Development Economics

Lecture 21: Health, Growth, and Physiology

Professor Anant Nyshadham

ECON 2273

This lecture

1. Fogel (1994) "Economic Growth, Population Theory, and Physiology" (Nobel prize lecture)
2. Relationship between the human body, nutrition, health, and economic growth

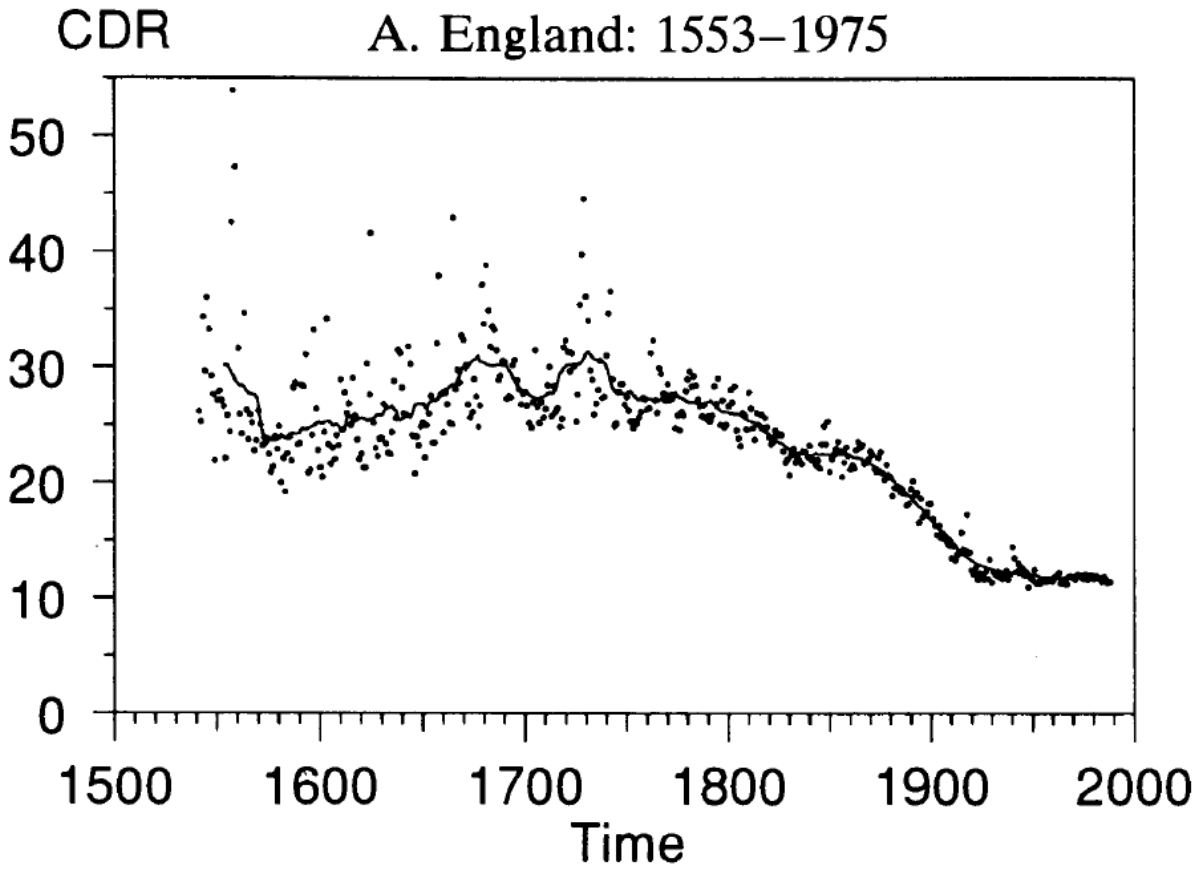
Robert Fogel

- Economic historian, mostly at University of Chicago
- Nobel prize in 1993 (with Douglas North), died 2013
- Most famous for work on American Economic History
  - *Time on the Cross* (with Stanley Engerman) approached slavery from an economic viewpoint
    - Controversial conclusion: slaves better treated than northern factory workers—because slave owners benefited
  - *Railroads and Economic Growth* analyzes the importance of railroads in US growth
    - Controversial conclusion: Railroads not that important
- But most recent work is on population

