Methods for studying socio-demographic and socio-economic patterns in cause-specific mortality

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Outline

- How education influences mortality?
- Causes of death: patterns of inequalities between and within countries
- Measurement approaches
- Empirical examples
- Public health consequences

Three models of relationships between education and health (Ross & Mirowsky, 1999; Mirowsky and Ross, 2003, 2005)

1. **The quantity model:**
   - more years of schooling – 1) more human capital, more skills, abilities, and resources; 2) greater perceived control over life (incl. health behaviour), better coping in stressful situation; 3) more social support.

2. **The credential model:**
   - effect of education is an artifact; education is unrelated to skills; the degree effect is mediated by advantaged market positions.

3. **The selection model:**
   - Selectivity by education institution (quality of education provided) - high quality education – higher market value and better social networks; cultural differences between schools, …

Accumulative advantage vs. "age-as-leveler" hypothesis

changes in health at older ages are increasingly dependent on biological ageing, whereas impacts of other variables such as education tend to decrease

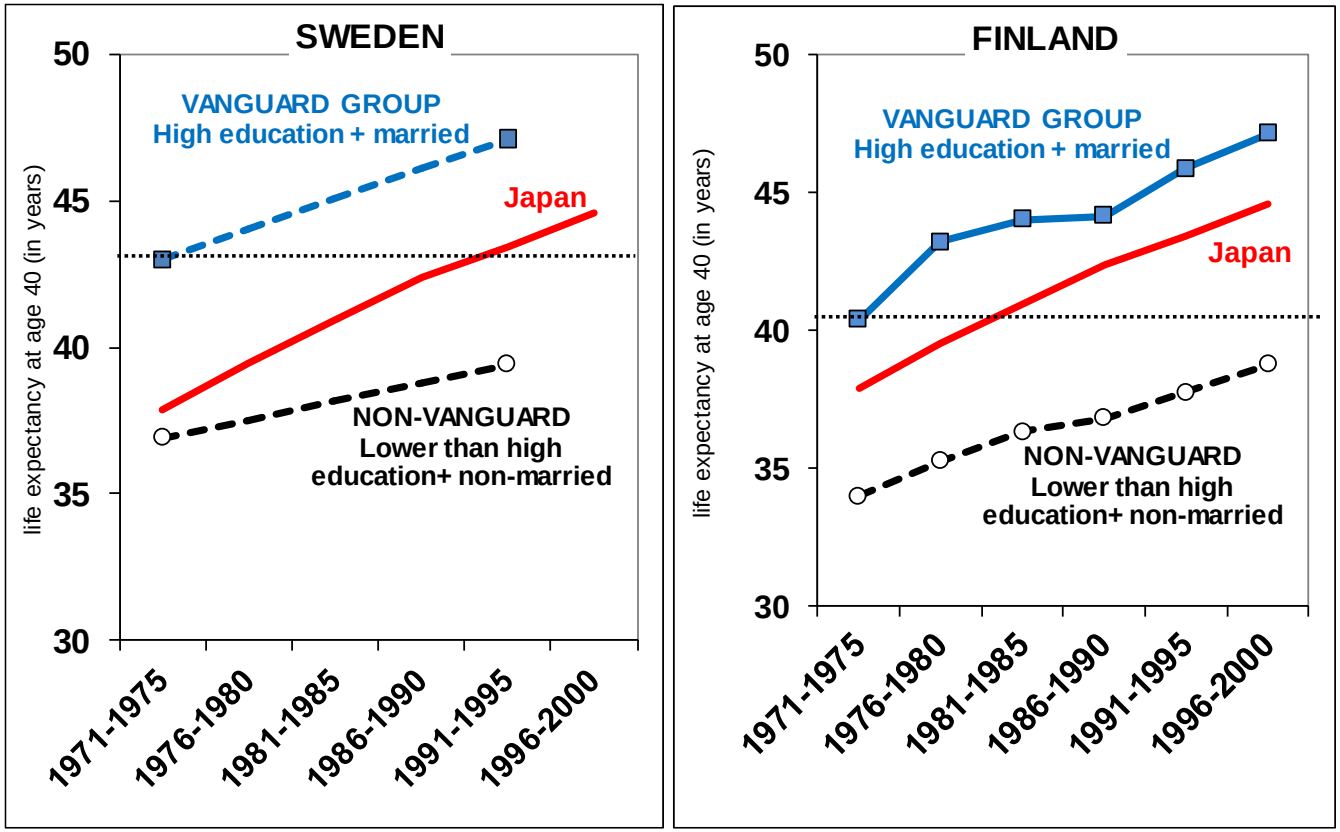
High education group – a vanguard (elite) group?

