# Measuring Social Inequality

## Advanced Social Epidemiology PhD Course

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# Measuring Inequality

# Measuring Inequality

# Why monitor health inequalities?

## Surveillance

- Natural complement to monitoring overall health
- Essential for detecting important changes in risk

## Impact

- 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

# Inequalities in health are based on *observations*

We are relatively good at measuring inequalities.

- 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

# Inequities in health are based on *ethical judgements*

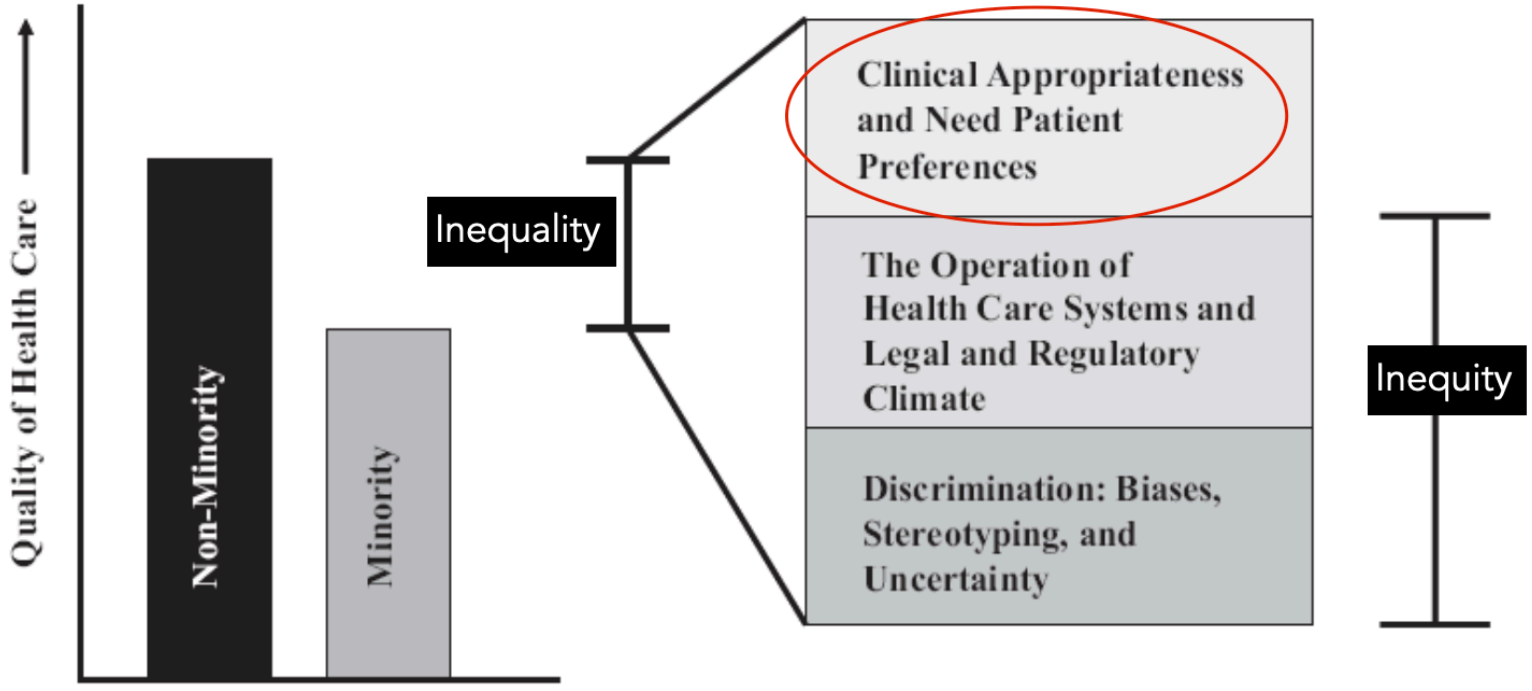
Inequities are much harder to measure

- 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?

# Anatomy of an Inequality

- How much of inequality is *unfair*?
- How would you know?

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



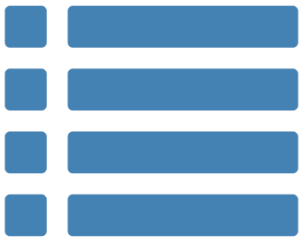

Adapted from McGuire et al. *Health Services Research* 2006

# Inequality is an ambiguous concept

Different measures of inequality emphasize different concepts.

