

Population and Health

Лекция 13. Различия между мужчинами и женщинами в здоровье и смертности

Lecture 13. Sex differences in health and survival



MAX PLANCK INSTITUTE
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- ❖ Higher biological resistance of women
- ❖ Variation of the male-female mortality gap across space and time
- ❖ Health disadvantage of women in traditional societies
- ❖ Trends since the 1950s
- ❖ Underlying factors and role of smoking
- ❖ Excess male death in Russia
- ❖ Differences in health and the “health-mortality” paradox



- If a mutation affects one of the genes of the X chromosome in women, it does not always cause a disease because the second X chromosome may compensate for the loss of function. Men experience a greater risk of genetic diseases (hemophilia, myopathy etc.) and of congenital abnormalities.
- Folliculine-stimulating hormone (FSH) is secreted until menopause and facilitates dilatation of veins and protects against CVDs. Estrogen-to-testosterone ratio is 100-fold higher in women than in men. Estrogen enables to eliminate LDL cholesterol and ensures greater immunity against ischemic and cerebrovascular problems.
- Testosterone may lead to aggressiveness (violence, risk taking in men).
- The part played by the biology in the male-female mortality gap is hard to quantify.

Jacques Vallin: "... God made women little stronger than men."



- Sex is not just a biological variable. It largely determines economical status, social/cultural patterns and behaviors. Difficult to isolate “pure” effects of genetic and biological factors.
- Studies on special population groups with minor behavioral and economic differences between men and women (e.g. monks and nannies) reveal only a small female advantage in survival.
- Models of biological (endogenous) mortality by Jean Bourgeois-Pichat (1952) – a 2 year female advantage in e_0 . Later model (1978) – 6.5 years. The models were unable to separate between biological and cumulated behavioral influences (higher level of smoking and other risks among men).
- Assumption by Roland Pressat. On the first year of life, no outside influence cause any survival difference between boys and girls in western countries. At this age, the female mortality advantage is 20% to 30%. If this difference continues over the whole life, the life expectancy female advantage will be about 2 years.
- The range of inter-population differences and temporal variations in the male-female longevity gap is great. No way to explain it by biology.
- Potentially growing importance of the biological component as mortality tends to concentrate more and more at older ages.

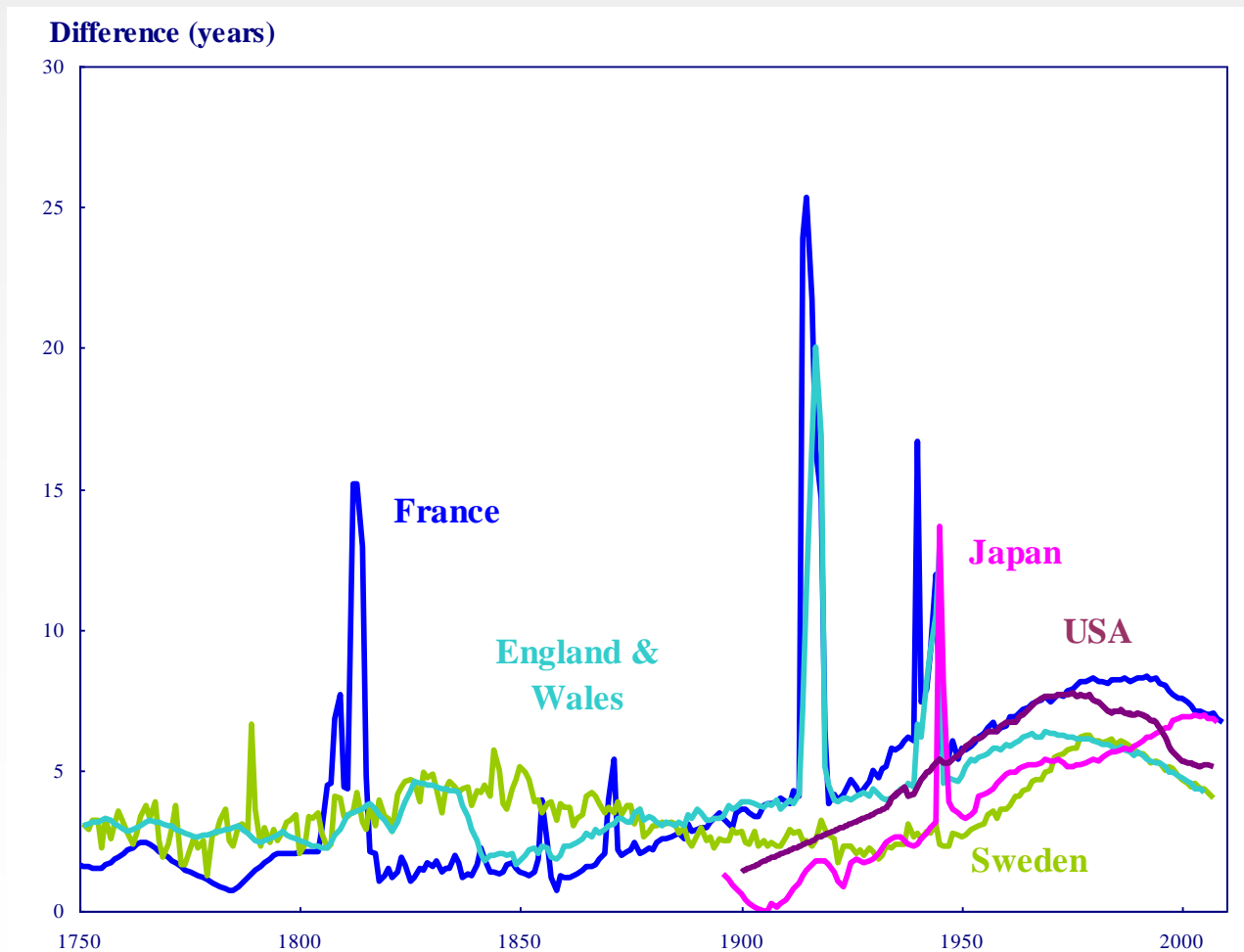


Variability of the male-female gap in length of life

Life expectancy of men and women in different countries since the 1950s

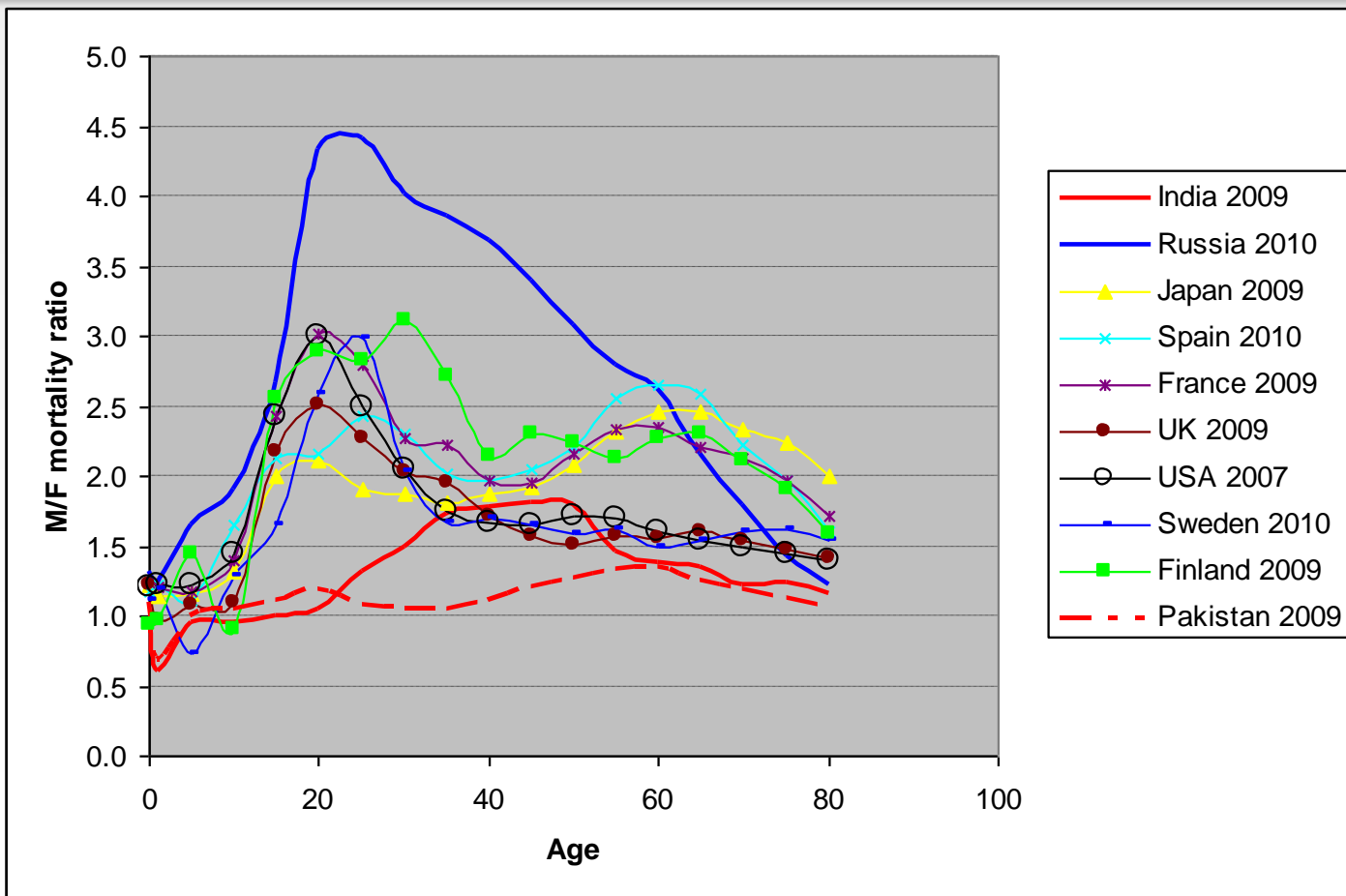
	1950-55			1975-80			2005-10		
	M	F	F-M	M	F	F-M	M	F	F-M
World	46.7	48.7	2.0	58.7	62.6	3.9	65.7	70.1	4.4
India	38.7	37.1	-1.6	54.3	54.1	-0.2	62.8	65.7	2.9
Bangladesh	46.3	44.2	-2.1	53.6	52.2	-1.4	67.4	68.3	0.9
Japan	60.4	63.9	3.5	72.6	79.6	7.0	79.3	86.1	6.8
Czech Republic	64.5	69.5	5.0	67.1	74.2	7.1	73.8	80.2	6.4
Russia	60.5	67.3	6.8	61.9	73.1	11.2	61.6	74.0	12.4
Hungary	61.9	66.1	4.2	66.4	72.9	6.5	69.5	77.6	8.1
Finland	62.7	69.3	6.6	68.1	74.2	6.1	75.9	82.8	6.9
Estonia	61.7	68.3	6.6	64.5	76.9	12.4	68.4	79.2	10.8
Sweden	70.8	73.1	2.3	72.1	78.4	6.3	78.1	82.9	4.8
UK	66.7	71.8	5.1	69.8	76.0	6.2	77.4	81.7	4.3
Spain	61.8	66.4	4.6	71.1	77.1	6.0	77.2	83.8	6.6
France	64.2	70.2	6.0	69.7	77.8	8.1	77.5	84.3	6.8
Germany	65.3	69.6	4.3	69.0	75.5	6.5	77.2	82.4	5.2
USA	65.8	71.7	5.9	69.4	77.0	7.6	75.4	80.5	5.1

Female survival advantage is highly predominant. Very few negative or very small differences mostly in less developed countries. The gender gap tends to rise with time. In several developed countries, the gap has recently narrowed. In some countries/periods (Russia, France in the 1970s) male excess mortality is very substantial.