A) Better health-related life styles of high education group – "an example" for the remaining population groups?

B) Is high education group showing a pathway to reduction of mortality of entire population?

Do vanguard populations pave the way towards higher life expectancy to the others?

Trends in life expectancy at age 40 for married highly educated females, remaining females in Sweden and Finland, and for the Japanese female life expectancy at age 40, 1971-75 to 1996-2000.



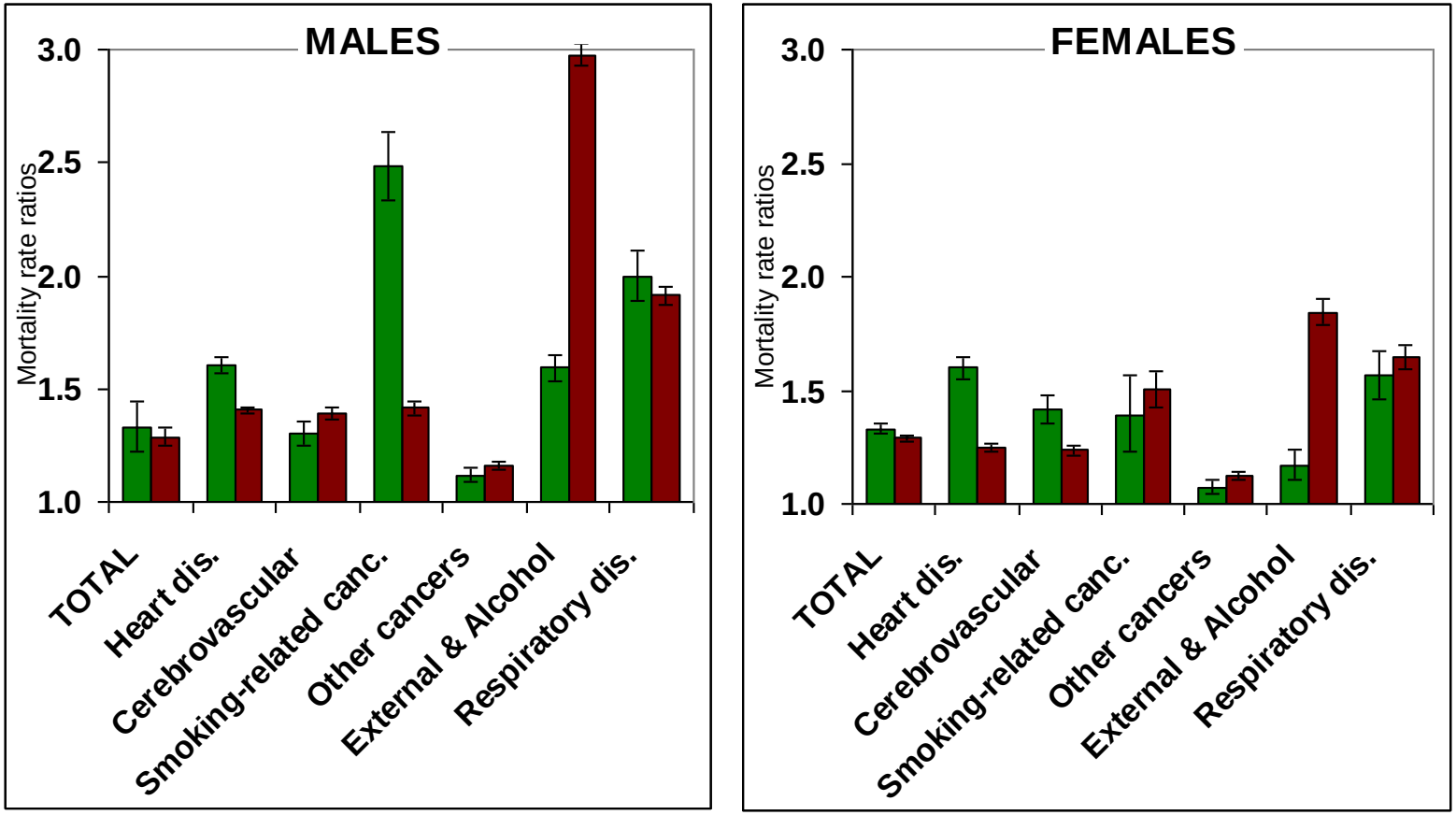
Source: Jasilionis et al., 2014 (forthcoming).

