Measuring Health Inequalities

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University of Copenhagen

Part 2:
Measuring the “Inequality” in Social Inequality

Overview

- Why it matters
- Conceptual Issues
  - Inequality vs. inequity
  - Issues for measurement
- Value judgments and why they are unavoidable

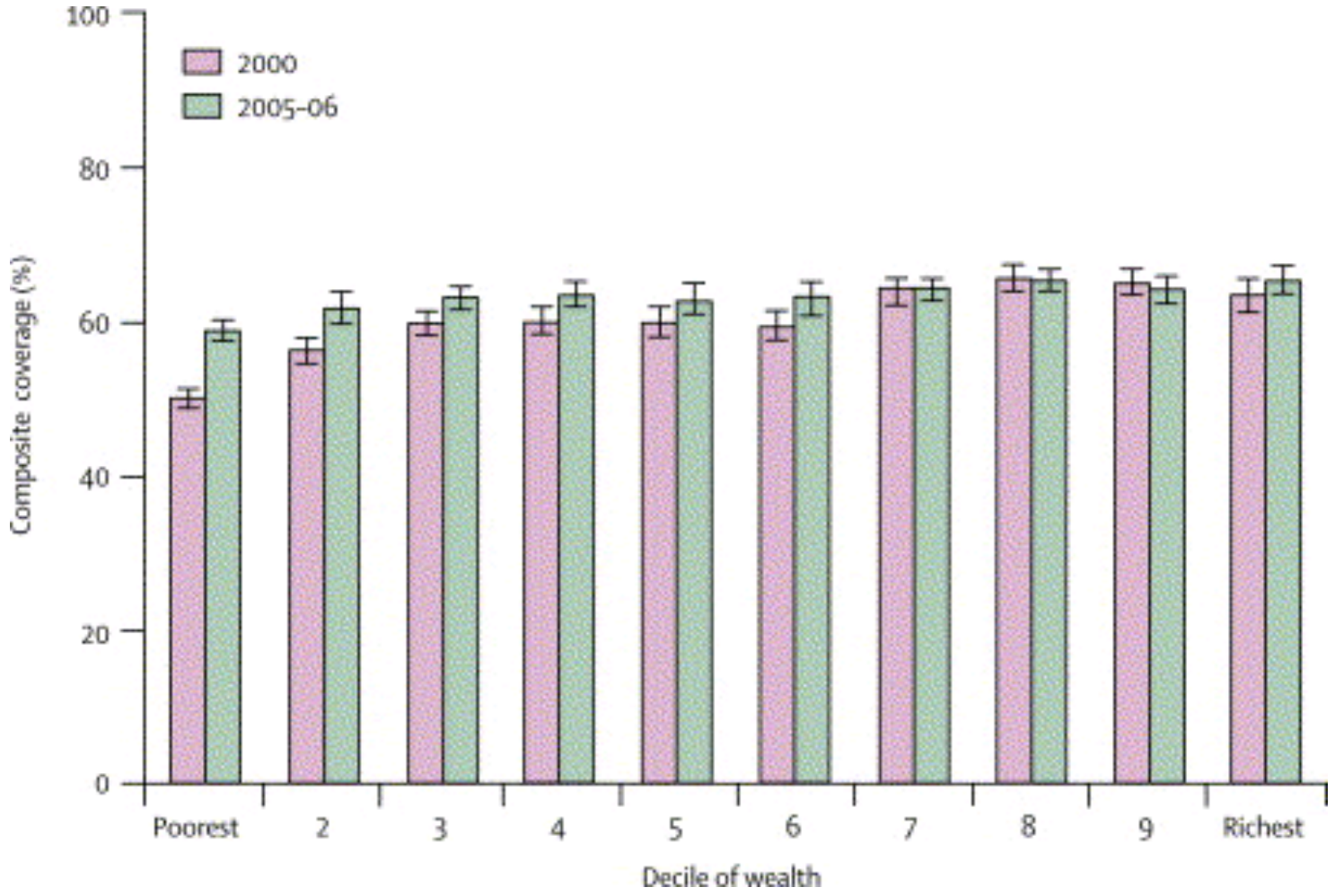
Why Monitor Health Inequalities?

- Natural complement to monitoring overall health
- Essential for detecting important changes in risk
- Opportunity to evaluate etiological explanations for health inequalities
- Evaluating the distributional impacts of public health interventions and medical innovations
- Crucial for measuring the responsiveness of health care systems to those most in need

Example: Distributional effects of Mexican health reforms

"inequalities in composite coverage [of interventions] have been greatly reduced over the past 5 years, since coverage has increased the most in the poorest states and for the poorest deciles of the population."

-Gakidou et al. ***Lancet*** (2006)



More recent example in USA

Effect of Massachusetts healthcare reform on racial and ethnic disparities in admissions to hospital for ambulatory care sensitive conditions: retrospective analysis of hospital episode statistics

Danny McCormick,[1] Amresh D Hanchate,[2,3] Karen E Lasser,[3] Meredith G Manze,[3] Mengyun Lin,[3] Chieh Chu,[3] Nancy R Kressin[2,3]

- Evaluated impact of MA reform on inequalities in hospital admissions.
- Compared MA to nearby states: NY, NJ, PA.
- Intervention “worked”: % uninsured halved (12% to 6%) from 2004-06 to 2008-09.

McCormick et al. BMJ (2008)

Perspective of the WHO Commission

BOX 16.3: TOWARDS A COMPREHENSIVE NATIONAL HEALTH EQUITY SURVEILLANCE FRAMEWORK

Closing the gap in a generation

HEALTH INEQUITIES

Include information on:

health outcomes stratified by:

- sex
- at least two socioeconomic stratifiers (education, income/wealth, occupational class);
- ethnic group/race/indigeneity;
- other contextually relevant social stratifiers;
- place of residence (rural/urban and province or other relevant geographical unit);

the distribution of the population across the sub-groups;

a summary measure of relative health inequity: measures include the rate ratio, the relative index of inequality, the relative version of the population attributable risk, and the concentration index;

a summary measure of absolute health inequity: measures include the rate difference, the slope index of inequality, and the population attributable risk.

WHO Commission (2008)

Inequalities in health are based on observations

- Poor people die younger than rich people
- Low social class infants have lower birth weight
- Smokers get more lung cancer than non-smokers
- Women live longer than men

We are (relatively) good at measuring inequalities

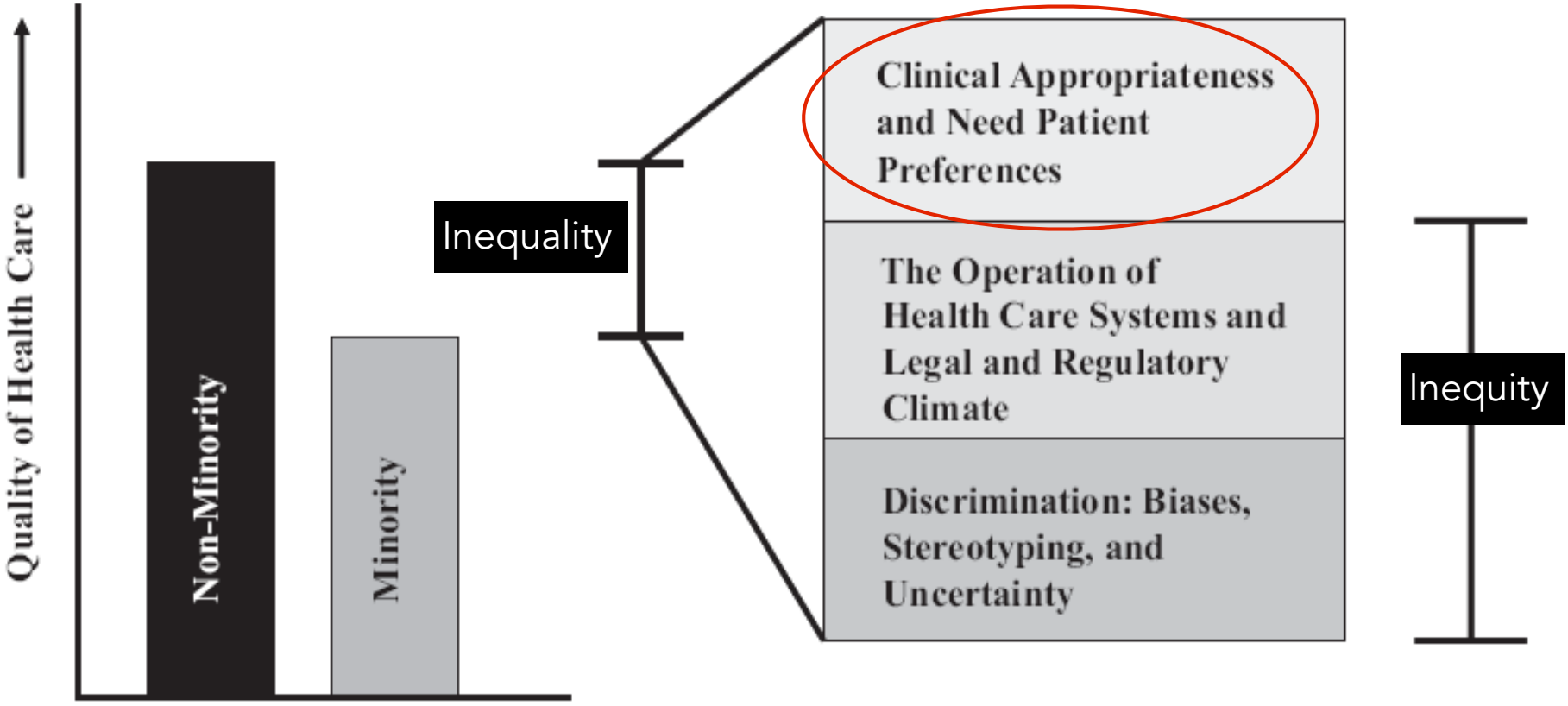
Inequities in health are based on ethical judgments

- Should poor people die younger than rich people?
- Should low social class infants have lower birth weight?
- Should smokers get more lung cancer than non-smokers?
- Should women live longer than men?

Inequities are much harder to measure

Anatomy of an Inequality

Figure 1: Differences, Disparities, and Discrimination: Populations with Equal Access to Health Care.



Adapted from McGuire et al. Health Services Research, 2006

Inequality is an ambiguous concept

"If a concept has some basic ambiguity, then a precise representation of that ambiguous concept must preserve that ambiguity…This issue is quite central to the need for descriptive accuracy in inequality measurement, which has to be distinguished from fully ranked, unambiguous assertions."

-Amartya Sen, On Economic Inequality, 1997

Summary Table of Advantages and Disadvantages of Potential Health Inequality Measures

Inequality Measure	Symbol	Absolute or Relative	Reference Group	All Social Groups	Reflect SES Gradient	Social Group Weighting	Inequality Aversion Parameter	Graphical Analogue
Total Disparity								
Inter-Individual Difference	IID	Variable	ATBO[a]	No	No	No	Yes	No
Individual-Mean Difference	IMD	Variable	Average	No	No	No	Yes	No
Social Group Disparity								
Absolute Difference	AD	Absolute	Best	No	Yes	No	No	Yes
Relative Difference	RD	Relative	Best	No	Yes	No	No	Yes
Regression-based Relative Effect	RRE	Relative	Best	Yes	Yes	No[b]	No	Yes
Regression-based Absolute Effect	RAE	Absolute	Best	Yes	Yes	No[b]	No	Yes
Slope Index of Inequality	SII	Absolute	Average	Yes	Yes	Yes	No	Yes
Relative Index of Inequality	RII	Relative	Average	Yes	Yes	Yes	No	Yes
Index of Disparity	ID_{isp}	Relative	Best	Yes	No	No	No	No
Population Attributable Risk	PAR	Absolute	Best	Yes	No	Yes	No	Yes
Population Attributable Risk%	PAR%	Relative	Best	Yes	No	Yes	No	No
Index of Dissimilarity	ID	Absolute	Average	Yes	No	Yes	No	Yes
Index of Dissimilarity%	ID%	Relative	Average	Yes	No	Yes	No	No
Relative Concentration Index	RCI	Relative	Average	Yes	Yes	Yes	Yes	Yes
Absolute Concentration Index	ACI	Absolute	Average	Yes	Yes	Yes	Yes	Yes
Between Group Variance	BGV	Absolute	Average	Yes	No	Yes	Yes	No
Squared coefficient of Variation	CV^2	Relative	Average	Yes	No	Yes	No	No
Atkinson's Measure	A	Relative	Average	Yes	No	Yes	Yes	No
Gini Coefficient	Gini	Relative	Average	Yes	No	Yes	No	Yes
Theil Index	T	Relative	Average	Yes	No	Yes	Yes	No
Mean Log Deviation	MLD	Relative	Average	Yes	No	Yes	Yes	No
Variance of Logarithms	VarLog	Relative	Average	Yes	No	Yes	No	No

[a]All those better off.
[b]In the case of regression-with grouped data.

Source: Harper S, Lynch J (2005)

Measuring Inequality: Some issues to consider

1. What to measure? Total vs. Social Group Inequality

2. Simple or complex measures of health inequality?

3. Scale: Is inequality relative or absolute?

4. Weighting: Who counts, and for how much?

5. Weighing lives: Do we care where changes in health inequality come from?

6. Reference points for measuring inequality: Different from what?

1. Total vs. Social Group Inequality

Health Inequalities: What should we measure?

- Total Health Inequality
  - complement to measurement of average health
  - measured across all individuals
  - avoids normative choice of social groups
  - facilitates unambiguous comparisons over time/place

- Social Group Differences in Health
  - measured across normatively important social groups
  - particular social groups chosen *a priori*
  - provide insights into causal processes linking health and social position

Ethical concern has typically been for social group differences

"Equity in health can be defined as the absence of systematic disparities in health (or in the major social determinants of health) between social groups who have different levels of underlying social advantage/ disadvantage—that is, different positions in a social hierarchy."

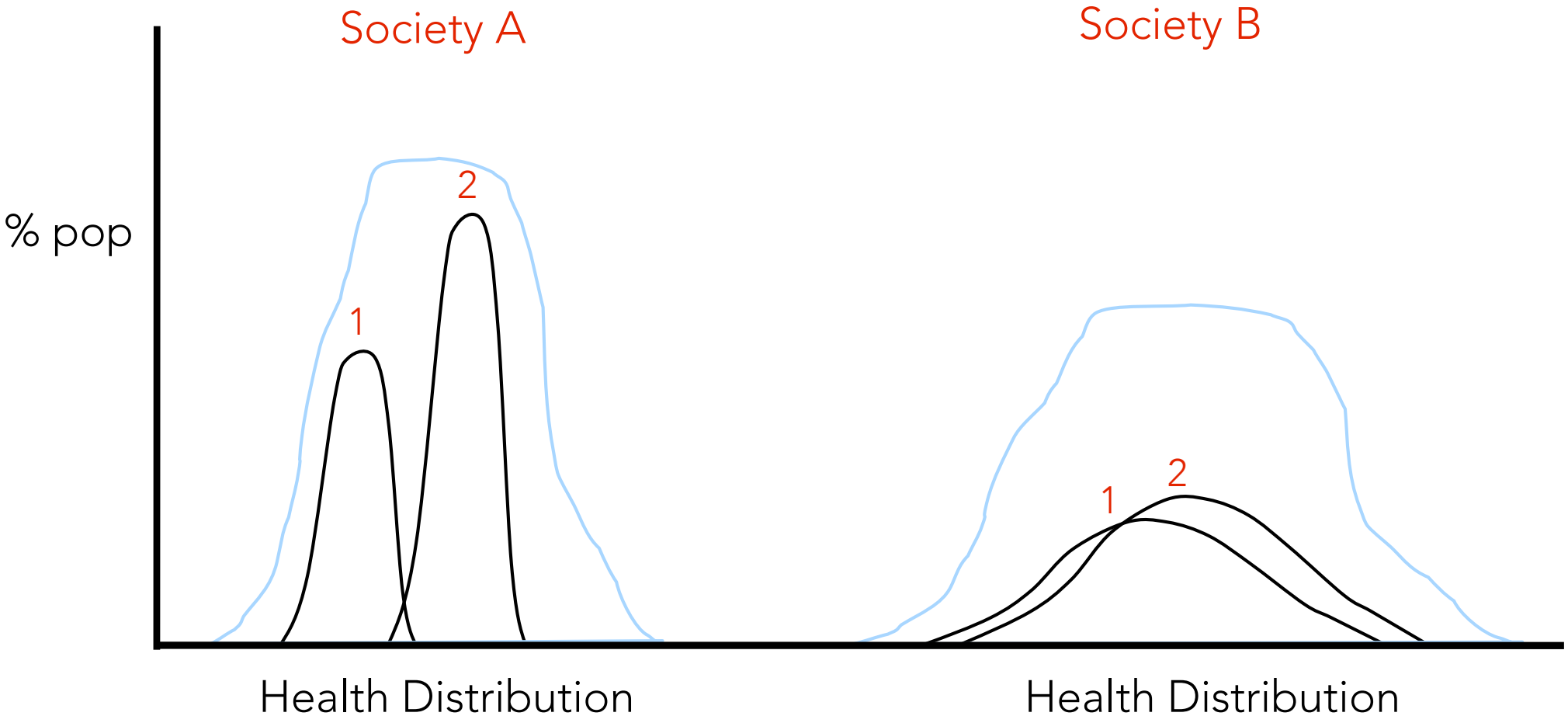
-Braveman, (2003)

"Health disparities are differences in the incidence, prevalence, mortality, and burden of diseases and other adverse health conditions that exist among specific population groups in the United States."

-NIH Strategic Plan to Reduce and Ultimately Eliminate Health Disparities, 2001

Health Inequality Between Whom?

Total Inequality: A<B
Group Inequality: A>B



Adapted from Asasda (2002)

POLICY FORUM

DEMOGRAPHY AND INEQUALITY

The case for monitoring life-span inequality

Focus on variation in age at death, not just average age

By **Alyson A. van Raalte[1], Isaac Sasson[2], Pekka Martikainen[1,3,4]**

for instance, the standard deviation, Gini coefficient, or interquartile range. To illus-

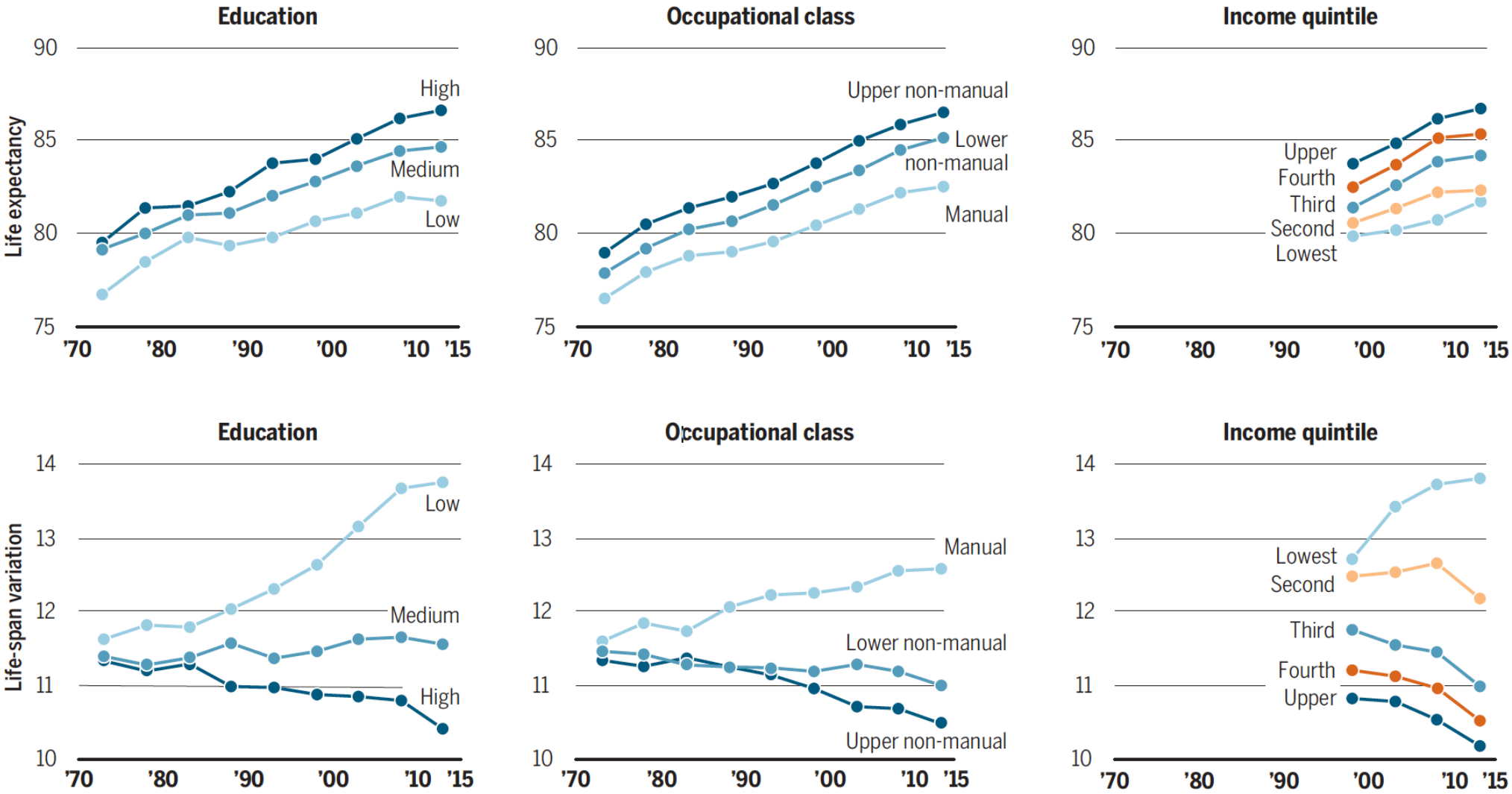
- Life-span variation reflects uncertainty in the risk (timing) of death.
- People are generally willing to pay to reduce uncertainty.