Secular decline in mortality

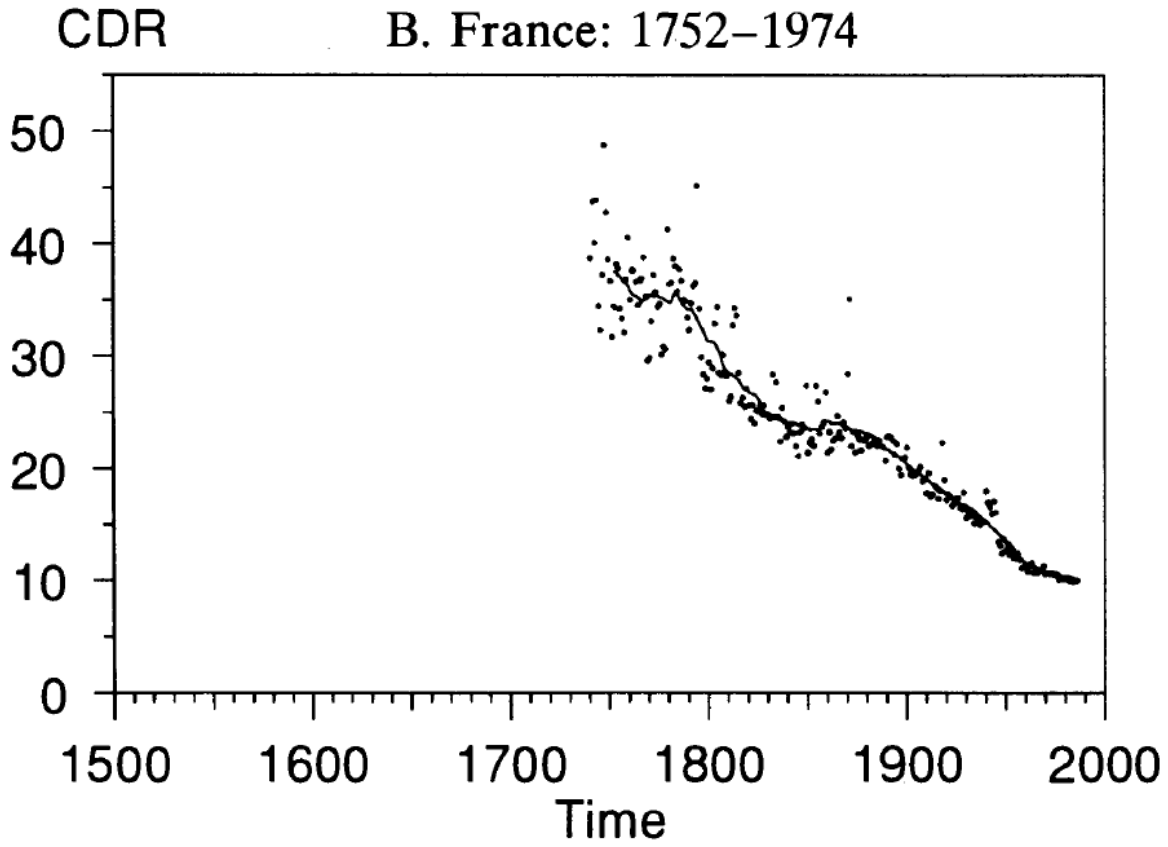
- *Secular*: long term or of indefinite duration
- Secular decline in mortality is the long-term decline in mortality in the currently developed world starting around 1800
- Decline in mortality (at least in Britain and France) took place in two waves
  - Early one around 1750-1825,
  - Later one after 1875 or so, continued to WWI or after

Secular decline in mortality: Britain



- First wave started after 1725-1750 and continued to 1825
- Then stabilized
- Decline began again after 1875 or so, and continued until 1925
- Then stabilized