MAIN FINDINGS:

- **No systematic convergence** between vanguard and non-vanguard groups **in life expectancy, age-specific mortality, and major causes of death** even in egalitarian Nordic countries.
- Non-vanguard groups have **own pathways to low mortality**.
- **Each major breakthrough** in epidemiological development such as “cardiovascular revolution” **induces divergence in mortality at the sub-population level**.

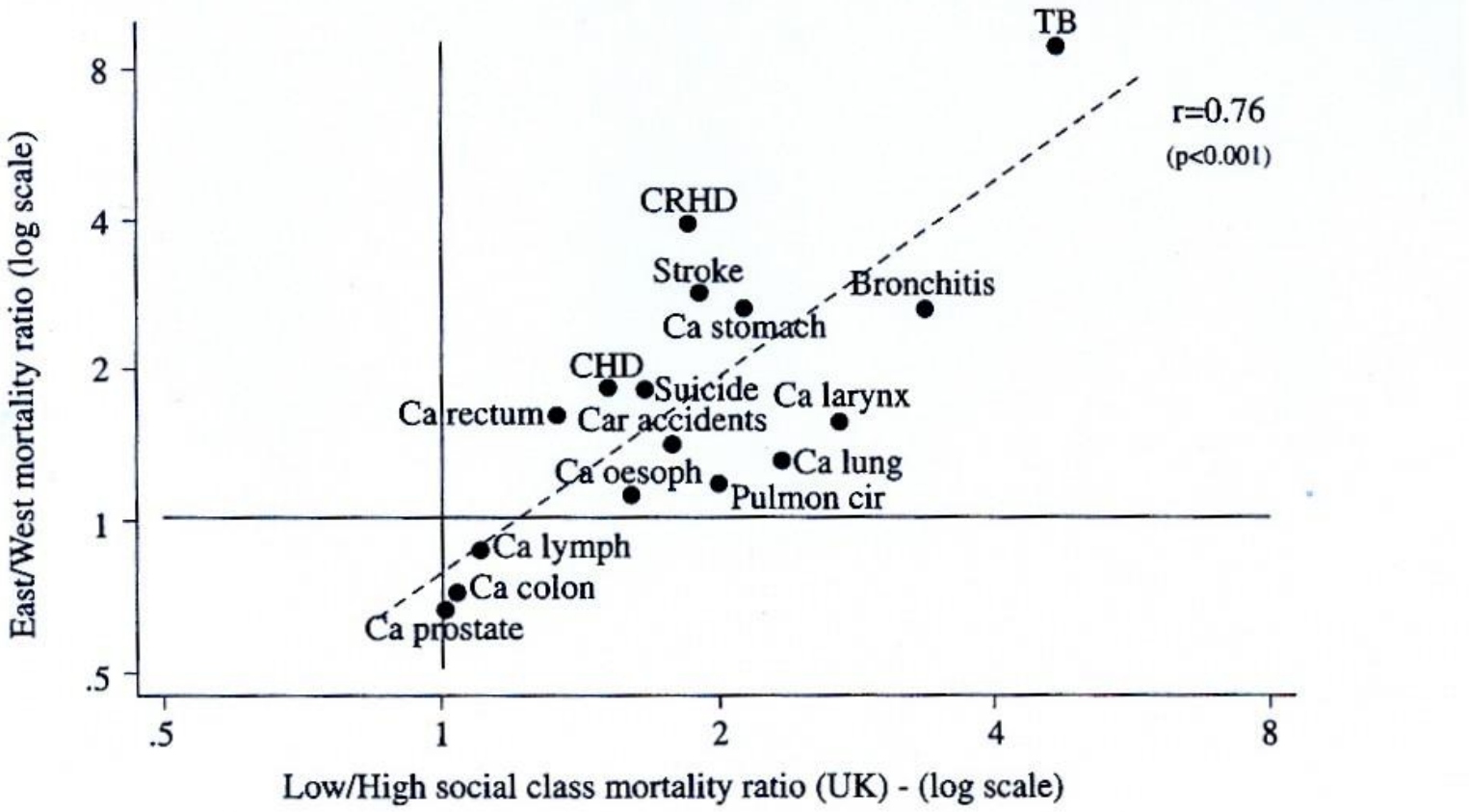
How education and marital status impact risk of dying from different causes of death