- Heterogeneity is crucial for accurate forecasts in insurance and annuity markets, and should be measured.
- Monitoring life-span variation may facilitate early detection of adverse mortality developments and warrant social interventions at younger ages.

van Raalte et al. (2018)

Trends in life expectancy and life-span variation for Finnish females, 1971–1975 to 2011–2014

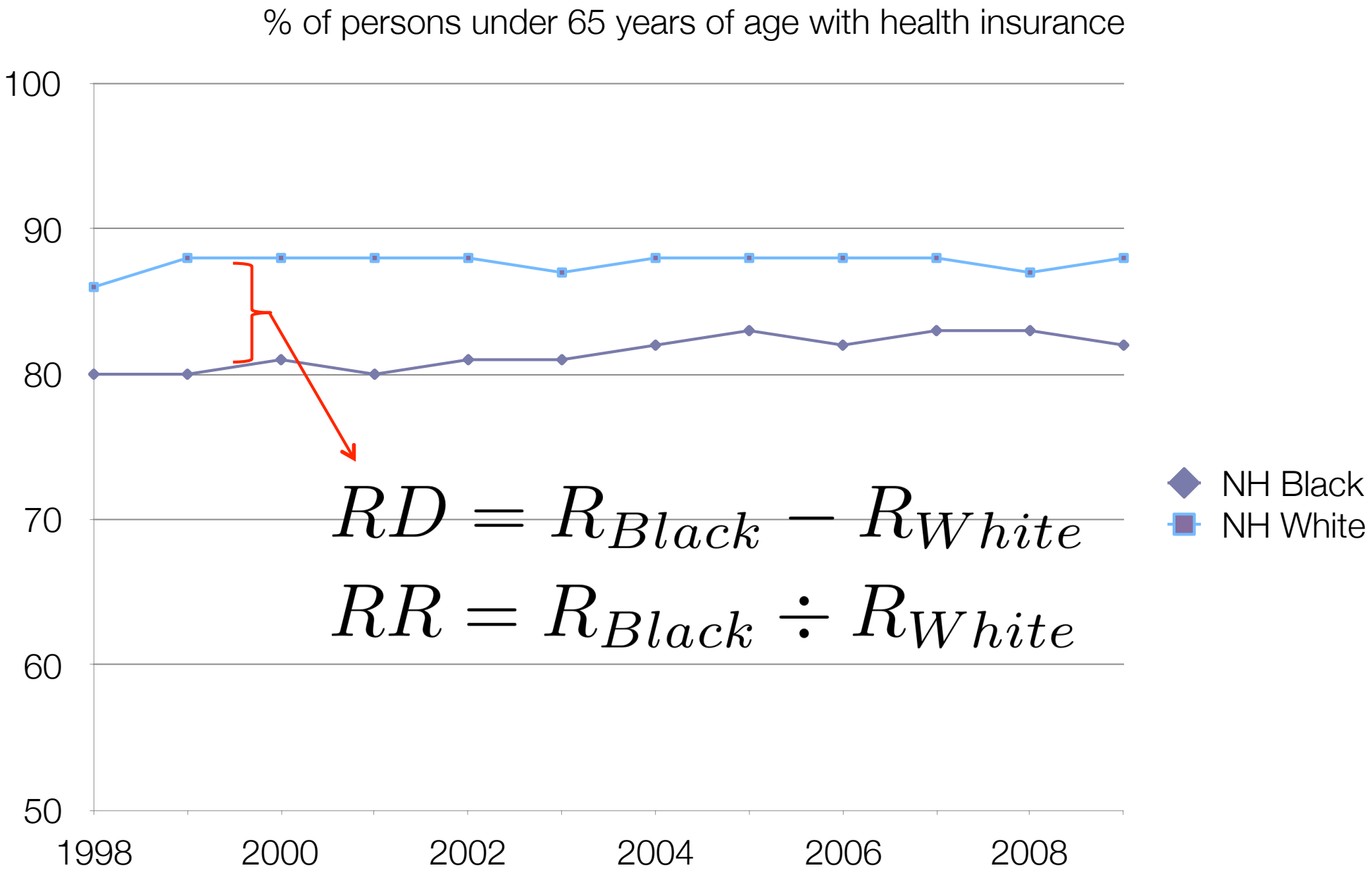
Life expectancy is the average age at death, and life-span variation is the standard deviation, conditional upon survival to age 30, with age-specific death rates frozen at those observed in the given year. See supplementary materials for data and methods, including trends for males (which are qualitatively similar), and robustness checks using alternative measures of life-span variation.



van Raalte et al. (2018)

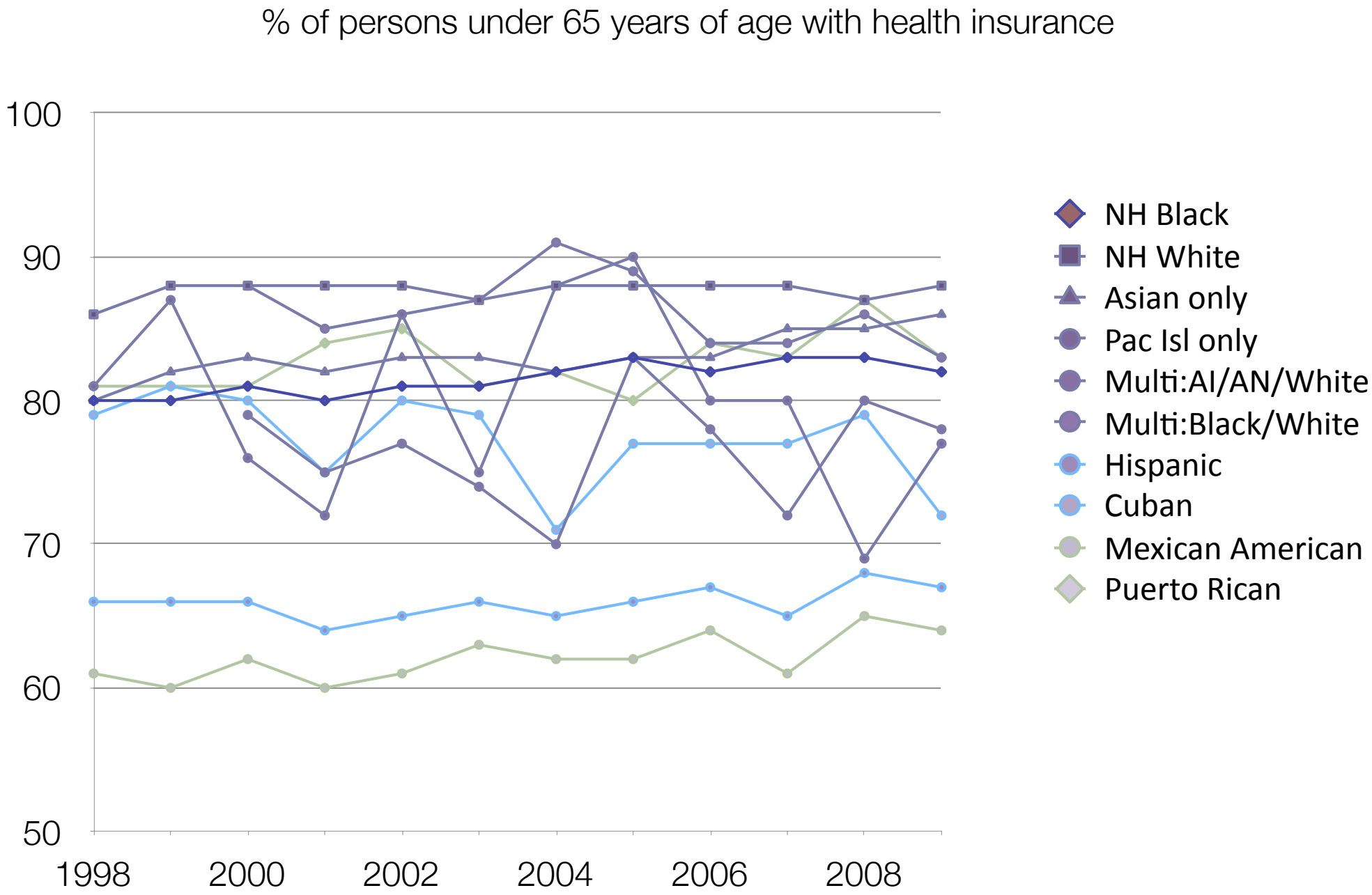
2. Simple vs. (More) Complex Measures of Inequality

Pairwise comparisons work well for a few groups



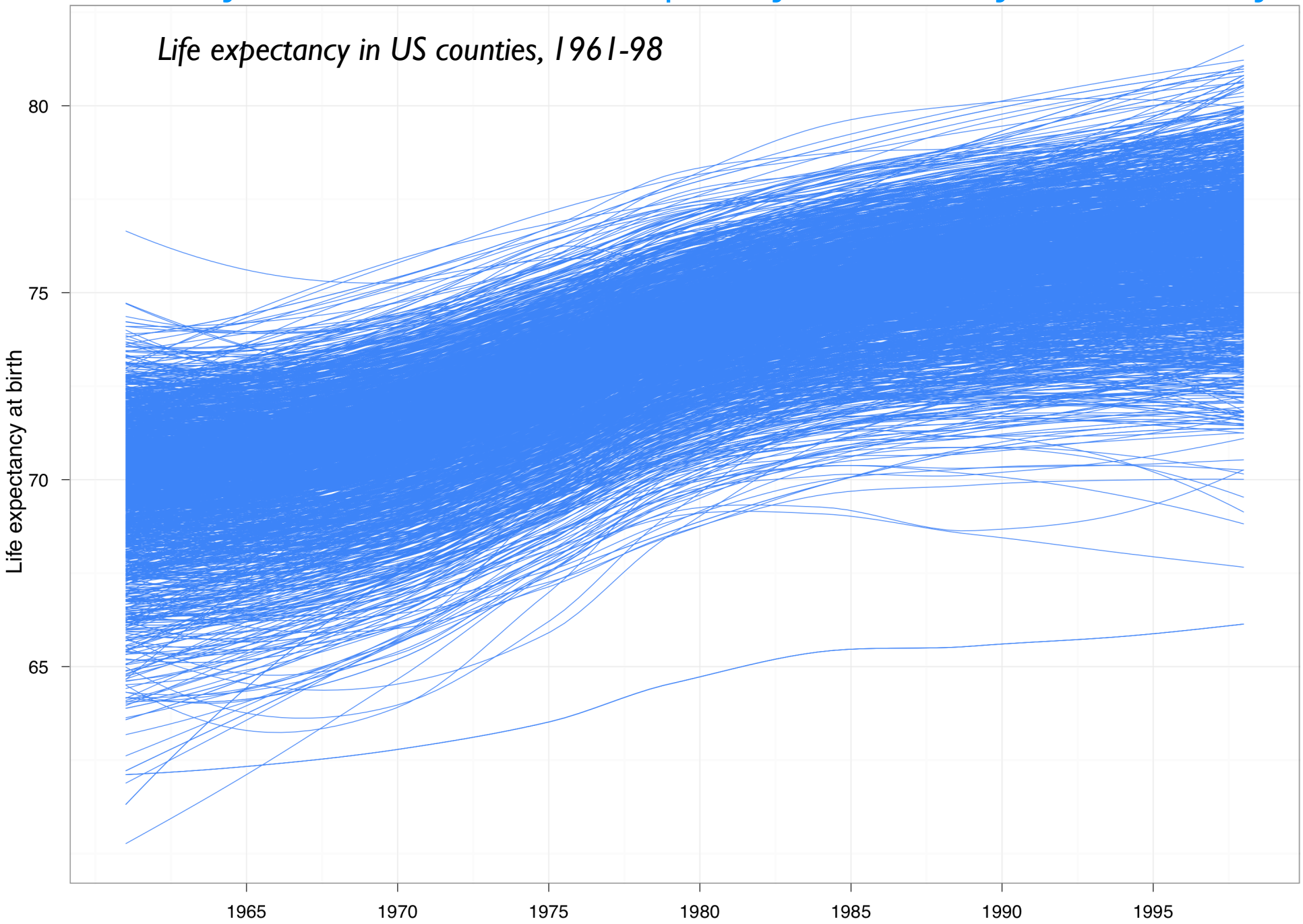
Source: Data2010

Additional subgroups make summary measures appealing



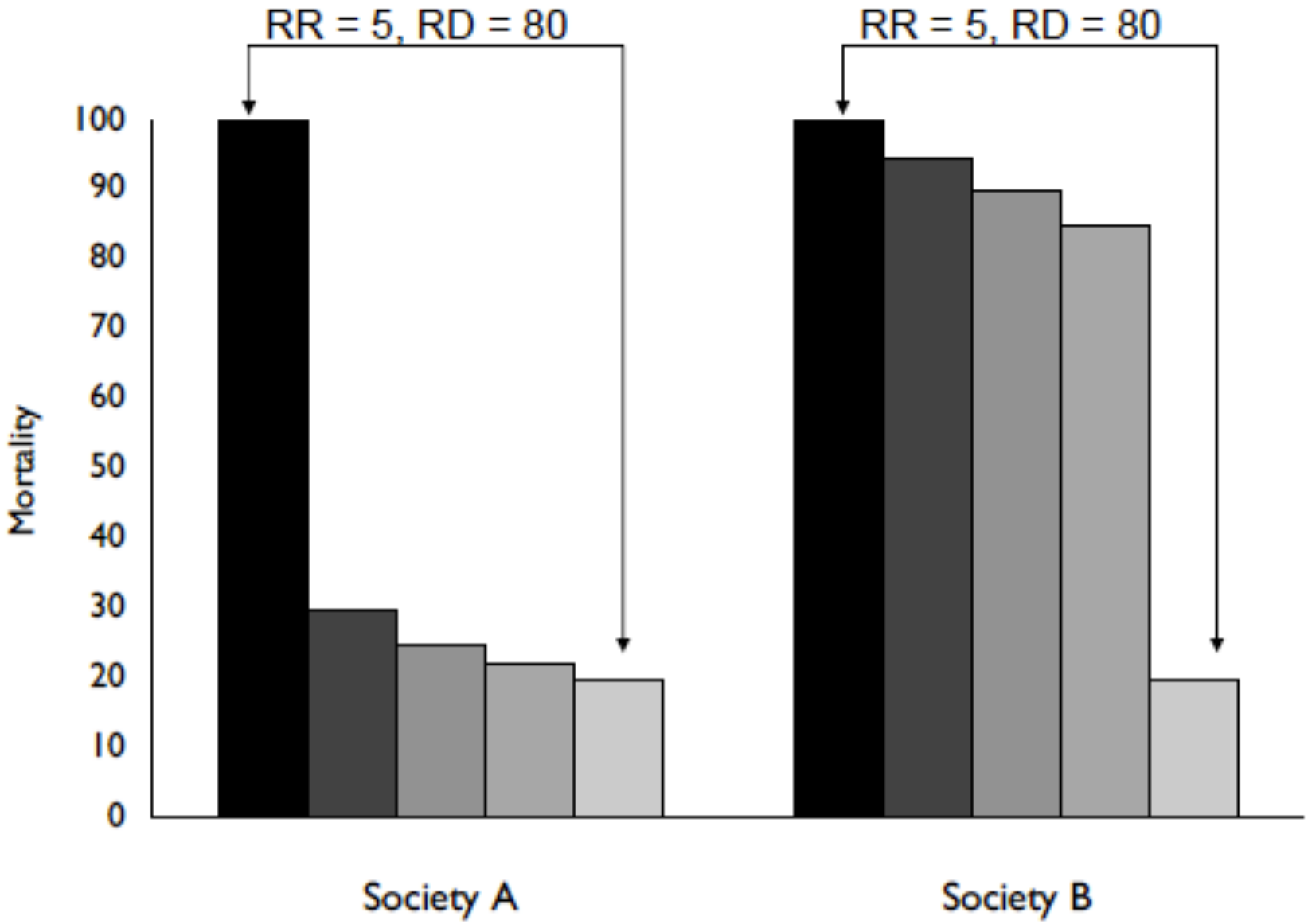
Source: Data2010

Summary measures of inequality definitely necessary



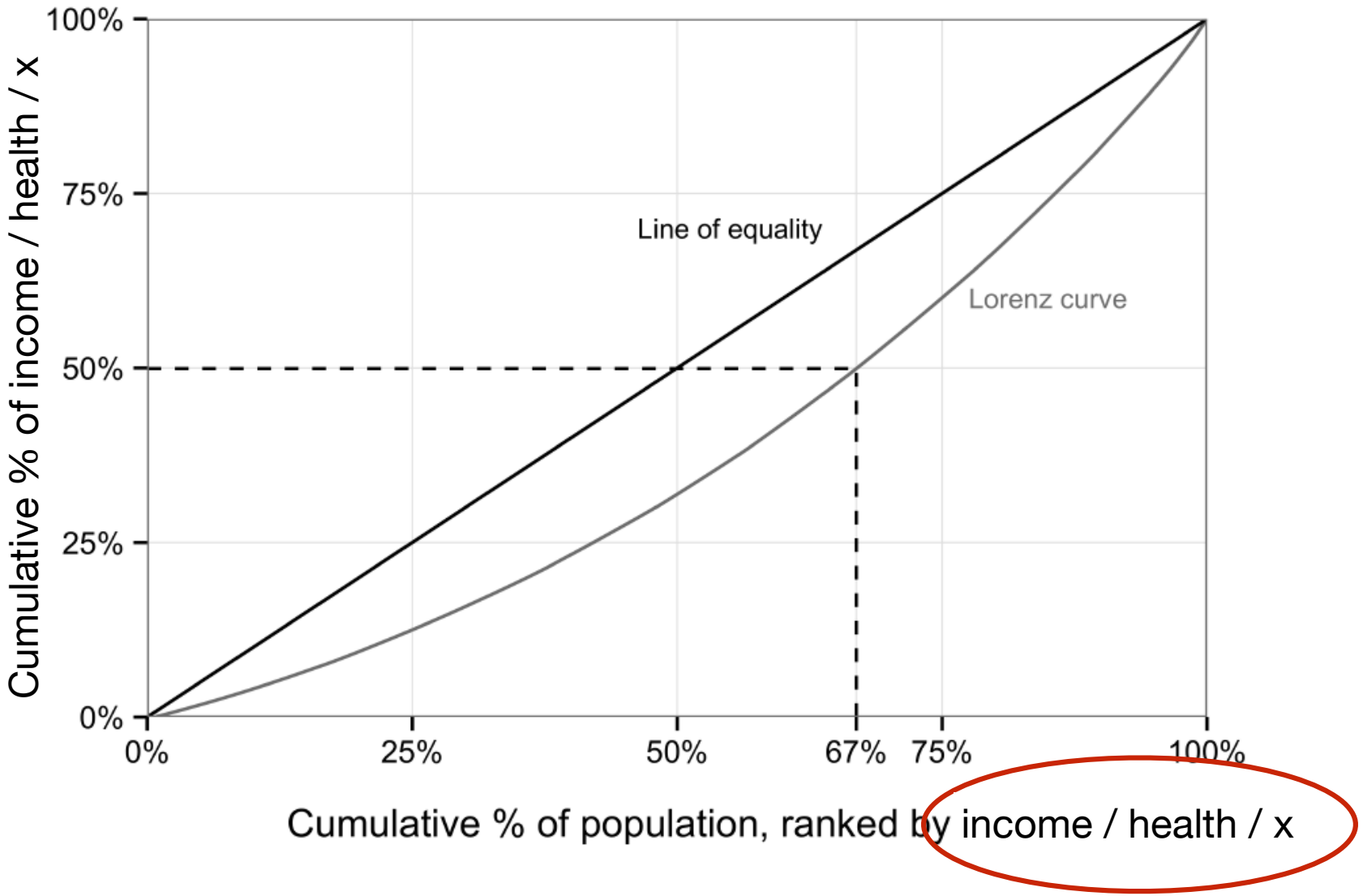
Source: Ezzati et al. 2008

Range-type measure: Ignores the entire distribution



Moving beyond simple group comparisons

- More complex measures look at the entire distribution.
- E.g., Lorenz curve for income, health, or any *X*:



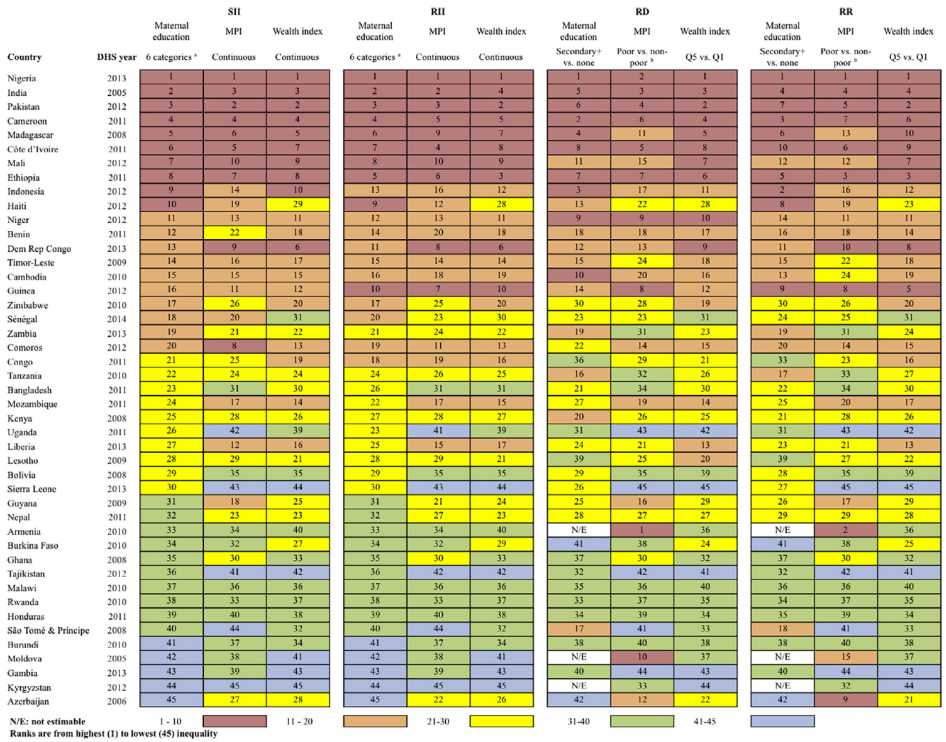
Consequences of metric for interpretation

Monitoring equity in vaccination coverage: A systematic analysis of demographic and health surveys from 45 Gavi-supported countries

Catherine Arsenault [a,*], Sam Harper [a,b], Arijit Nandi [a,b], José M. Mendoza Rodríguez [c], Peter M. Hansen [d], Mira Johri [e,f]

Vaccine 35 (2017) 951–959

- Compared country ranks for magnitude of wealth-related inequalities in vaccination using extreme groups vs. whole-pop measures.
- Mostly similar, however, some serious inconsistencies:
- Armenia had highest inequality using poor vs. non-poor, but 34th using whole pop measure.
- Moldova ranks 10th using pairwise measure but 38th using whole pop measure.



		SII			RII			RD			RR		
		Maternal education	MPI	Wealth index	Maternal education	MPI	Wealth index	Maternal education	MPI	Wealth index	Maternal education	MPI	Wealth index
Country	DHS year	6 categories [a]	Continuous	Continuous	6 categories [a]	Continuous	Continuous	Secondary+ vs. none	Poor vs. non-poor [b]	Q5 vs. Q1	Secondary+ vs. none	Poor vs. non-poor [b]	Q5 vs. Q1
Nigeria	2013	1	1	1	1	1	1	1	2	1	1	1	1
India	2005	2	3	3	2	2	4	5	3	3	4	4	4
Pakistan	2012	3	2	2	3	3	2	6	4	2	7	5	2
Cameroon	2011	4	4	4	4	5	5	2	6	4	3	7	6
Madagascar	2008	5	6	5	6	9	7	4	11	5	6	13	10
Côte d'Ivoire	2011	6	5	7	7	4	8	8	5	8	10	6	9
Mali	2012	7	10	9	8	10	9	11	15	7	12	12	7
Ethiopia	2011	8	7	8	5	6	3	7	7	6	5	3	3
Indonesia	2012	9	14	10	13	16	12	3	17	11	2	16	12
Haiti	2012	10	19	29	9	12	28	13	22	28	8	19	23
Niger	2012	11	13	11	12	13	11	9	9	10	14	11	11
Benin	2011	12	22	18	14	20	18	18	18	17	16	18	14
Dem Rep Congo	2013	13	9	6	11	8	6	12	13	9	11	10	8
Timor-Leste	2009	14	16	17	15	14	14	15	24	18	15	22	18
Cambodia	2010	15	15	15	16	18	19	10	20	16	13	24	19
Guinea	2012	16	11	12	10	7	10	14	8	12	9	8	5
Zimbabwe	2010	17	26	20	17	25	20	30	28	19	30	26	20
Sénégal	2014	18	20	31	20	23	30	23	23	31	24	25	31
Zambia	2013	19	21	22	21	24	22	19	31	23	19	31	24
Comoros	2012	20	8	13	19	11	13	22	14	15	20	14	15
Congo	2011	21	25	19	18	19	16	36	29	21	33	23	16
Tanzania	2010	22	24	24	24	26	25	16	32	26	17	33	27
Bangladesh	2011	23	31	30	26	31	31	21	34	30	22	34	30
Mozambique	2011	24	17	14	22	17	15	27	19	14	25	20	17
Kenya	2008	25	28	26	27	28	27	20	26	25	21	28	26
Uganda	2011	26	42	39	23	41	39	31	43	42	31	43	42
Liberia	2013	27	12	16	25	15	17	24	21	13	23	21	13
Lesotho	2009	28	29	21	28	29	21	39	25	20	39	27	22
Bolivia	2008	29	35	35	29	35	35	29	35	39	28	35	39
Sierra Leone	2013	30	43	44	30	43	44	26	45	45	27	45	45
Guyana	2009	31	18	25	31	21	24	25	16	29	26	17	29
Nepal	2011	32	23	23	32	27	23	28	27	27	29	29	28
Armenia	2010	33	34	40	33	34	40	N/E	1	36	N/E	2	36
Burkina Faso	2010	34	32	27	34	32	29	41	38	24	41	38	25
Ghana	2008	35	30	33	35	30	33	37	30	32	37	30	32
Tajikistan	2012	36	41	42	36	42	42	32	42	41	32	42	41
Malawi	2010	37	36	36	37	36	36	35	36	40	36	36	40
Rwanda	2010	38	33	37	38	33	37	33	37	35	34	37	35
Honduras	2011	39	40	38	39	40	38	34	39	34	35	39	34
São Tomé & Príncipe	2008	40	44	32	40	44	32	17	41	33	18	41	33
Burundi	2010	41	37	34	41	37	34	38	40	38	38	40	38
Moldova	2005	42	38	41	42	38	41	N/E	10	37	N/E	15	37
Gambia	2013	43	39	43	43	39	43	40	44	43	40	44	43
Kyrgyzstan	2012	44	45	45	44	45	45	N/E	33	44	N/E	32	44
Azerbaijan	2006	45	27	28	45	22	26	42	12	22	42	9	21