> "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

# Measuring inequality: Some issues to consider



1. What to measure? Total vs. Social Group Inequality
2. Scale: Is inequality relative or absolute?
3. Simple or complex measures of health inequality?
4. Weighting: Who counts, and for how much?
5. Reference points for measuring inequality: Different from what?

# What should we measure?

## Total Health Inequality

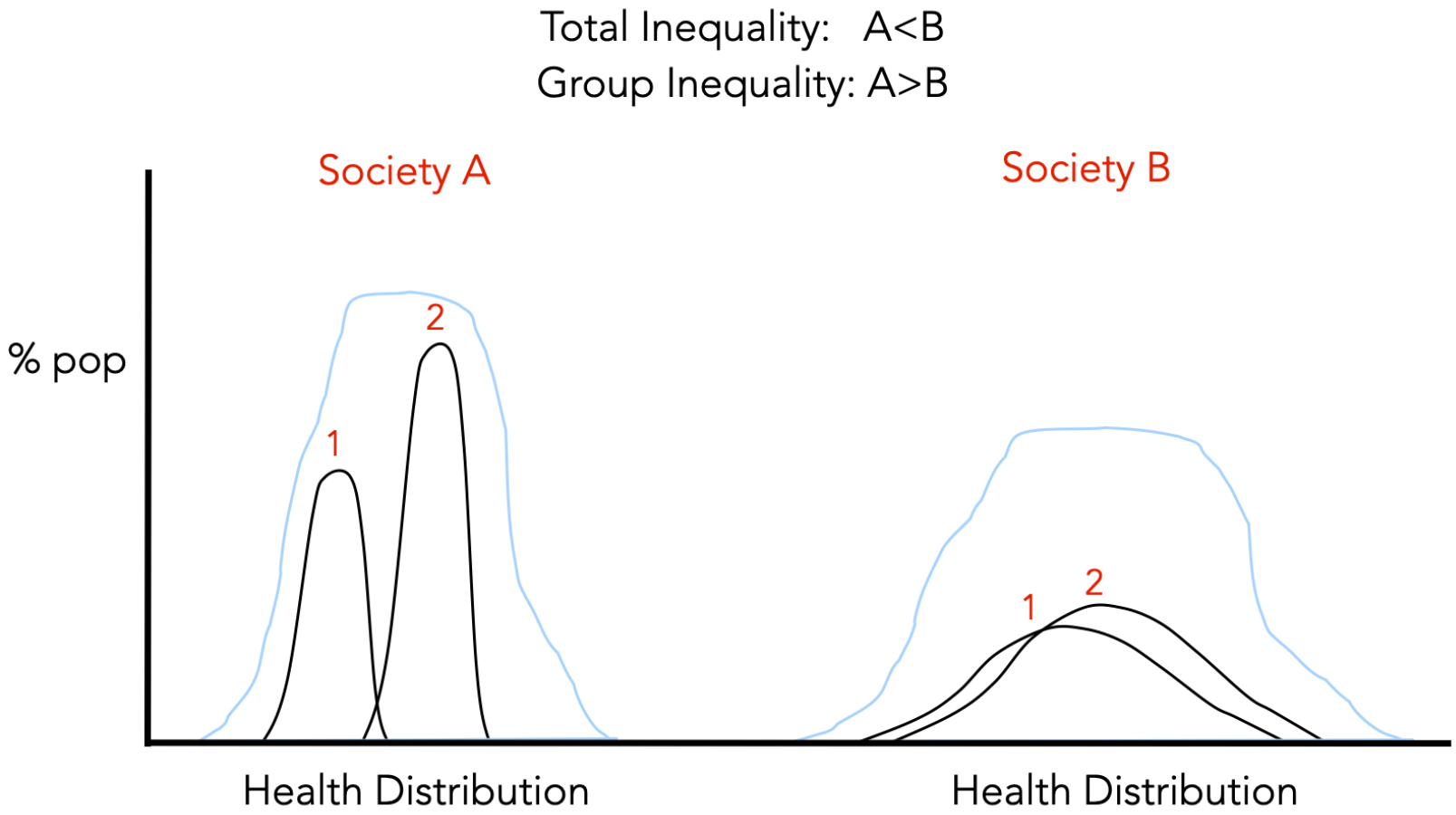
- complement to measurement of average health
- measured across all individuals
- avoids normative choice of social groups
- facilitates unambiguous comparisons over time/place

## 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

# Health Inequality Between Whom?

- Which society has more inequality?
- Which one is worse from the perspective of inequality?




Asada 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.