Secular decline in mortality: France



- From higher base, decline seems to have been faster
- First wave starts around 1750
- Stabilized 1800-1875
- Decline began again after 1875 or so
- Continued, more slowly after 1950

Secular decline in mortality

- What caused the decline in mortality?
  - Not decline in famines!
    - Surprise to many historians/demographers/economists
    - Famines stand out as big events, but don't cause much of mortality (maybe 2-4%)
- High mortality caused by chronic malnutrition (not acute malnutrition—famine)
- To consider the role of malnutrition, useful to think of man as a machine with inputs and outputs

Man as a machine

- Key insight:
  - Human Beings take inputs (calories) to produce outputs (work)
  - We may be more or less efficient at turning calories into work at different levels of nutrition
    - Nutrition poverty trap model is an example of the implications
- *Thermodynamics*: study of the energy conversion between heat and work
  - Many of main ideas developed in Scotland around 1800, and borrowed ideas from the nascent field of economics (work, efficiency, waste)

Man as a machine

- Fogel approach is to consider:

  "Thermodynamic and physiological aspects of economic growth"

  How human energy efficiency has changed and contributed to economic growth
- Thermodynamic analysis of the "human engine"
  - Account for energy in and work out
  - A more efficient human engine transfers more energy into work
- *Physiology*: the study of the functioning of living organisms or systems

Man as a machine

- What factors determines human efficiency?
  - Size
    - The bigger you are, the more calories are required simply to maintain life (breathing, heart pumping, digestion, all require more energy the bigger you are)
    - Basal Metabolic Rate: Minimum amount of energy to maintain organs, about 1794 kilo calories for 172 pound man
      - Stay in bed all day, don't eat, soil yourself, absolute minimum
    - Baseline or resting metabolic rate: Amount required for digestion and vital hygiene, about 2279 kcal for 172 pound man
  - Illness
    - Those who are ill absorb fewer calories (diarrhea . . .), need more calories (fighting disease)

Energy cost accounting

- Can estimate agricultural production of Britain and France pretty well
  - Gives the potential inputs of calories
  - Use these to construct “national food balance sheet”
- Comparisons:
  - Average British male in 1790 had available 2700 kcal
  - Average French male in 1800 had available 2300-2400 kcal around 1800
  - Average US male in 1993 was 172 pounds
    - 172 pound man needs around 2300 just to digest, do no work

Energy cost accounting

- So modern male would not have been able to do any work in France in 1800. How is this possible?
- Two possibilities:
  - Either there were almost no calories left over to work
  - Or (more plausibly) people were much smaller
- Evidence suggests that people were much shorter
  - Get by measuring skeletons (femur tends to be correlated with height)
- Probably much lighter as well (but evidence is less good)

Energy cost accounting

- Around 1790
  - average British male 134 pounds, 168 centimeters (5’5”)
  - average French male 110 pounds, 164 centimeters (5’4”)
- Small—traveling back in time we would have towered over them and been much stronger
- But we would not be able to survive: our bodies are too large
  - We would have used all of the available calories just to keep our large bodies alive—nothing left to work

Energy cost accounting

- Mean caloric consumption low
- But not equally distributed!
  - The richest probably ate pretty close to standards today
- Even accounting for being lighter and shorter, poorest 20% of population took in so few calories that they could not do any effective work
  - Explains why beggars constituted such large portion of population—they did not (literally) have the energy to do anything else

Energy cost accounting

Decile	France, circa 1785		England, circa 1790	
	Daily kcal consumption	Cumulative percentage	Daily kcal consumption	Cumulative percentage
Highest	3,672	100	4,329	100
Ninth	2,981	84	3,514	84
Eighth	2,676	71	3,155	71
Seventh	2,457	59	2,897	59
Sixth	2,276	48	2,684	48
Fifth	2,114	38	2,492	38
Fourth	1,958	29	2,309	29
Third	1,798	21	2,120	21
Second	1,614	13	1,903	13
First	1,310	6	1,545	6
$\bar{X}$:	2,290		2,700	
$s/\bar{X}$:	0.3		0.3	