N/E: not estimable
Ranks are from highest (1) to lowest (45) inequality

1 - 10 | 11 - 20 | 21-30 | 31-40 | 41-45

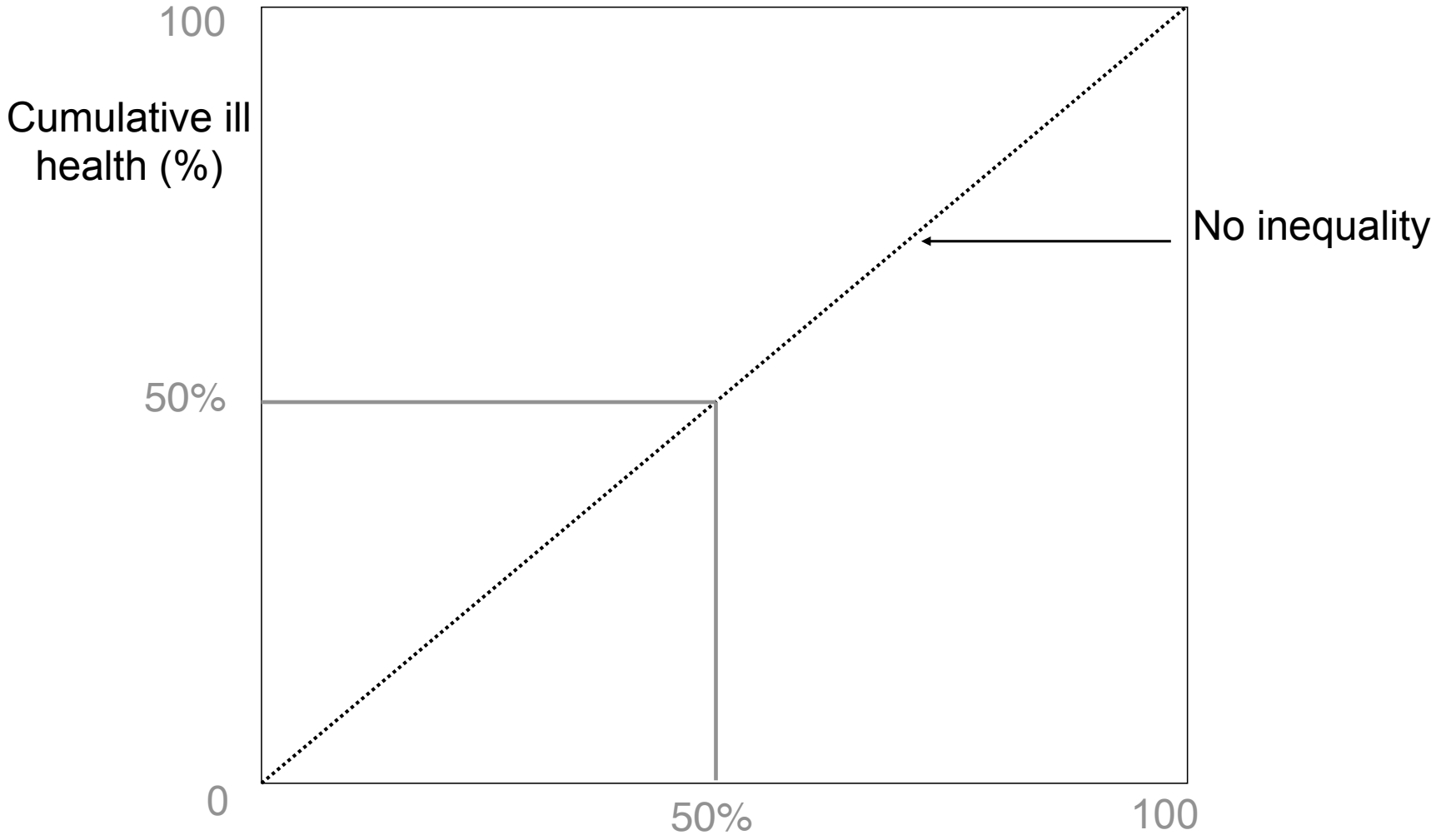
Moving beyond binary comparisons

Distribution of Socioeconomic Position in a Hypothetical Population

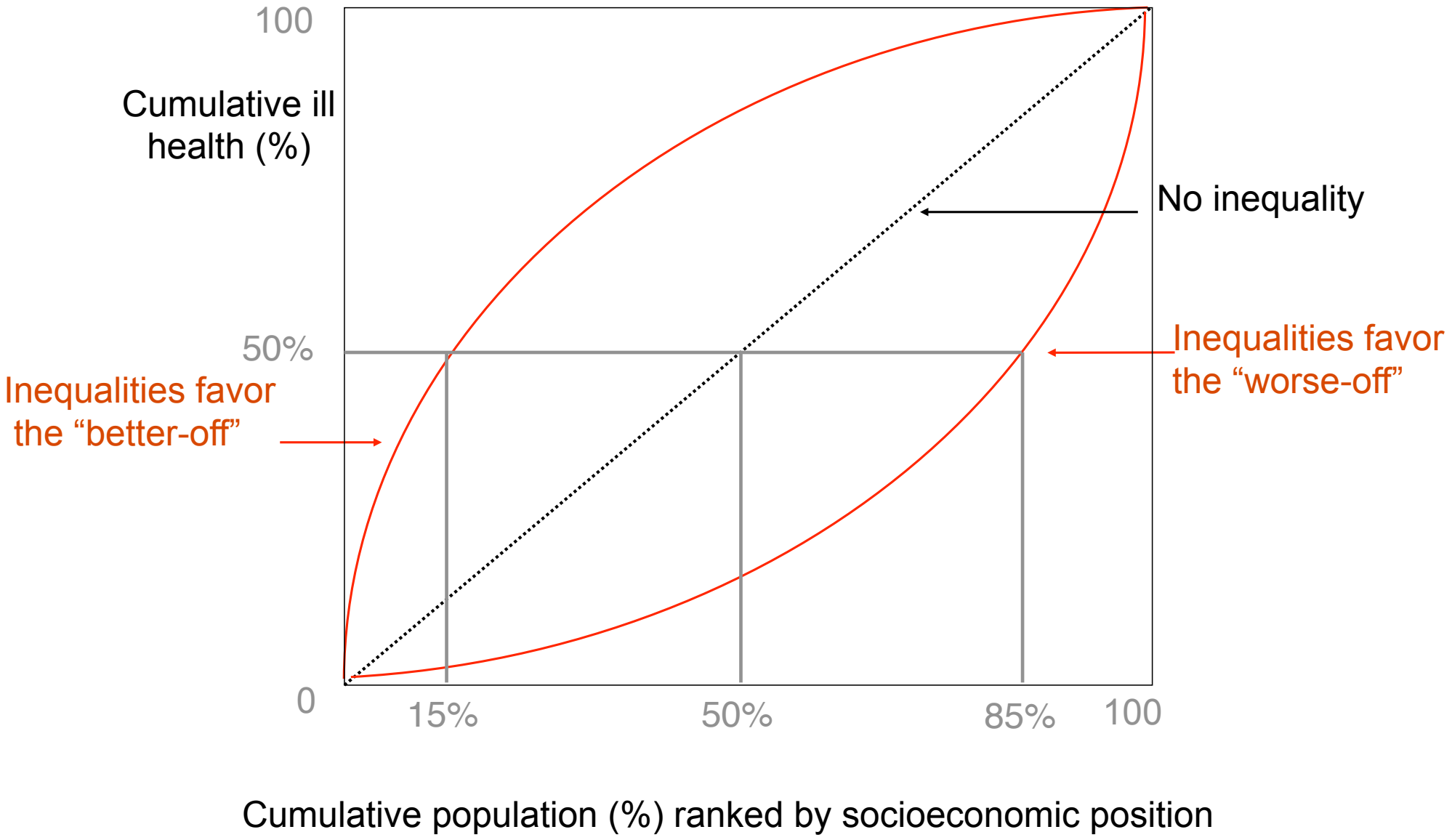
Education Level	%	Cumul%	Range	Midpoint
None	11.93	11.93	0.0 – 11.93	5.97
<Primary school	15.04	26.97	11.93 – 26.97	19.45
Primary school	26.86	53.83	26.97 – 53.83	40.40
Secondary school	16.05	69.88	53.83 – 69.88	61.86
>Secondary	30.12	100	69.88 – 100.0	84.94

"Socioeconomic Rank"

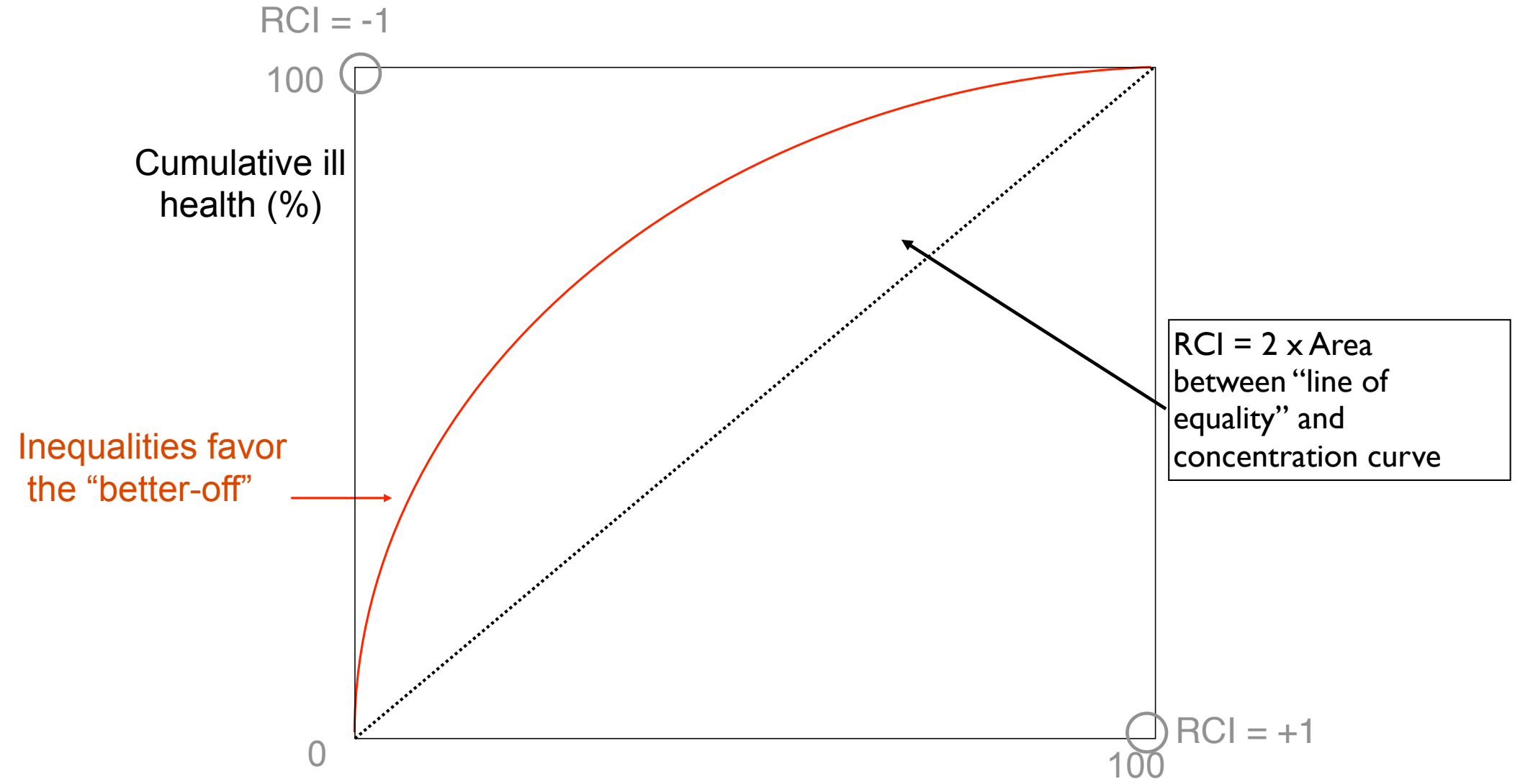
Summarizing across SEP: Relative Concentration Curve



Summarizing across SEP: Relative Concentration Curve



Relative Concentration Index



Formula for Calculating the Relative Concentration Index

One way of writing the Relative Concentration Index* is

$$RCI = \frac{2}{n\mu}\sum_{i=1}^{n} y_i R_i - 1$$

Where μ is the mean of y_i (e.g., smoking status), R_i is the fractional rank of the ith person in the socioeconomic (e.g., income) distribution

The Absolute Concentration Index simply multiplies RCI by the mean smoking rate:

$$ACI = \mu RCI$$

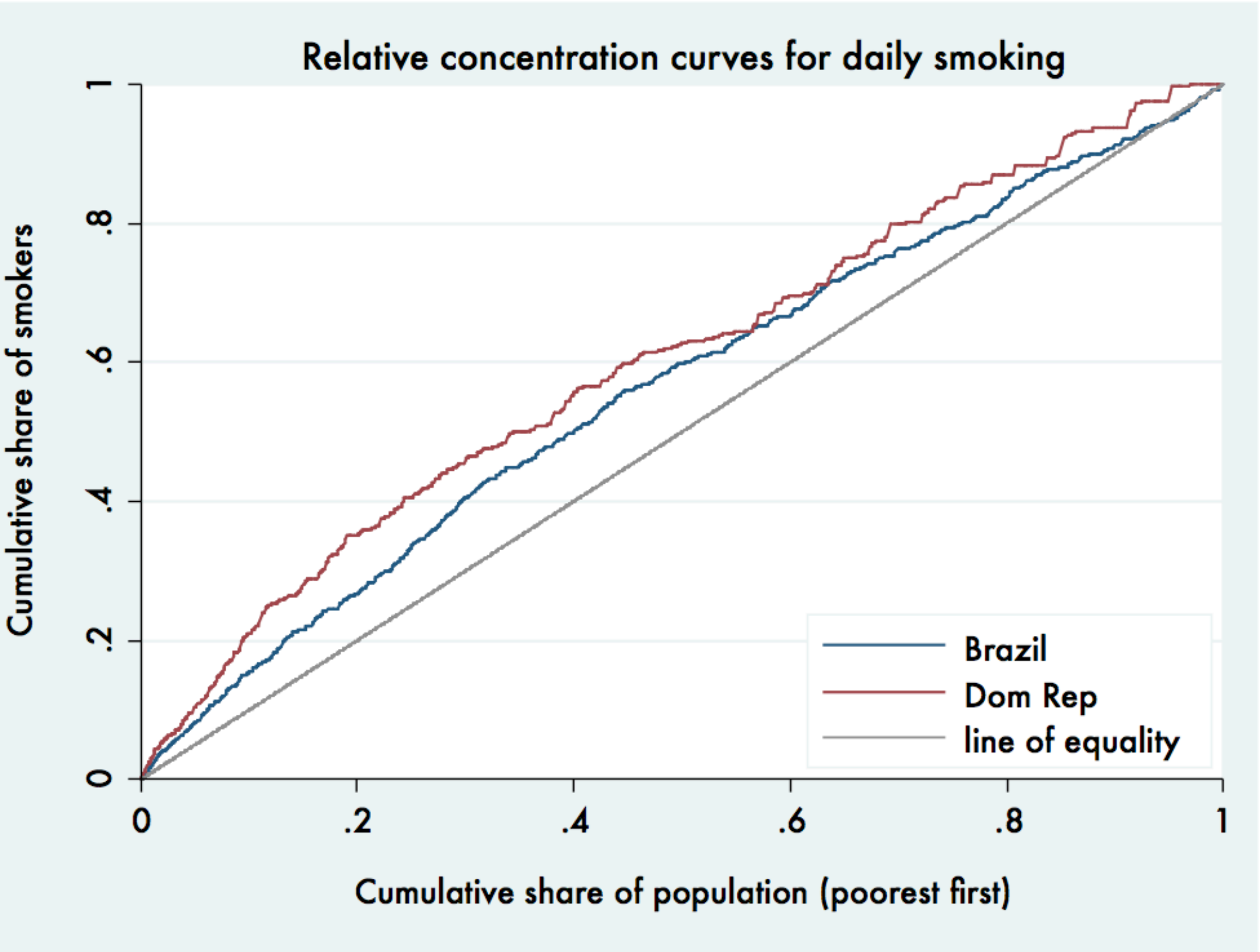
*(Kakwani et al. 1997)

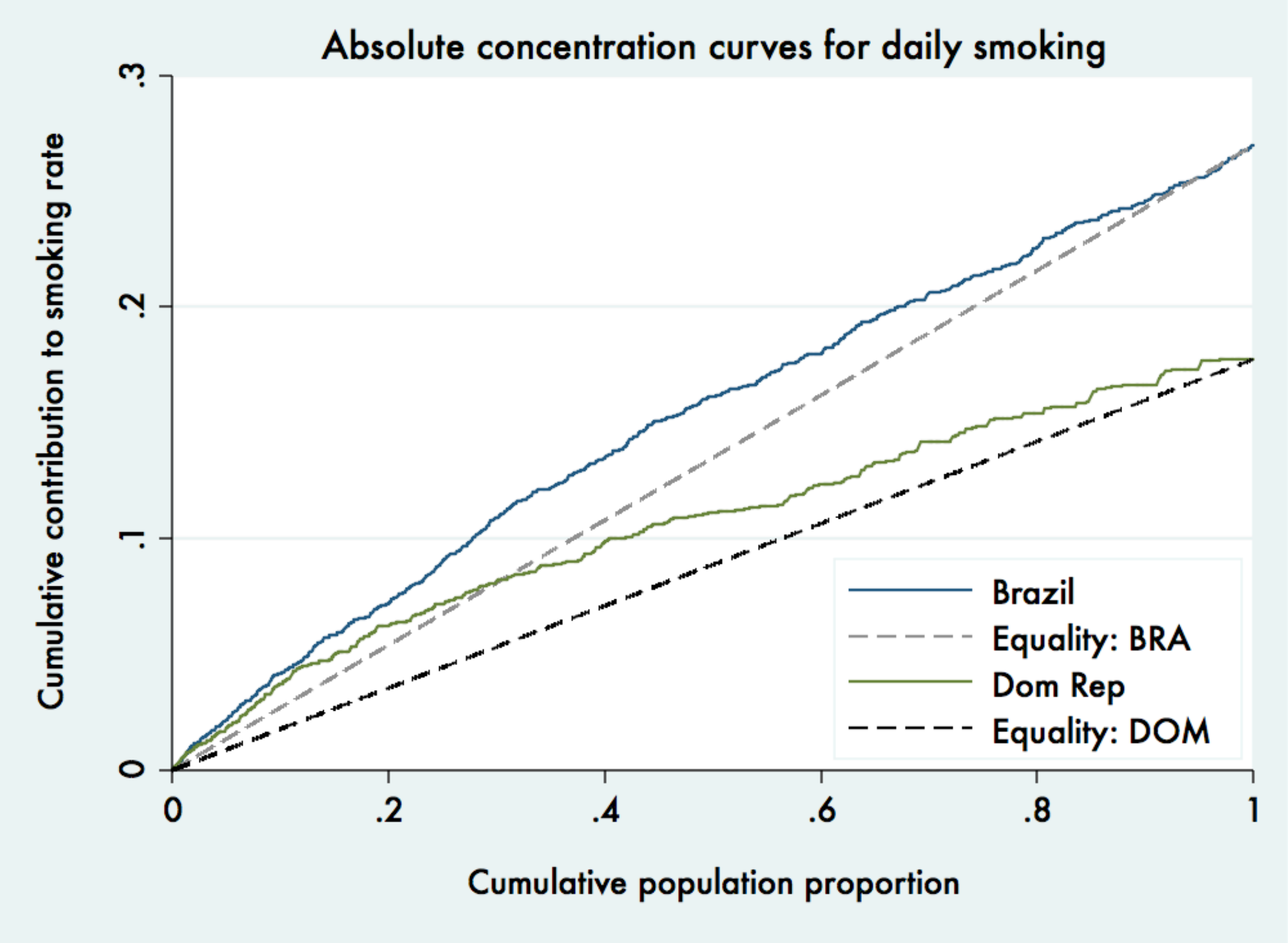
Example of Relative and Absolute CI

TABLE 6.2. EDUCATIONAL INEQUALITY IN CURRENT SMOKING AMONG FEMALES, 1965 AND 2003.

Education	Smoking Prevalence	Population Share	Relative Rank	RCI
1965				
<12 years	23.8%	0.267	0.133	0.008
12 years	38.7%	0.568	0.551	0.121
13–15 years	37.1%	0.079	0.875	0.026
16+ years	35.0%	0.086	0.957	0.029
Total	34.3%	1.0		0.184
		Relative Concentration Index →		**0.074**
		Absolute Concentration Index →		**0.025**
2003				
<12 years	21.7%	0.165	0.083	0.003
12 years	24.0%	0.299	0.315	0.023
13–15 years	20.2%	0.304	0.616	0.038
16+ years	9.5%	0.232	0.884	0.020
Total	19.1%	1.0		0.083
		Relative Concentration Index →		**−0.132**
		Absolute Concentration Index →		**−0.025**

Note: Authors' calculations of the 1965 and 2003 NHIS.


Relative concentration curves for daily smoking
Cumulative share of smokers
0
.2
.4
.6
.8
1
Cumulative share of population (poorest first)
Brazil
Dom Rep
line of equality


Absolute concentration curves for daily smoking
Cumulative contribution to smoking rate
0
.1
.2
.3
0
.2
.4
.6
.8
1
Cumulative population proportion
Brazil
Equality: BRA
Dom Rep
Equality: DOM

Ways of estimating the RCI from micro-data

- Use "convenient covariance" formula: $RCI = 2 * \text{cov}(h,r) / \mu$
  - where h is the health/illness variable, r is socioeconomic rank, μ is mean health.

- Can also use regression, after suitable transformation of the left-hand-side variable:

$$2\sigma_r^2\left(\frac{h_i}{\mu}\right)=\alpha+\beta r_i+\varepsilon_i$$

  - Where σ^2 is the variance of the socioeconomic rank (r_i) variable, which, for individual-level data is calculated as:

$$r_i=\sum_{j=0}^{i-1}w_j+\frac{w_i}{2},\qquad w_0=0$$

  - and w is the weight attached to each individual (i.e., 1 / N for data without sample weights.)
  - The coefficient β above provides a direct estimate of the RCI and its SE.

O'Donnell et al. (2008)

Stata example: RCI

```
clear
input class pop smokers
1 165 36
2 299 72
3 304 61
4 232 22
end

* rate of smoking
gen rate = smokers/pop

sum rate [fw=pop]       // mean smoking
scalar mrate=r(mean)    // save this value as a scalar

* create the ranking variable (Method 1)
qui tab class, gen(rclass_)
gen rank=.
label var rank "fractional rank in education distribution"

forvalues i = 1/4 {
     local j = `i' - 1
     scalar csum0=0
     quietly sum rclass_`i' [fw=pop]
     scalar csum`i'=csum`j' + r(mean)
     quietly replace rank=csum`i' - 0.5*r(mean) if rclass_`i'==1
     }
drop rclass*

* using -wridit command (Method 2: note that this is much easier!)
wridit class [fw=pop], gen(easyrank)
```

	class	pop	smokers	rate	rank	easyrank
1	1	165	36	.2181818	.0825	.0825
2	2	299	72	.2408027	.3145	.3145
3	3	304	61	.2006579	.616	.616
4	4	232	22	.0948276	.884	.884

Stata example: convenient regression format

$$2\sigma_r^2\left(\frac{h_i}{\mu}\right)=\alpha+\beta r_i+\varepsilon_i$$

```
. qui sum easyrank [fw=pop]                  // summary of ranking variable
. scalar var_rank=r(Var)                     // save variance as a scalar
. gen lhsu=2*var_rank*(rate/mrate)           // transformed outcome variable

. reg lhsu easyrank [fw=pop], cformat(%4.3f)      // convenient regression

      Source |       SS       df       MS              Number of obs =    1000
-------------+------------------------------          F(  1,   998) = 2374.45
       Model |  1.40584501     1  1.40584501           Prob > F      =  0.0000
    Residual |  .590888386   998  .000592073          R-squared     =  0.7041
-------------+------------------------------          Adj R-squared =  0.7038
       Total |  1.99673339   999  .001998732          Root MSE      =  .02433

------------------------------------------------------------------------------
        lhsu |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    easyrank |     -0.135      0.003   -48.73   0.000       -0.140      -0.129
       _cons |      0.222      0.002   140.41   0.000        0.219       0.225
------------------------------------------------------------------------------
```

- The coefficient on the “rank” variable is -0.135, which is equivalent to what we showed for the degree of educational inequality in smoking in 2003 a couple of slides ago. Smoking is more “concentrated” among the lower classes.

