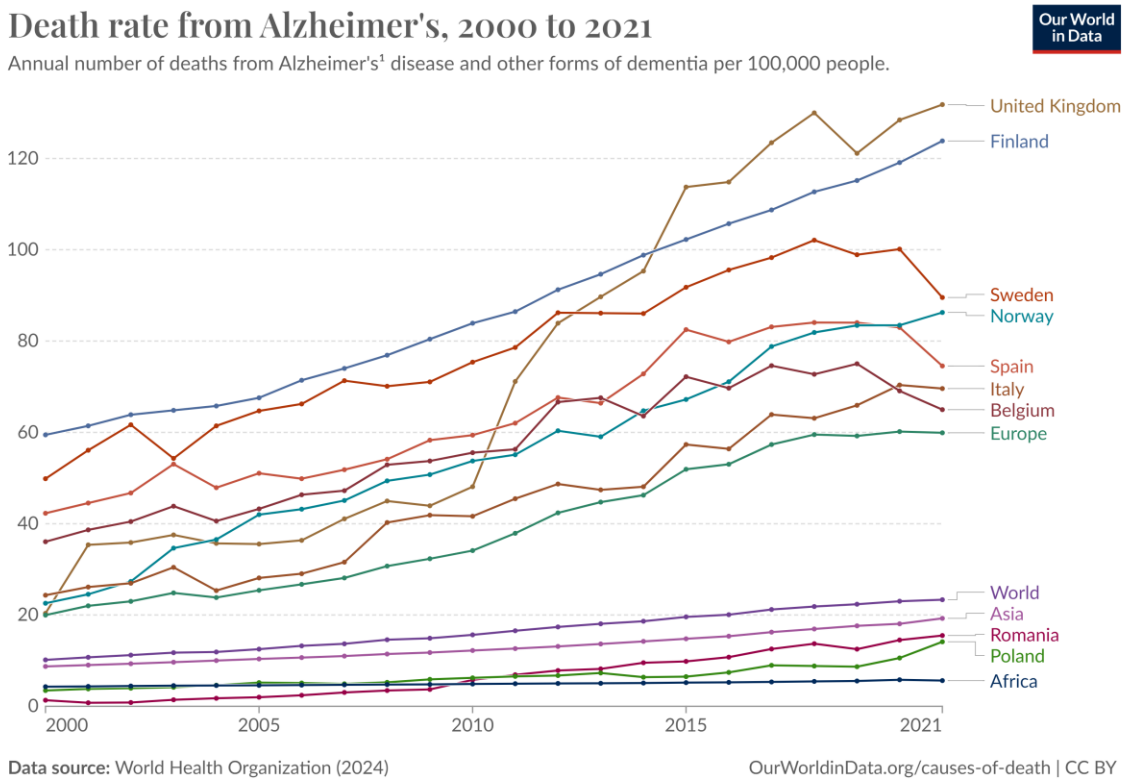
New, emerging diseases: neurodegenerative diseases



1. Alzheimer's: Alzheimer's disease is the most common form of dementia. Dementia patients show worsening cognitive function over time, beyond what might be expected from typical aging. Dementia affects memory, thinking, orientation, comprehension, calculation, learning capacity, language, and judgment. This is commonly accompanied by changes in mood, emotional control, behavior, or motivation.

6. DETERMINANTS OF EPIDEMIOLOGICAL TRANSITION

Omran (1971) distinguished **3 types of determinants**:

- Ecobiological factors: changing patterns of immunity and the movement of pathogens.
- Socioeconomic factors: living standards, health habits, hygiene and nutrition.
- Medical/public health: preventive and curative measures, improved public sanitation, immunization, etc.

- Classical model of epidemiologic transition (Europe, most western countries): mainly **ecobiologic and socioeconomic factors.** Medical factors largely inadvertent until the 20th century (cf. Mc Keown)
- Contemporary and delayed transition model (Afro-Asian countries): effect of medical factors direct and more salient. **Imported medical technologies, massive public health programs**.