Poisson regression mortality rate ratios for Finnish males and females, ages 40+, 1971-2000:
low education vs. high education (ref.), non-married vs married (ref)
Controlled for: age, period, education, marital status.



Common patterns of inequalities between and within countries (1)

East-West vs. social class
age-standardized mortality rate ratios by cause, men aged 15-74

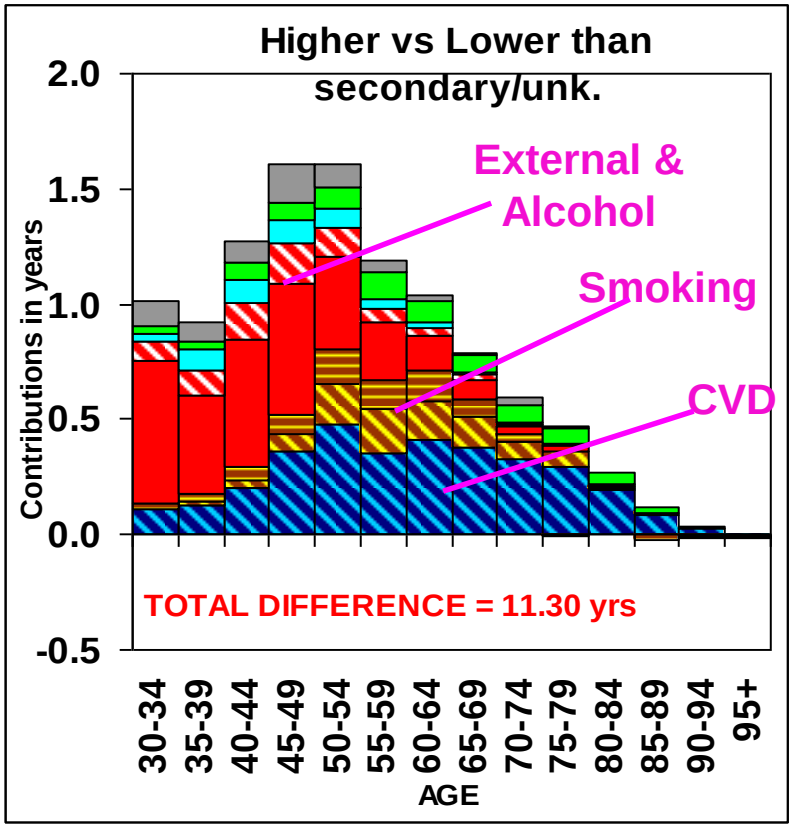


East-West mortality gap is built by (broadly) the same causes of death as the mortality difference between social classes.