RCI: Issues of Interpretation

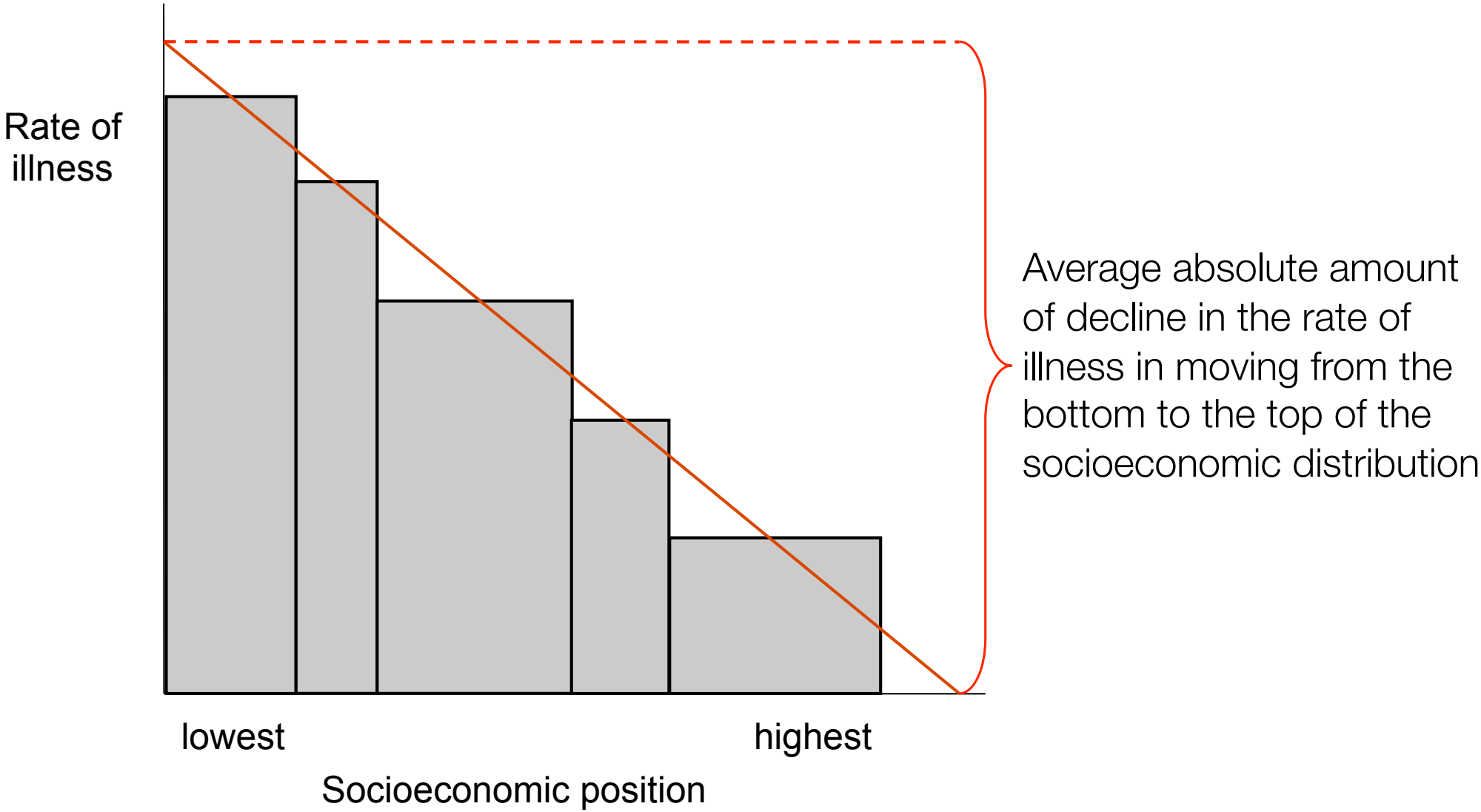
"Like the Gini, the CI has the disadvantage of lacking a straightforward interpretation in natural units."

-Koolman and van Doorslaer (2004)

ability in the health variable. Although this is valuable information, one may also wish to place an intuitive interpretation on the value of the index. Koolman and van Doorslaer (2004) have shown that multiplying the value of the concentration index by 75 gives the percentage of the health variable that would need to be (linearly) redistributed from the richer half to the poorer half of the population (in the case that health inequality favors the rich) to arrive at a distribution with an index value of zero.

Slope and Relative Index of Inequality (SII, RII)

Regress relative SES rank on health, weight by population size



SII: Calculation

Regress health outcome (e.g., smoking) on midpoint of socioeconomic categories, weighted by proportion in the population

$$y = \beta_0 + \beta_1(\text{Rank}) + \varepsilon$$

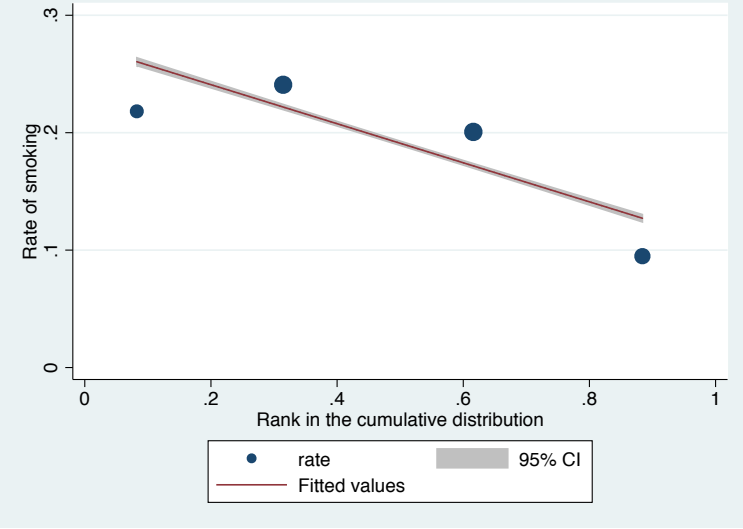
$$\text{Slope Index of Inequality} = \beta_1$$

There is a specific parallel with the RCI by transforming the health variable:

$$2\sigma(\text{rank})^{2*}(y/\mu) = \beta_0 + \beta_1(\text{Rank}) + \varepsilon$$

$$\text{Relative Concentration Index} = \beta_1$$

Stata example: SII




```
. * regress smoking rate on rank
. reg rate easyrank [fw=pop], cformat(%4.3f)

      Source |       SS       df       MS              Number of obs =    1000
-------------+------------------------------           F(  1,   998) = 2374.45
       Model |  2.13874444     1  2.13874444           Prob > F      =  0.0000
    Residual |  .898932157   998  .000900734           R-squared     =  0.7041
-------------+------------------------------           Adj R-squared =  0.7038
       Total |   3.0376766   999  .003040717           Root MSE      =  .03001

------------------------------------------------------------------------------
        rate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    easyrank |      -0.166      0.003   -48.73   0.000       -0.173      -0.160
       _cons |       0.274      0.002   140.41   0.000        0.270       0.278
------------------------------------------------------------------------------
```

- The coefficient on the “rank” variable is the estimated change in the rate of illness (e.g., smoking) as one moves from the bottom to the top of the class distribution (decreases by 17 percentage points).

Relative Index of Inequality: Example

Relative Index of Inequality = (β_1) / mean(y)

$$RII = (\beta_1) / y = -16.6 / 19.1 = -87\%$$

This indicates that as one moves from the bottom to the top of class distribution the outcome (smoking) decreases by 87%

Kunst-Mackenbach modification: $\alpha / (\alpha + \beta)$

$$RII_{KM} = 27.4 / 10.8 = 2.5$$

Interpreted as the ratio of health for the bottom vs. the top of the socioeconomic distribution (analogous to more traditional RR used in epidemiologic studies)

RCI/ACI or RII/SII?

Wagstaff et al. (1991) demonstrated that the RCI and RII are mathematically related:

$$RCI = 2 \times RII \times var(rank)$$

Before we estimated the RII as 87%, so:

$$2 * -.871 * var\_rank = -.135$$

This is exactly the RCI we calculated earlier by Stata:

```
. reg lhsu easyrank [fw=pop], cformat(%4.3f)      // convenient regression

------------------------------------------------------------------------------
        lhsu |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    easyrank |     -0.135      0.003   -48.73   0.000       -0.140      -0.129
       _cons |      0.222      0.002   140.41   0.000        0.219       0.225
------------------------------------------------------------------------------
```

Table 3.9 Education-based inequality in contraceptive prevalence (modern methods) in the Philippines, DHS 1993 and 2008

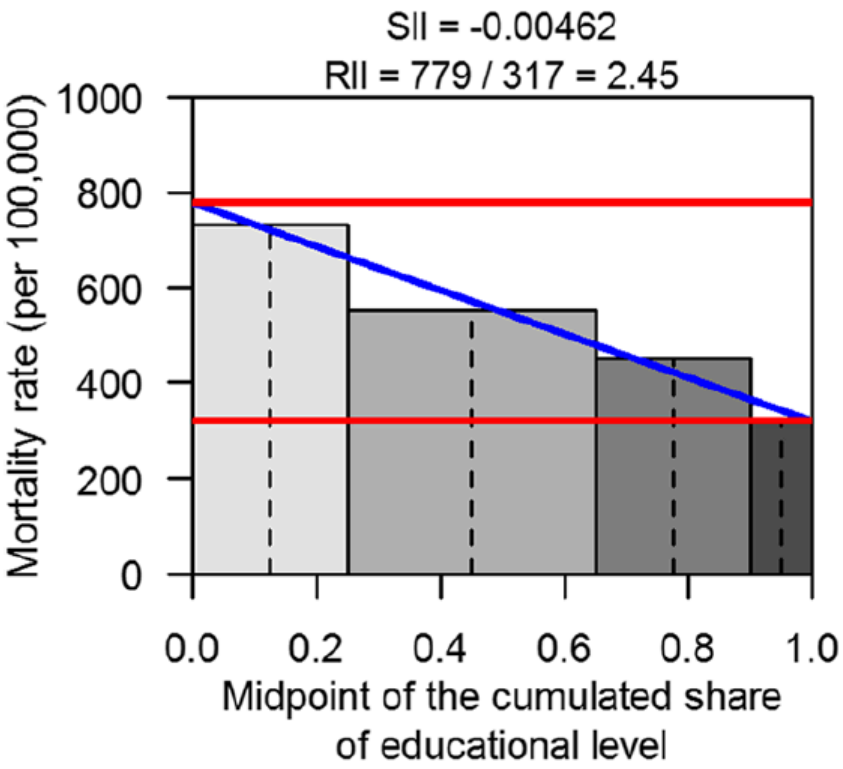
Survey year	Simple measures of inequality		Complex measures of inequality	
	Difference (secondary school or higher – none) (percentage points)	Ratio (secondary school or higher / none)	Slope index of inequality (percentage points)	Concentration index
1993	20.8	3.9	15.7	0.08
2008	27.1	4.1	14.3	0.04

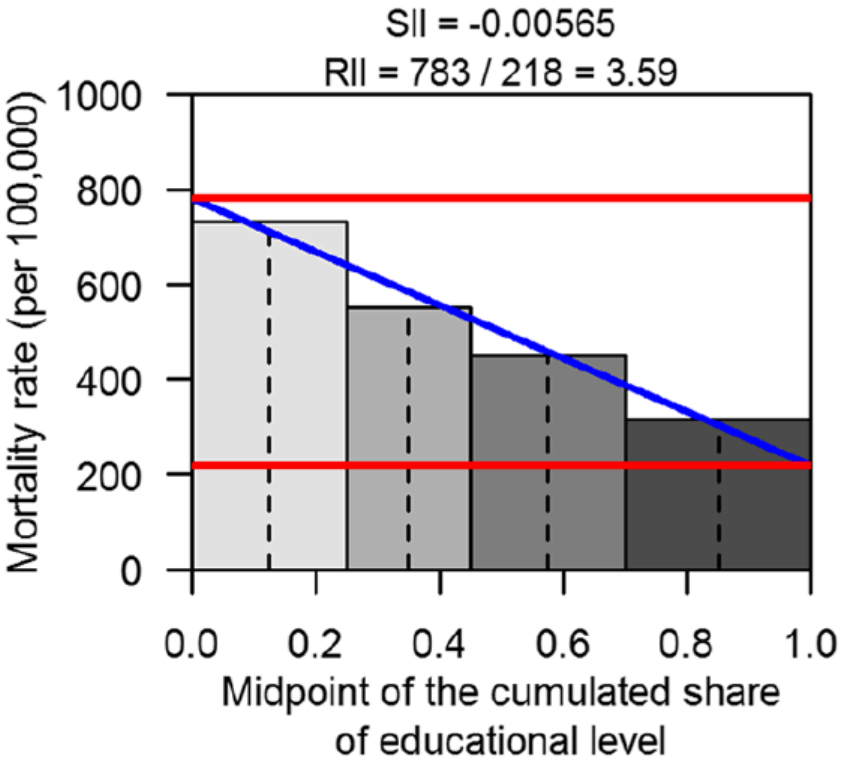
Using complex measures to account for population shifts is particularly important when health inequality monitoring is carried out to assess the effects of social policy. Broad social policies that are successful in alleviating poverty, increasing educational opportunities or creating jobs can result in a decrease in the size of disadvantaged subgroups. Evaluating the impact of such policies on health inequality is often of interest to those involved in the policy-making process. In order to generate measures that can be compared across time, health inequality monitoring should be sensitive to such changes in population characteristics.

Hosseinpoor et al. (2013)

Two ways of changing inequality

- Size of social groups will also change SII/RII **without** mortality change.
- Increasing the size of higher educated groups (e.g., larger share with higher education) increases inequality:

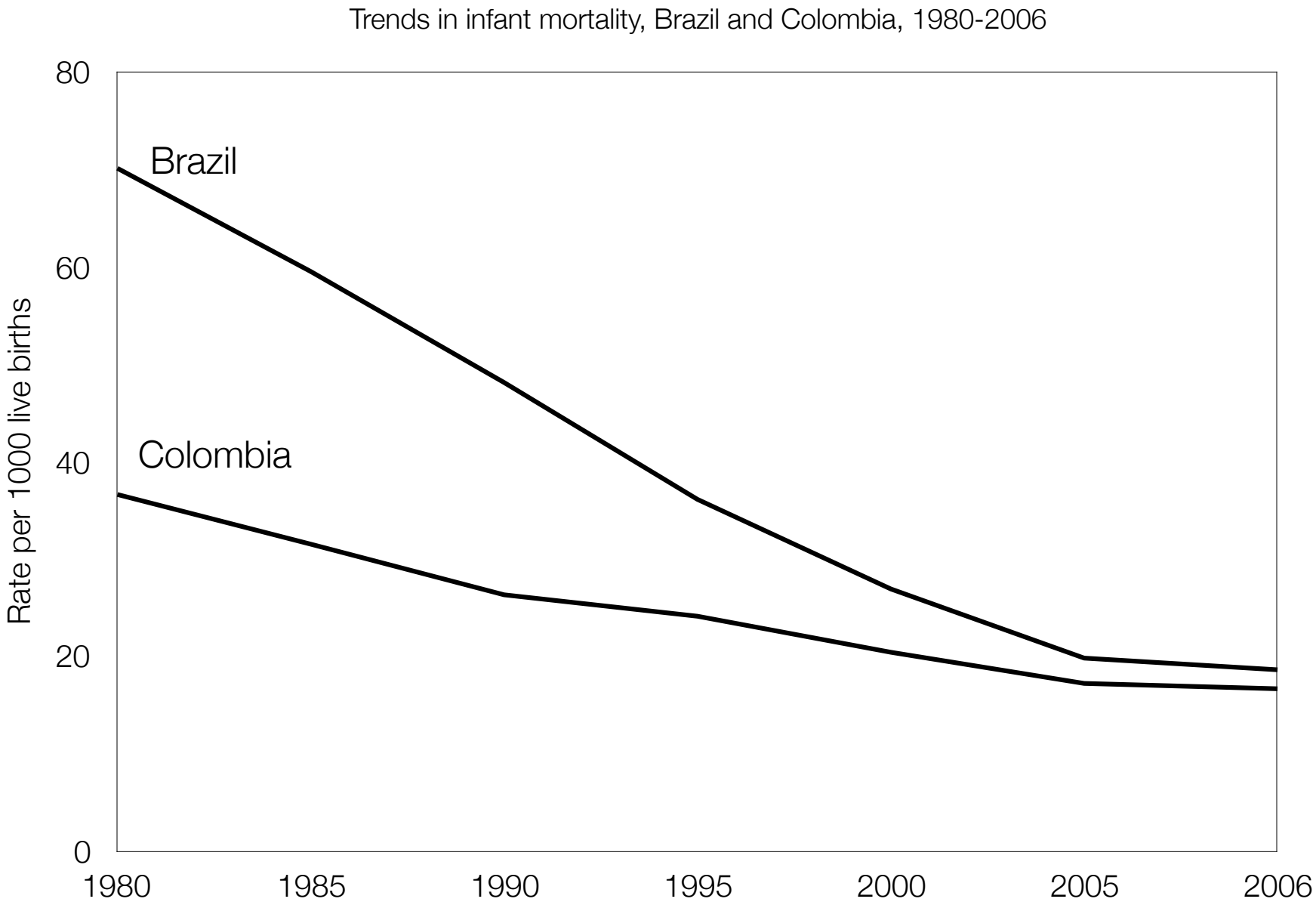




Renard et al. (2019)

3. Absolute or Relative Inequality?

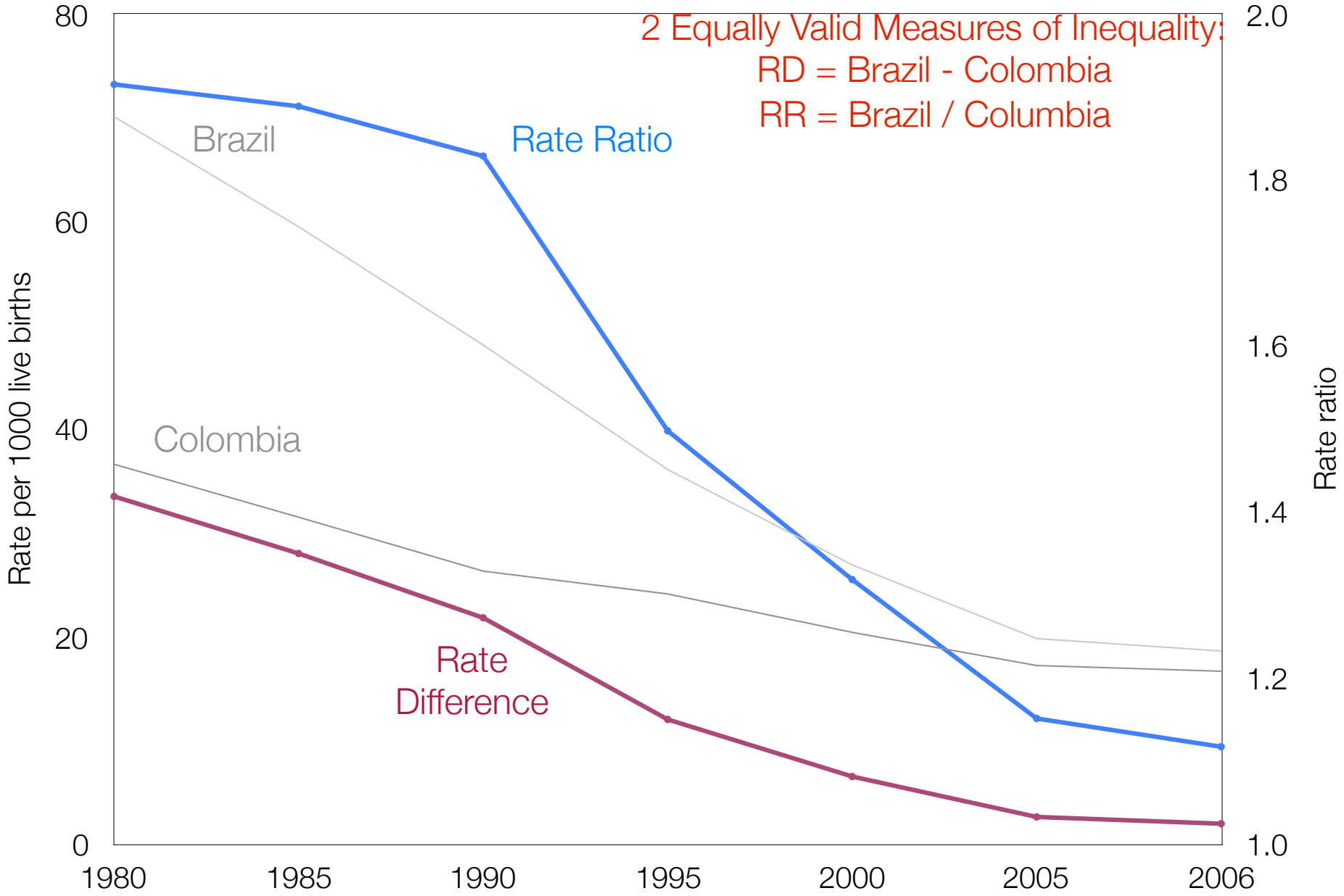
The Easy Case: Evidence of clear progress



Source: World Development Indicators, 2008

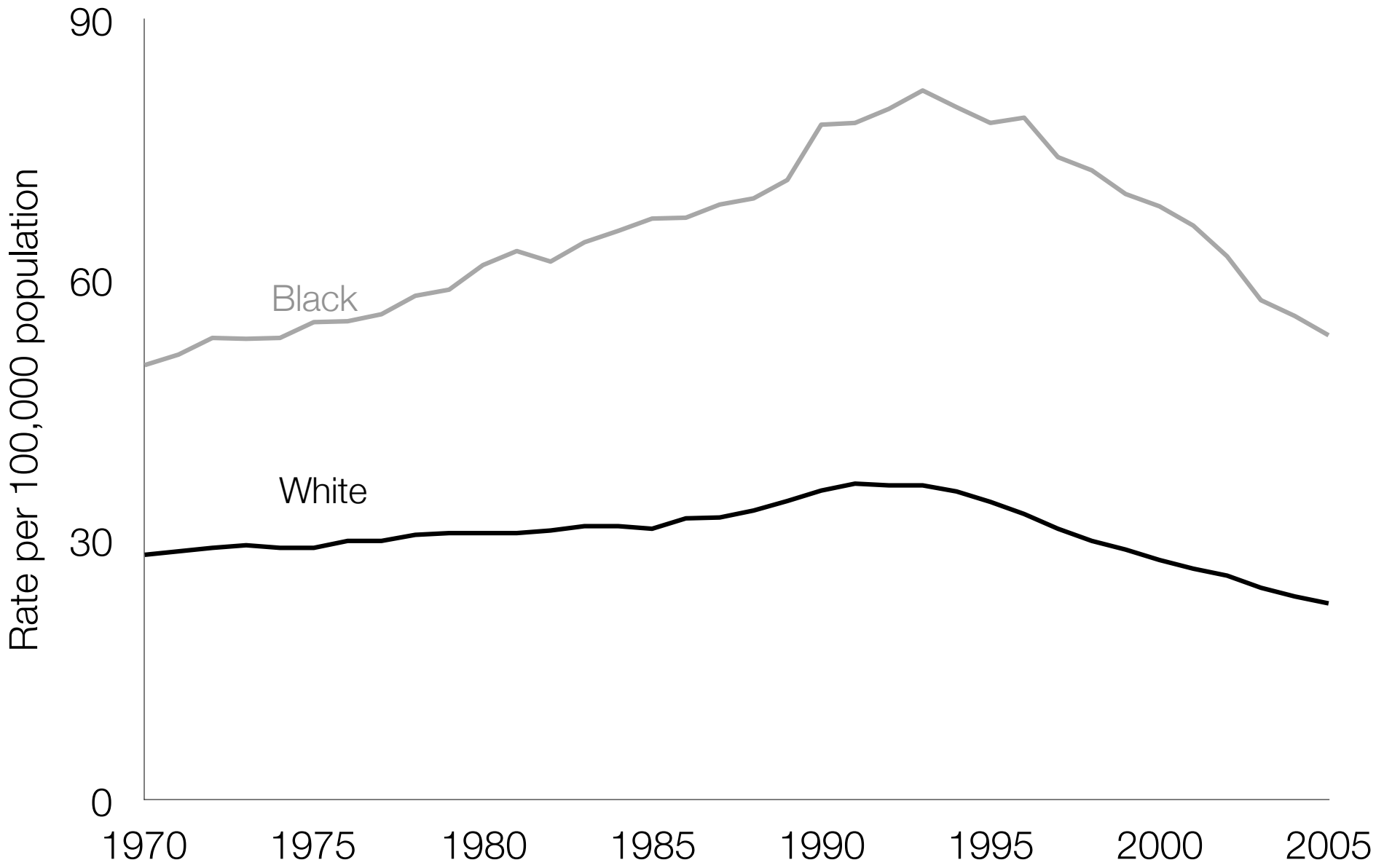
The Easy Case: Evidence of clear progress