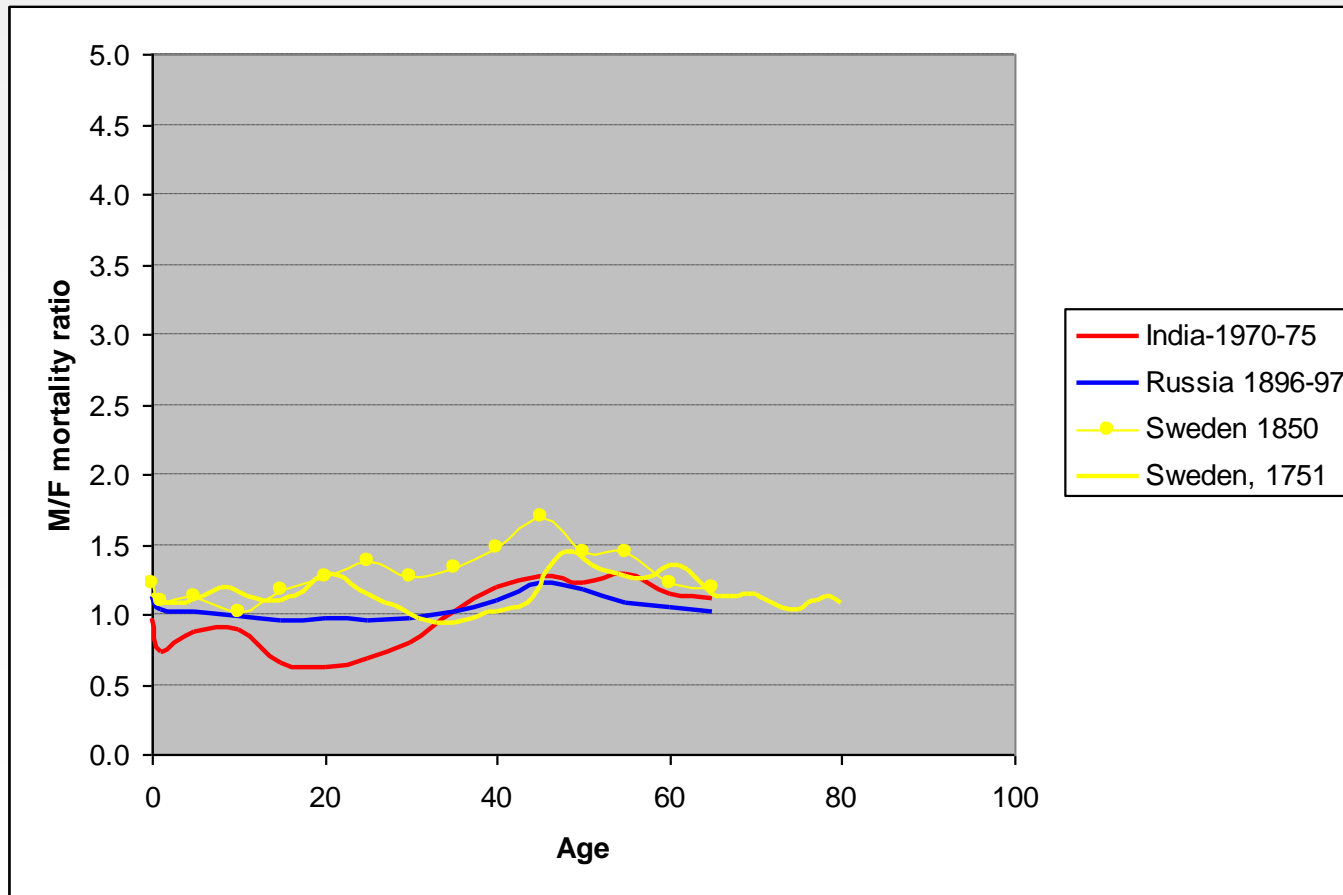
The F-M difference in LE remained below 5 years (mostly between 2 and 3 yrs).
Outbreaks due to wars. Increase in later times, especially after 1950. Recent decrease/stabilization of the gap.

Characteristic patterns of the male-female mortality difference in the 2000s



Striking contrast between extreme male excess mortality in Russia and remaining female disadvantage in India and Pakistan. Shapes of excess male mortality somewhat differ. Maximum at young adult ages in the US, UK, and Sweden. Additional maximum around age 60-70 in Japan, France, Spain, and Finland.

Male-female mortality in times of traditional mortality regime



Small differences. Female disadvantage or equal mortality in men and women at young and reproductive ages. Some mortality advantage of women at older ages. Difference between Sweden and Asian/Eurasian countries – due to social status of woman.



Factors working against the female advantage in traditional societies

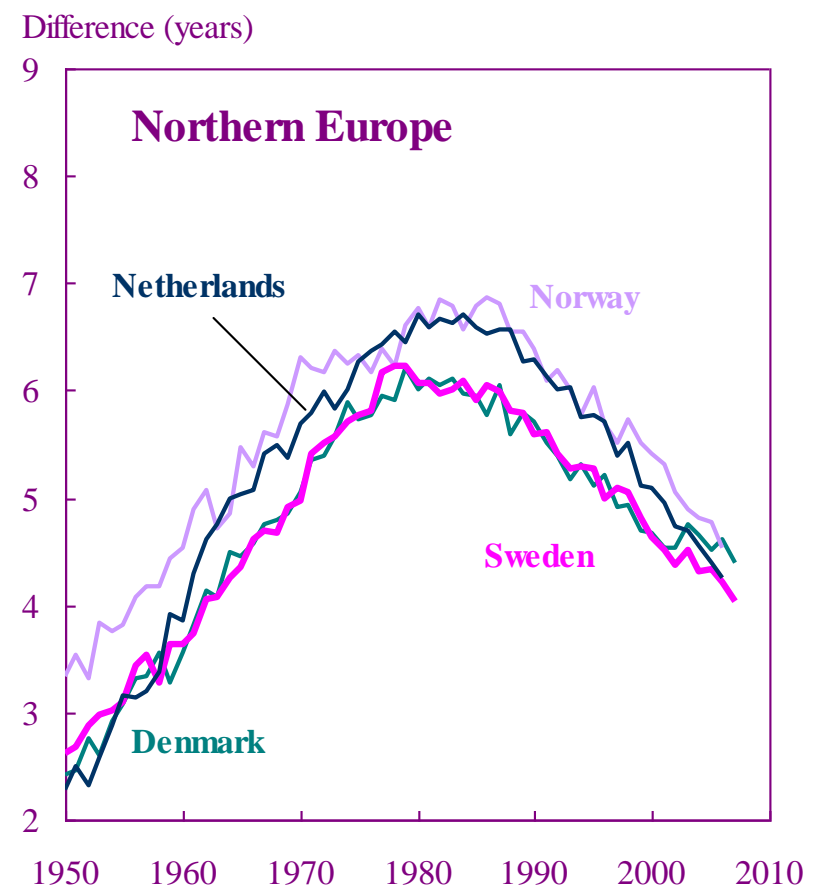
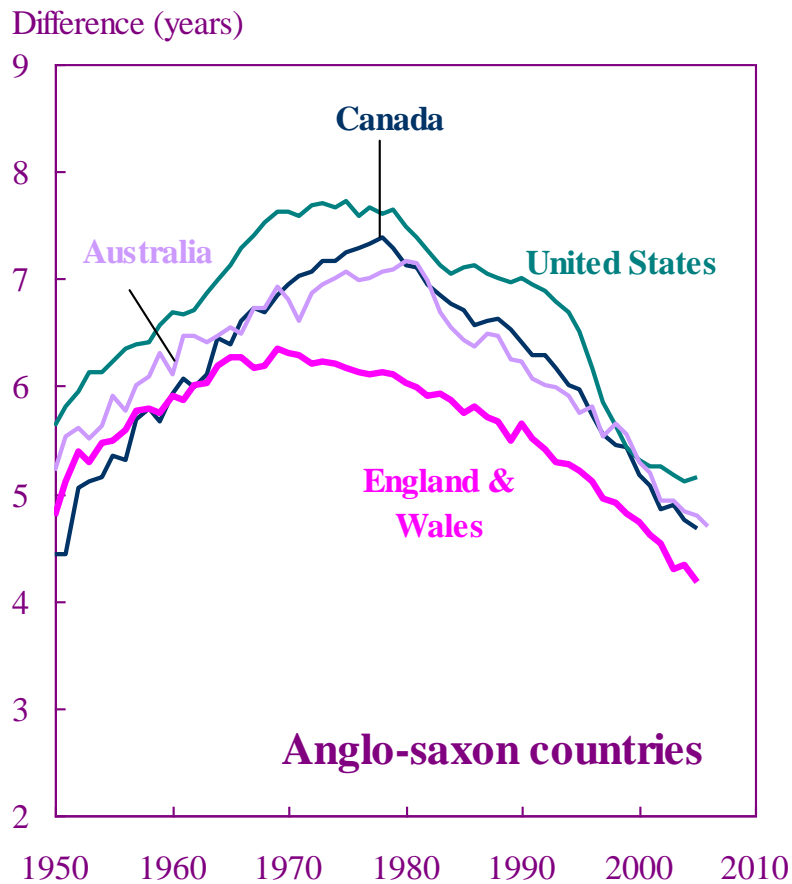
- In the 18th and early 19th century and in some of developing countries in recent decades, women experienced higher mortality at ages from 20 to 45 (by 5% to 20%) due to maternal death. Too early marriages and pregnancies of young girls.
- The lack of value of female sex under conditions of poverty. Worse treatment of little girls. Female excesses of infant and child mortality in historical Europe and in some developing countries today (India, Bangladesh).
- In France, in the 18th century and other historical populations in absence of medicine and hygiene, there was a “biological” male excess of infant mortality, but female mortality was higher at ages 5 to 18.
- Female health disadvantage at younger ages, leads in some cases to female disadvantage in length of life or to very small gender differences in the total life expectancy at birth.
- Evidence of feticide (elimination of female embryos after an ultrasound scan) or even female infanticide in some countries.
- Progress of medicine in fight with infectious disease, general humanization and improvement of social status of women have resulted in reduction of negative health influences on women and contributed to a re-gain of their natural advantage.