# Measuring Inequality

1 Conceptual Issues

2 Absolute and Relative Inequality

3 Simple vs. Complex Measures

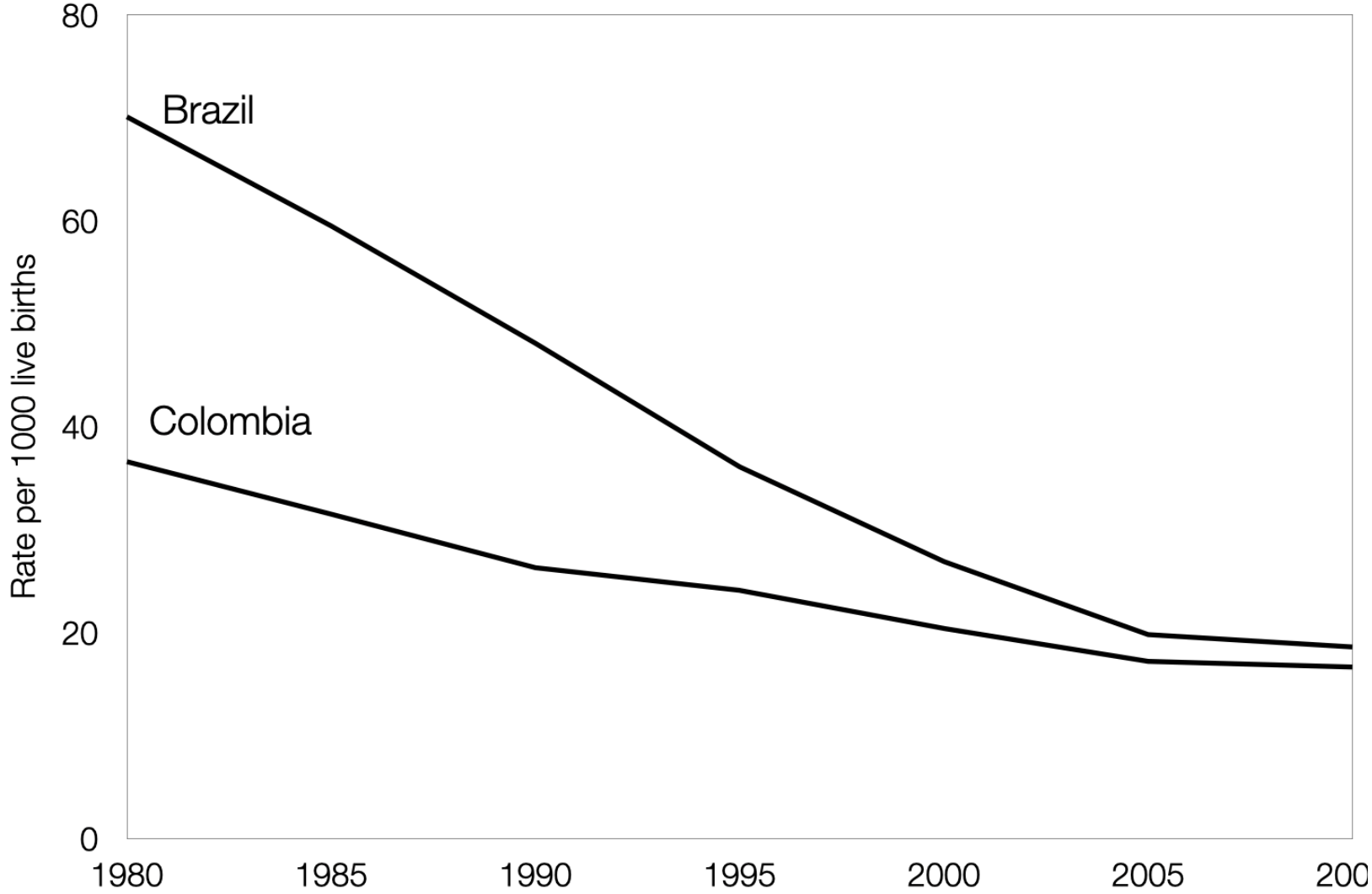
4 Weighting