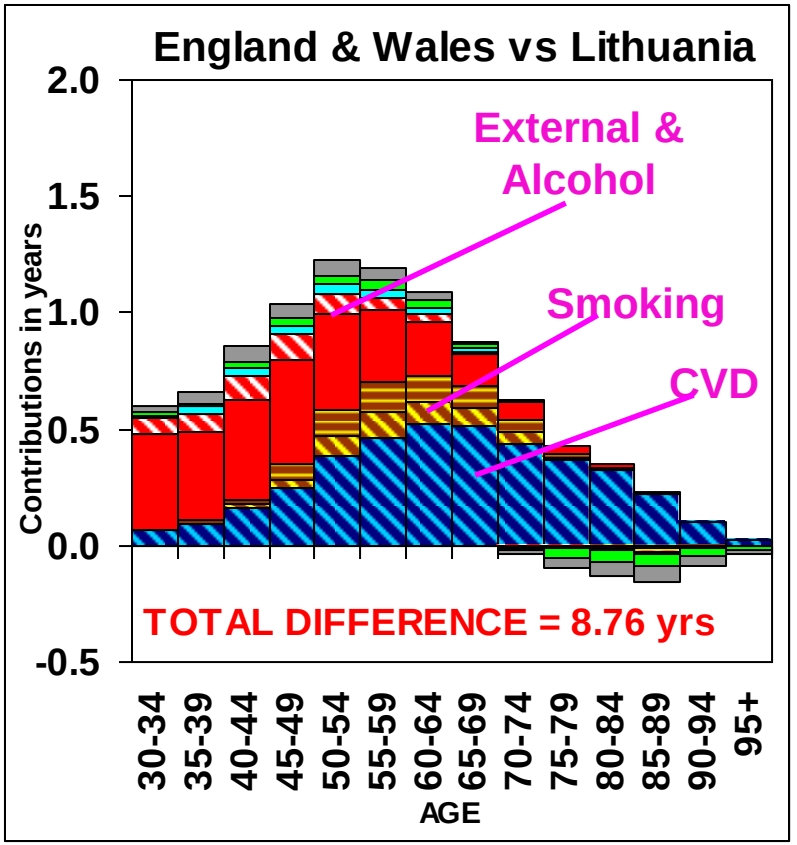
Source: Leon, 2001.

Common patterns of inequalities between and within countries (2)

Lithuanian males, highest vs lowest education



Lithuanian vs E&W males



CVD

External causes

Respiratory syst. diseases

Smoking-related cancers

Alcohol-related deaths

All other causes

Other cancers

Infectious dis.

Source: Jasilionis et al., 2007.

Measurement issues of inter-group mortality differences: absolute vs. relative differences

Relative inter-group differences in mortality or illness:
e.g. mortality rate ratios or regression-based indexes of relative effects. They measure the inequality in relation to a certain group.

Absolute inter-group differences in mortality or illness:
e.g. mortality rate differences . They measure absolute differences (losses) in comparison to a certain group.

Absolute inter-group differences in life expectancy or temporary life expectancy

All measures usually compare illness / mortality / life expectancy between the least healthy and the healthiest group or between the lowest and highest socio-economic groups.

Although relative measures seem to be more illustrative and understandable, sometimes they cannot give a definite answer about trends or differences in inequality levels between countries. In addition, “50% higher rate of a rare health problem may be much less important for the public's health than a 10% higher rate of a frequent health problem” (Mackenbach & Kunst, 1997).

Absolute vs. relative differences: an example

Standardized death rates from ischaemic heart disease among men age 35-64 by social class in England & Wales (per 100,000)

	1976-81	1986-92
Social classes		
Highest	246	160
Lowest	363	266
Rate ratio (low to high)	**1.48**	**1.66**
Rate difference (low minus high)	**117**	**106**

Sources: Drever & Whitehead, 1997 (quoted in Anand et al., 2001).