Determinants of the widening gap from the 1950s to the 1980s

- During the first decades of the 20th century factors working against the female advantage have weakened in developed countries.
- By the mid-1950s mortality at young ages and infectious diseases had been largely eliminated. Although mortality decrease at these ages and from these causes continued, it had no potential to influence the overall life expectancy substantially. The new epidemiological pattern was dominated by chronic and man-made diseases (CVD, cancers, various accidents).
- At this stage, sex differences in behaviors are becoming more important for the total mortality. Throughout the 20th century, men were exposed to smoking, alcoholism, risky driving, and industrial exposures more than women. In this period, the new health hazards were related to instant or delayed impacts of these factors on disease and death.
- Over most of the 20th century, the life expectancy gap between men and women has been increasing. In the 1960s and the early 1970s, male life expectancy stagnated and male mortality from IHD increased, while female life expectancy continued increasing (at a slower pace).
- Other differences between male and female behaviors might be of importance. Women pay more attention to their body and consume more medical services.

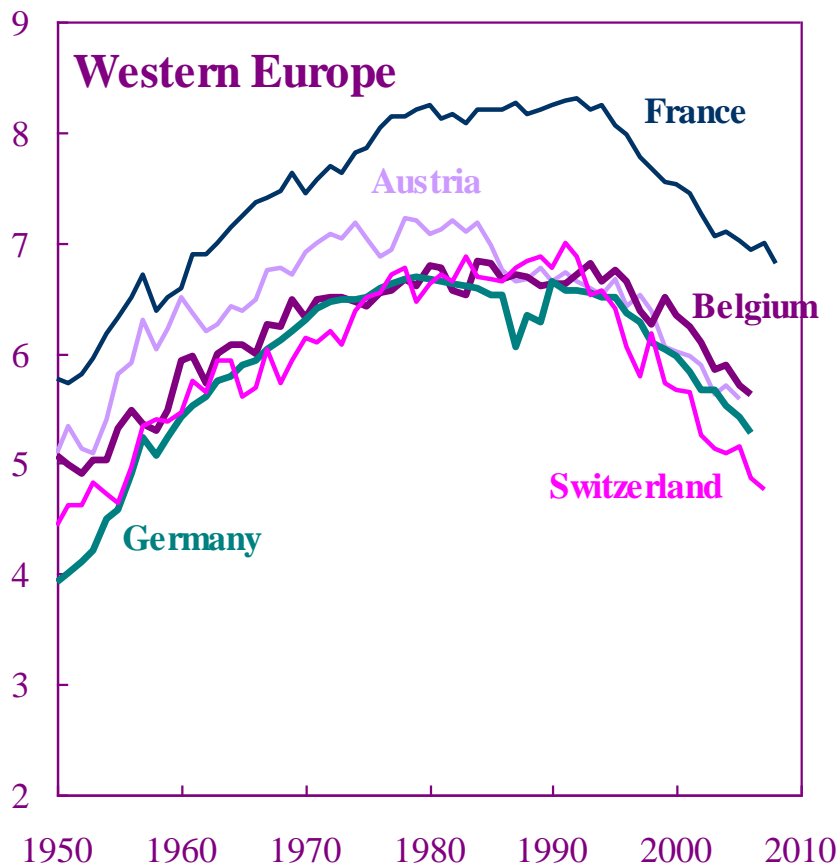
Increases and decreases in the male-female life expectancy gap (1)



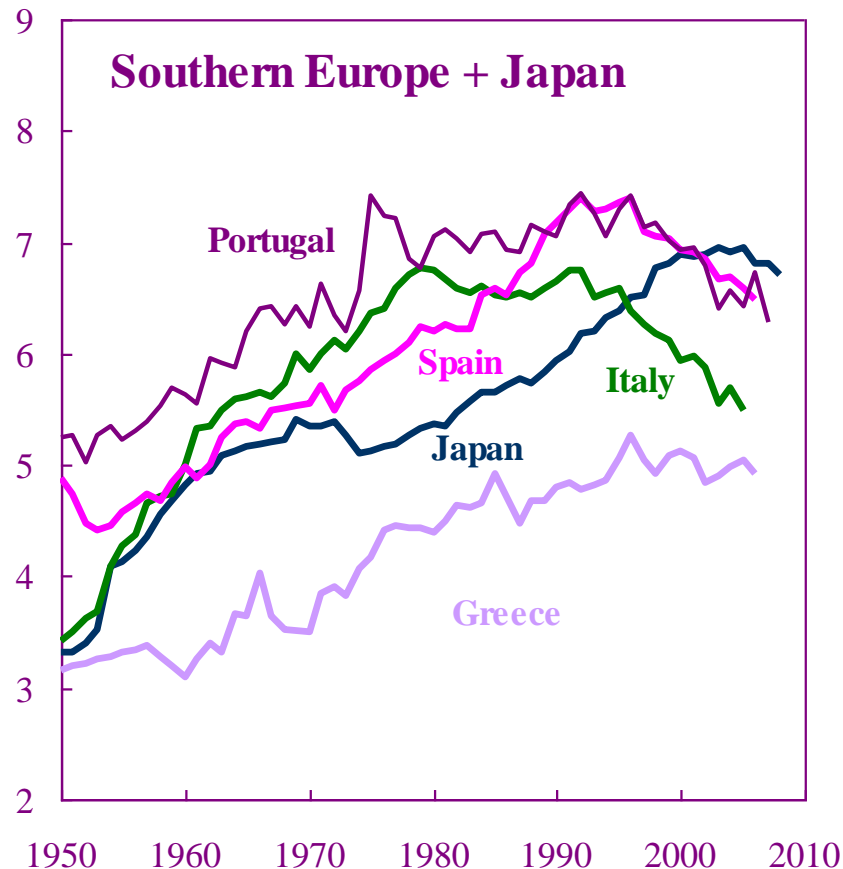
Clear phases of increase and decrease in the Anglo-Saxon and Nordic countries. A difference: lower initial gap in Nordic countries in the 1950s. Somewhat earlier beginning of the decrease in the Anglo-Saxon group.

Increases and decreases in the male-female life expectancy gap (2)

Difference (years)



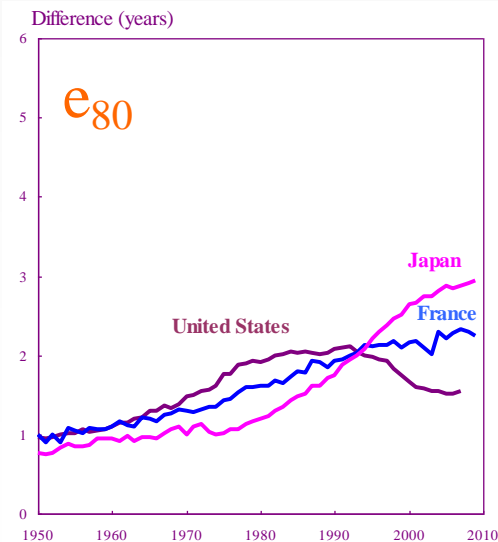
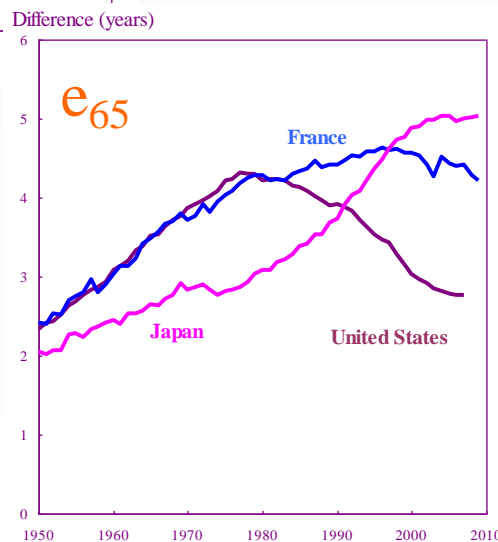
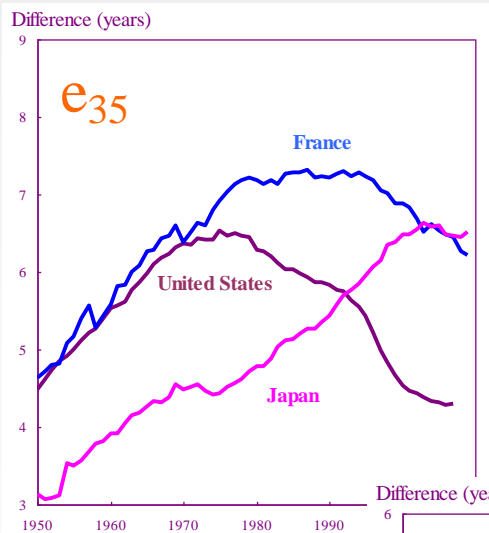
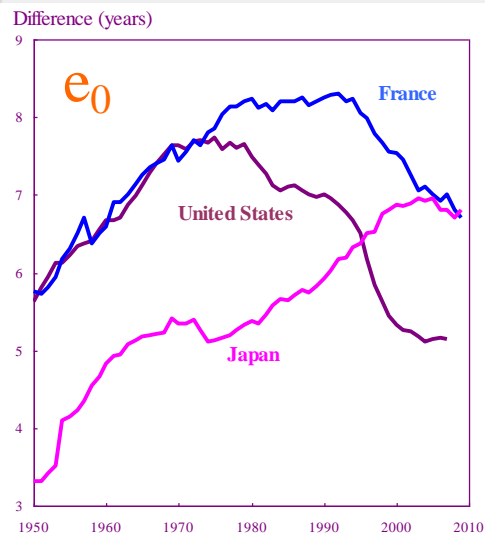
Difference (years)



A less pronounced increase and decrease stages with a plateau over the 1980s-90s in Western Europe. Very late beginning of decrease in the gap in Southern Europe and Japan.