Trends in infant mortality, Brazil and Colombia, 1980-2006



Source: World Development Indicators, 2008

Harder case: US Prostate Cancer Mortality Trends



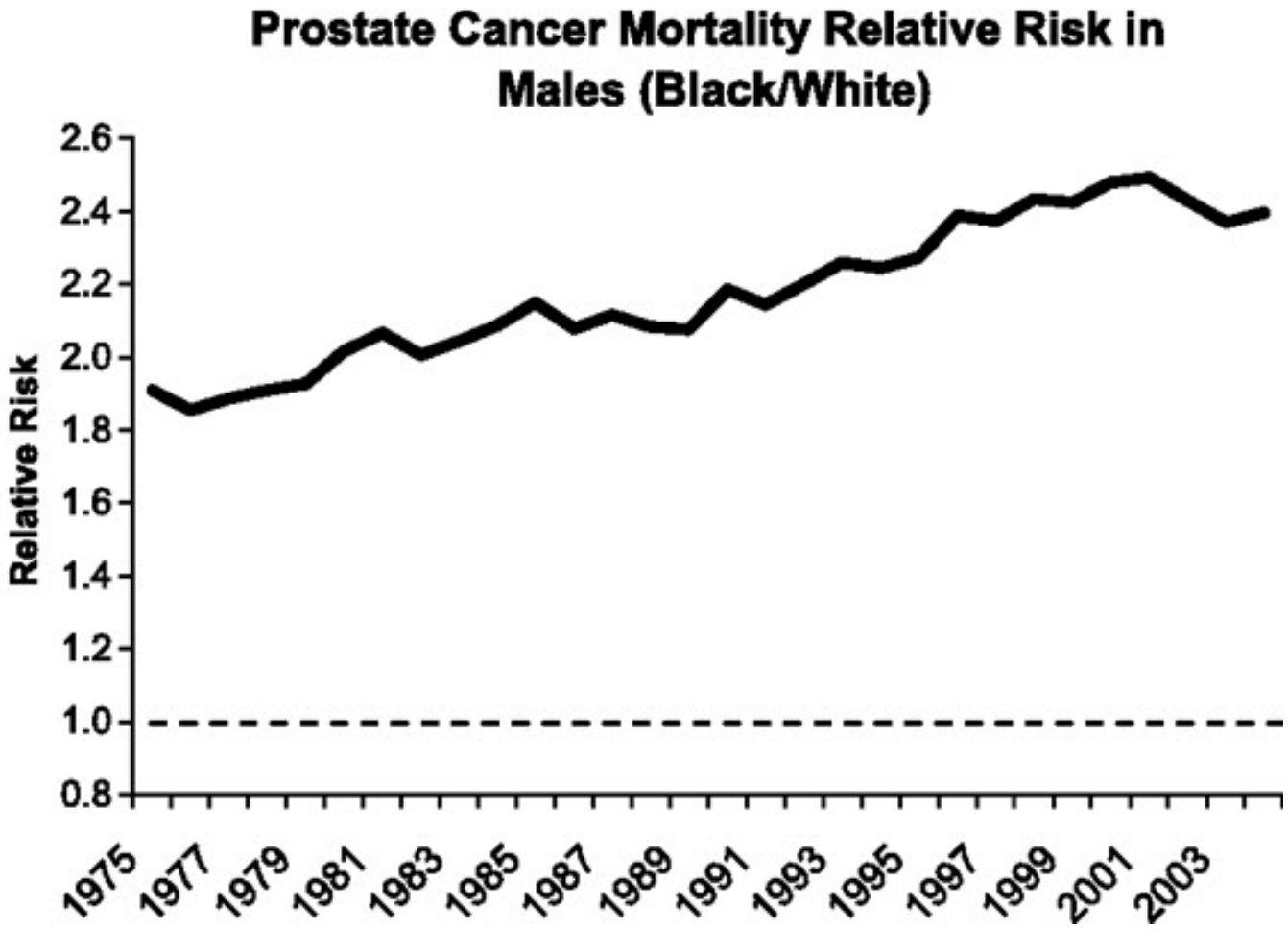
Source: SEER*Stat Database, 2008

13

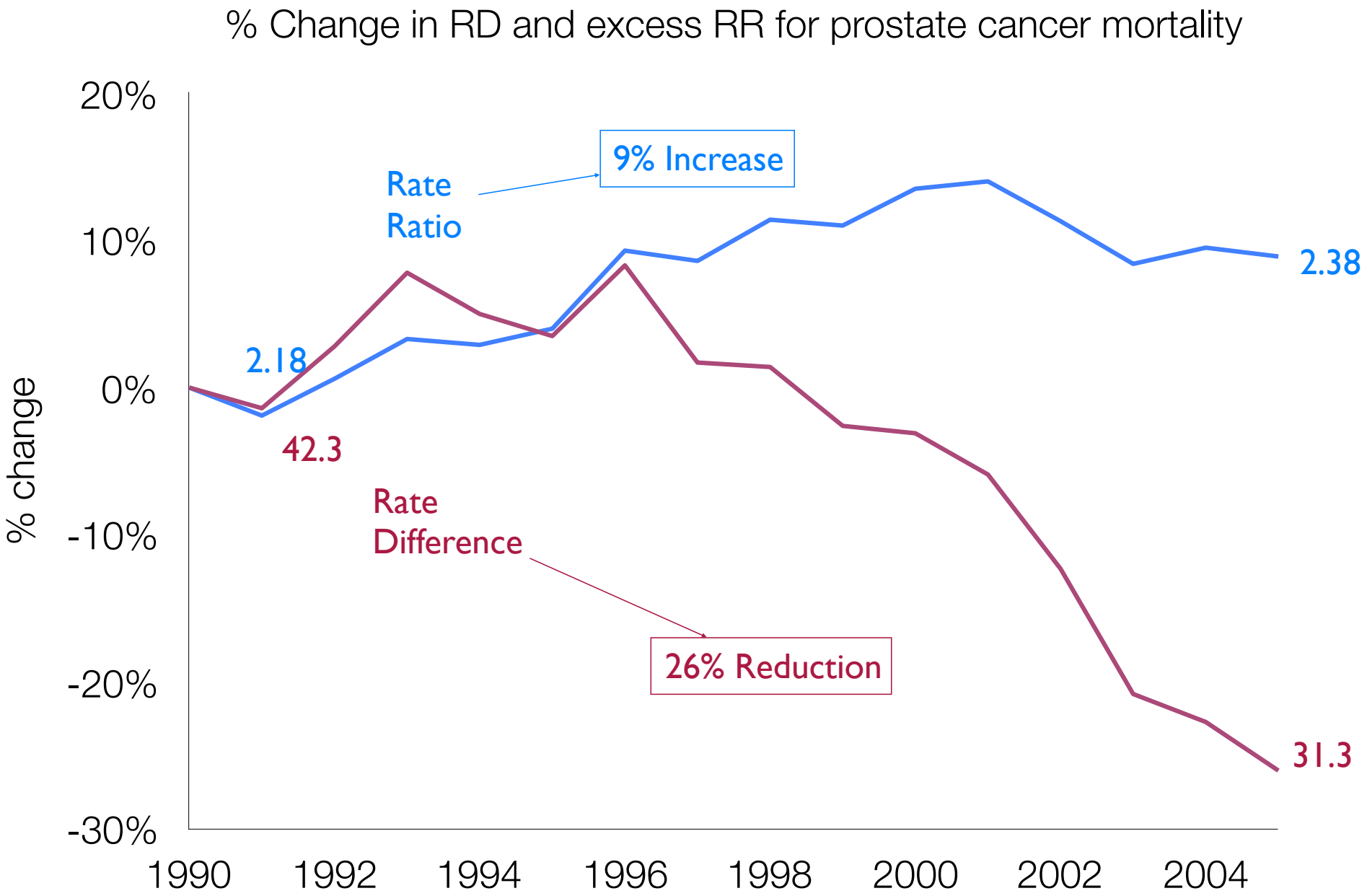
Recent Trends in Black-White Disparities in Cancer Mortality

John Oliver L. DeLancey, Michael J. Thun, Ahmedin Jemal, and Elizabeth M. Ward

Cancer Epidemiol Biomarkers Prev 2008;17(11). November 2008



"…racial disparities in mortality from cancers potentially affected by screening and treatment increased over most of the interval since 1975."



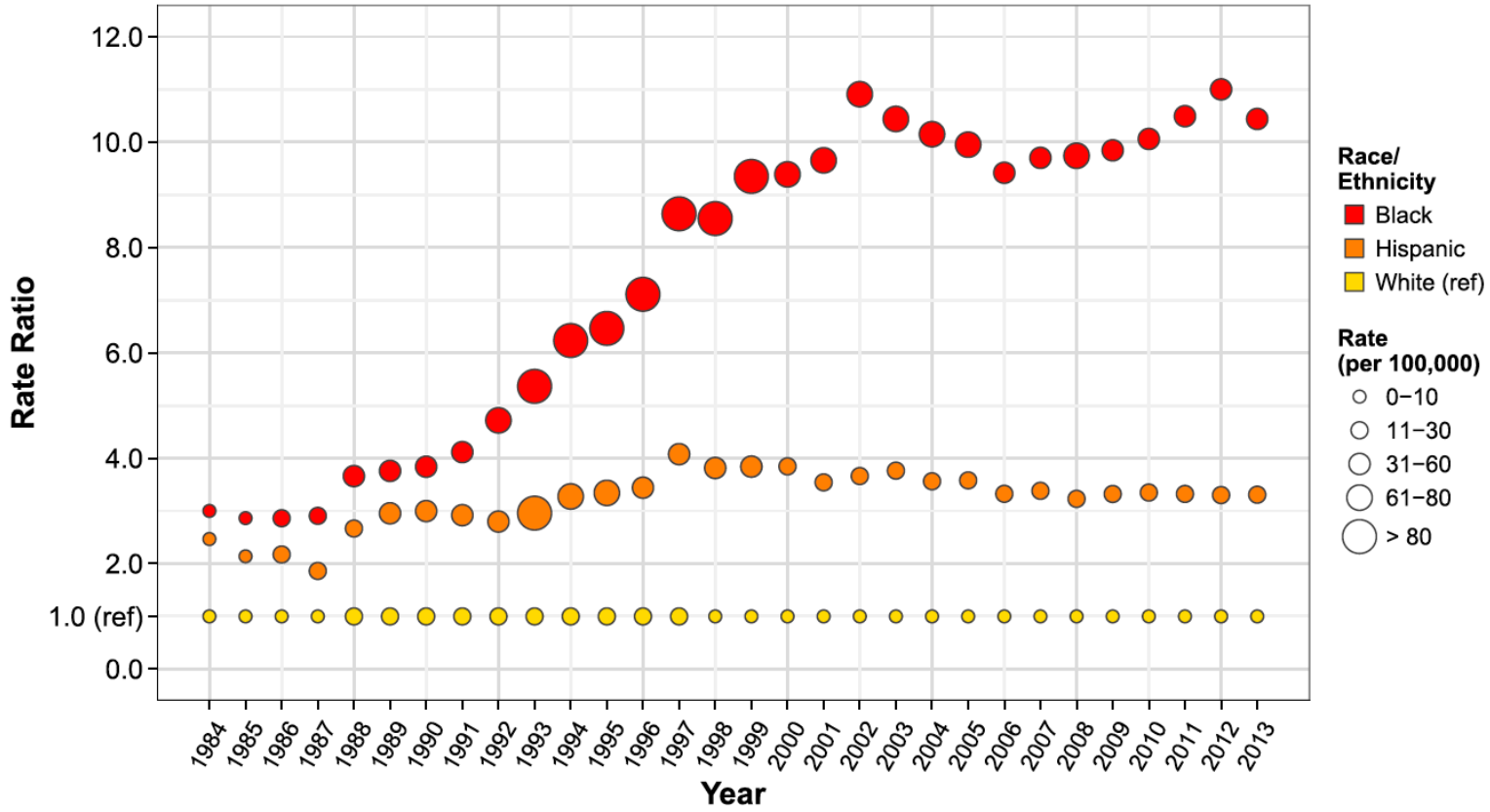
Source: SEER*Stat Database, 2008

Trends in racial/ethnic disparities of new AIDS diagnoses in the United States, 1984–2013

Johanna Chapin-Bardales MPH *, Eli Samuel Rosenberg PhD, Patrick Sean Sullivan PhD

Department of Epidemiology, Rollins School of Public Health, Emory University, Atlanta, GA

Annals of Epidemiology 27 (2017) 329–334

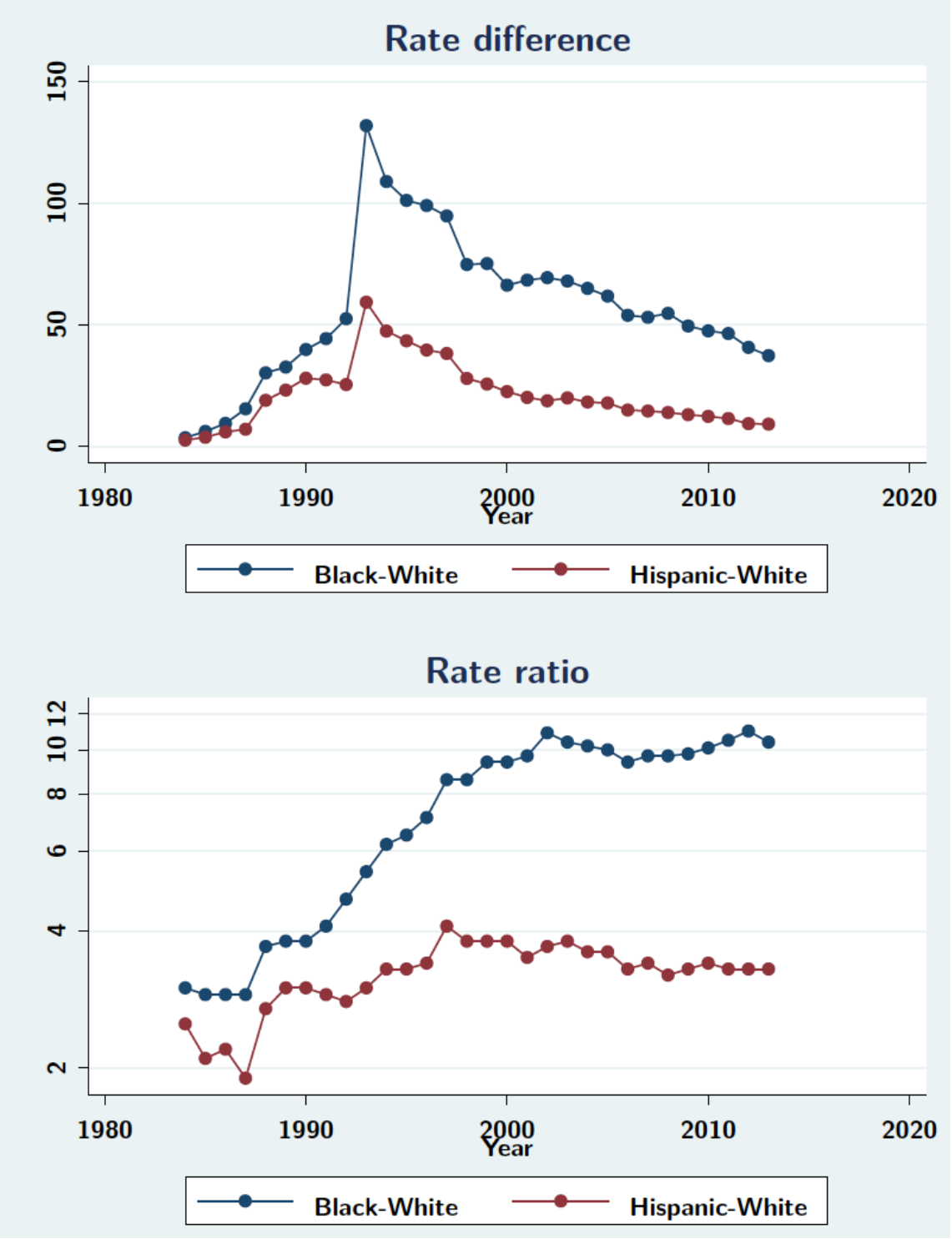


"Racial disparities rose sharply from 1984 to the early 2000s for Blacks…concerningly, we documented a significant increase from 2006 to 2013."

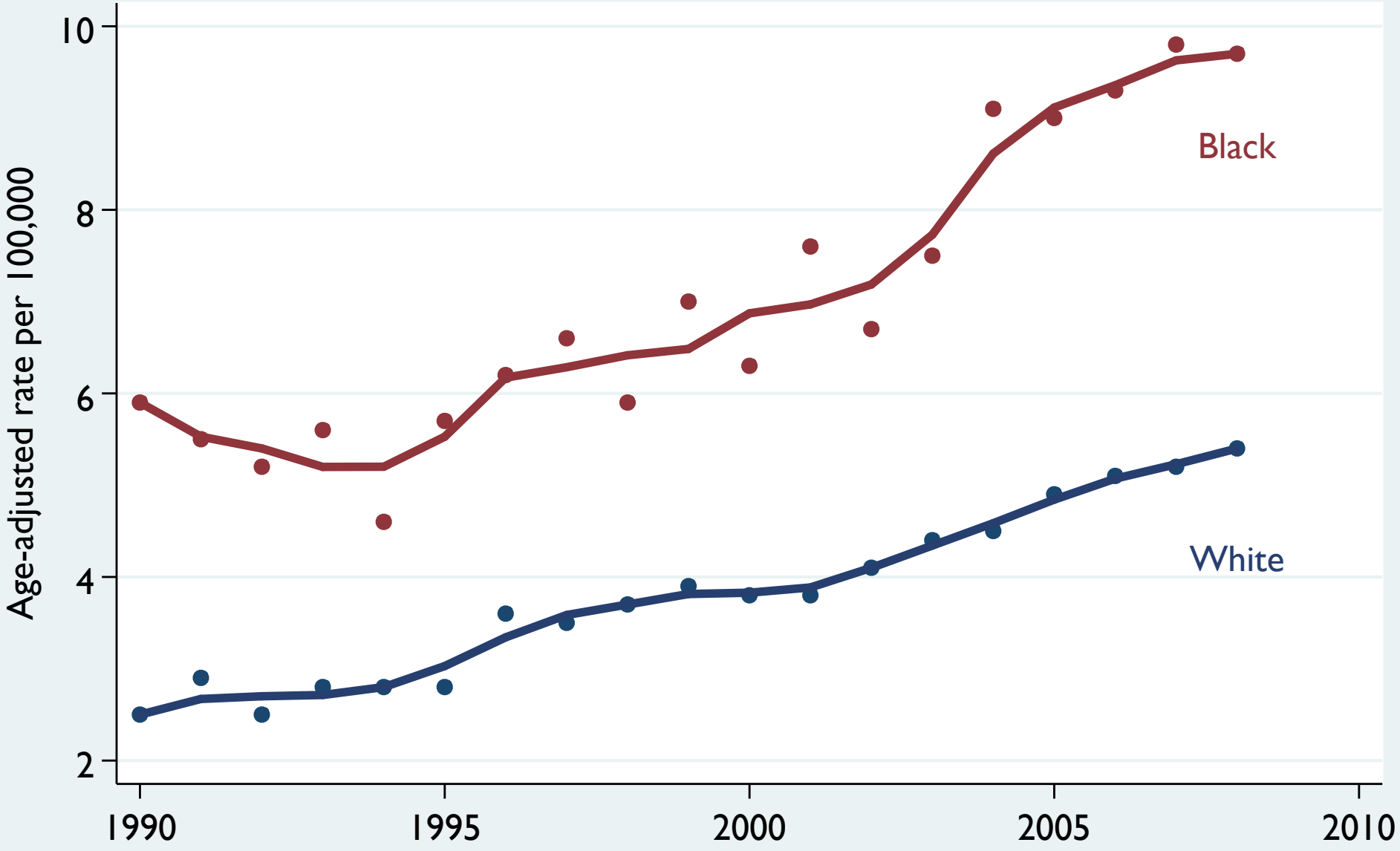
"The increasing trend we observed in the Black-White disparity from 2006 to 2013 likely stemmed from a combination of high HIV incidence among young Black MSM and persistent disparities in the HIV care continuum in recent years"

- Failure to consider the scale on which inequalities are measured can have dramatic impacts on study conclusions.

- This also has broad implications for thinking about explanations for inequality trends.

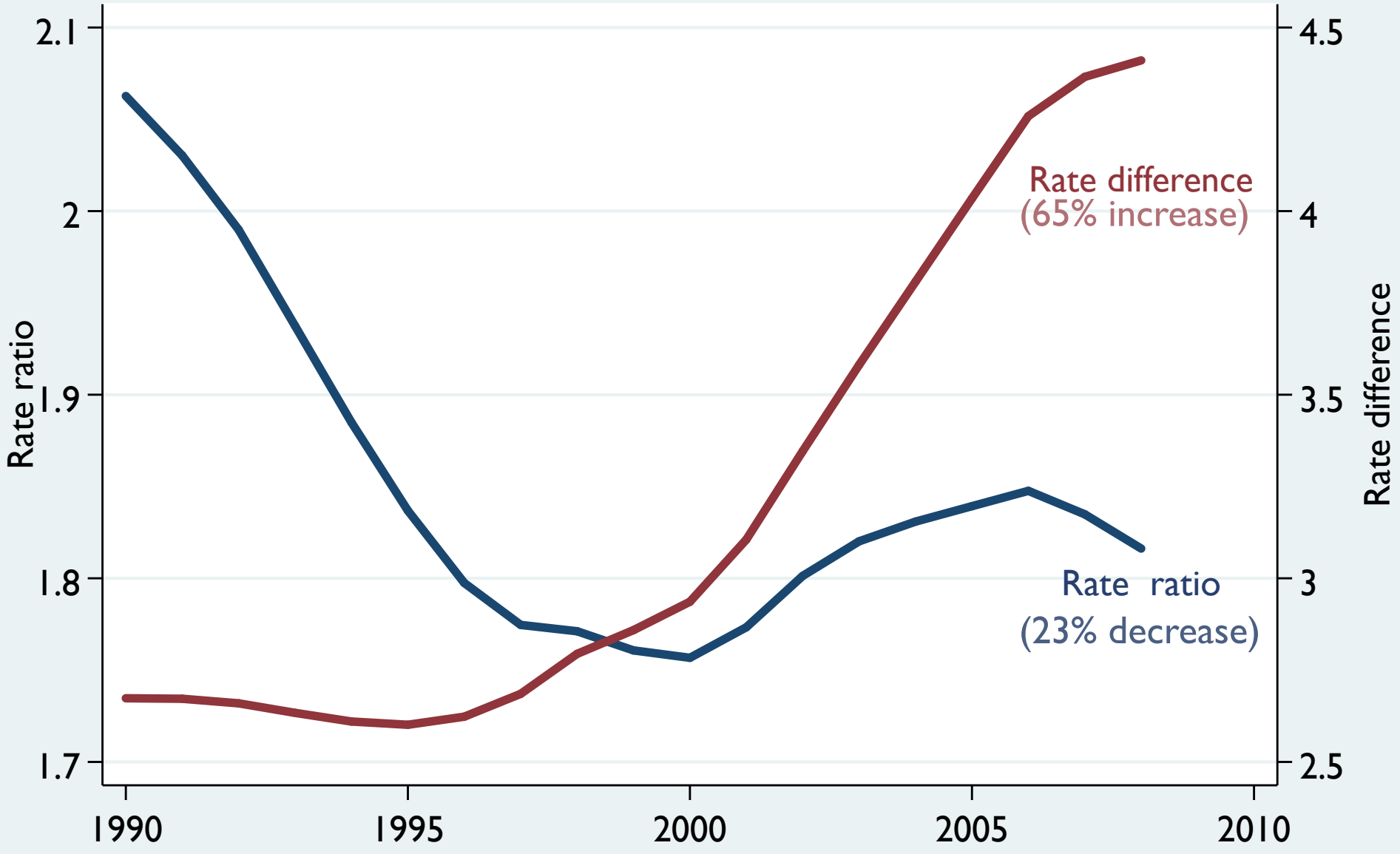


Incidence of Liver Cancer, 1990-2008



Source: SEER*Stat, SEER 9 Registries

Black-White Inequalities in Incidence of Liver Cancer, 1990-2008



Source: SEER*Stat, SEER 9 Registries

Not an isolated incident...