ADVANCED GINI-TYPE MEASURES OF INEQUALITY

1. Measure of absolute inequality: Average inter-group difference in mortality (AID)

$$AID = \frac{1}{2}\sum_{i=1}^{N}\sum_{j=1}^{N}\left|SDR_i - SDR_j\right| p_i p_j$$

where p_i, p_j – population weights of socioeconomic groups (i, j) (where i, j = 1, 2, 3, …, N); SDR_i and SDR_j – standardised death rates in socioeconomic groups (i, j). AID is defined as the population-weighted average of mortality differences across all pairs of group-specific SDRs and measured as number of deaths per 100,000 person years of exposure (Shkolnikov et al., 2011).

2. Measure of relative inequality: (Pseudo) Gini coefficient

$$G = \frac{AID}{\overline{SDR}} * 100,$$

where $\overline{SDR}$ – weighted (using group-specific population weights) average of group-specific standardised death rates. Gini (G) refers to average inter-group mortality differences as reflected by a percentage of the SDR for the total population (Shkolnikov et al., 2011).

Relative mortality differences by education
Lithuania (2001-2004) and Sweden (1998-2000).

Poisson regression mortality rate ratios, ages 35+
Outcomes from models including age only.

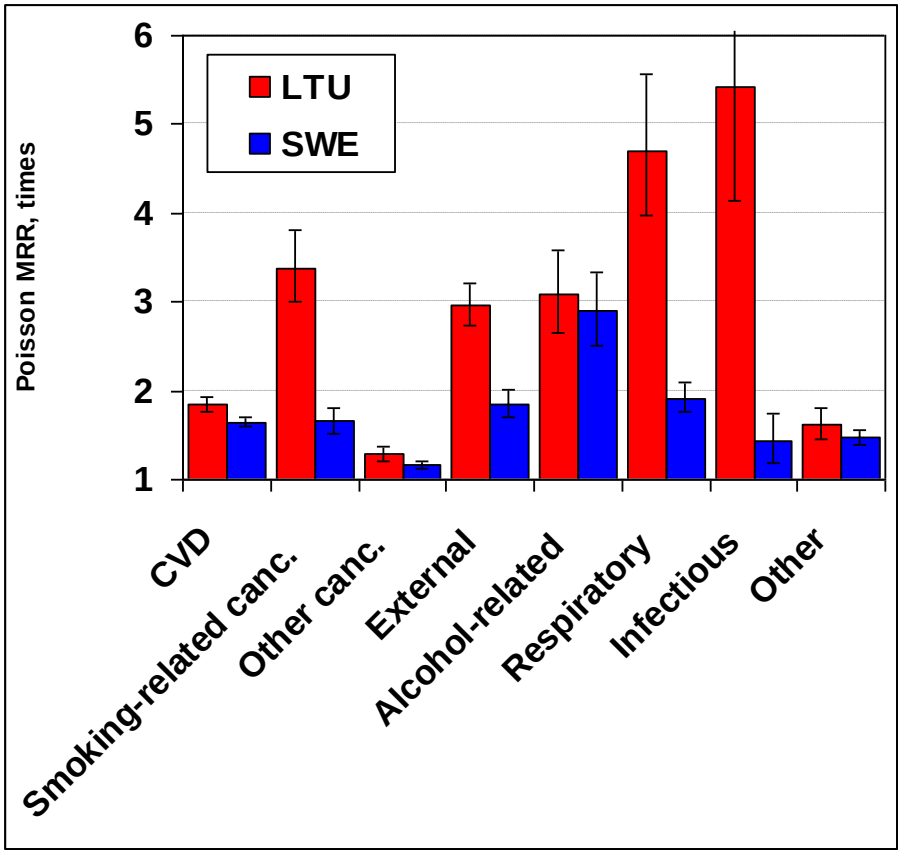
	MALES		FEMALES	
	LTU	SWE	LTU	SWE
High	1.00	1.00	1.00	1.00
Medium	1.59 *(1.55-1.64)*	1.28 *(1.25-1.31)*	1.48 *(1.42-1.54)*	1.20 *(1.17-1.24)*
Low	2.09 *(2.03-2.15)*	1.55 *(1.52-1.58)*	1.69 *(1.63-1.76)*	1.46 *(1.42-1.50)*