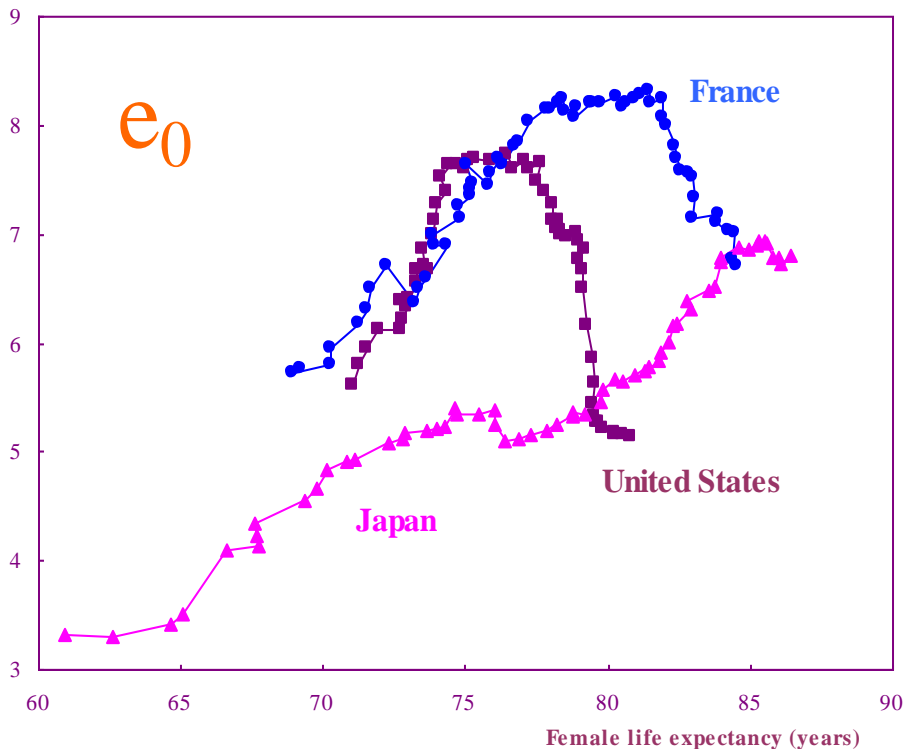
Male-female life expectancy gaps at different ages: France, Japan, and the USA



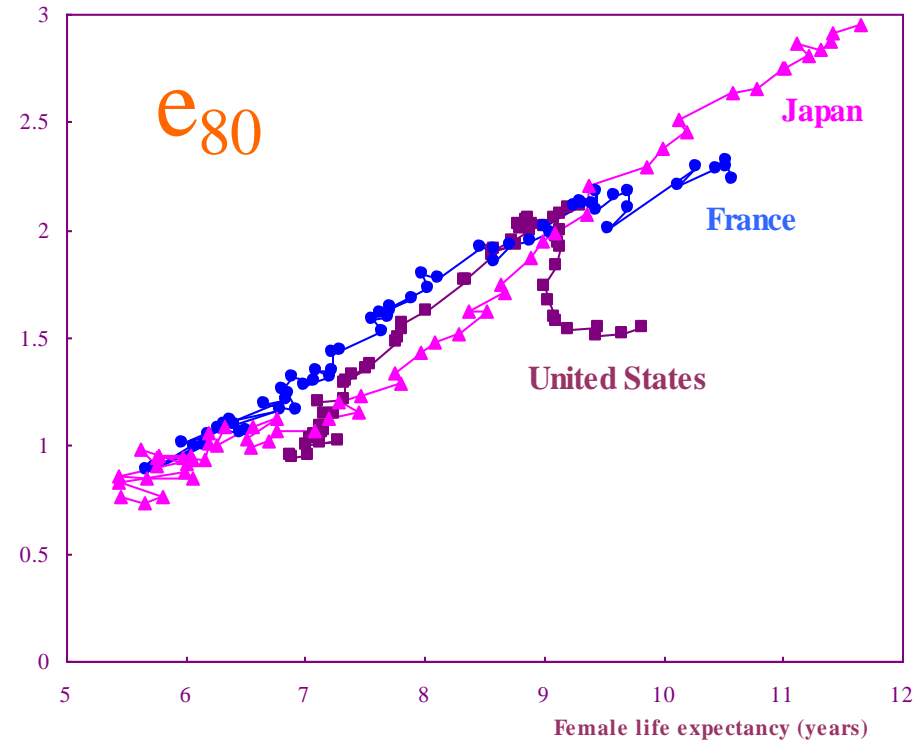
Clear patterns for e_{35} . Less significant decrease for e_{65} and very flat trends for e_{80} .

To what extent the gap is driven by female and male mortality decreases?

Difference (years)

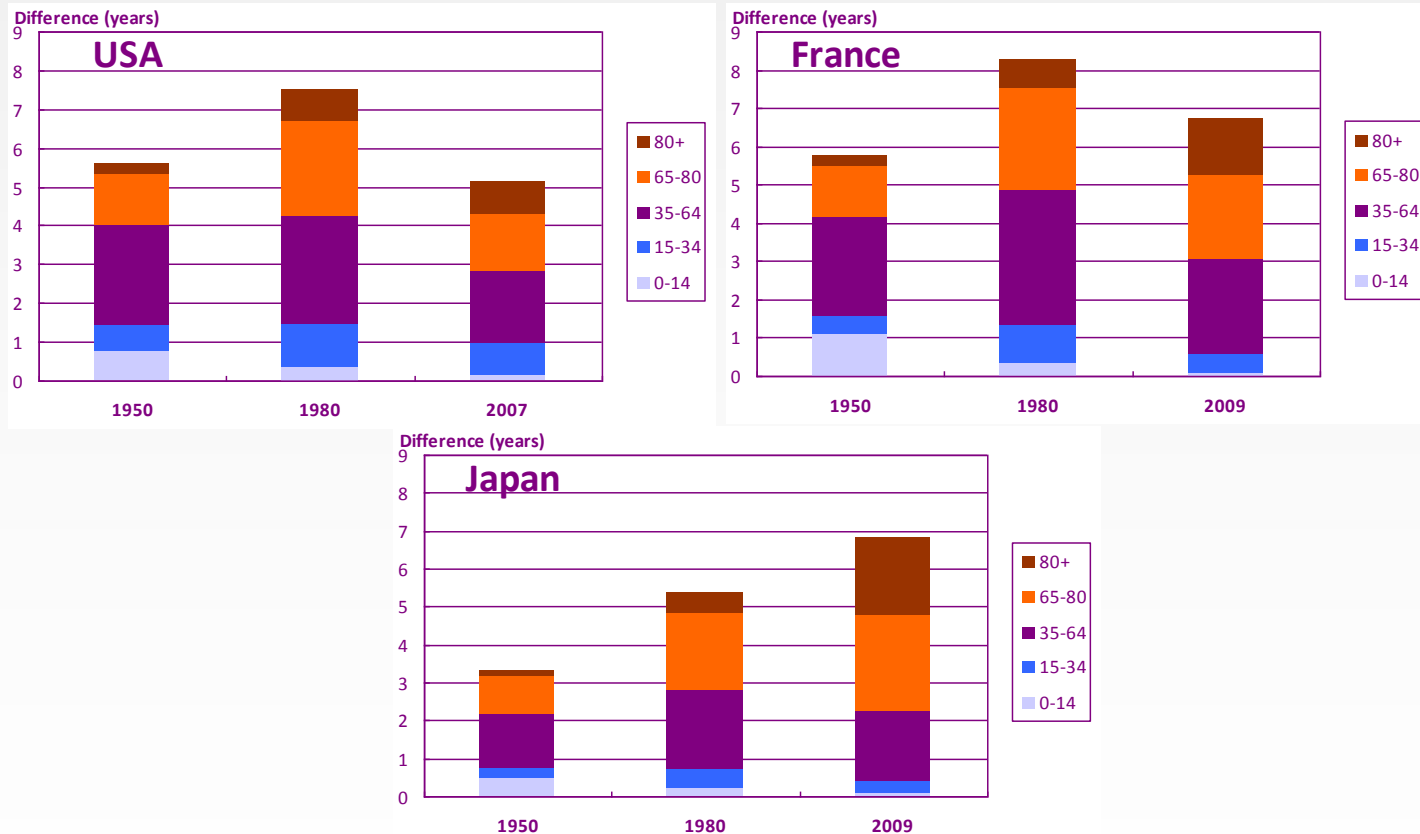


Difference (years)



The $e(F)$ vs. $e(M)$ vs. $e(F)$ trajectories. The US: increase stage - slow female progress and nearly no male progress; decrease stage: male progress and much slower female progress. France: steeper progress for females than for males, then progress continues at the speed for both sexes, then progress for males becomes steeper than that for females. Japan: progress for both sexes that is always steeper for females. Very old age: progress for both sexes, but steeper for females. Remarkable slow-down in the female progress in the US.

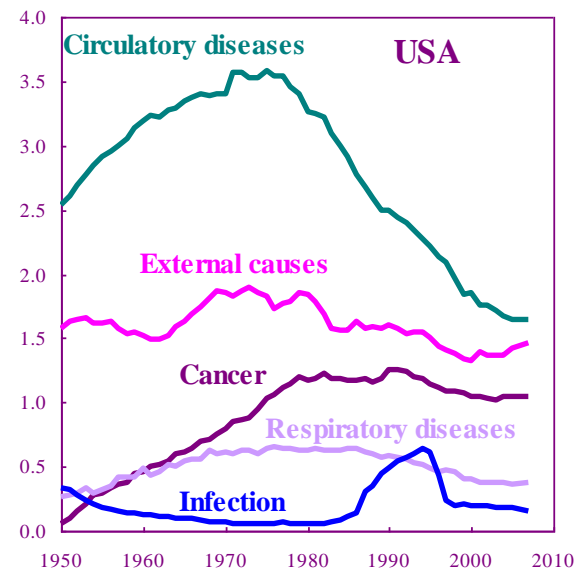
Age-specific components of the life expectancy gap



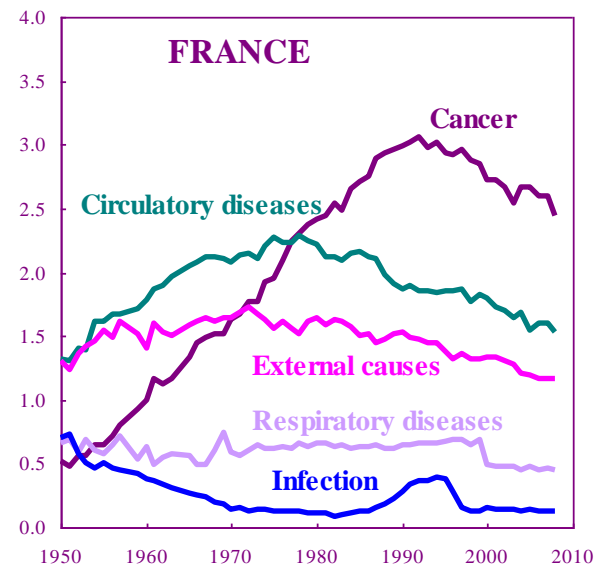
The changing sex gap depends more and more on the sex mortality differences at old ages.

Cause-specific components of the life expectancy gap

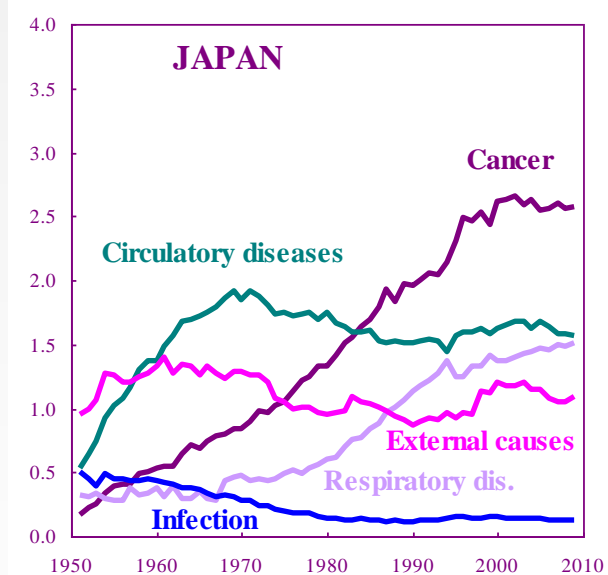
Contribution (years)



Contribution (years)



Contribution (years)



Decomposition of the sex LE difference for every year.