BMJ 2012;345:e5774 doi: 10.1136/bmj.e5774 (Published 3 September 2012)

Use of relative and absolute effect measures in reporting health inequalities: structured review

Nicholas B King *assistant professor*[1], Sam Harper *assistant professor*[2], Meredith E Young *assistant professor*[3]

Table 2| **Frequency of absolute and relative effect measures**

	No	Percentage (95% CI)
Abstract		
No measure reported	206	60 (55 to 65)
Only relative measure	122	35 (30 to 41)
Only absolute measure	13	3.8 (1.8 to 5.8)
Both relative and absolute measures	3	0.9 (0.0 to 1.9)
Full text		
Only relative measure	258	75 (70 to 80)
Absolute risks not reported	119	46 (40 to 52)
Absolute risks reported	139	54 (48 to 60)
Only absolute measure	61	18 (14 to 22)
Both relative and absolute measures	25	7.3 (4.5 to 10)

Among 344 papers on social inequalities published in 2009

Question for Discussion:

Are absolute or relative inequalities more important?

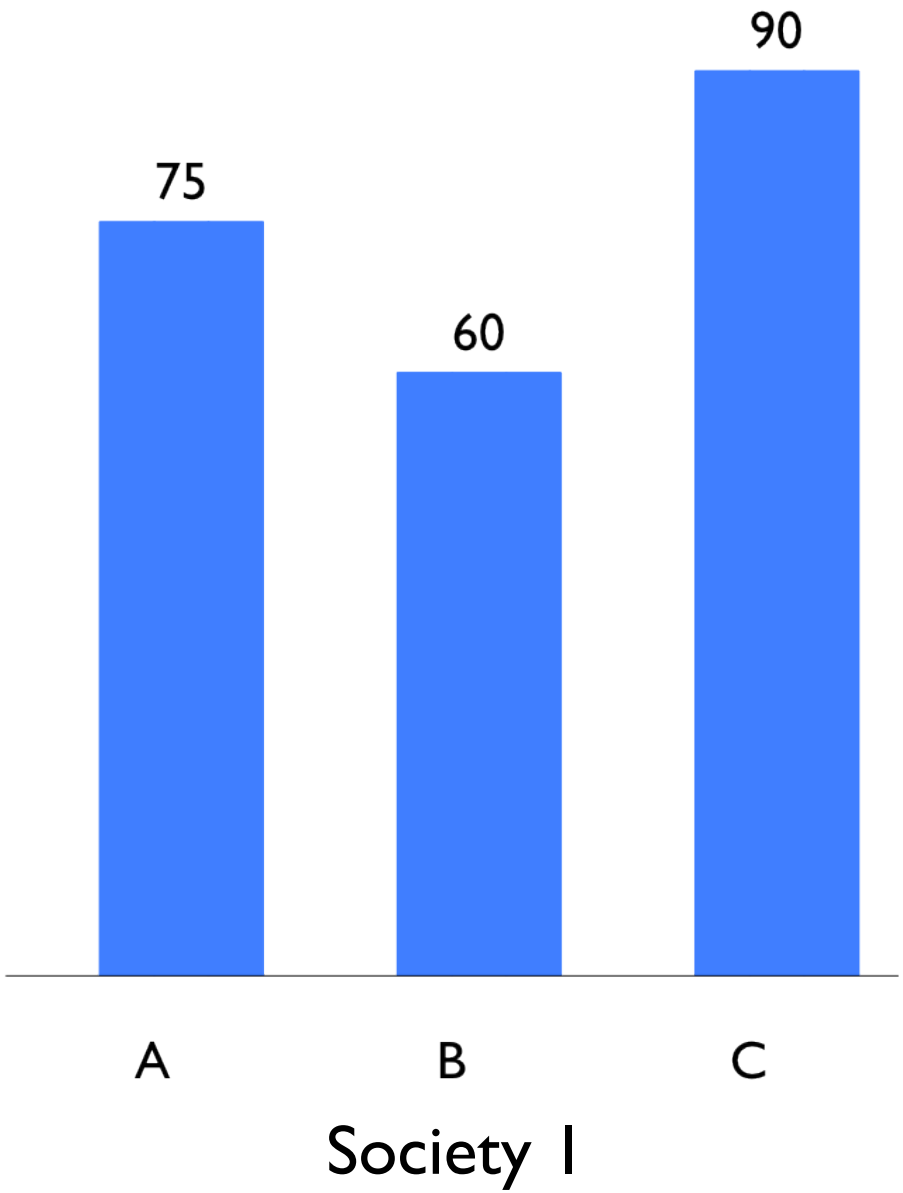
“Inequality” is an ambiguous concept

“There is no economic theory that tells us that inequality is relative, not absolute. It is not that one concept is right and the other wrong. Nor are they two ways of measuring the same thing. Rather, they are two different concepts.”

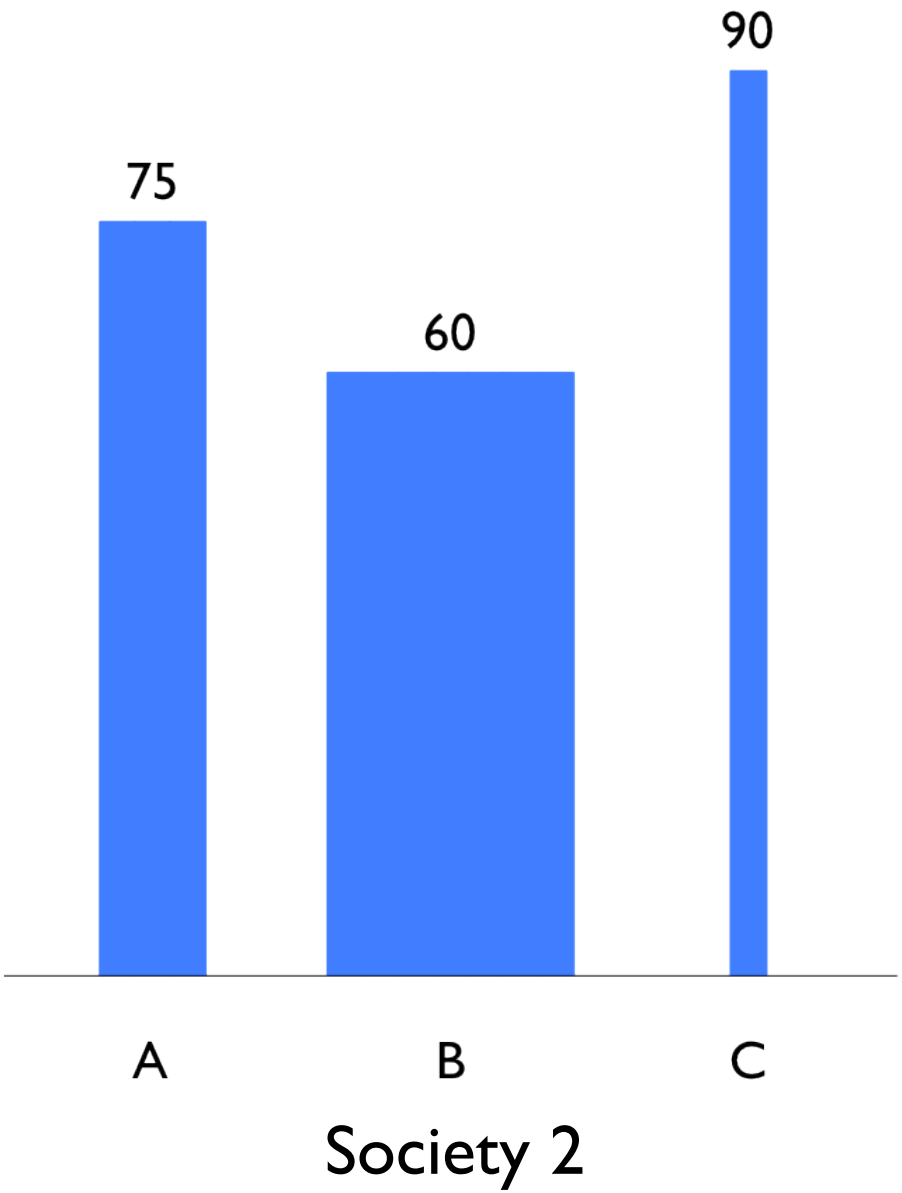
-Martin Ravallion, 2004
World Bank Economist

4. Weighting: Should we count individuals equally or social groups equally when evaluating inequality?

Is the amount of inequality the same in these two societies?

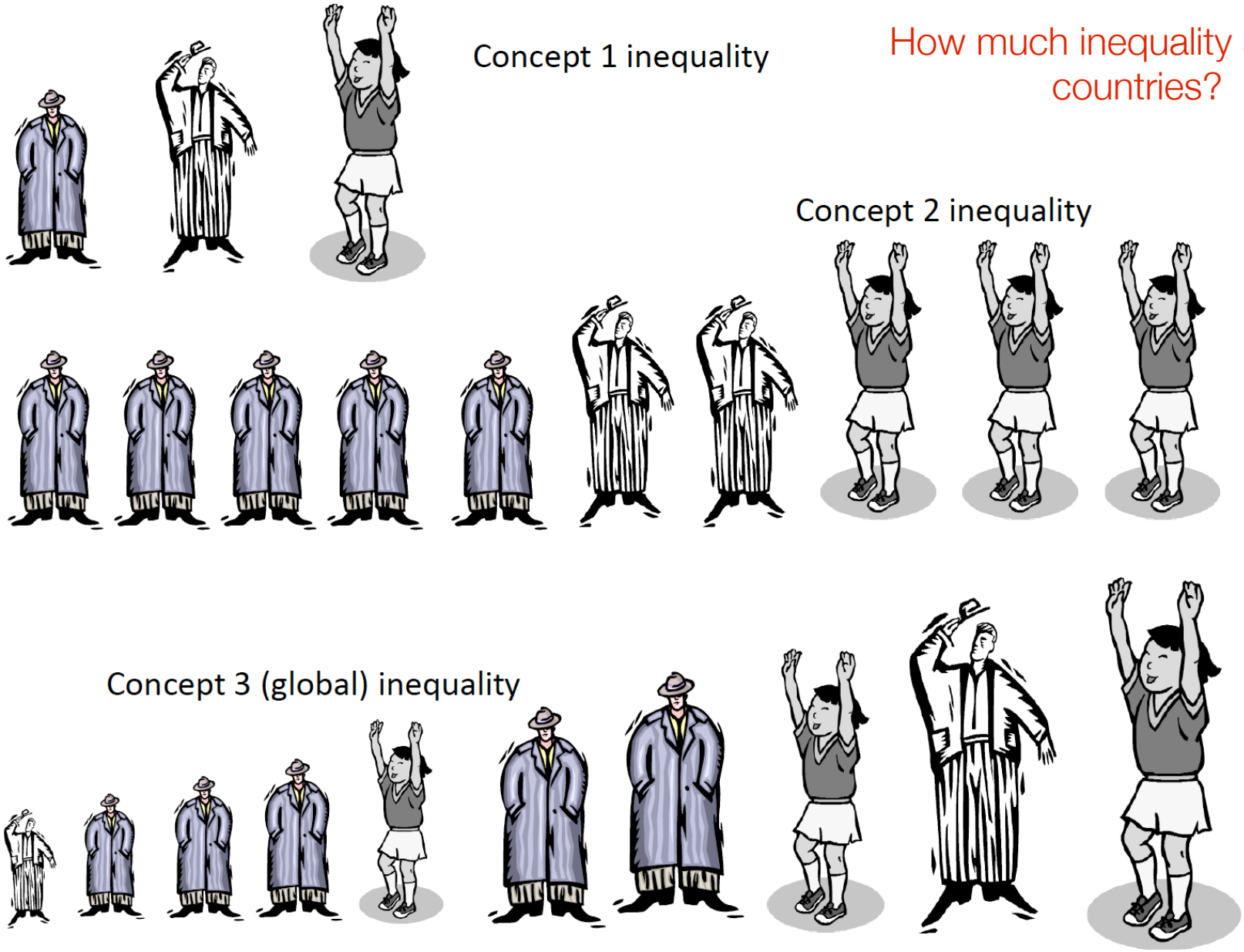


Society 1



Society 2

Population weighting: should it matter?



Milanovic (2008)

OPEN ACCESS Freely available online PLOS MEDICINE

The Reversal of Fortunes: Trends in County Mortality and Cross-County Mortality Disparities in the United States

Majid Ezzati[1,2*], Ari B. Friedman[2], Sandeep C. Kulkarni[2,3], Christopher J. L. Murray[1,2,4]

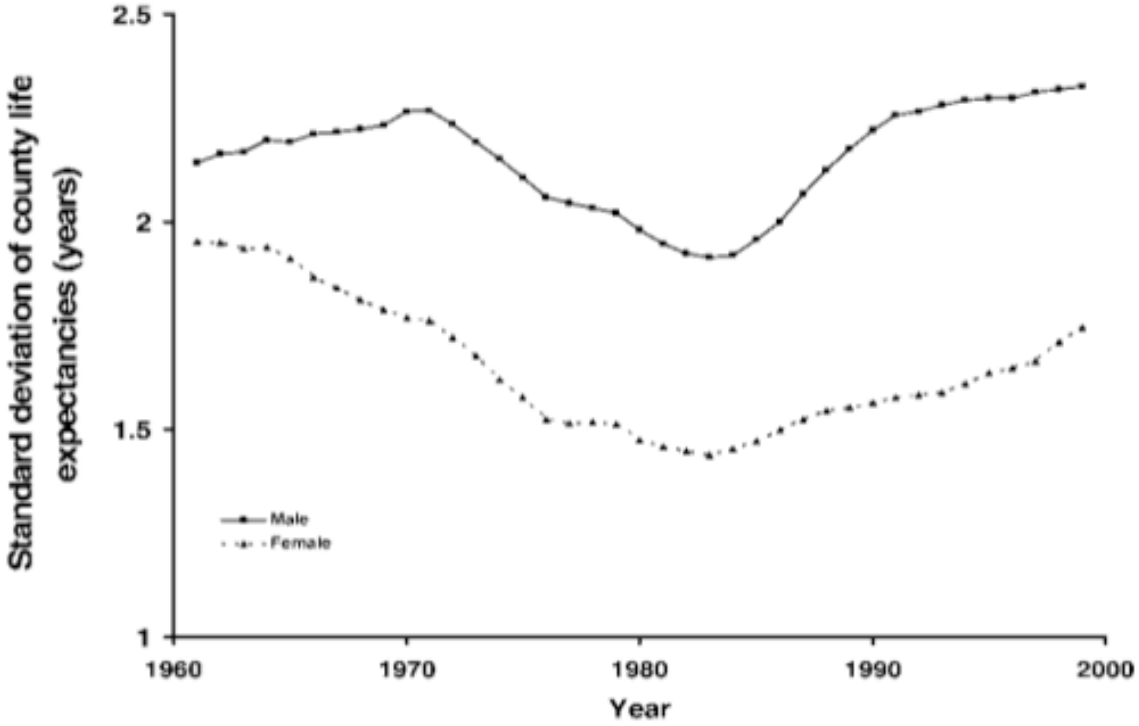


Figure 1. SD of Life Expectancies of the 2,068 County Units in the United States by Sex

Inequality in family income (e.g., as measured by the Gini coefficient) declined in the United States between the 1920s and 1970s, and has increased after that period [49,50].
doi:10.1371/journal.pmed.0050066.g001

"We report the standard deviation (SD) of life expectancies of the 2,068 county units in the United States"

"There was a steady increase in mortality inequality across the US counties between 1983 and 1999, resulting from stagnation or increase in mortality among the worst-off segment of the population."

TABLE 1
Comparison of Population-Weighted and -Unweighted Measures of Geographic Inequality in Life Expectancy at Birth in the United States, 1969–1973 and 1999–2003

Geographic Unit	Units	Life Expectancy at Birth		Measure of Health Inequality	
		Min.	Max.	Unweighted Index of Disparity	Weighted Mean Log Deviation
1969–1973					
Census region	4	70.2	72.2	1.67	0.050
Census division	9	69.7	72.4	1.80	0.072
State	51	65.9	74.3	4.36	0.137
County[a]	3,087	56.2	85.0	16.77	0.423
1999–2003					
Census region	4	76.2	78.5	1.61	0.074
Census division	9	74.7	78.7	2.02	0.097
State	51	73.0	80.7	4.43	0.150
County[b]	3,140	62.0	96.1	20.35	0.379
% Change, 1969–73 to 1993–2003					
Census region				−3.6%	+48.0%
Census division				+12.2%	+34.7%
State				+1.6%	+9.5%
County				+21.2%	−10.4%

Different direction!

Different magnitude

Different direction!

Issues to consider regarding weighting

- Weighting individuals equally is consistent with practice for estimating population average health, and allows for inequality measures to be responsive to demographic change.

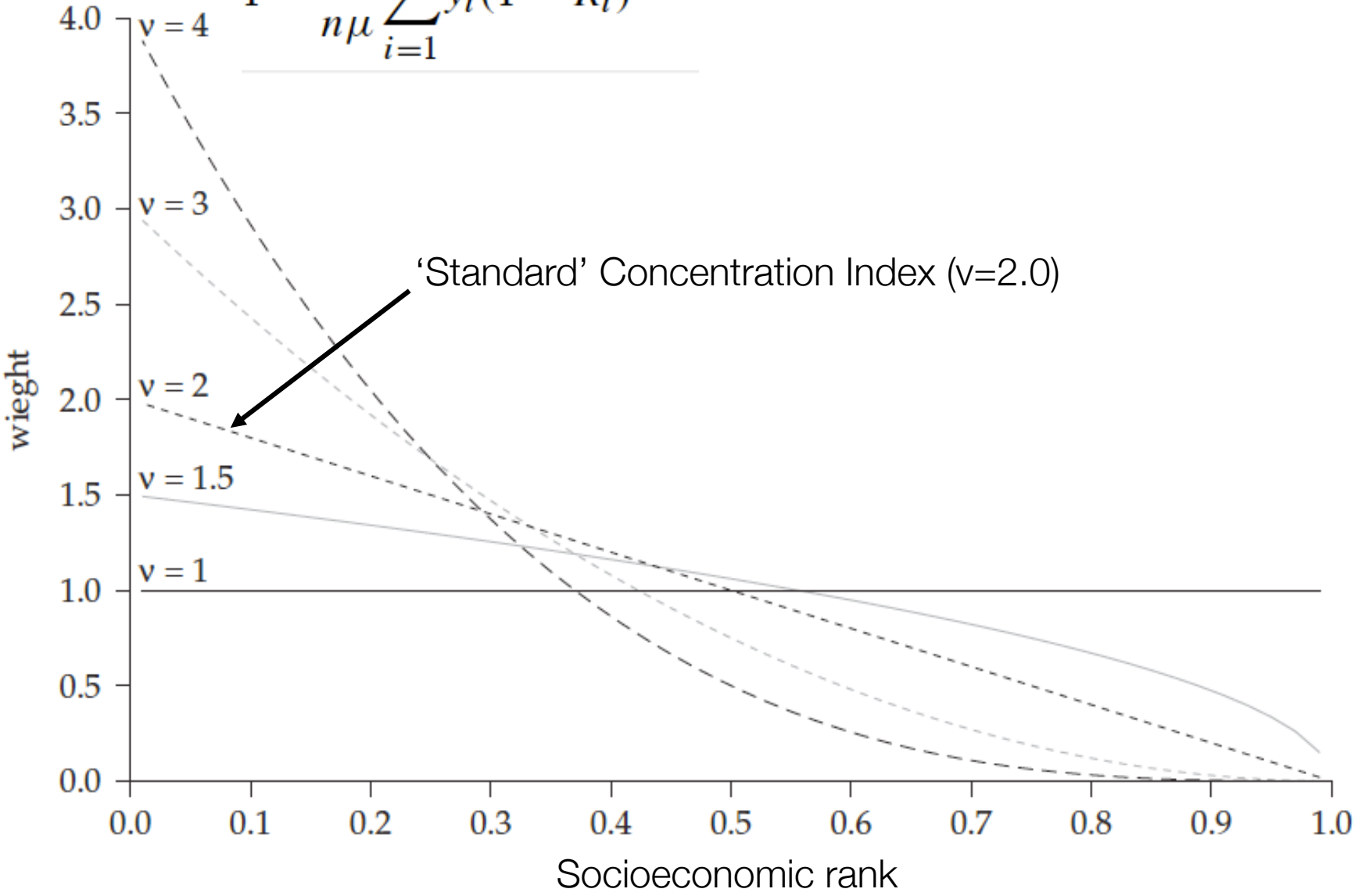
- Weighting social groups equally (and therefore individuals unequally in most cases) may make sense if one is concerned with disproportionate impacts on small or marginalized social groups.

5. Weighting: Do we care where changes in health inequality come from?

Weighting scheme for the Concentration Index

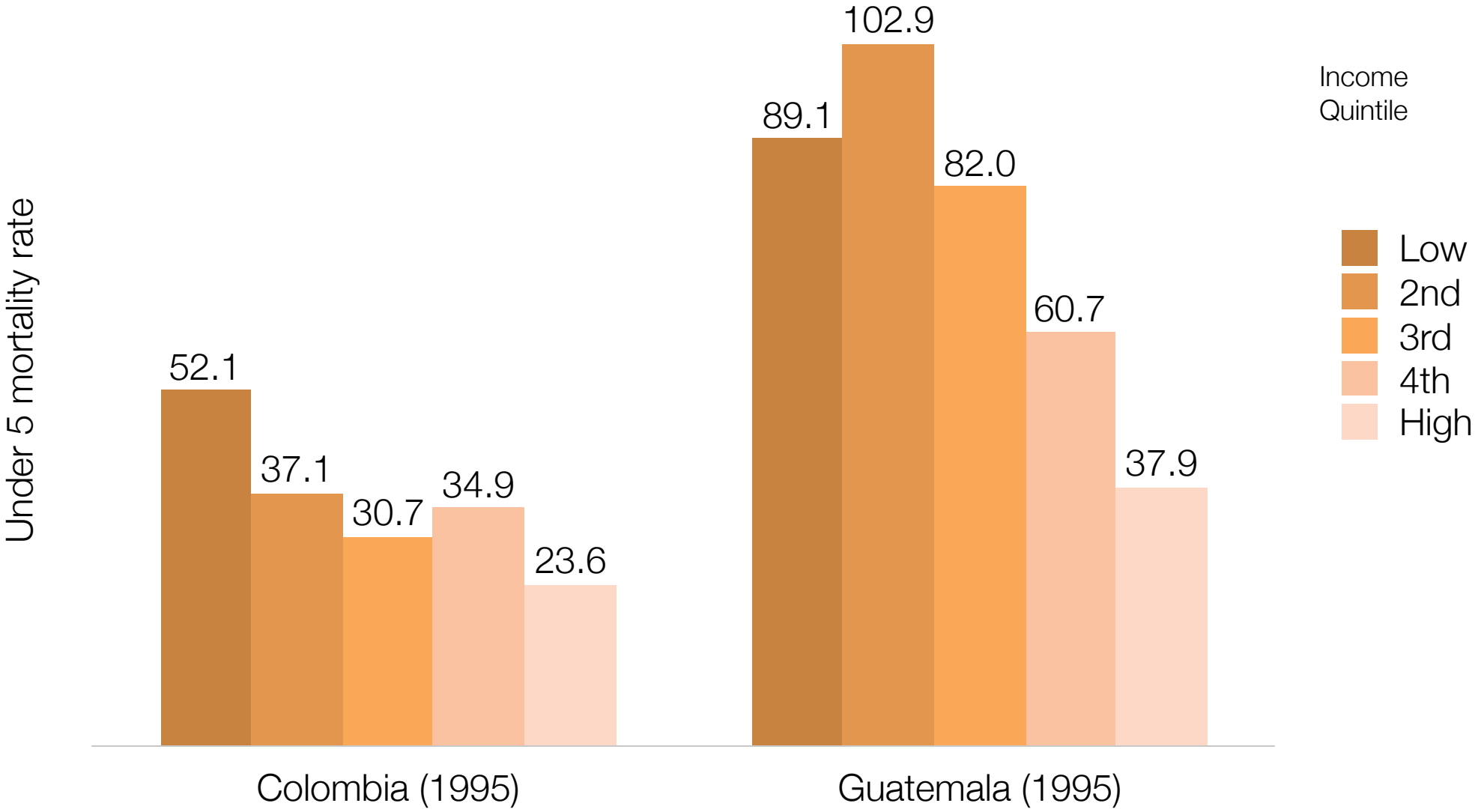
‘Aversion’ to inequality parameter

$$1 - \frac{\nu}{n\mu}\sum_{i=1}^{n} y_i (1 - R_i)^{\nu - 1}$$



Source: Wagstaff (2002)

Effect of differential weighting of the poor on child health inequalities



	RCI(2)	Rank	RCI(4)	Rank
Colombia	-0.13	28/44	-0.25	31//44
Guatemala	-0.12	25/44	-0.15	20/44

Sources: Wagstaff (2002), Gwatkin et al., (2007)

How to summarize this variation by ethnicity?