5 Reference Points

# Easy case

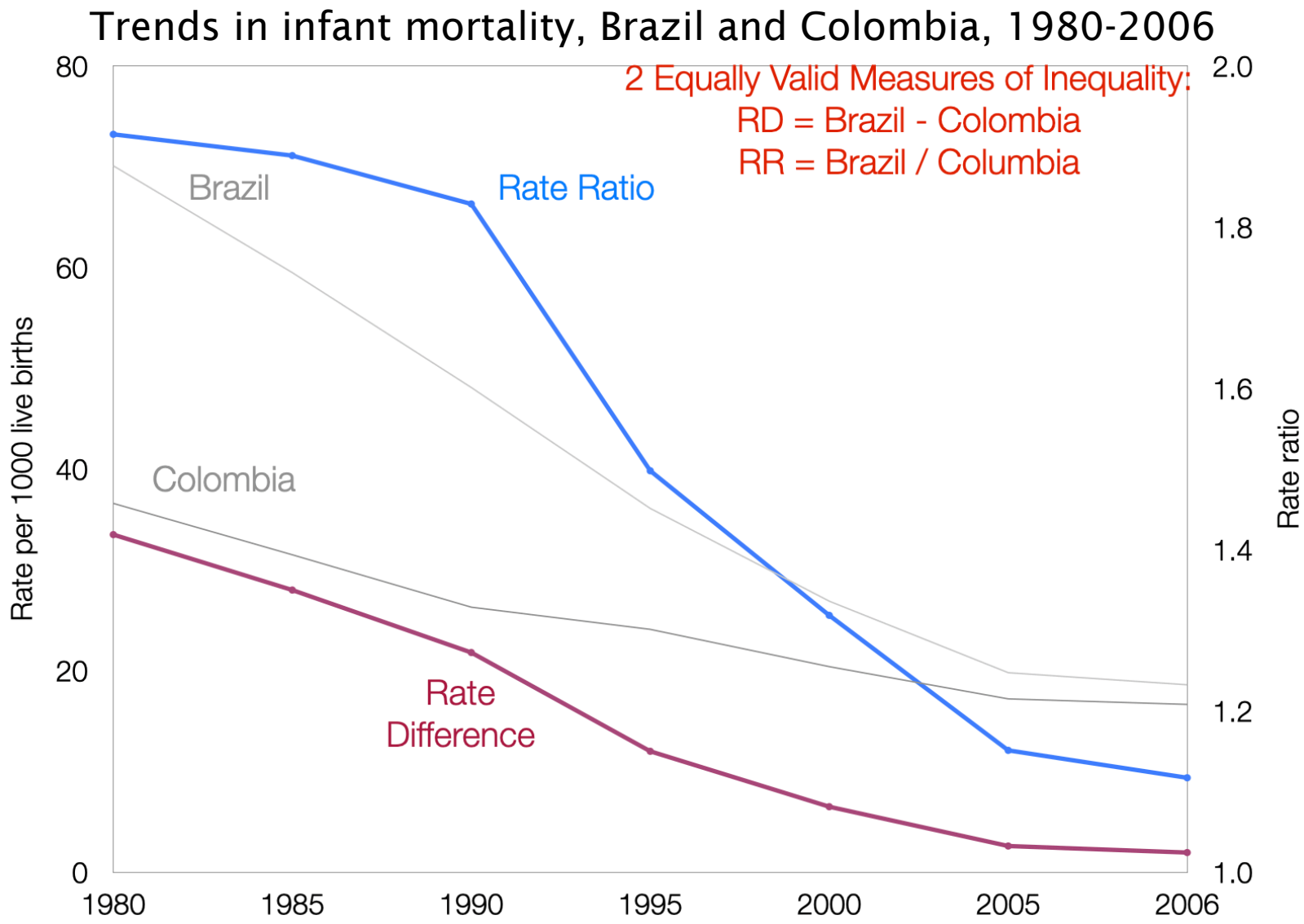
Evidence of clear progress

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