Relative mortality differentials by cause of death

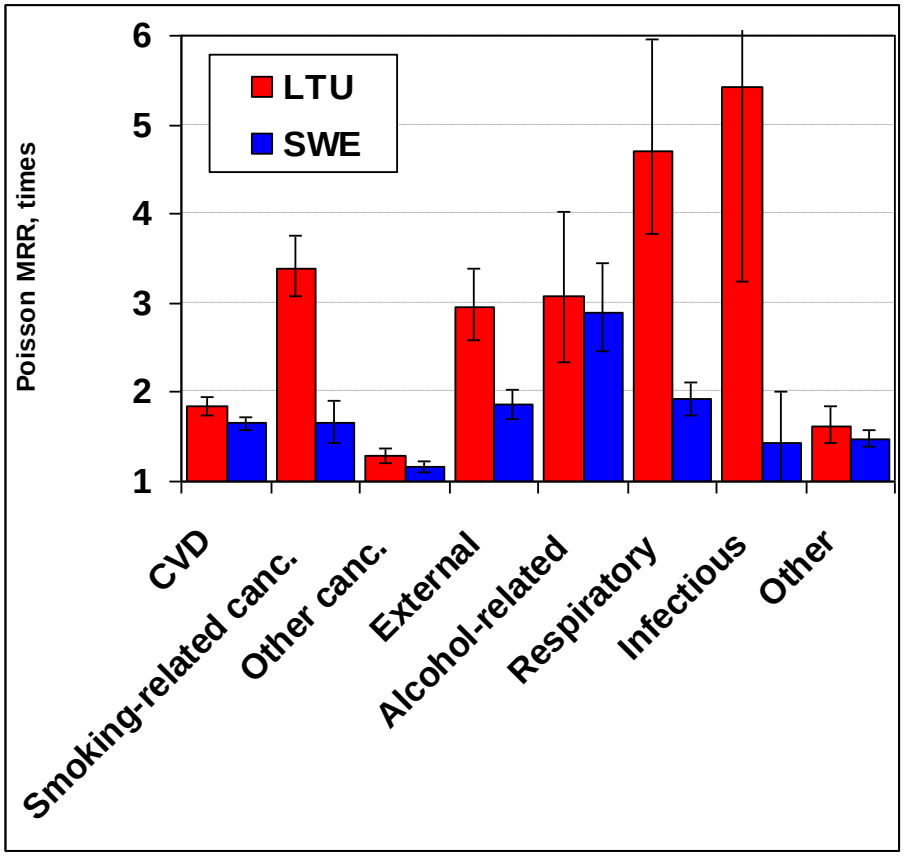
Poisson regression mortality rate ratios for Lithuania and Sweden, ages 35+