Thomas McKeown (1912-1988)

The modern rise of population (1976), *The role of medicine* (1979): very influential

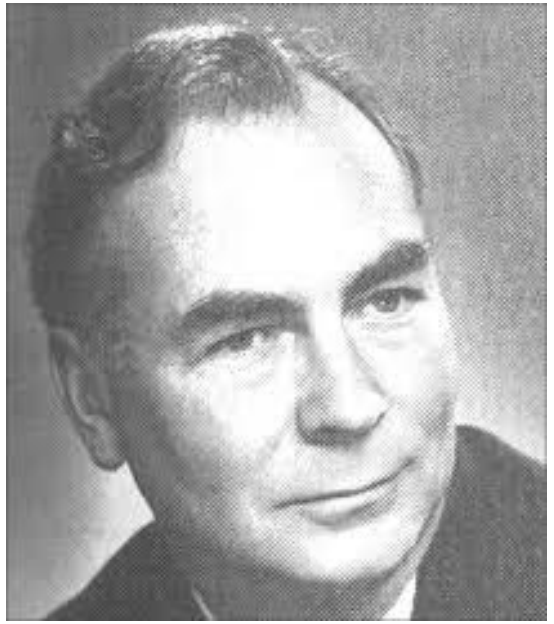
- '**Medical measures had relatively little effect on the trend of mortality from infections**'

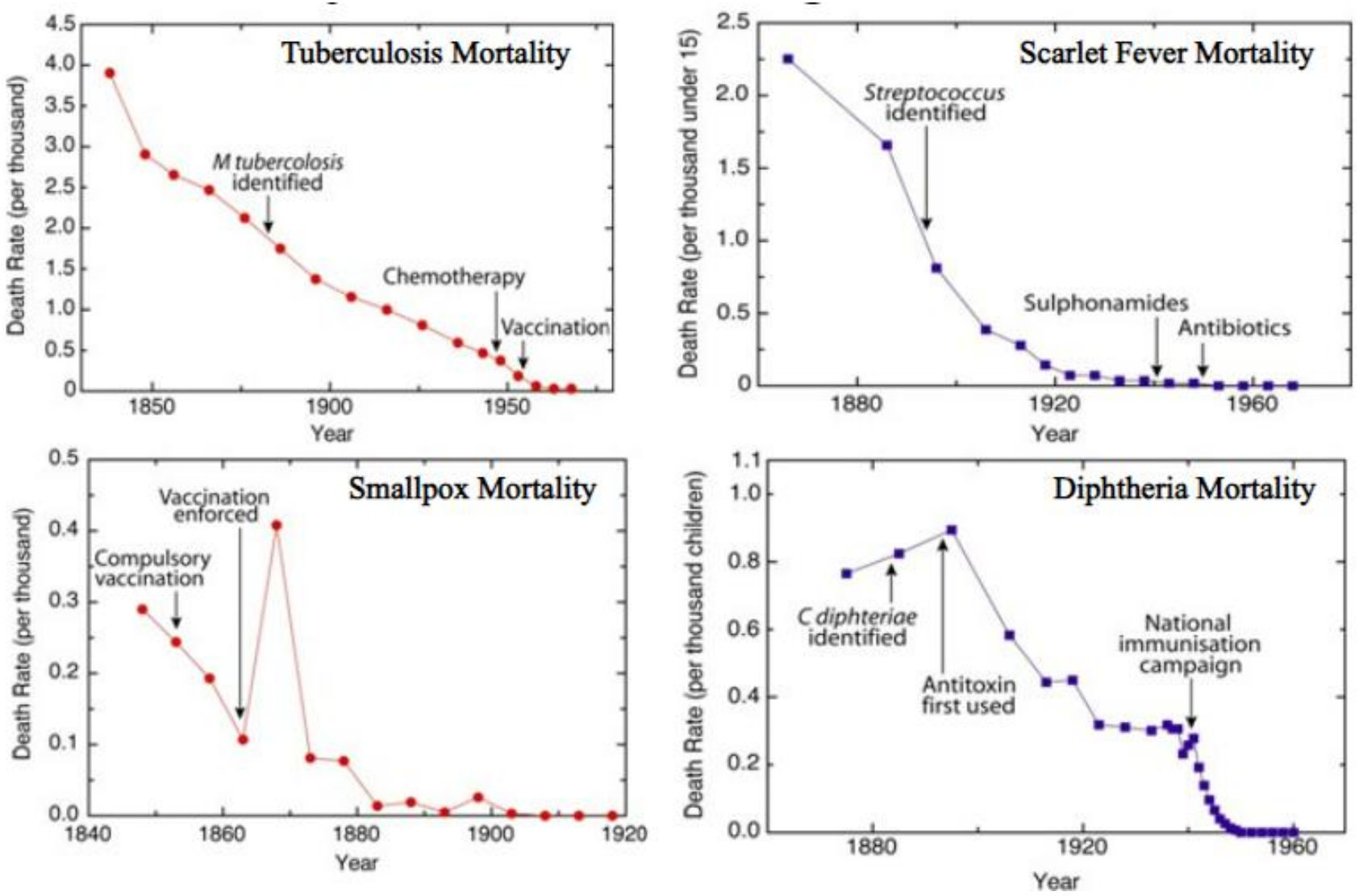
Start of the mortality decline precedes the spread of efficient medical treatments in England