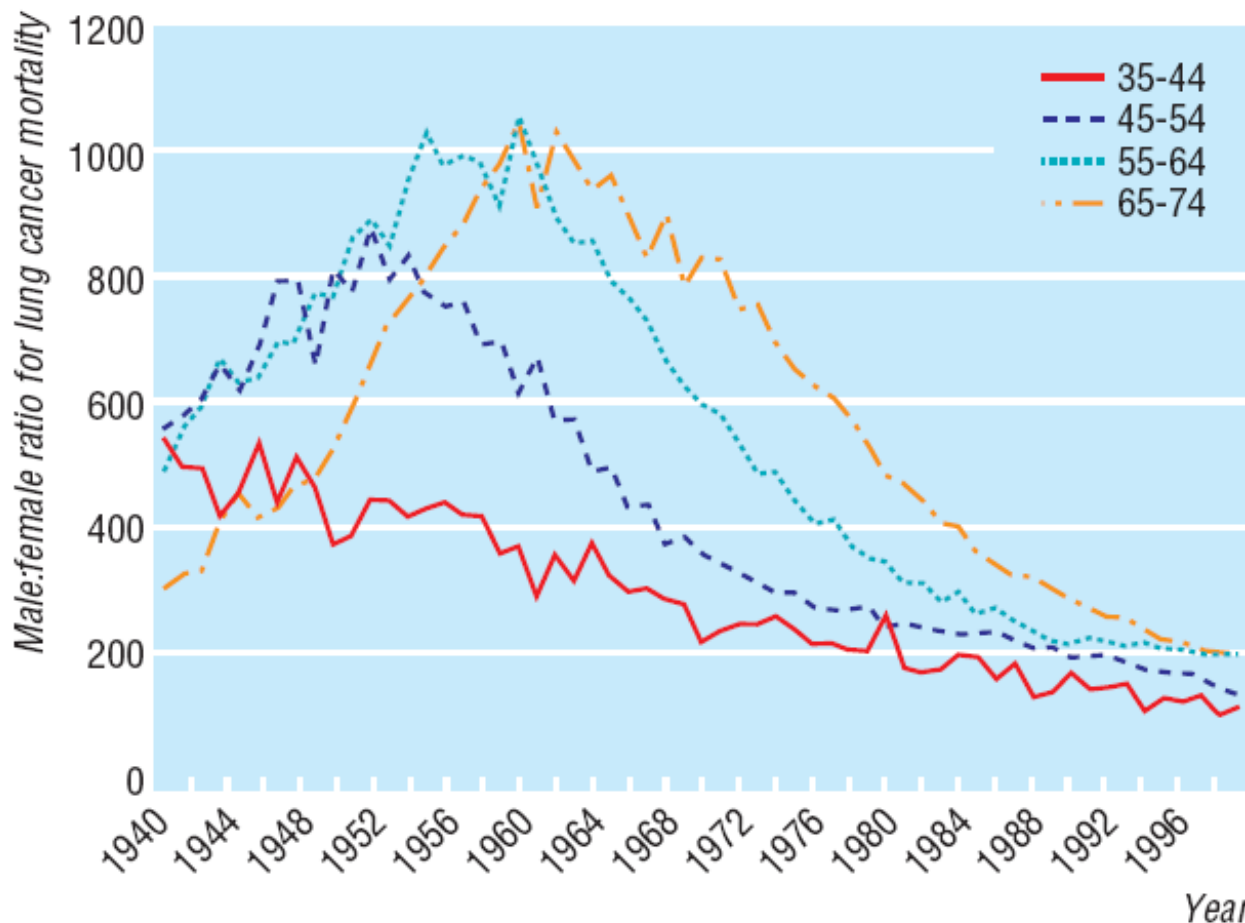
Dominant role of CVD and cancers for both increase and decrease of the gap. Always high contribution of external causes. Rise of the respiratory disease component in Japan. Temporary rise of the infections' component in the US and France (HIV/AIDS).



Determinants of the narrowing gap since the 1980s-1990s

- Changes in male behaviors: reductions in smoking and alcoholism. New speed limits and other regularities reduce risky driving. Decrease in industrial manual jobs leads to narrowing of the occupational differences between men and women.
- Later smoking epidemic among women results in narrowing of the gap in smoking in younger cohorts. Women are more and more involved in labor, car driving and other former “male” activities.
- Developments in medicine allow to prevent or treat circulatory disorders and tumors that had been untreatable earlier.
- Female mortality was largely suppressed at young and midlife ages already in the 1980s. Harder to make further progress for women. The same proportional mortality reductions cause greater gains in life expectancy when the initial level of mortality is higher (males). (Glei and Horiuchi, 2007).
- What else ?

Role of smoking (1). A cohort elevation of the male/female lung cancer mortality ratio



Source: Lawlor, Ebrahim, Davey Smith, 2001

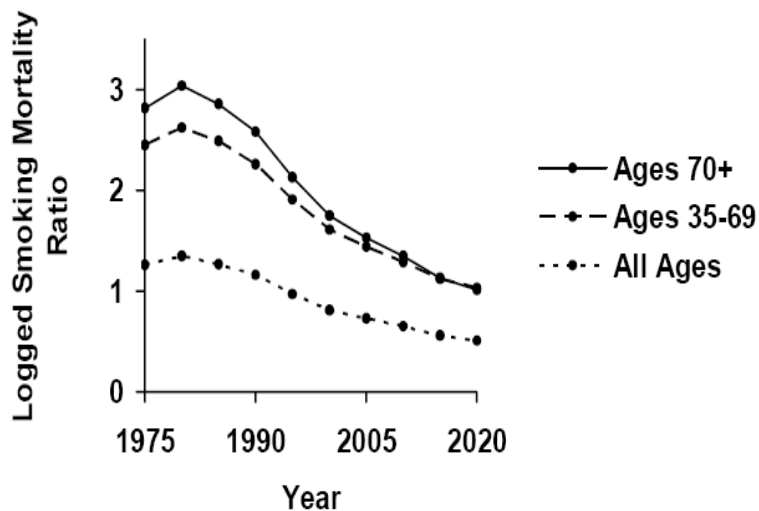
England and Wales. The ratio greatly varies with respect to year of birth. The maximum male/female ratio is at maximum among those who were born around 1900. Men born in these years were exposed to tobacco much more than women born in the same years.



Smoking and non-smoking mortality (Pampel, 2005)

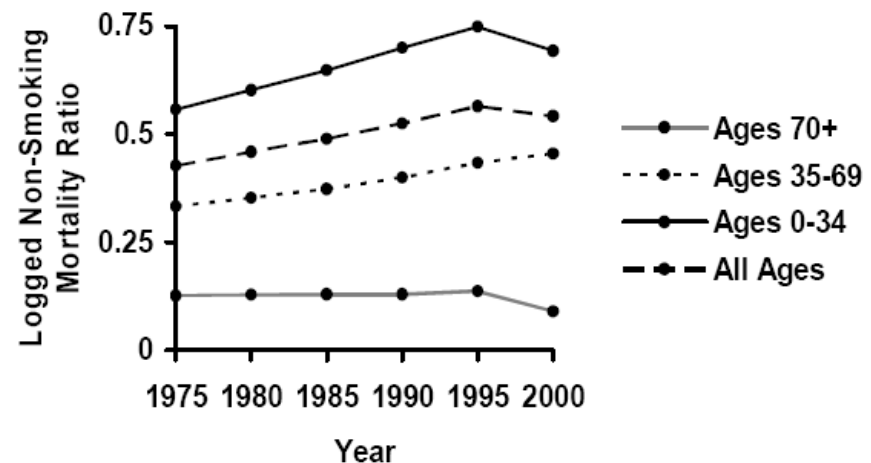
Using data on mortality of men and women in 21 high income countries (1975-2000) and cigarette diffusion statistics over 1955-1970 in the same countries, F.Pampel produced indirect estimates of smoking and non-smoking mortality, modeled changes in the male/female mortality ratios for these two parts of mortality and projected them into the future. The method for indirect estimation of smoking-related mortality BY Peto, Lopez et al., 1994.

Figure 1: Predicted Trends (From Fixed Effects OLS Regression Models) in Logged Smoking Mortality Ratio from 1975-2020, by Age



Source: Pampel, 2005.

Figure 2: Observed Trends in Logged Non-Smoking Mortality Ratio from 1975-2000, by Age





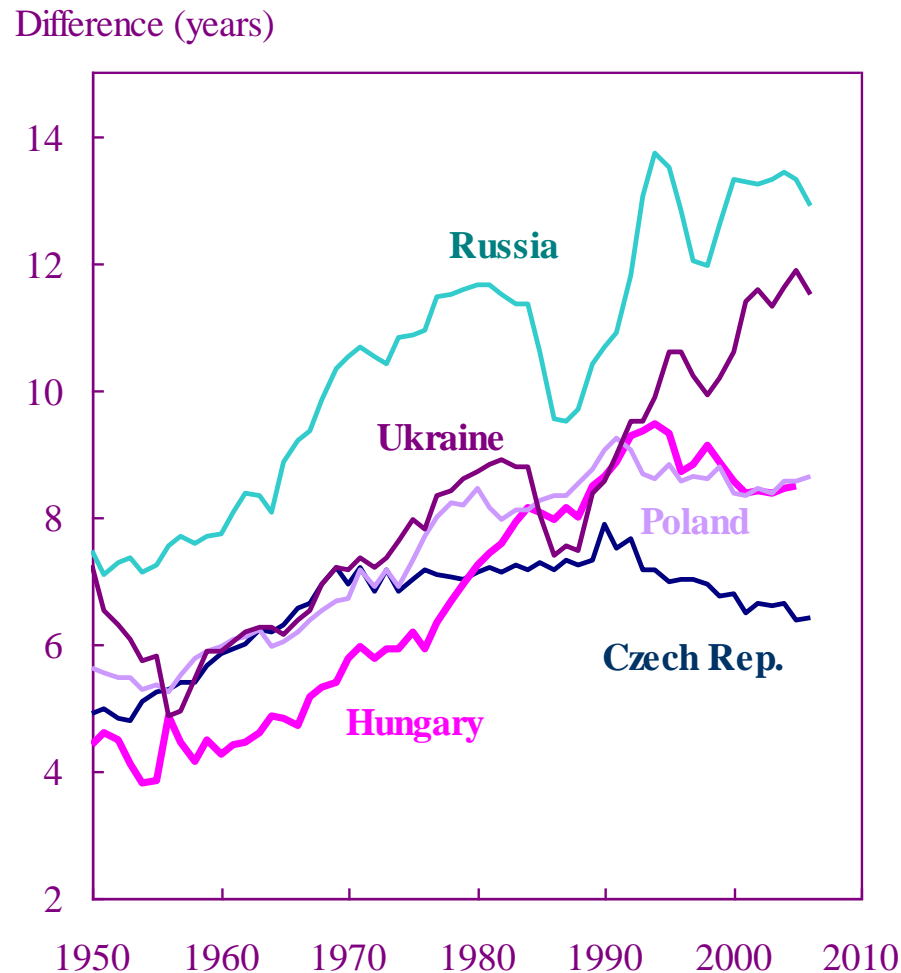
Role of smoking (3). Smoking and non-smoking mortality

Outcomes:

- Reduction of the male mortality excess is related to a general decrease of smoking and equalization of smoking with respect to sex.
- As men affected by the tobacco epidemic earlier than women, the sex differential in smoking-attributable mortality rises.
- Later as smoking mortality among men peaks and begins rising among women, the differential stops growing and begins narrowing.
- The more advanced the stage of the epidemic, the closer the smoking mortality rates of men and women. This explains inter-country differences in the extent of the recent reduction of the male-female mortality gap (e.g. the US vs. Spain).
- As smoking mortality becomes lower, sex differential in the non-smoking mortality becomes more important.