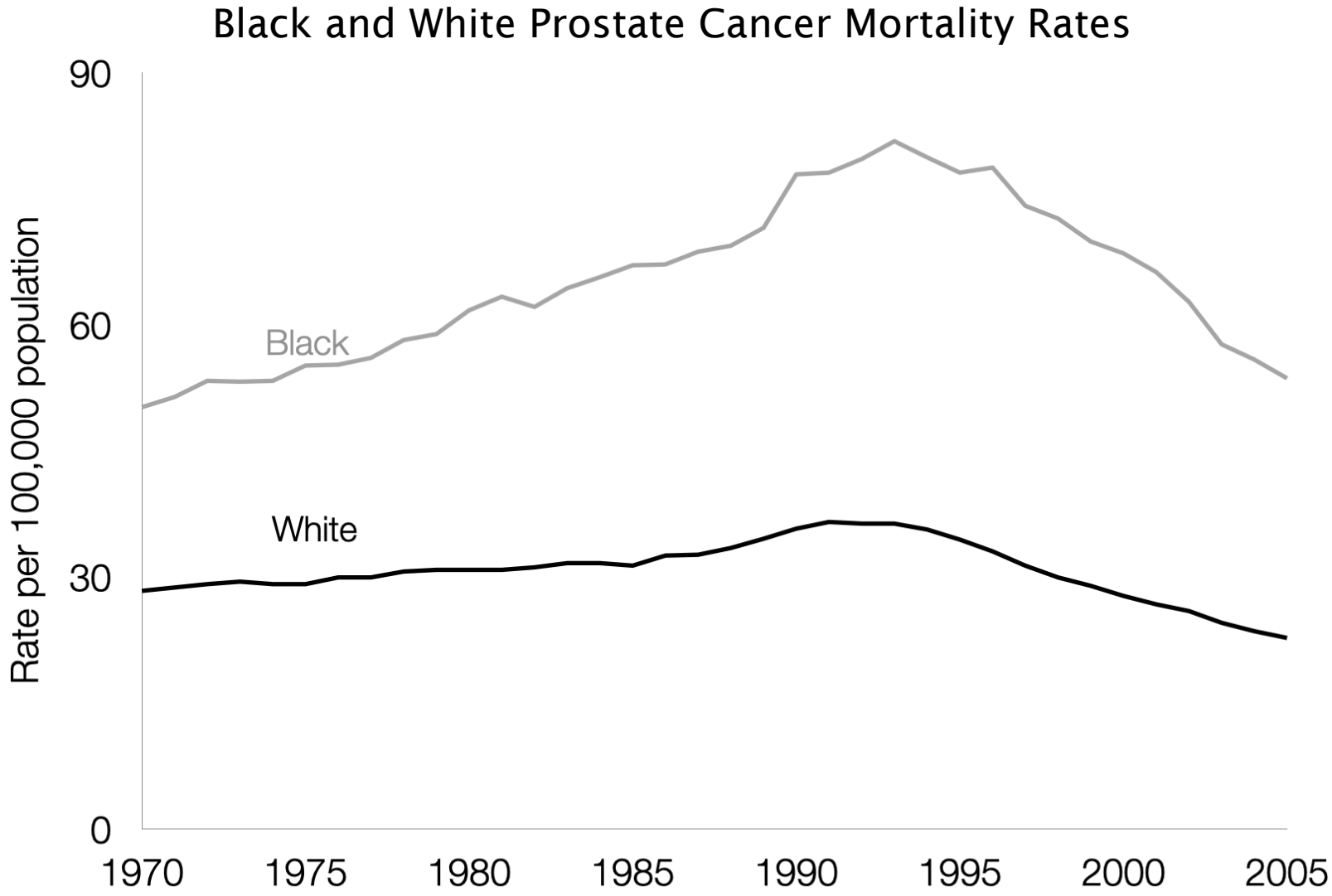
# Easy case

Evidence of clear progress



# Harder case

Are black-white inequalities in prostate cancer mortality increasing or decreasing?