Energy cost accounting

- Pervasive myth (even today): Poor are lazy
- Alternative interpretation: poor lack the calories (energy) to do anything except very light work
- The Europeans conquering India, China, and Africa during 19th century
  - Bigger, stronger, able to work harder than almost everyone in the population
  - No wonder they thought themselves superior!
- Probably not much size advantage when conquering Americas—comparable nutrition

Malnutrition and illness

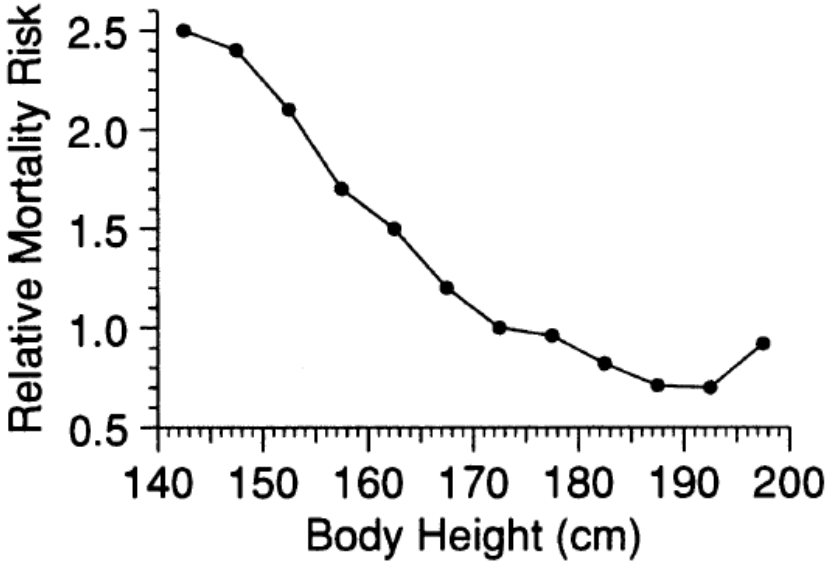
- People in the past short and light
- Poor in past (and today) very light and short
- Lower height and weight also appear to mean higher susceptibility to disease
  - Shorter, lighter people do not live as long, higher morbidity
- So people in the past were shorter and lighter, which meant they could survive on fewer calories
- But short and light is not optimal for long term health

Malnutrition and illness

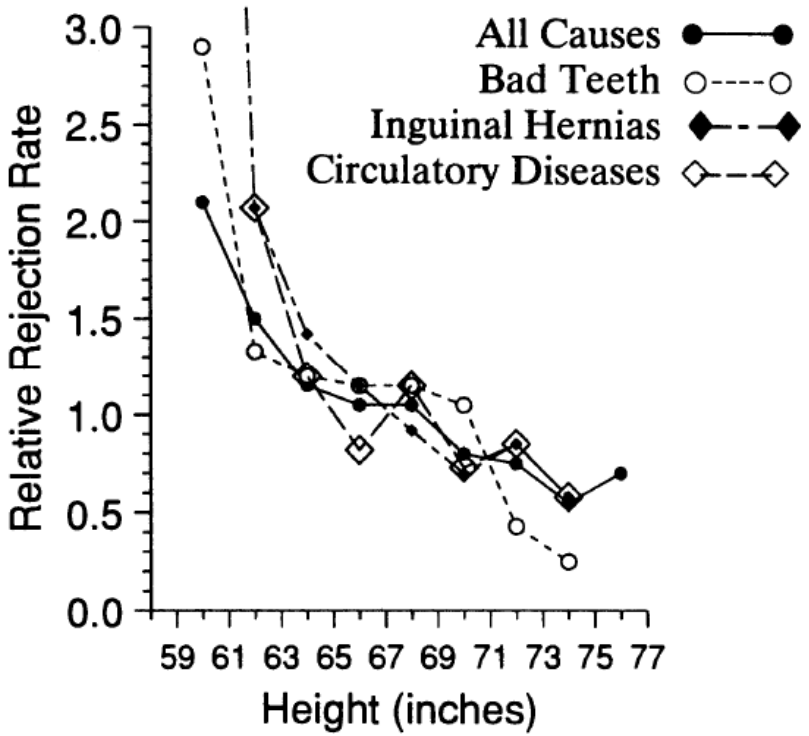
- Tradeoff—people shorter and lighter need fewer calories, but not as healthy, even when given adequate nutrition
- Physiological explanation:
  - Poor nutrition means body expends most of energy surviving now, rather than making investments to live for longer
  - While survival optimal in short term in a low calorie environment, it comes at cost of long term
  - Biology and economics closer than you think!
  - Physiological explanation has become more complex over time—this is a simplified version