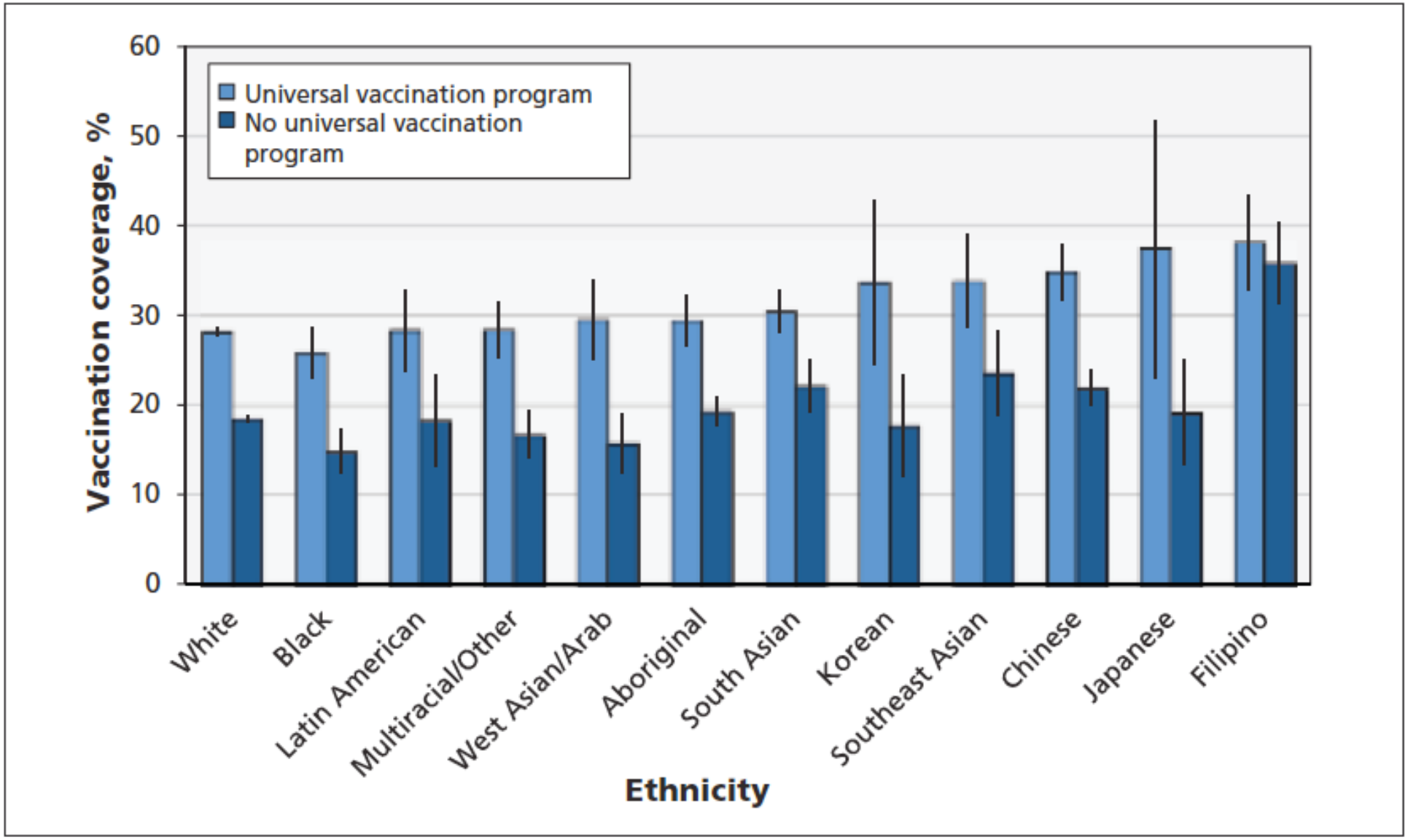


Figure 2: Influenza vaccine coverage, by ethnic group and availability of a universal influenza vaccination program, in Canadians aged 12–64 years without chronic diseases (2003–2009). Error bars represent 95% confidence intervals.

Quach et al (CMAJ 2012)

Relative Inequality: The Index of Disparity

Measures the mean deviation of the group rates from some reference point as a proportion of that reference point

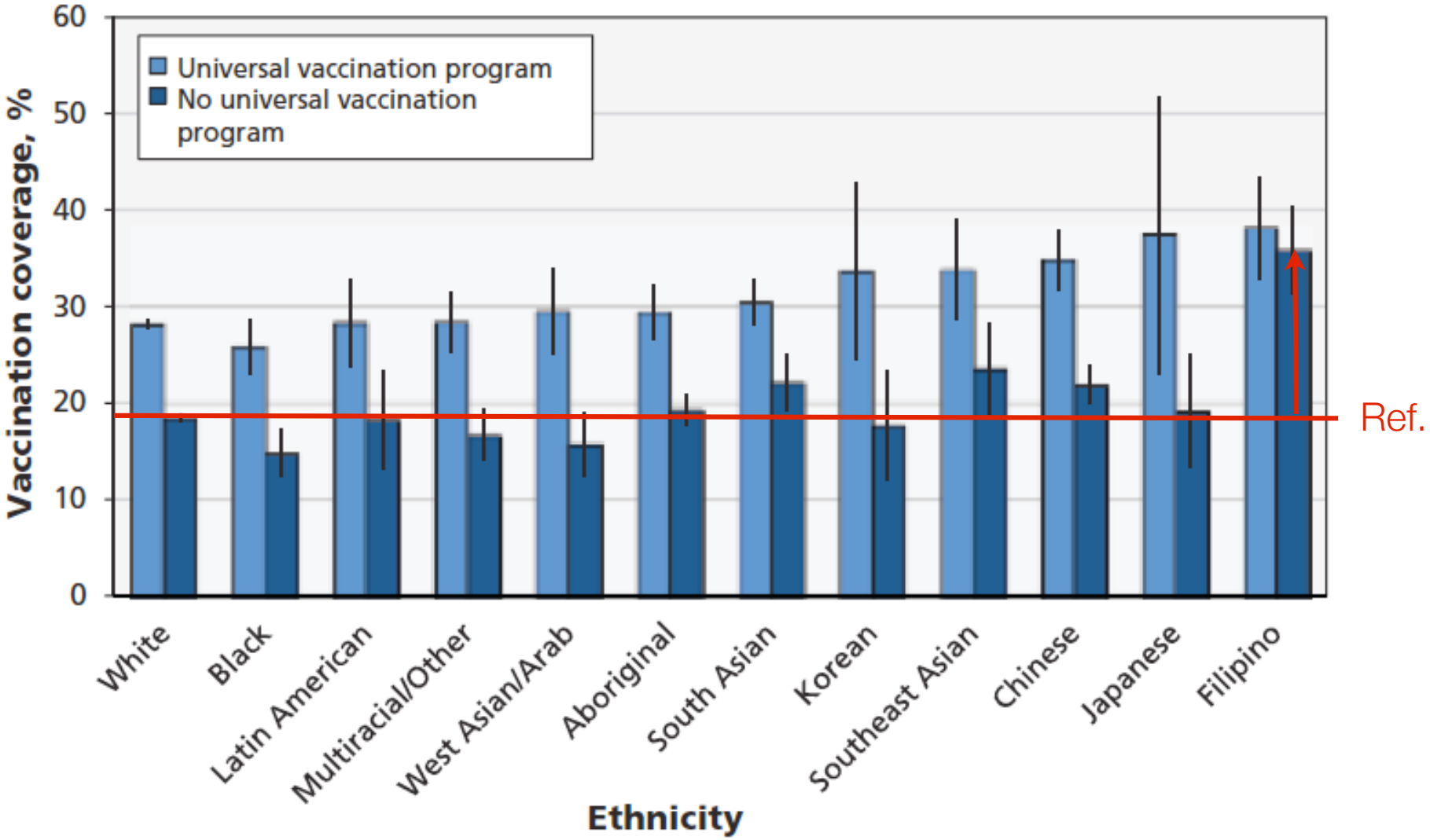
Formula:

$$ID = \sum_{j=1}^{J} \left(|y_j - y_{ref}| / n \right) / y_{ref}$$

Where y_j is the rate in group j, y_{ref} is the rate for the reference point, and J is the number of groups, or the number of groups minus 1 if one of the groups is the reference point

Source: Pearcy and Keppel. (1999)

$$ID = \sum_{j=1} \left(|y_j - y_{ref}| / n \right) / y_{ref}$$



Quach et al (CMAJ 2012)

Index of Disparity: Calculation

How great is the mean deviation between Andean countries specific infant mortality rates and the total rate as a proportion of the total rate?

Andean Country	Infant mortality rate	$\lvert r_i - r_{rp} \rvert$
Bolivia, r_1	54.0	28.7
Colombia, r_2	17.2	8.1
Ecuador, r_3	22.3	3.0
Peru, r_4	33.4	8.1
Venezuela, r_5	18.5	6.8
Total Rate, r_{rp}	25.3	-
	Sum of the Deviations $=\Sigma \lvert r_i - r_{rp} \rvert$	54.7
	Mean Deviation $=\Sigma \lvert r_i - r_{rp} \rvert / n$	10.94
Index of Disparity = Mean Deviation / Reference Point	$= (\Sigma \lvert r_i - r_{rp} \rvert / n) / r_{rp}$	0.43

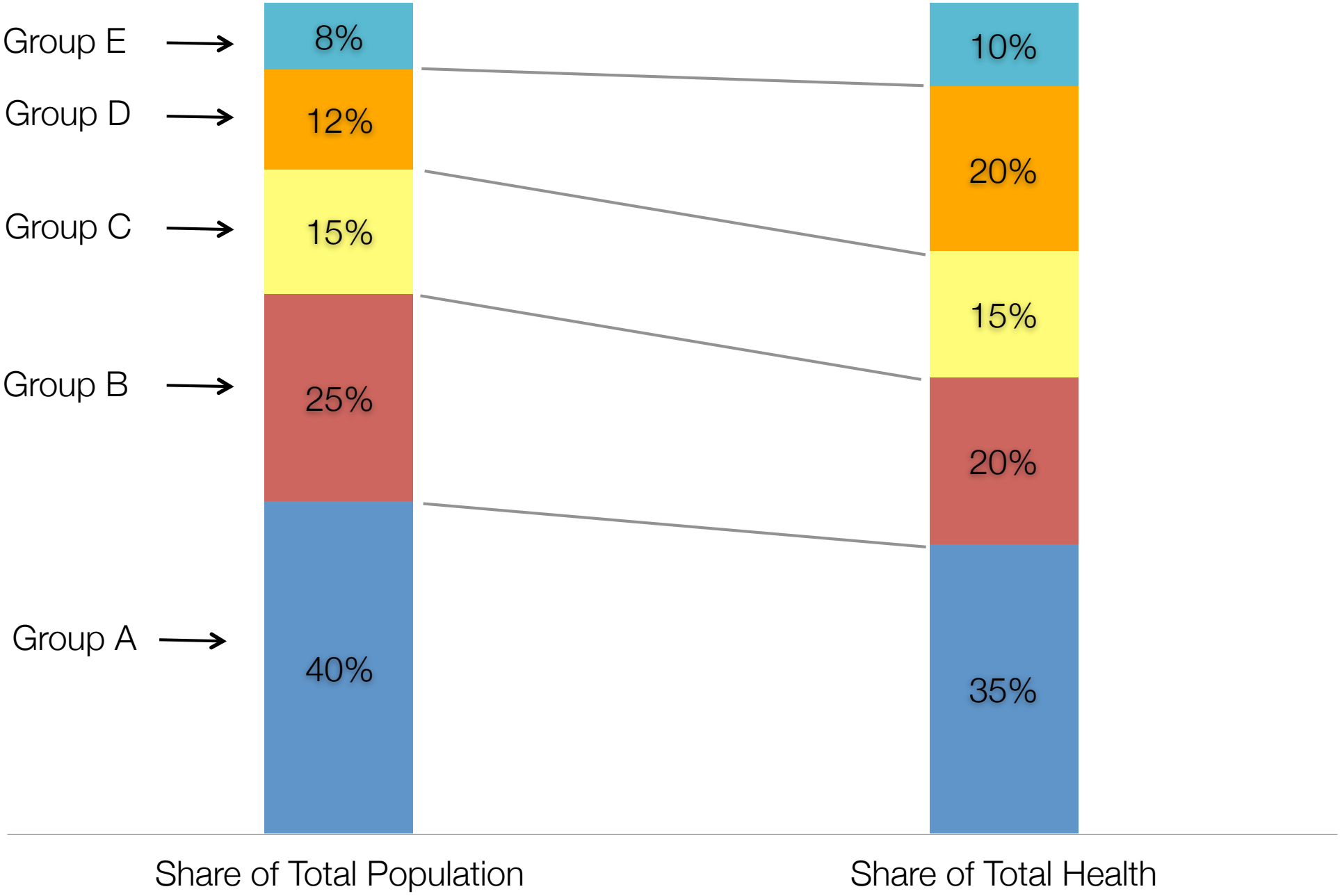
Index of Disparity

- As originally defined, note that *ID* has a few important but potentially modifiable characteristics:
  - Measures relative inequality
  - Does not account for population size of groups
  - Uses best observed health as reference level

- Interpretation is also a little awkward: the average deviation across social groups as a proportion of the reference level

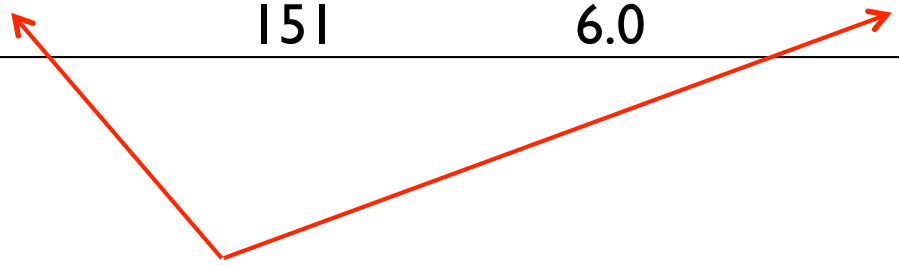
- Are there alternatives?

Health Inequality as Disproportionality



Relative Inequality: Health Inequality as Disproportionality

Group	Population	Share of Population (p_j)	Deaths	Mortality Rate per 1,000	Share of Deaths (s_j)
A	10000	40%	53	5.3	35%
B	6250	25%	30	4.8	20%
C	3750	15%	23	6.1	15%
D	2000	12%	30	10.0	20%
E	500	8%	15	7.5	10%
Total	25000		151	6.0	



Entropy-based measures of between-group inequality compare shares of population against shares of health/deaths/behaviors/outcome.

Two Measures of "Entropy"—from Information Theory

- Defined by Theil (1967): Theil index (T) and Mean Log Deviation (MLD) as measures of economic inequality
- Interpretation of *T*: "expected information…which transforms the population shares as prior probabilities into the income [health] shares as posterior probabilities."

$$T = \sum_{j=1}^{J} s_j \left[ln \left(s_j / p_j \right) \right]$$

Log of the ratio of shares of health to shares of population, weighted by shares of health

$$MLD = \sum_{j=1}^{J} p_j \left[ln \left(p_j / s_j \right) \right]$$

Log of the ratio of shares of population to shares of health, weighted by shares of population

Mean Log Deviation

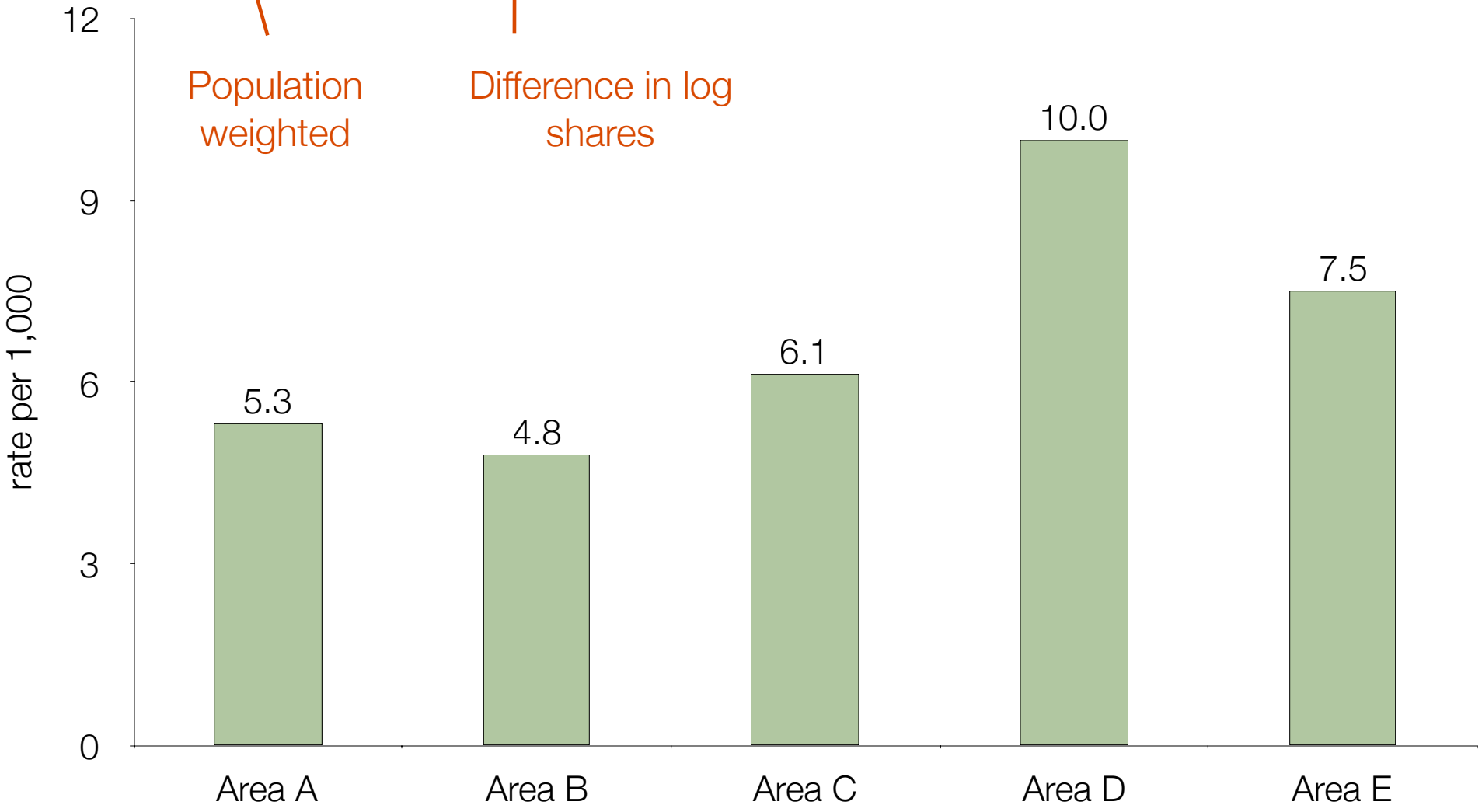
$$\sum_{j=1}^{J} p_j \left[ln\left(p_j\right) - ln\left(s_j\right) \right]$$

Population weighted

Difference in log shares

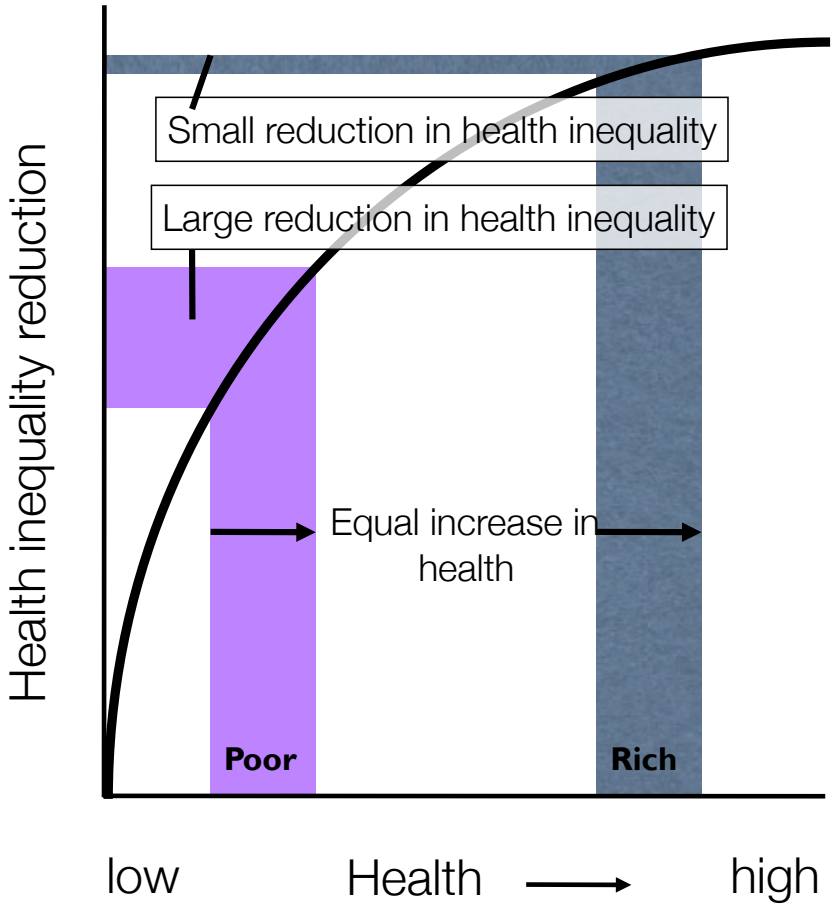
Index of Disparity

$$\sum_{j=1}^{J} \left(\left| y_j - y_{ref} \right| / n \right) / y_{ref}$$

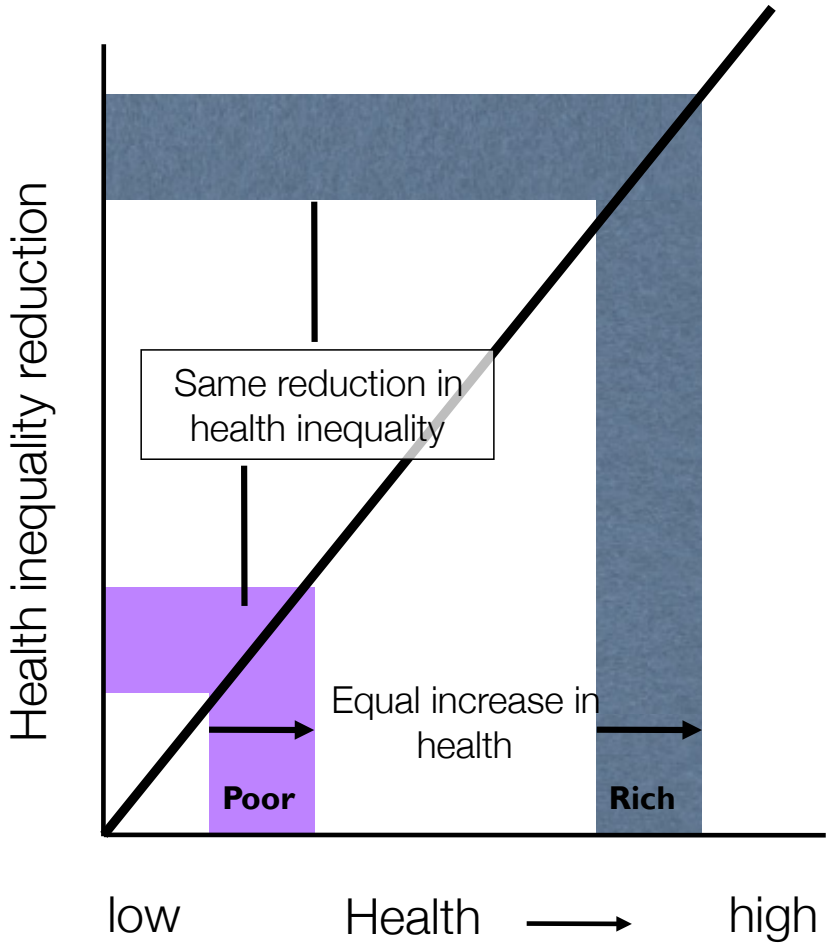


Do we care where health improvements come from?