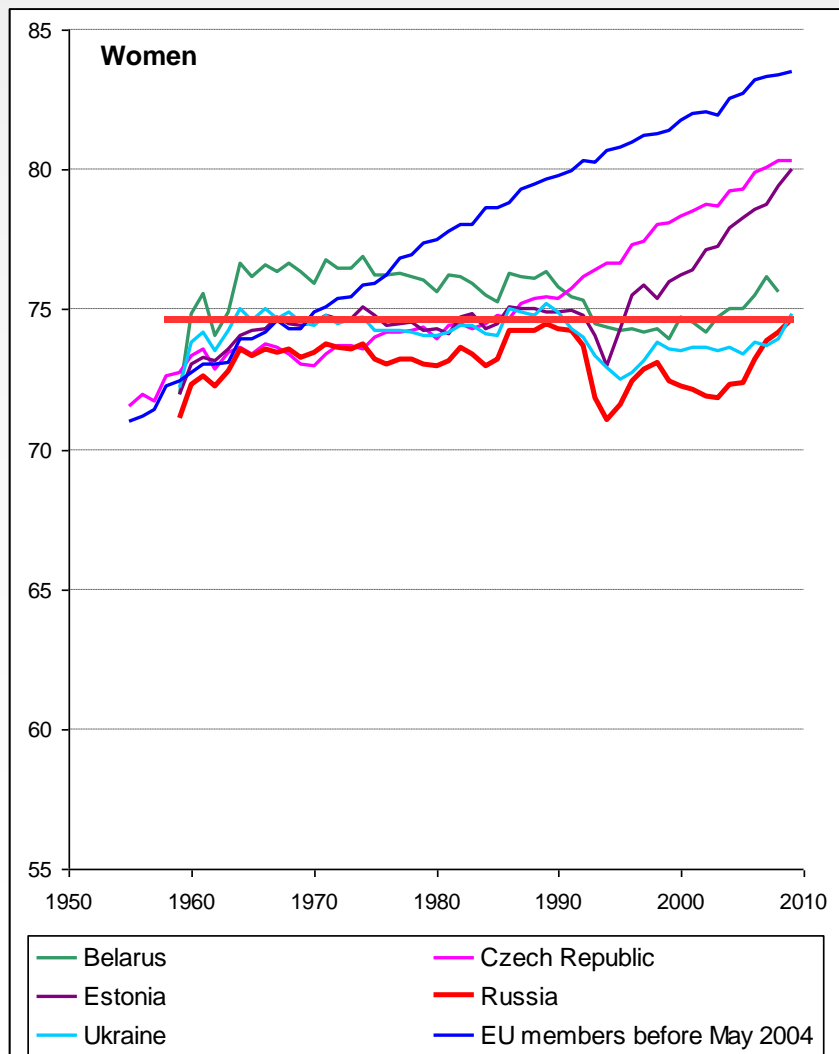
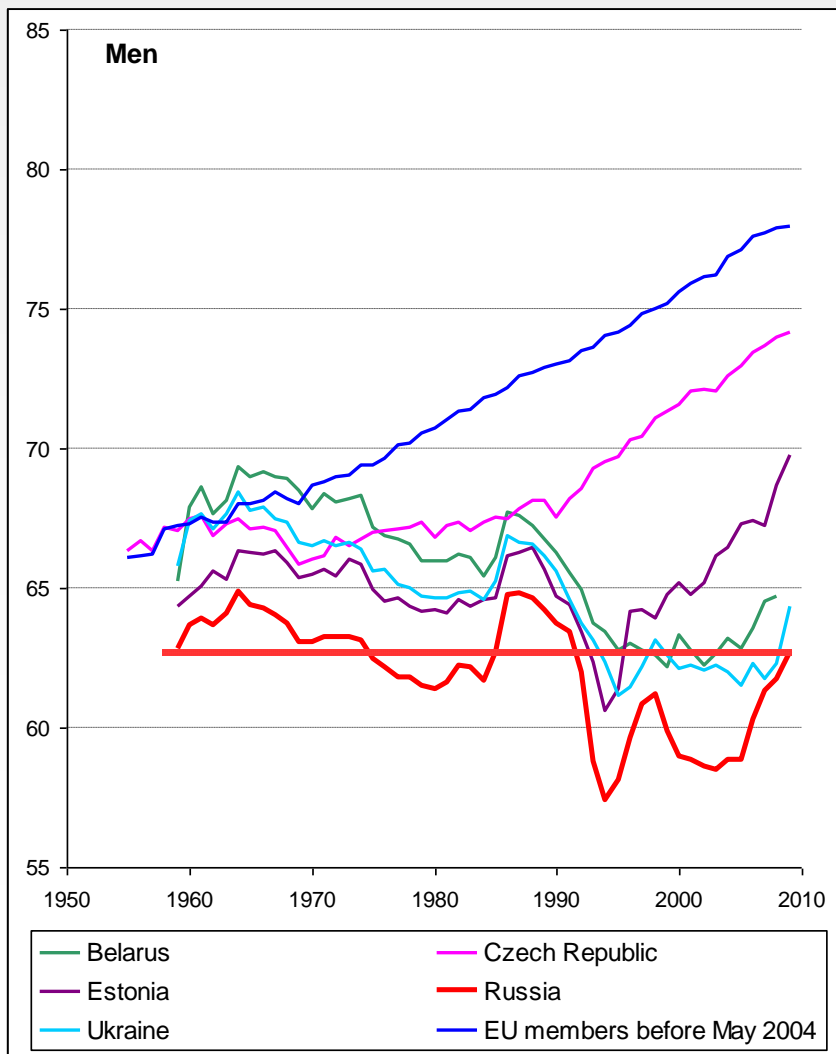


Male-female life expectancy gap in Eastern Europe. A different story.

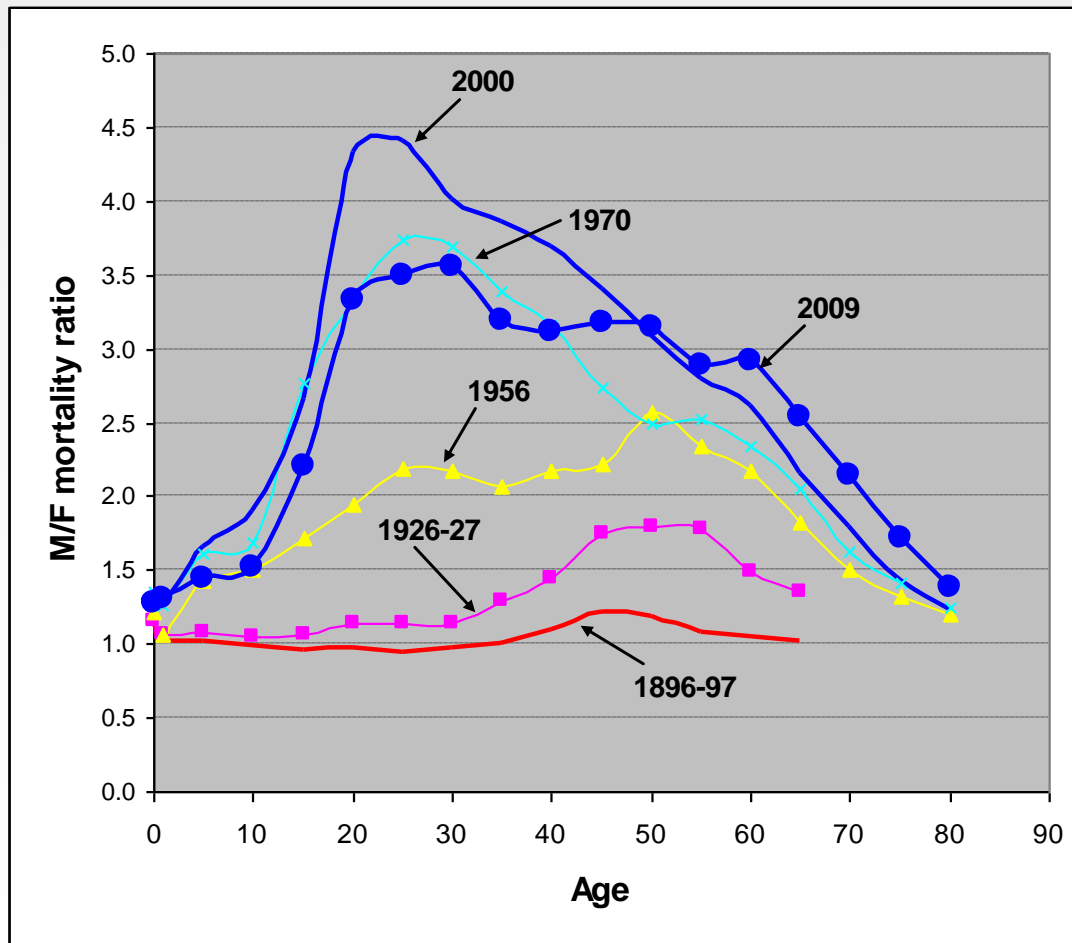


Widening of the gap up to values exceeding ten years in Russia and Ukraine. A contrast to recent reductions in Hungary and Poland and a longer-term reduction in the Czech Republic.