Malnutrition and illness

A. *Relative Mortality Risk among Norwegian Men Aged 40–59, Between 1963 and 1979*



B. *Relative Rejection Rates for Chronic Conditions in a Sample of 4,245 Men Aged 23–49, Examined for the Union Army*



Malnutrition and illness

- Typical way to compare malnutrition and illness through the Body Mass Index (BMI)
  - BMI=Weight/Height^2 (kg/m^2)
- Not a perfect measure, but captures basic relationship
  - Taller people should weigh more in order to be in proportion
  - Athletes probably have different relationship than rest of population (lots of dense muscle)
- Strong relationship that low BMI is associated with high mortality and morbidity

Malnutrition and illness: Waaler Curves

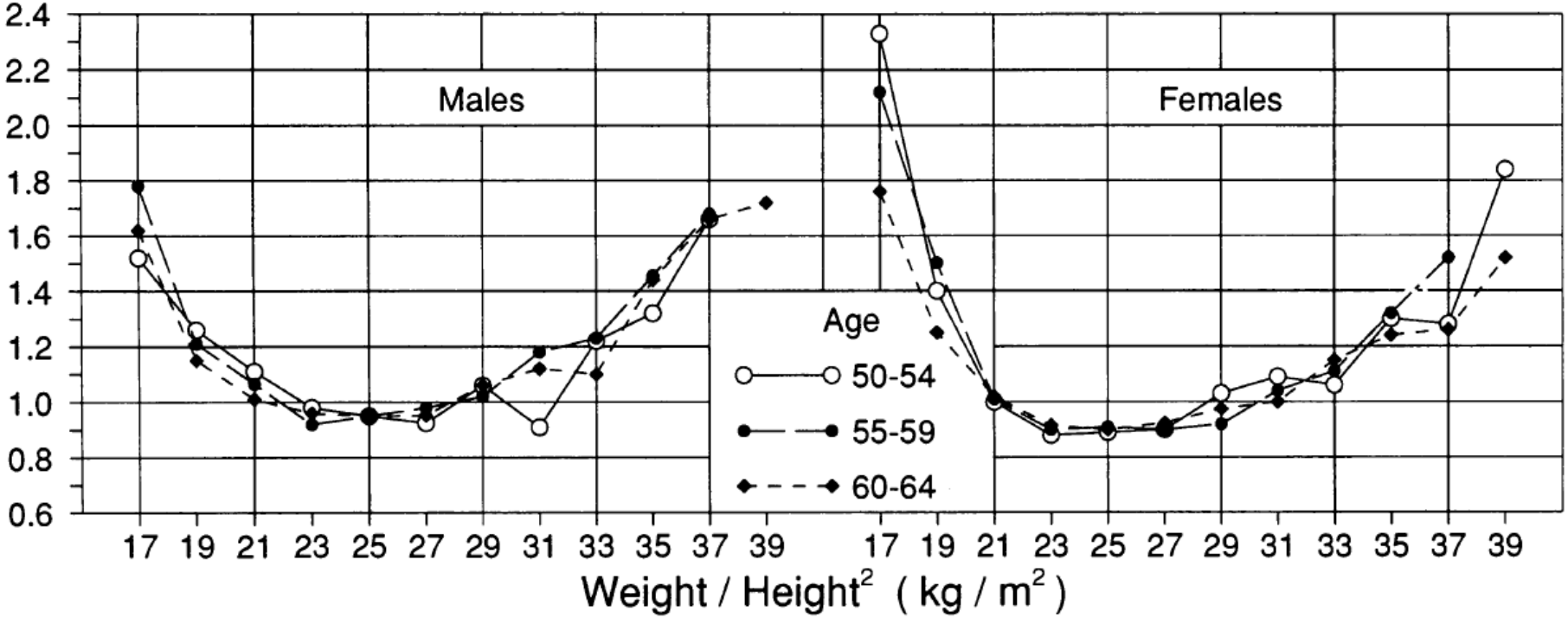


FIGURE 3. RELATIONSHIP BETWEEN BMI AND PROSPECTIVE RISK AMONG NORWEGIAN ADULTS AGED 50–64 AT RISK, BETWEEN 1963 AND 1979

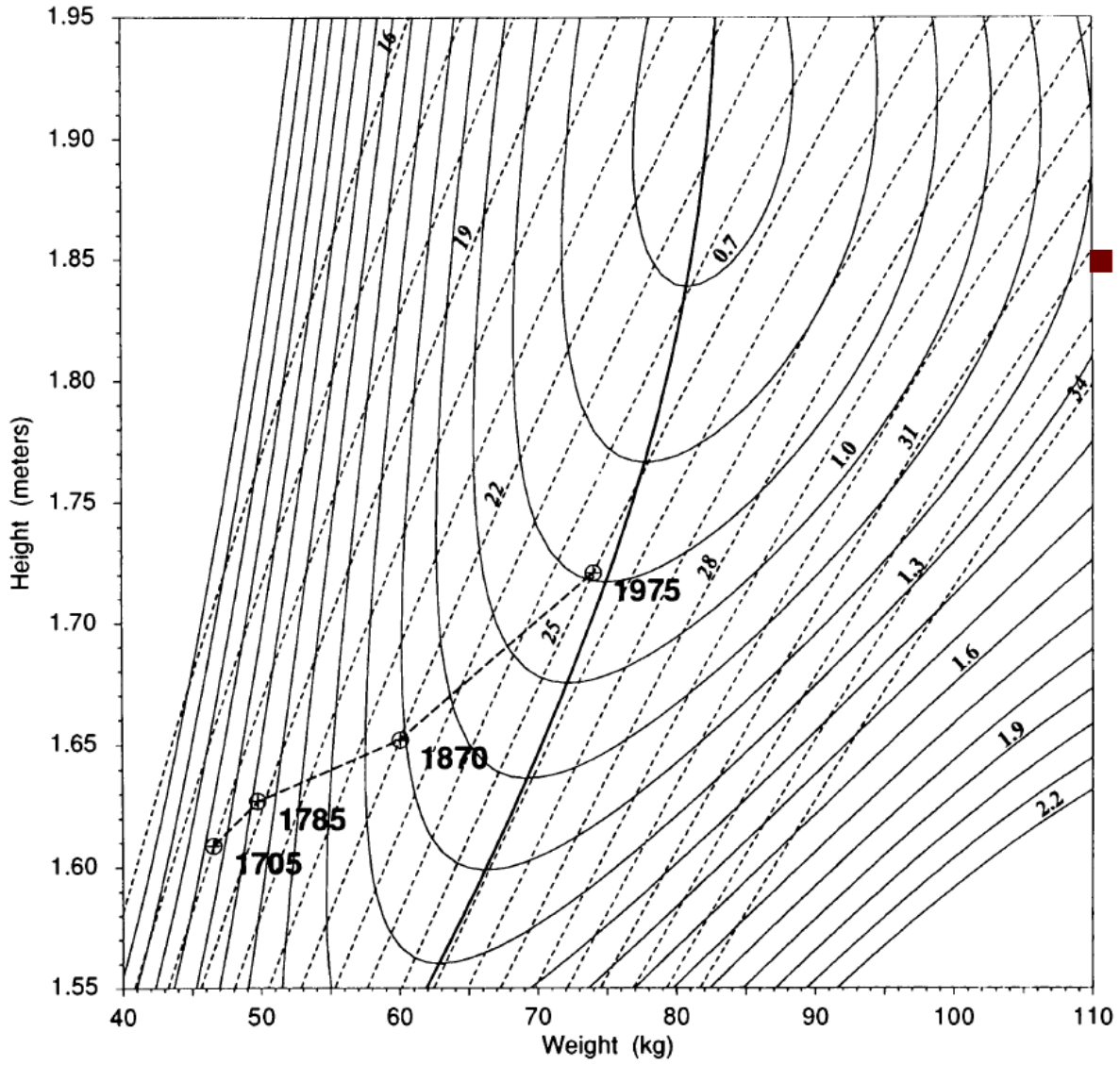


FIGURE 4. ISOMORTALITY CURVES OF RELATIVE RISK FOR HEIGHT AND WEIGHT AMONG NORWEGIAN MALES AGED 50–64 WITH A PLOT OF THE ESTIMATED FRENCH HEIGHT AND WEIGHT AT FOUR DATES

How calculate

- Tom Brady 6'4" (1.93 meters), 225 lbs (102kg), BMI $27.3=102/1.93^2$
- Giselle Bundchen 5'11" (1.82 meters), 115 lbs (52kg) BMI 16
- Mark Wahlberg (Marky Mark) 174 cm, 75kg BMI 28.3

Malnutrition: Climbing Mt. Waaler

- Health Disclaimer:
  - Extremes dangerous for health
    - Severe malnutrition and very low BMI dangerous for health
    - Very high BMI, morbid obesity bad for health
  - Not so obvious in the middle, and evidence is changing
  - The evidence that somewhat high, or somewhat low BMI is bad for health seems poor
- Long history of elites instructing poor what to eat
  - Around 1900 movement to get poor in US to eat more meat, potatoes, cod balls, rather than expensive fruits and vegetables
  - Largely reaction against Italian immigrants (whose food was tasty—imagine the outrage!)

Malnutrition: Climbing Mt. Waaler

- Decline in mortality from 1700 to 1875 came almost entirely from improvements in BMI
  - Can explain most of the mortality decline by charting the differences in height
- Decline after 1870 about half from improvements in height
- Other factors (public health) became important
- Improved BMI and height also explain fall in many chronic diseases

Malnutrition and Physiology

- Why are height and weight predictive of health?
  - Various explanations, becoming better since 1993
  - Not terribly well understood (at least by me), but the investment in short term at cost of long term approach seems common
  - Early malnutrition and stress—in utero and in early childhood seem to be very important
  - Later malnutrition and stress bad, but consequences can be overcome if nutrition improves

Malnutrition and growth

- Malnutrition may have caused bad health
- Also reduced ability of population to do work
- In 1800, even in "rich" countries
  - poorest 20% unable to work at all,
  - Second quintile could not have been very productive based on calories consumed
- Fogel estimates that when adjust labor for intensity, improved nutrition accounts for about 30% of the growth of per capita income in Britain between 1790-1980

Malnutrition and growth

- The economic revolution since 1800 (in rich countries) was accompanied by rapid human evolution
  - We've gone from small, short, and unable to do much work
  - To bigger, stronger, and capable physically of much more
- We are also likely much smarter (on average)—nutrition important in early childhood brain development

Fogel's work and development

- Emphasis on nutrition, rather than fighting disease
- Malnutrition early on has long term costs
  - Even in rich countries taller people earn more, are in better health, and are smarter (on average)
- As poor countries have fed population somewhat better (China and India during "Green Revolution") may have created conditions for growth
  - Now their populations can work harder, and are healthier
- Feedback: healthier population can produce more, eats better, is healthier