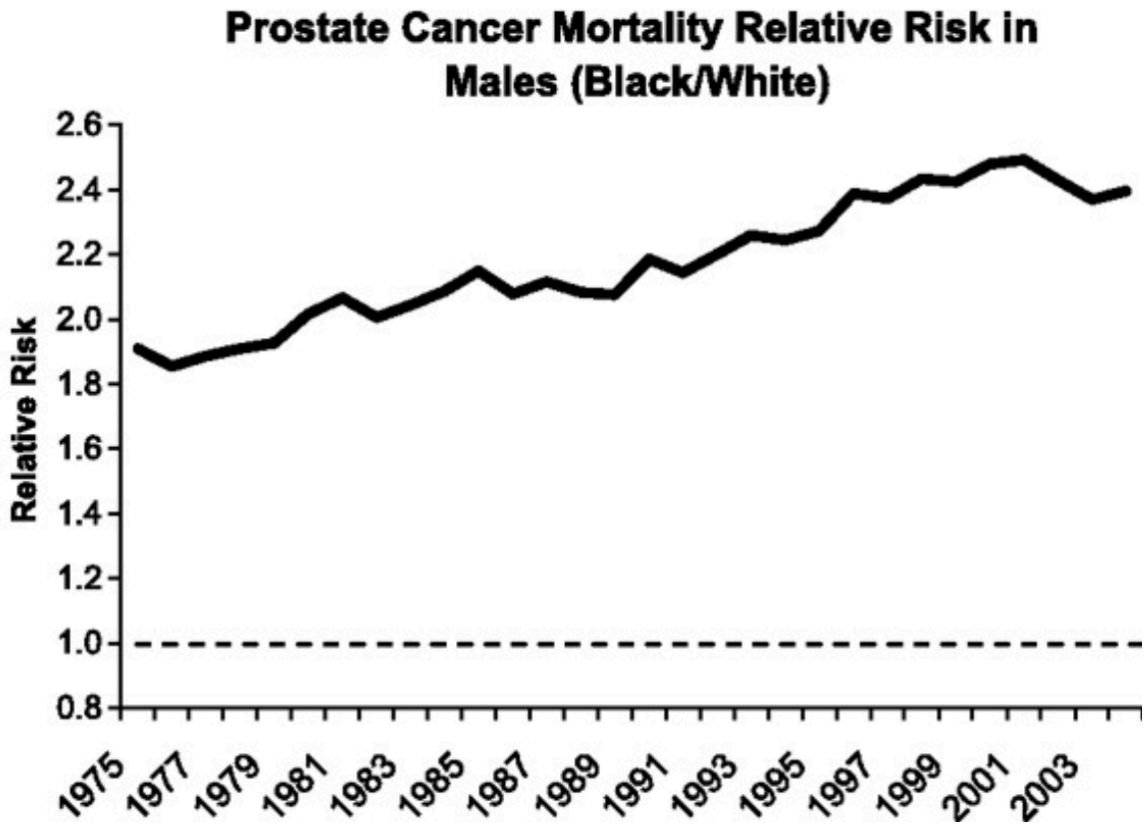



Source: US NCI SEER*Stat Database

# Recent Trends in Black-White Disparities in Cancer Mortality

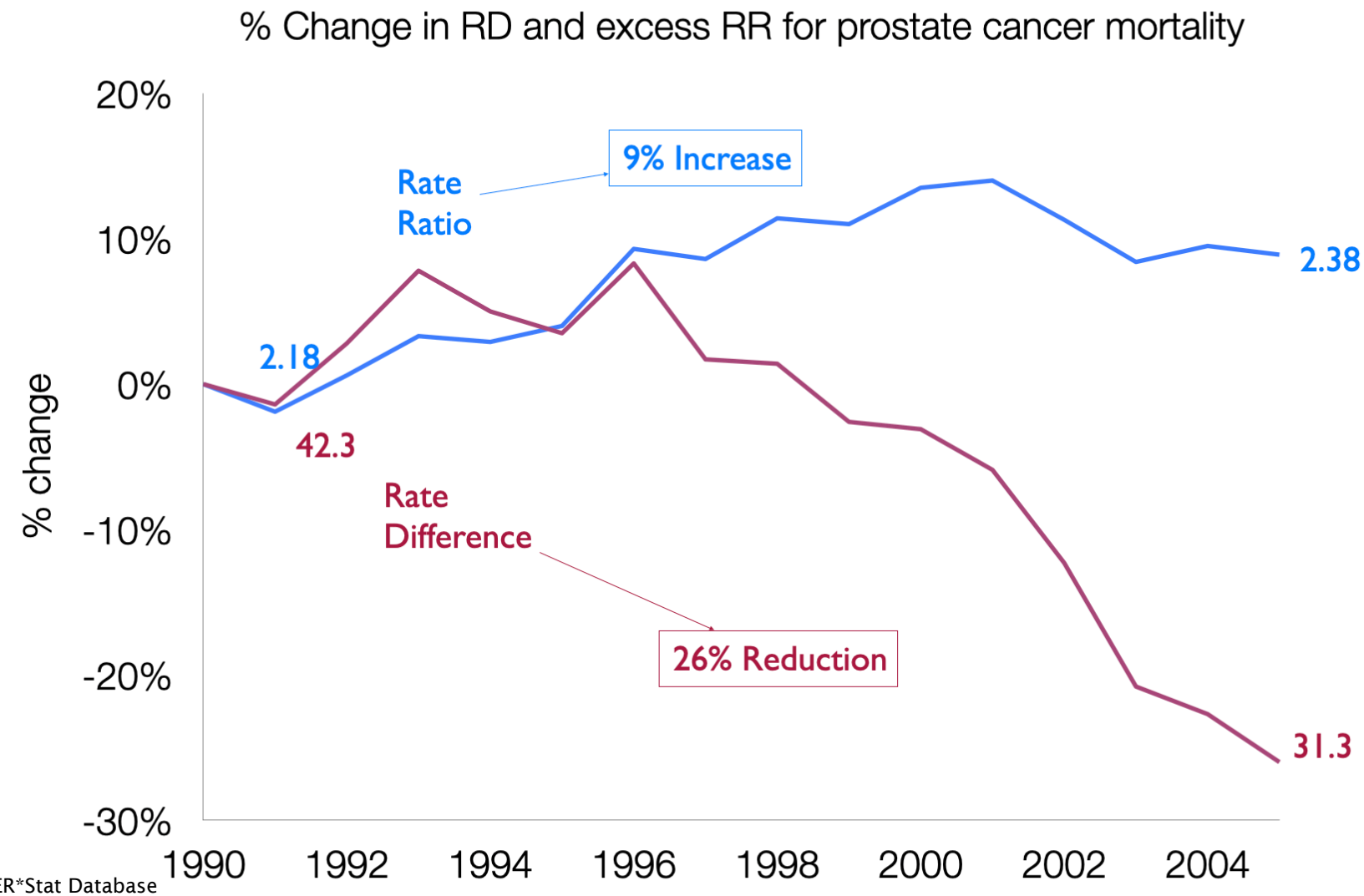
John Oliver L. DeLancey, Michael J. Thun, Ahmedin Jemal, and Elizabeth M. Ward