  - Bacteriological revolution (end 19th century)
  - Discovery antibiotics (1930s)
  - Distribution of antibiotics and vaccination (after 1945)

Exception: smallpox (Vaccin Jenner end 18th century)

- Decline of mortality could largely be attributed to **rising living standards (nutrition);** downgrade public health
- **Cause-of-death categorization:** airborne, water-, foodborne and other infections, degenerative diseases





T. McKeown (1976). The Role of Medicine. Dream, Mirage, or Nemesis?, 93.

Discoveries in the control of major infectious diseases

A. Mode of transmission, 1800–1909

Date	Disease	Investigator
1847	Measles	Panum
	Puerperal fever	Semmelweiss, Holmes
1854	Cholera	Snow
1859	Typhoid fever	Budd
1867	Sepsis (surgical)	Lister
1898	Malaria	Ross, Grassi
	Hookworm	Looss
1900	Yellow fever	Reed
1906	Dengue	Bancroft
	Rocky Mountain spotted fever	Ricketts, King
1909	Typhus	Nicolle

B. Causal agent, 1880–1900

Date	Disease	Investigator
1880	Typhoid (bacillus found in tissues)	Eberth
	Leprosy	Hansen
	Malaria	Laveran
1882	Tuberculosis	Koch
	Glanders	Loeffler and Schutz
1883	Cholera	Koch
	Streptococcus (erysipelas)	Fehleisen
1884	Diphtheria	Klebs and Loeffler
	Typhoid (bacillus isolated)	Gaffky
	Staphylococcus Streptococcus	Rosenbach
	Tetanus	Nicolaier
1885	Coli	Escherich
1886	Pneumococcus	A. Fraenkel
1887	Malta fever	Bruce
	Soft chancre	Ducrey
1892	Gas gangrene	Welch and Nuttall
1894	Plague	Yersin, Kitasato
	Botulism	van Ermengem
1898	Dysentery bacillus	Shiga

A. Vaccines

Date	Disease	Developer
1798	Smallpox	Jenner
1881	Anthrax	Pasteur
1885	Rabies	Pasteur
1892	Diphtheria	von Behring
1896	Cholera	Kolle
1906	Pertussis	Bordet-Gengou
1921	Tuberculosis	Calmette, Guerin
1927	Tetanus	Ramon, Zoeller
1930	Yellow fever	Theiler
	Typhoid fever	Weigl
1948	DTP	(Multiple)
1950	Polio	Salk
1954	Measles	Enders, Peebles

B. Drugs

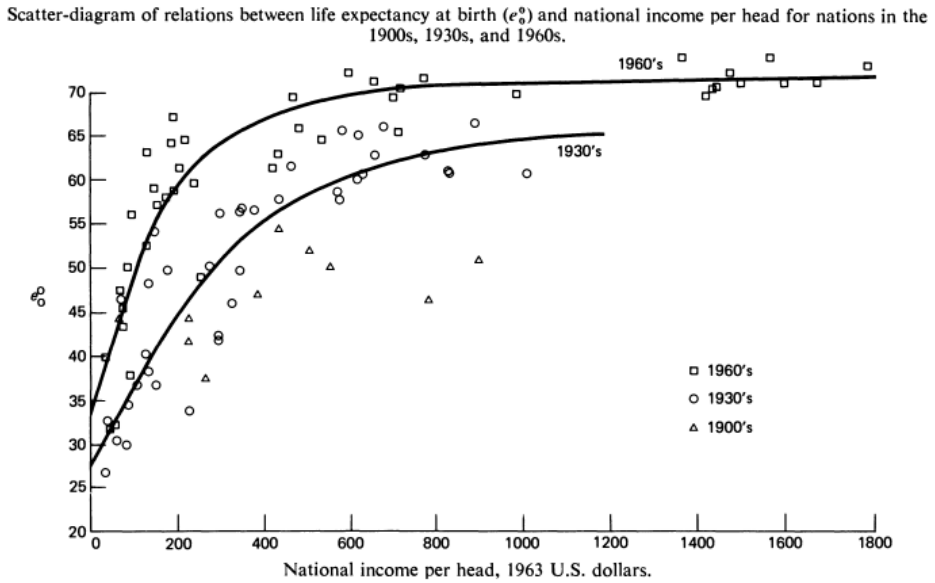
Date	Drug	Developer
1908	Salvarsan	Ehrlich
1935	Sulfanomides	Domagk
1941	Penicillin	Fleming, Florey, Chain
1944	Streptomycin	Waksman
1947–	Broad spectrum antibiotics[a]	