Diseases of the Rich and Poor

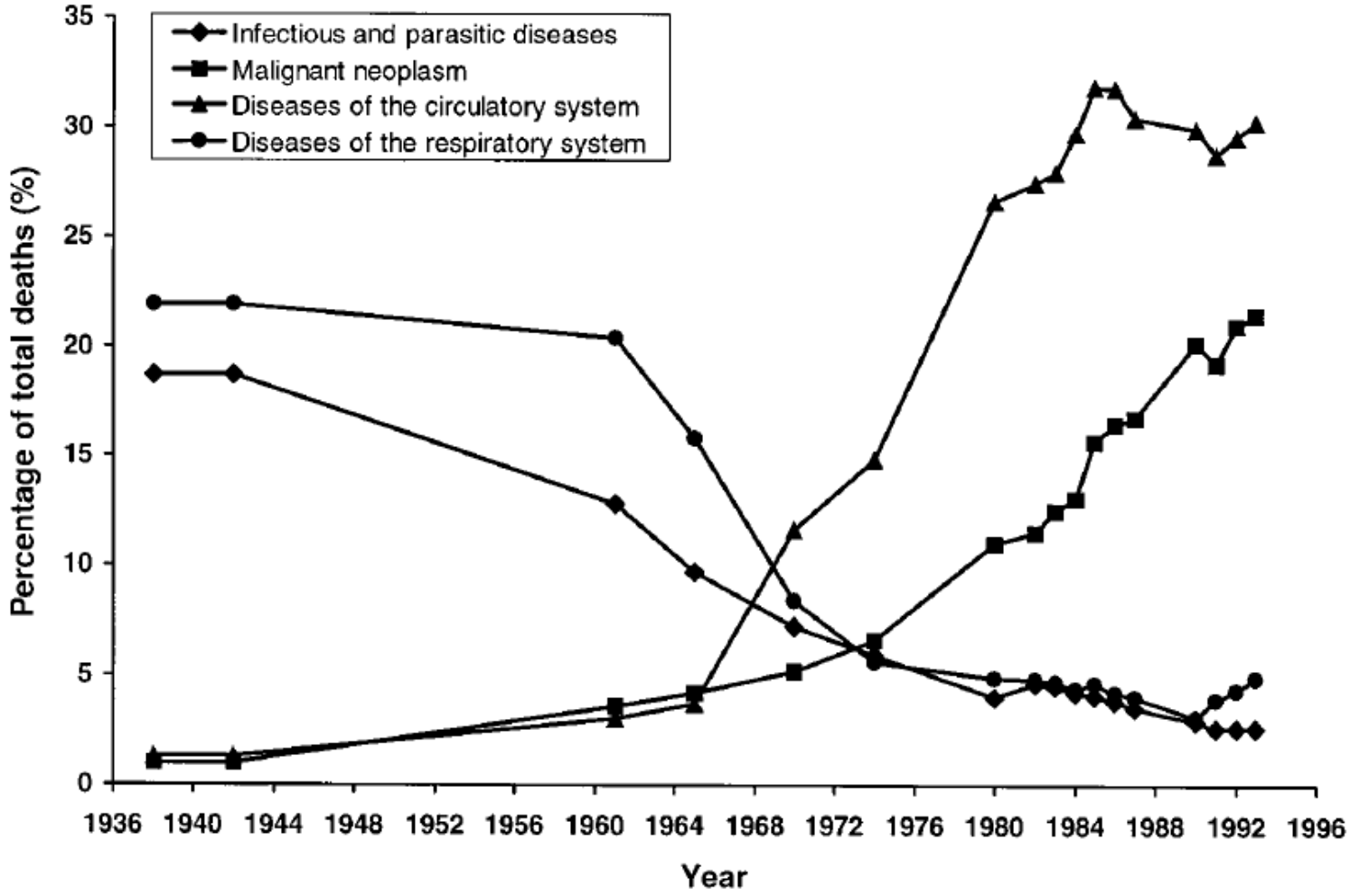


FIGURE 7. Trends in causes of death in South Korea, 1938–1993 (28, 29).

Source: Soowon Kim, Soojae Moon and Barry M Popkin. (2000). "The nutrition transition in South Korea" *American Journal of Clinical Nutrition*, Vol. 71, No. 1, 44-53, January 2000.