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."

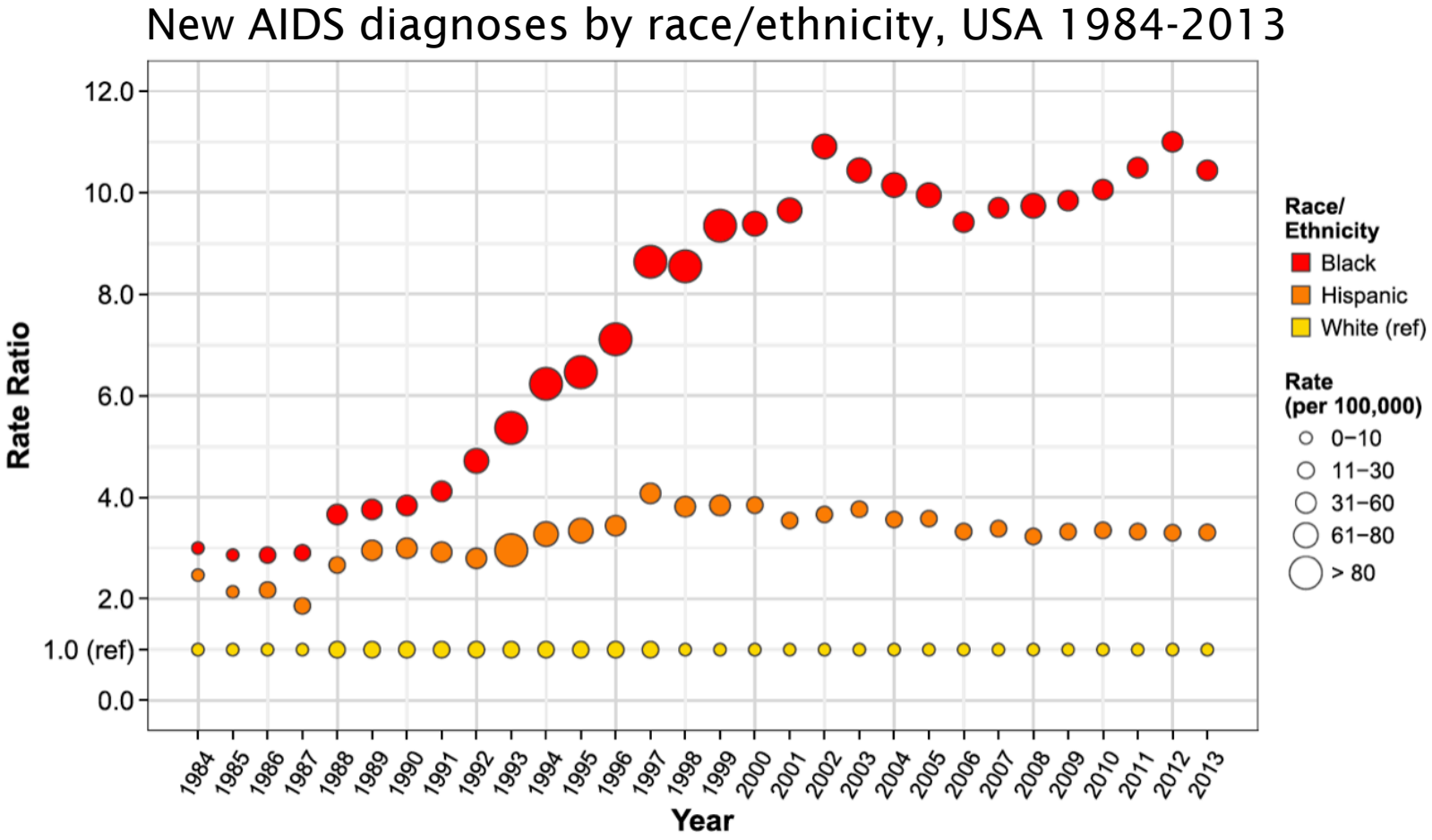
DeLancey (2008)




Source: US NCI SEER*Stat Database

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

On what scale?