Ratios of mortality in low education group to mortality in high education group

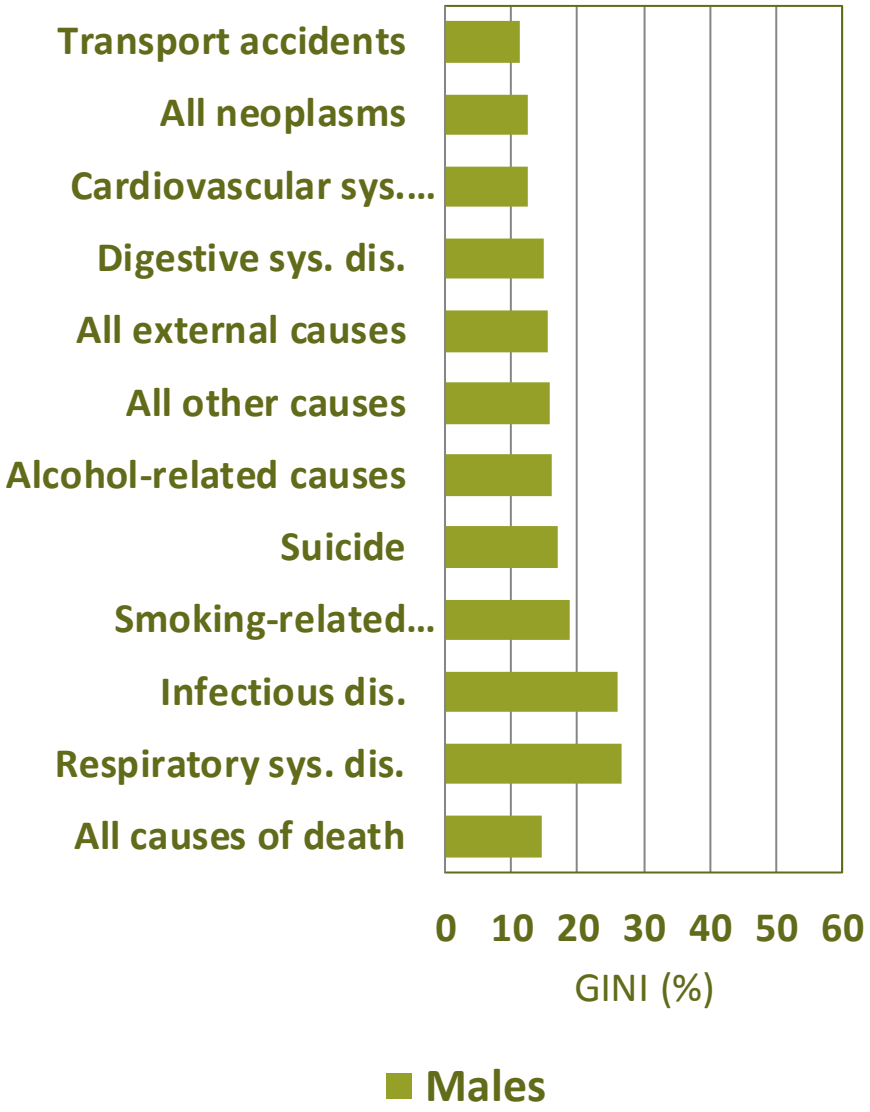
Males



Females



Total amount of socio-economic mortality inequality by major causes of death as reflected by inter-group Gini coefficients



Addressing health inequalities (2): Economic arguments

Mackenbach, Meerding, Kunst (2011):

EVERY YEAR inequality related losses to health in the European Union amount for:

➔ More than 700 thou. avoidable deaths;

➔ 33 mil. prevalent cases of ill-health.

EVERY YEAR inequality related ECONOMIC losses to health amount:

➔ 1.4% of GDP (or €141 billion) – through avoidable loss of labour productivity;

➔ 5% of the costs of social security systems;

➔ 20% of the costs of healthcare systems.

Population attributable fraction, a measure of public health impact

Population attributable fraction is a proportion of all deaths (diseases, losses, etc.) that can be avoided if all population groups had the same rate of mortality (illness, disability, etc.) as the best health status group.

$$PAF = \frac{\sum_i p_i (RR_i - 1)}{\sum_i p_i RR_i},$$

where RR_i - mortality rate ratio for the group i,
p_i - population weight of the group i.

In this formula:
the numerator = excess “deaths”,
the denominator = all “deaths”

Population attributable fractions by socioeconomic variable
Hypothetical share (%) of adult deaths that can be avoided if mortality had been removed. Lithuanian adults, aged 30-59

CAUSE OF DEATH	Education		Econ. activity status		Occupational group	
	Males	Females	Males	Females	Males	Females
All causes of death	**52**	**38**	**35**	**41**	**67**	**57**
Cardiovascular sys. dis.	45	51	35	46	61	69
All neoplasms	47	15	27	26	54	24
Smoking-related cancers	63	19	29	35	74	45
Alcohol-related causes	59	55	48	60	83	88
Infectious dis.	69	73	68	66	95	83
Respiratory sys. dis.	78	66	56	56	89	88
Digestive sys. dis.	57	50	49	59	82	83
All external causes	55	51	30	43	69	71
Transport accidents	38	46	16	24	47	37
Suicide	61	45	25	39	69	67
All other causes of death	50	41	50	64	79	77