Very influential… and controversial

- **Samuel H. Preston (1974, 75, 76)**: transition not an automatic effect of improved living standards, Preston-curve.
- **Simon Srzeter (1988):** Mc Keown too negligent about the role of public health, importance of (urban) sanitation movement, social intervention
- **James C. Riley (2007)**: 12 low-income countries with high life expectancies in (much of the) 20th c. (China, Costa Rica, Cuba, Jamaica, Japan, Korea, Mexico, Oman, Panama, USSR, Sri Lanka, Venezuela): social development

No systematic analysis of causes of death

- **Johan P. Mackenbach (2020):** human agency, policy



Samuel H. Preston (1975). The Changing Relation between Mortality and Level of Economic Development, Population Studies, 29 (2): 235

TABLE 2 Estimated contributions of public health and medical care to mortality decline

Group	Health problem	Causes of declining incidence and/or mortality[a]			Contribution to total mortality decline[c]	
		All other changes	Public health	Medical care[b]	ca. 1870–1950[d]	ca. 1970–2015[e]
Health problems of pre-industrial societies	War	+++++			[crisis]	.
	Homicide	+++++			+	+
	Famine	++++	+		[crisis]	.
	Plague	+	++++		.	.
	Smallpox	+	++++		++	.
	Typhus	+	++++		[crisis]	.
	Malaria	++	++	+	++	.
Health problems of industrializing societies	Cholera, intestinal infections	+	++++		++++	++
	Respiratory tuberculosis	++	++	+	++++	++
	Syphilis	+	++	++	+	+
	Childhood infections[f]	++	++	+	++++	+
	Pneumonia	++	+	++	+++	+++
	Influenza	++	+	++	[crisis]	++
	Puerperal fever	+		++++	+	.
	Infant mortality[g]	[++]	[++]	[+]	[+++++]	[+++]
	Still-births[h]	+		++++	-	-
	Pellagra	++	++	+	++	.
	Rickets	++	++	+	.	.
	Goitre	+	+++	+	.	.
	Peptic ulcer	++		+++	-	+
	Appendicitis	++		+++	+	+
	Pneumoconiosis	+	++++		-	.
	Stomach cancer	+++++			++	+++
Health problems of affluent societies	Ischaemic heart disease		++	+++	*rise*	+++++
	Cerebrovascular disease	+	+	+++	++	++++
	Colorectal cancer[i]		+	++++	*rise*	*rise*
	Breast cancer		++	+++	*rise*	+
	Prostate cancer[i]			+++++?	*rise*	*rise*
	Lung cancer[i]	+	++++		*rise*	*rise*
	Liver cirrhosis	+	++++		+	+
	Road traffic injuries	+	+++	+	*rise*	++
	Suicide	++?	+?	++?	*rise*	++
	AIDS	+	++	++	-	[crisis]

a Estimated relative contribution to disease-specific decline (sum over all three columns = +++++; source: see text)

b This includes preventive interventions given as part of medical care

c Contribution to total mortality decline

-	Unknown, inestimable or inapplicable
[crisis]	Substantial contribution, but inestimable because of strong fluctuations
.	<0.1%
+	0.1–1%
++	1–5%
+++	5–10%
++++	10–25%
+++++	>25%

CONCLUSIONS

- **SWOT-analysis of epidemiological transition theory** (Omran 1971, 1983, 1998)
  - Historical context of 1970s-1990s
  - Difficult to have a single unified theory of epidemiological transition: country-specific effects, varying patterns within countries, varying pathways towards high life expectancy
  - Framework for comprehensive picture, not many alternatives
- **Epidemiological transition 2.0** (Mackenbach 2020): decline AND rise (paradox of progress)

CONCLUSIONS

- **Data challenges** past and present
  - E.g. Emerging diseases: dementia today; cancer and CVD 19th-century
  - Comparisons across time and space (ICD changes, ill-defined and other related causes)

- **Aggregate data**: bird's eye view but limited analytical possibilities (registration and classification practices, diagnostics). Few options to solve problems and overcome challenges
  - Great Leap contribution to HMD cause-of-death database?

- **Individual data**: dig deeper and address some of the challenges
  - Rearrange and combine? ICD10h
  - Diagnostics? Qualitative sources: evolution of medical knowledge