Sex-specific life expectancy trends. Outstanding health crisis in Russia, Ukraine, and Belarus since the late 1960s

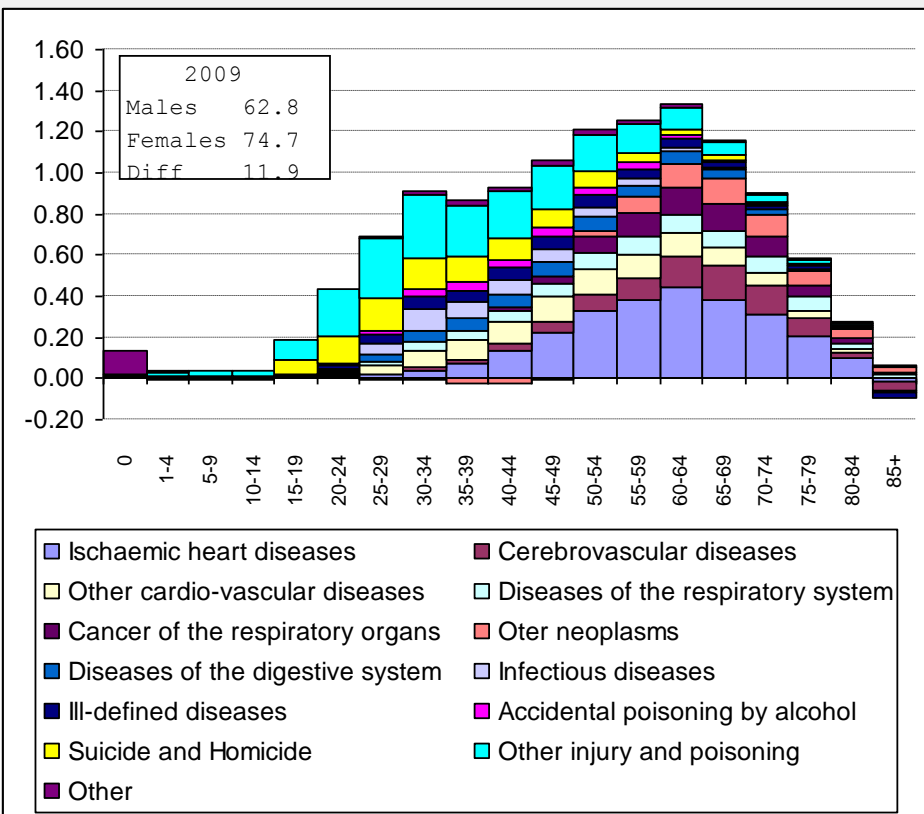
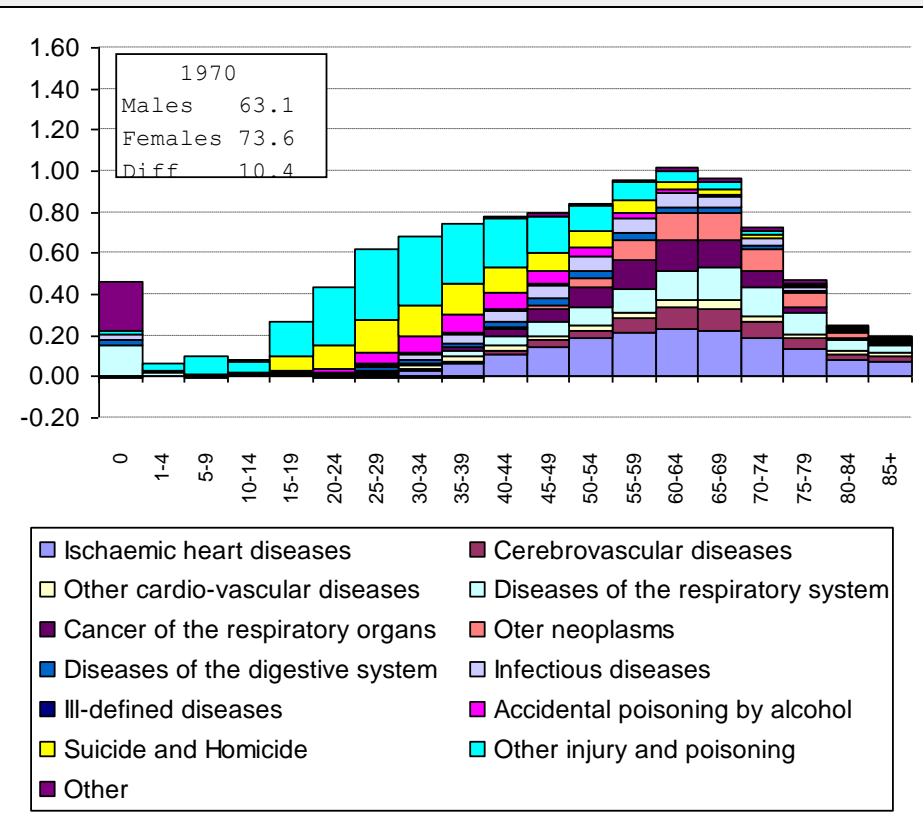


Age pattern of the male-female mortality difference in Russia: 1896-97 to 2009



Russia experienced a transition from very low sex difference on the edge of the 20th century to the extreme excess male mortality in last decades the 20th century.

Decomposition of the female-male life expectancy gap in Russia by age and causes of death



The same pattern that has aggravated. External causes at working ages. CVD at older ages. A much “younger” gap compared to that in the West.



Male and female mortality from selected causes. Russia vs. UK, 2009

	Russia			UK			Rus/UK	
	M	F	M/F	M	F	M/F	M	F
All causes	2249.4	1092.8	2.06	845.9	594.0	1.42	2.66	1.84
Ischemic heart disease	645.3	328.0	1.97	148.2	66.9	2.21	4.35	4.90
Cerebrovascular disorders	343.5	242.9	1.41	56.5	53.4	1.06	6.08	4.55
Rheumatic cardiopathies	3.2	3.6	0.89	1.1	1.7	0.65	2.82	2.05
Other diseases of the circulatory system	191.9	97.7	1.96	64.2	48.9	1.31	2.99	2.00
Chronic respiratory disease	55.1	11.3	4.89	44.6	30.7	1.45	1.24	0.37
Cancer of trachea, bronchus and lung	92.9	10.7	8.71	63.8	40.1	1.59	1.46	0.27
Cancer of stomach	44.5	18.1	2.45	10.0	4.3	2.34	4.46	4.26
Cancer of the intestine, rectum and anus	40.1	25.5	1.57	27.5	17.3	1.59	1.46	1.48
Cancer of the breast		31.1			32.5			0.96
Leukemia	14.8	9.2	1.61	21.1	12.6	1.68	0.70	0.73
Other neoplasms	150.2	76.0	1.98	145.6	86.5	1.68	1.03	0.88
Cirrhosis of liver	51.6	26.6	1.94	14.4	7.2	2.01	3.58	3.72
Tuberculosis, all forms	35.4	7.1	4.97	0.7	0.3	2.00	52.23	21.00
Other infection	11.1	4.6	2.40	8.7	7.3	1.19	1.28	0.63
Alcohol poisoning	30.5	7.6	4.04	0.8	0.3	2.34	39.83	23.12
Transport accidents	38.2	11.5	3.31	8.0	2.0	4.08	4.79	5.92
Homicide	28.6	7.9	3.61	0.5	0.2	2.41	57.74	38.46
Suicide	56.2	9.3	6.04	13.5	3.6	3.79	4.17	2.62
Violence of unspecified intent	54.8	12.1	4.53	4.0	1.7	2.40	13.55	7.18
Other causes	361.7	151.9	2.38	212.5	176.5	1.20	1.70	0.86

Age-standardized mortality rates (European population standard). For some causes, the sex differences are extremely high in Russia. For some causes, both male and female mortality in Russia is very high compared to the UK.



Determinants of the large male-female life expectancy gap in Russia

- The sex differential in survival in Russia is related to mortality at much younger ages compared to the sex differential in the West. A large part is due to excess death of men at ages from 15 to 60 due to external causes and CVD.
- During the period of gradual mortality elevation (1965-1984) and the “crisis” years in the early 1990s, proportional increases in male mortality were the same or even greater than proportional increases in female mortality in spite of much higher initial levels of male mortality.
- In present, the Russian mortality is very high both for men and women. But men experience much higher risks of early death from alcohol- and smoking-related causes, violent causes, and IHD.
- Male burden of alcohol abuse and other adverse behaviors. Cause deaths from certain alcohol-related, accidents and violence as well as certain CVDs.
- Spread of criminal and deviating behaviors due to lack of law and order.
- P.Watson: particularly high psychosocial stress among men due to their role of family breadwinners under unexpected and difficult economic circumstances. Hard to cope. Women are focused more on their role



Although mortality of women is substantially lower than mortality of men nearly everywhere, women usually report worse health, more sickness and activity limitations.

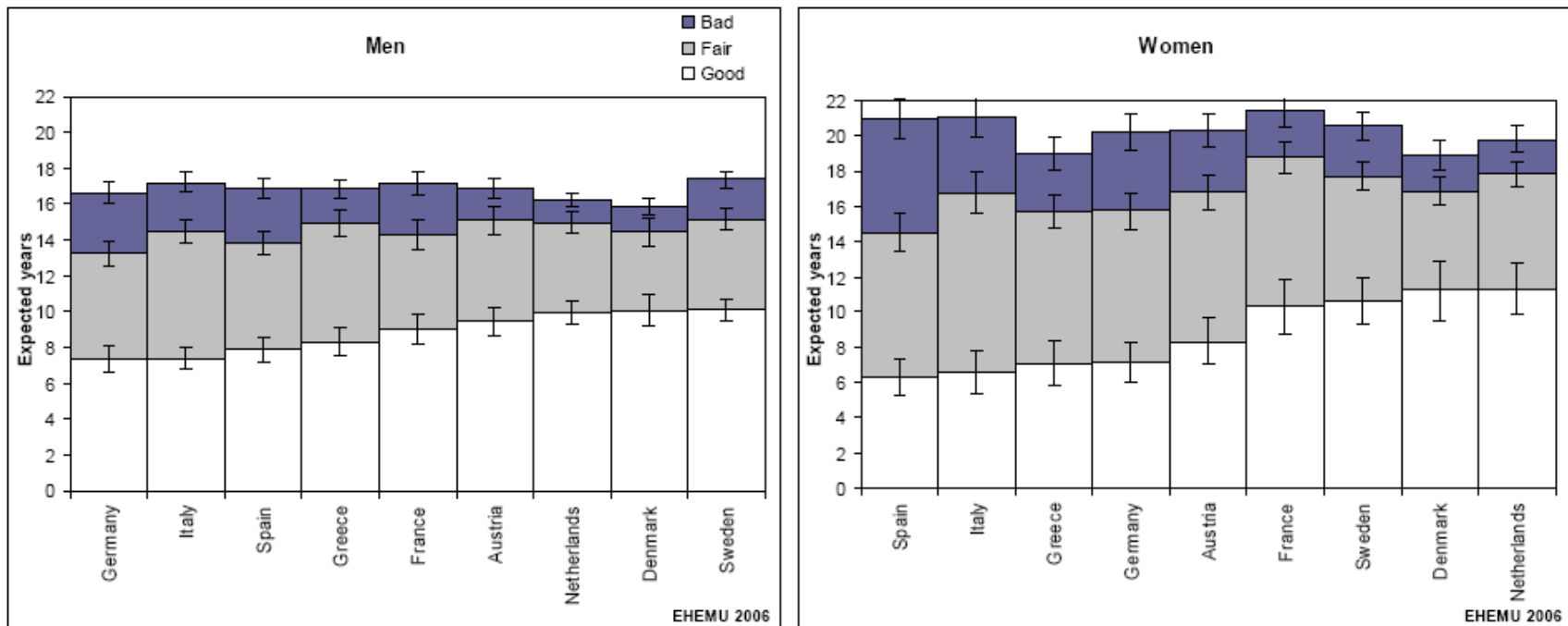
Age-standardized prevalence of bad health and activity limitations (per 1000) in selected national samples. SILC (EU Statistics on Income and Life Conditions) surveys

	Health		Activity limitations	
	M	F	M	F
Finland	60.6	53.3	208.5	241.6
France	68.0	75.2	153.5	178.8
Germany	66.2	71.3	224.9	230.7
Hungary	143.0	152.9	197.1	205.0
UK	48.9	45.2	138.4	148.7
EU old 15	64.2	71.3	171.6	193.3



Longer life in bad health among women. A consequence of worse reported health

Figure 3: Life expectancy and expected years in good, fair and bad perceived health at age 65 by country, men and women, 2004 (European version SHARE)



Sources: Eurostat and SHARE 2004



Why could it be ?