PRIORITARIAN VIEW



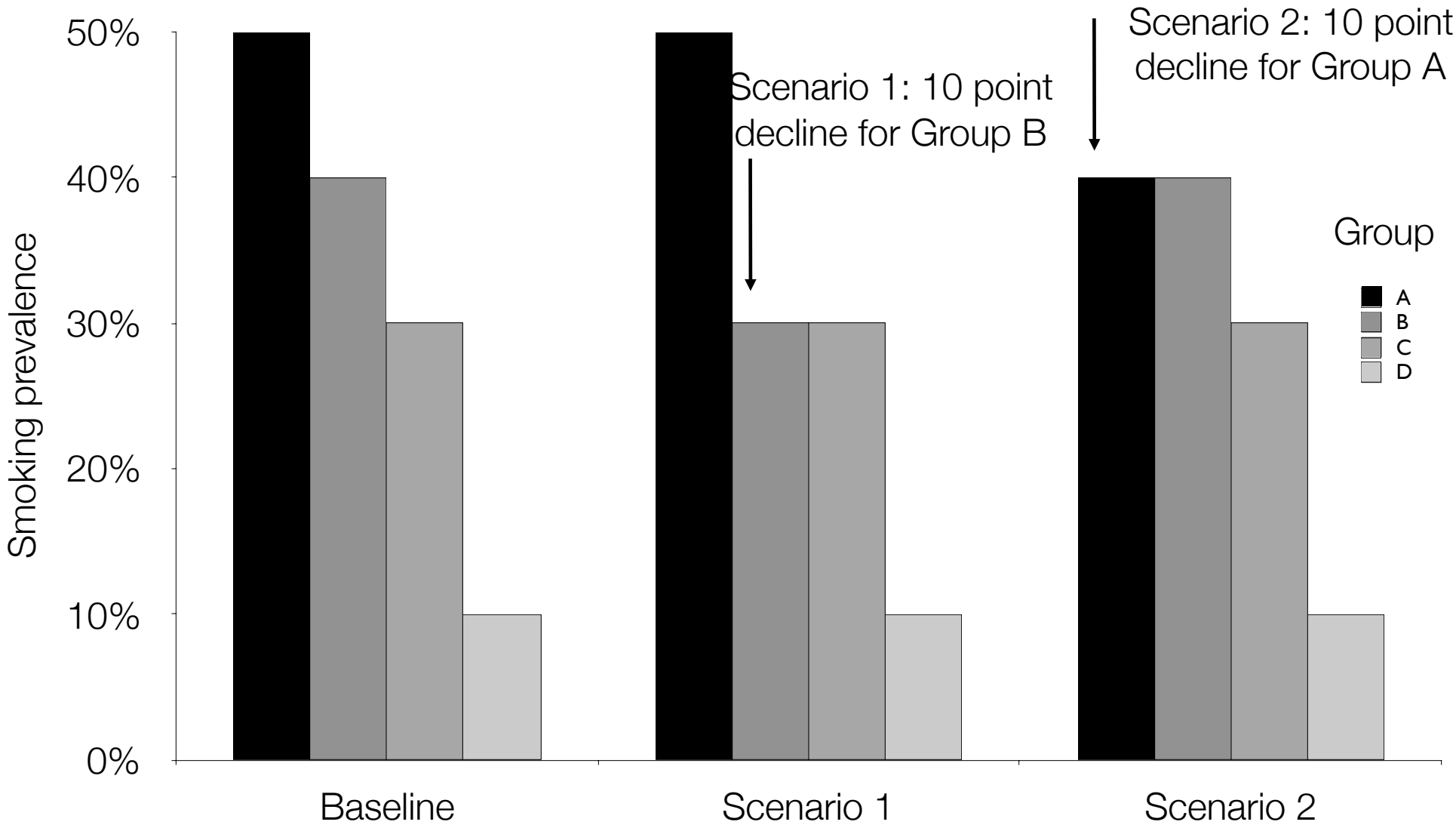
UTILITARIAN VIEW



Adapted from Broome (2008)

Changes in Inequality Measures for Hypothetical Scenarios

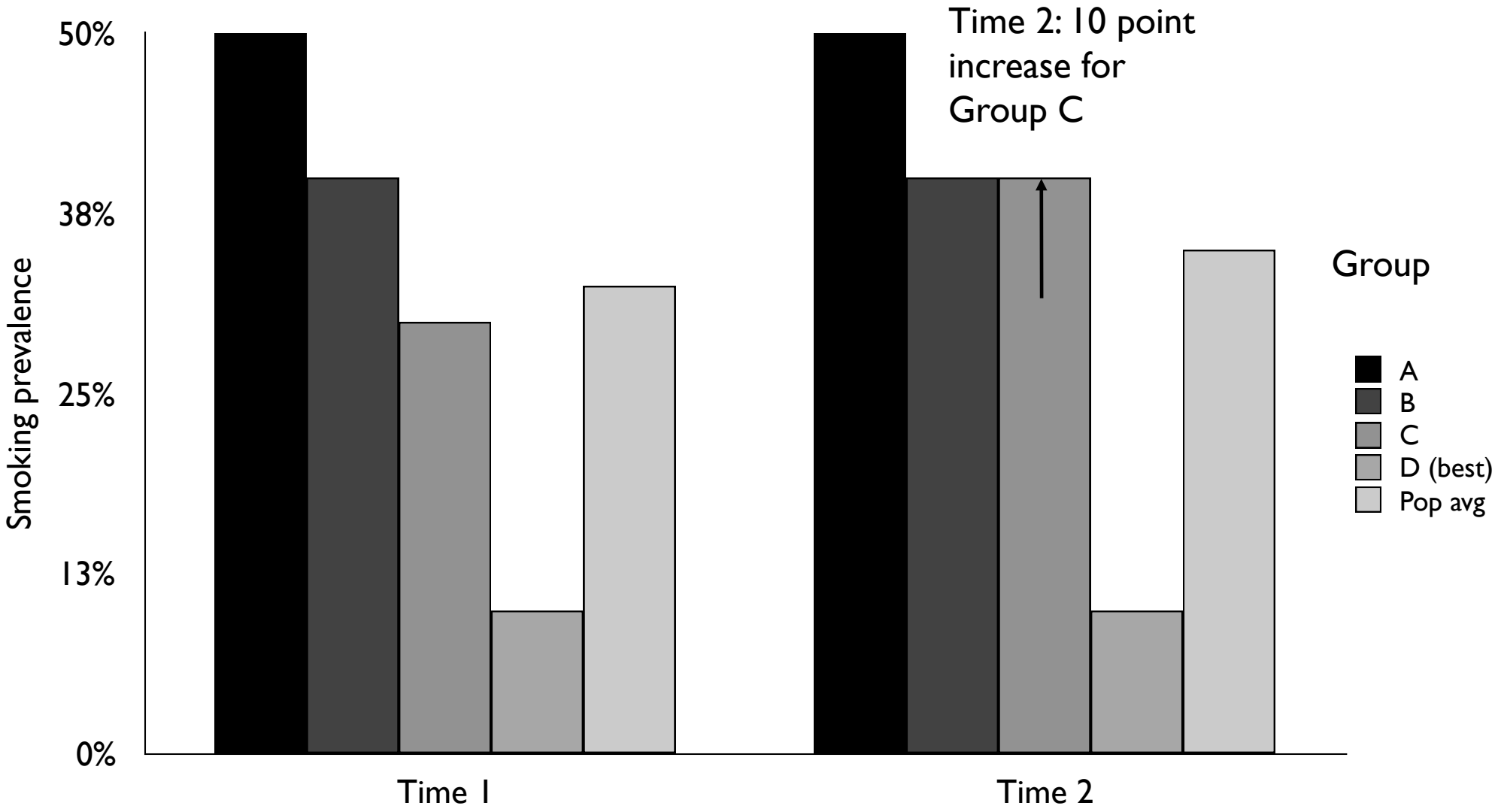
	Baseline	Scenario 1	%Change	Scenario 2	%Change
Index of Disparity	225.0	200.0	-11.1%	200.0	-11.1%
Mean Log Deviation	15.5	14.7	-5.2%	13.1	-15.6%



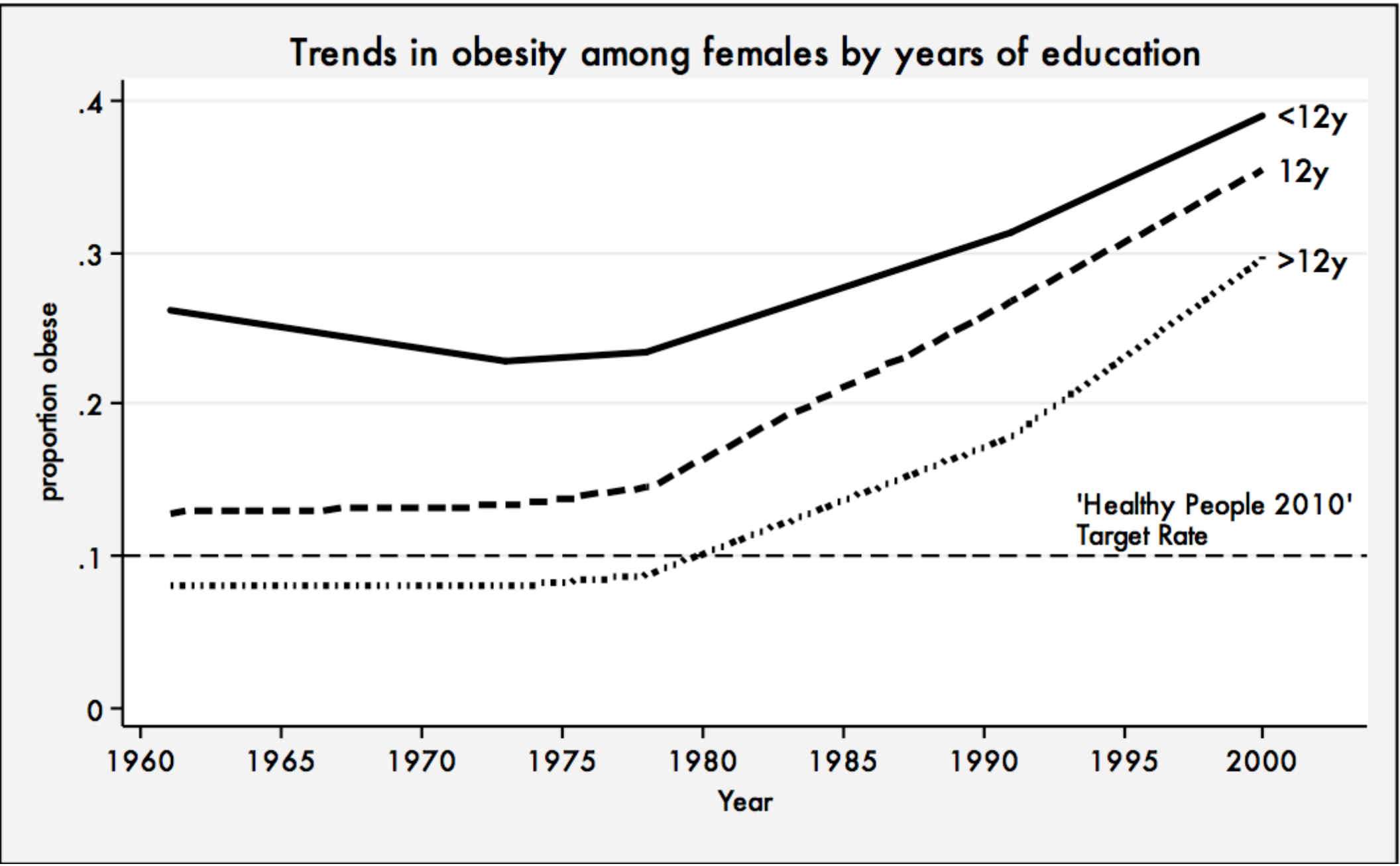
6. Reference points for measuring inequality: Different from what?

Changes in Index of Inequality Using Different Reference Points

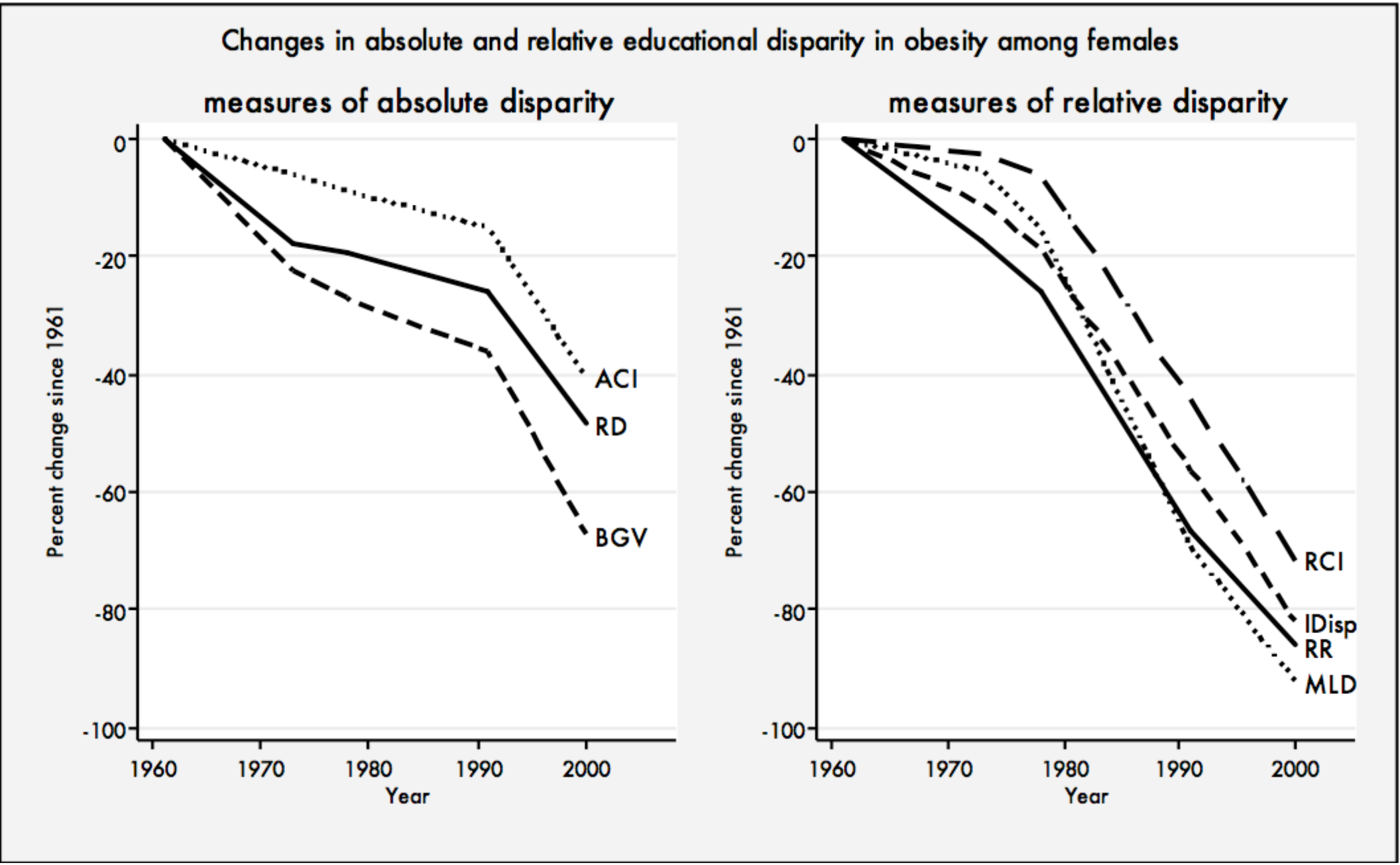
	Time 1	Time 2	%Change
Index of Disparity (Reference=Best rate)	300.0	333.3	+11.1%
Index of Disparity (Reference=Avg rate)	38	35.7	-7.1%

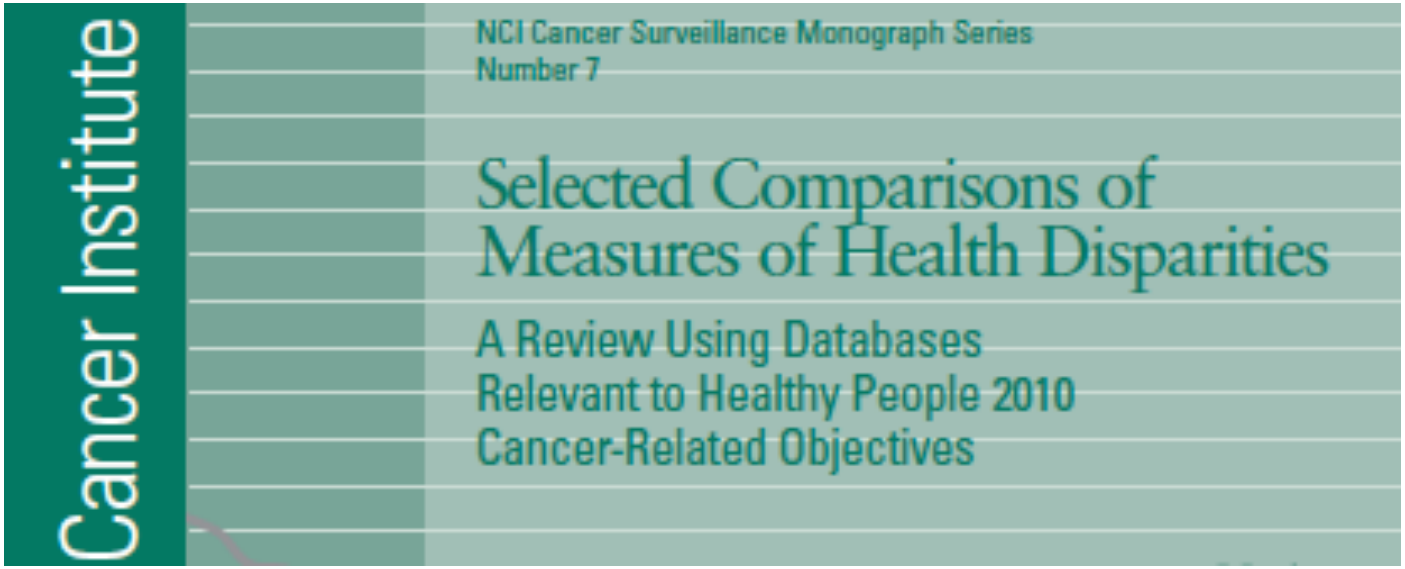


Example of all social groups moving away from target rate



Movement away from targets may reduce inequality



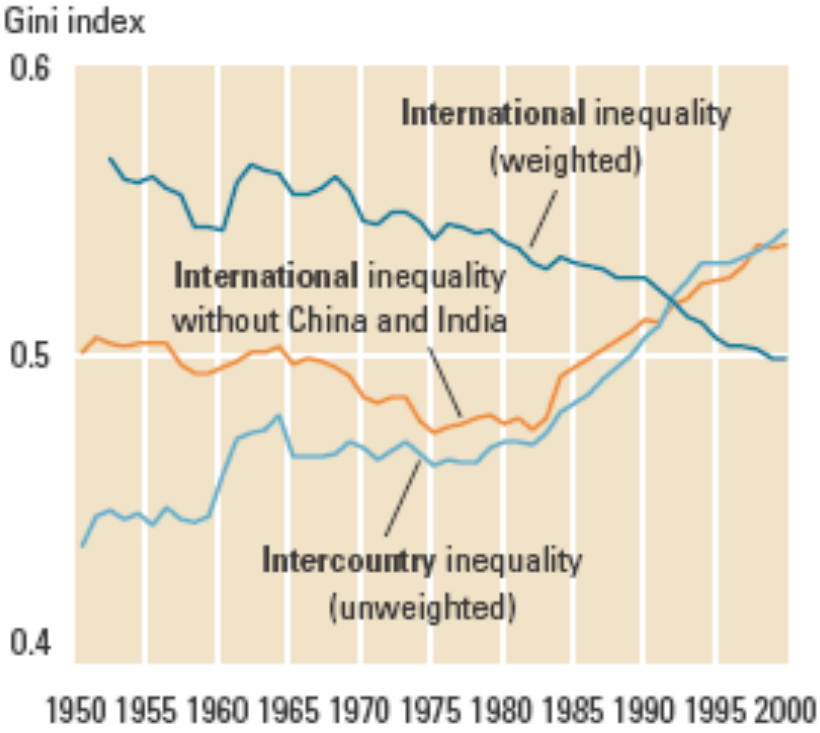


"we have systematically compared this same set of summary measures of disparity across 22 separate analyses of cancer incidence, mortality, and risk factors and found that, in nearly half of all cases, a substantive judgment about disparity trends required a priori decisions about whether disparities should be measured in absolute or relative terms or whether to use population-weighted versus unweighted disparity measures "

-Harper and Lynch (2007)

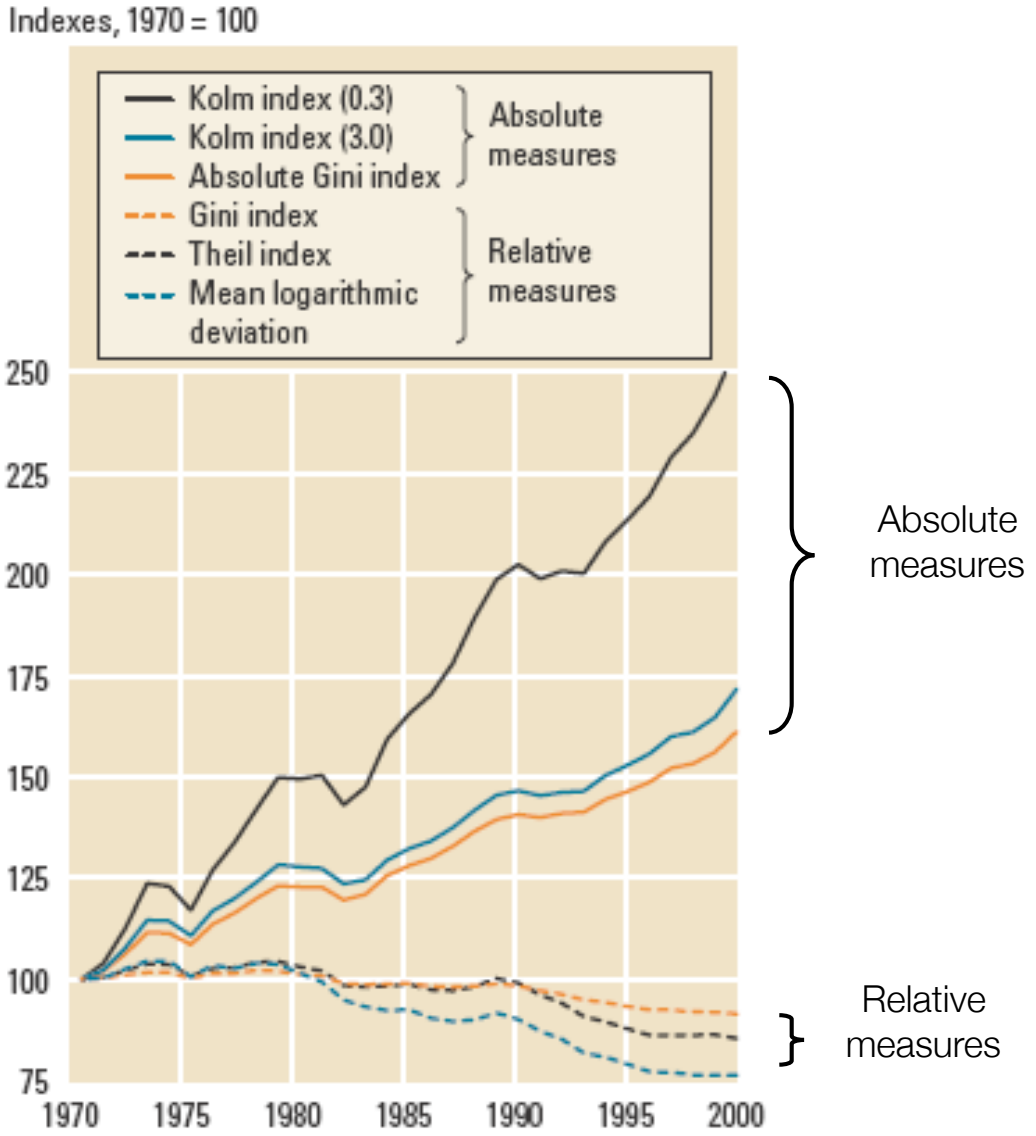
Understanding inequality is not only challenging for health

Figure 3.7 Since 1950, intercountry inequality increased, while international inequality declined



Source: Milanovic (2005).

Figure 3.8 Unlike relative inequality, absolute inequality has been steadily increasing



Source: Atkinson and Brandolini (2004).

Conclusions

- Measures of health inequality are not value neutral.
  - Scale of measurement (absolute/relative)
  - Weighting: how much and to whom?
  - Reference points: different from what standard?

- The choices above have an important impact on our judgments of both the magnitude of health inequality and whether health inequalities are worsening or improving.

- Monitoring health inequalities requires both precise measurement and value judgments—they are inseparable.

- A suite of health inequality measures is likely necessary to provide a complete description of the magnitude of inequality.