Potential explanations:

- Women are healthier than men but report more readily about their health problems and diseases. Women are less “stoical” than men.
- Sex differences in composition of morbidity. Women may be more likely than men to suffer from health conditions, such as arthritis or headaches, that result in poorer self-rated health but contribute little to mortality. Men may experience more dangerous but less painful conditions such as CVD or respiratory problems.
- Due to some measurement problems, facts underlying the paradox may be not correct. For example, within a given health condition women may experience higher prevalence, but may experience less of well-defined physical symptoms and organic changes.



The Case & Paxson (2005): study on “Sex differences in morbidity and mortality”

Data and methods

- The US National Health Interview Survey (NHIS) 1986 to 2001. Includes self-reports on health, hospitalizations, and a range of chronic health conditions (18 diseases/disorders). Follow-up data on deaths of subjects interviewed in 1986 to 1994.
- Assessment of sex-specific relationships: between SRH and health conditions, between hospitalizations and health conditions. Decomposition of the female-male gaps in SRH and in hospitalizations into prevalence and severity components (see the next slide).
- Assessment of sex-specific relationships:
 - between mortality within 24 months after interviewing and health conditions;
 - between hospitalizations and health conditions.



Case and Paxson (2): prevalence and severity components

Sex-specific regressions:

$$P(SRH = "poor") = \sum_i \beta_i^{Sex} C_i + \mathbf{X}\boldsymbol{\gamma}^{Sex}$$

The probability of being in poor health is expressed as a linear function of health conditions C_i , with adjustment for age, race, survey year, and categorical variable for education.

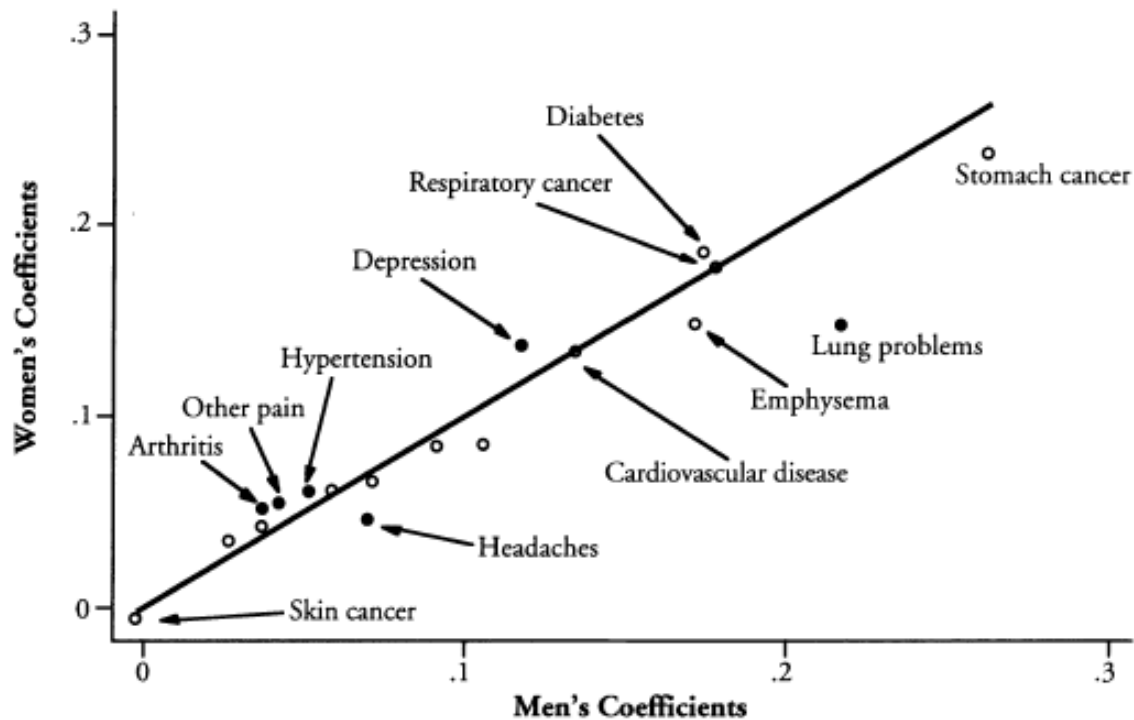
The same way the probabilities of being hospitalized or the probabilities of dying within two years after interview are expressed as a linear function of health conditions.

$$Severity_effect = \sum_i (\beta_i^W - \beta_i^M) \bar{C}_i$$

$$Prevalence_effect = \sum_i (C_i^W - C_i^M) \bar{\beta}_i$$



Figure 3. The Impact of Chronic Conditions on the Probability of Reporting Fair or Poor Health

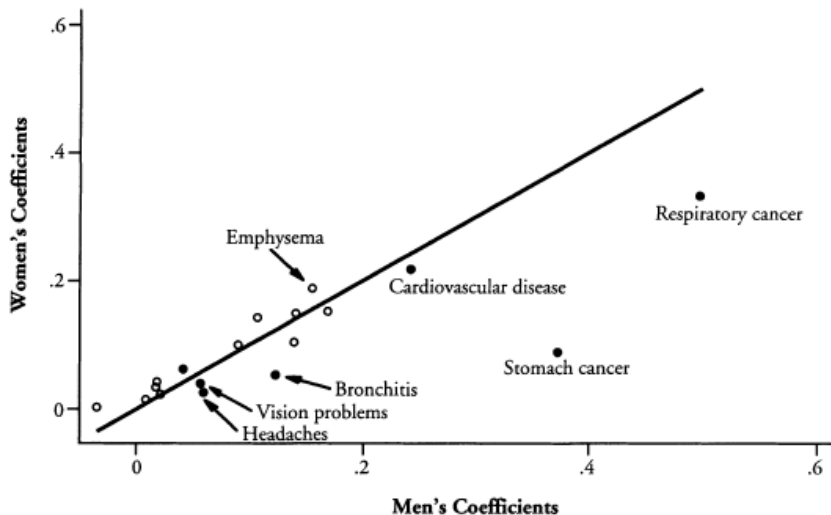


Note: Coefficients that are significantly different for men and women are represented by solid circles.

The sex difference in SRH is nearly entirely explained by higher female prevalence of health conditions.

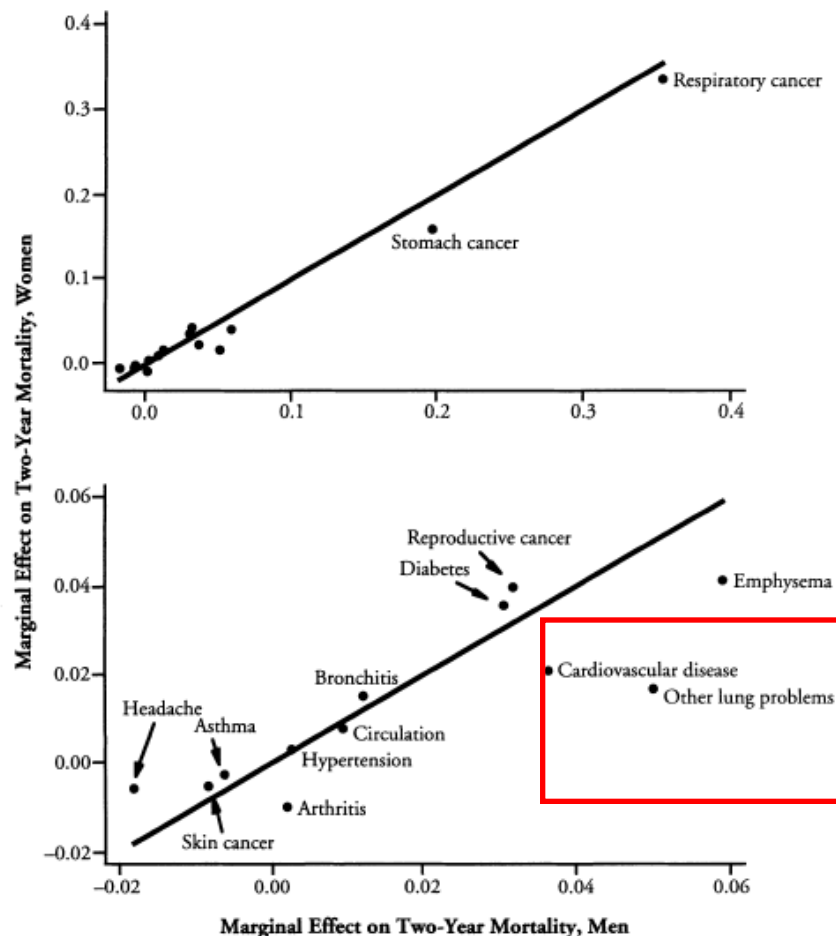
Case and Paxson (4): Significant sex differences in the hospitalizations-disease and the mortality-disease relationships

Figure 5. The Impact of Chronic Conditions on Hospital Episodes in the Past 12 Months



Note: Coefficients that are significantly different for men and women are shown as solid circles.

Figure 6. Marginal Effects of Health Conditions on Two-Year Mortality, Men and Women



Substantial differences in severity for several health conditions. For mortality: CVD, emphysema, other lung problems, respiratory cancer.



Principal findings:

- Sex differences in reported health are entirely explained by higher prevalence and different composition of health conditions among women compared to men.
- For certain health conditions (mostly related to smoking), strengths of their links to mortality (and to hospitalizations) are stronger for men than for women.

Some disadvantages of the study:

No direct information about severity/stage of the health conditions. Use of reported information on diseases (no objective medical data).
USA is a country with a weaker male-female health-mortality paradox.



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