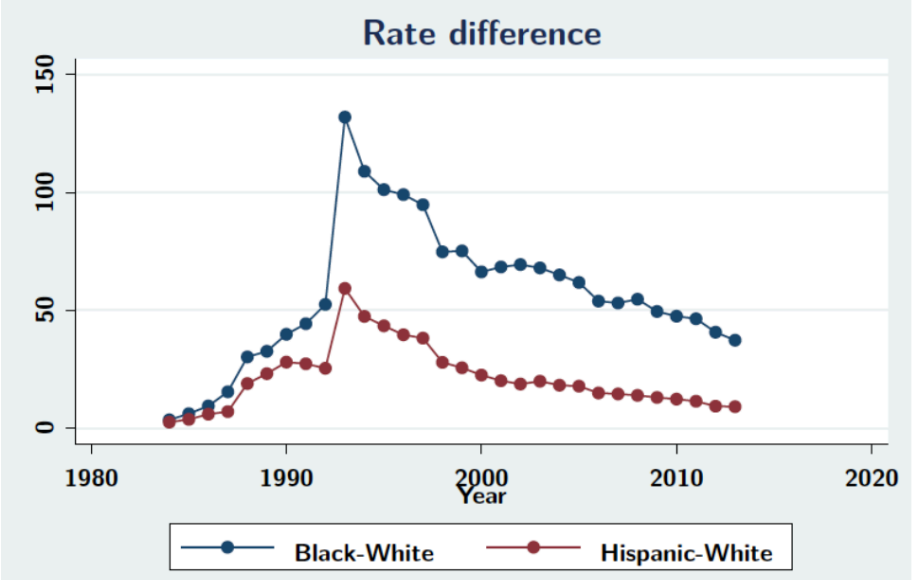

Chapin-Bardales et al. 2017

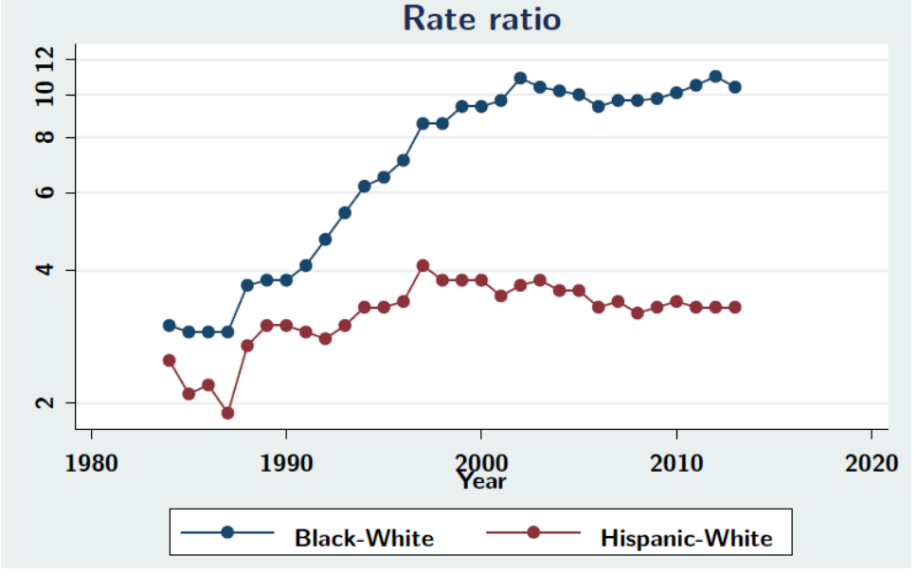
Failure to consider the scale on which inequalities are measured can have dramatic impacts on study conclusions.

- Steep declines on absolute scale.
- Increases on relative scale.

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

- Did the introduction of antiretrovirals exacerbate or mitigate inequalities?



# 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, World Bank Economist, 2004

# Measuring Inequality

1 Conceptual Issues

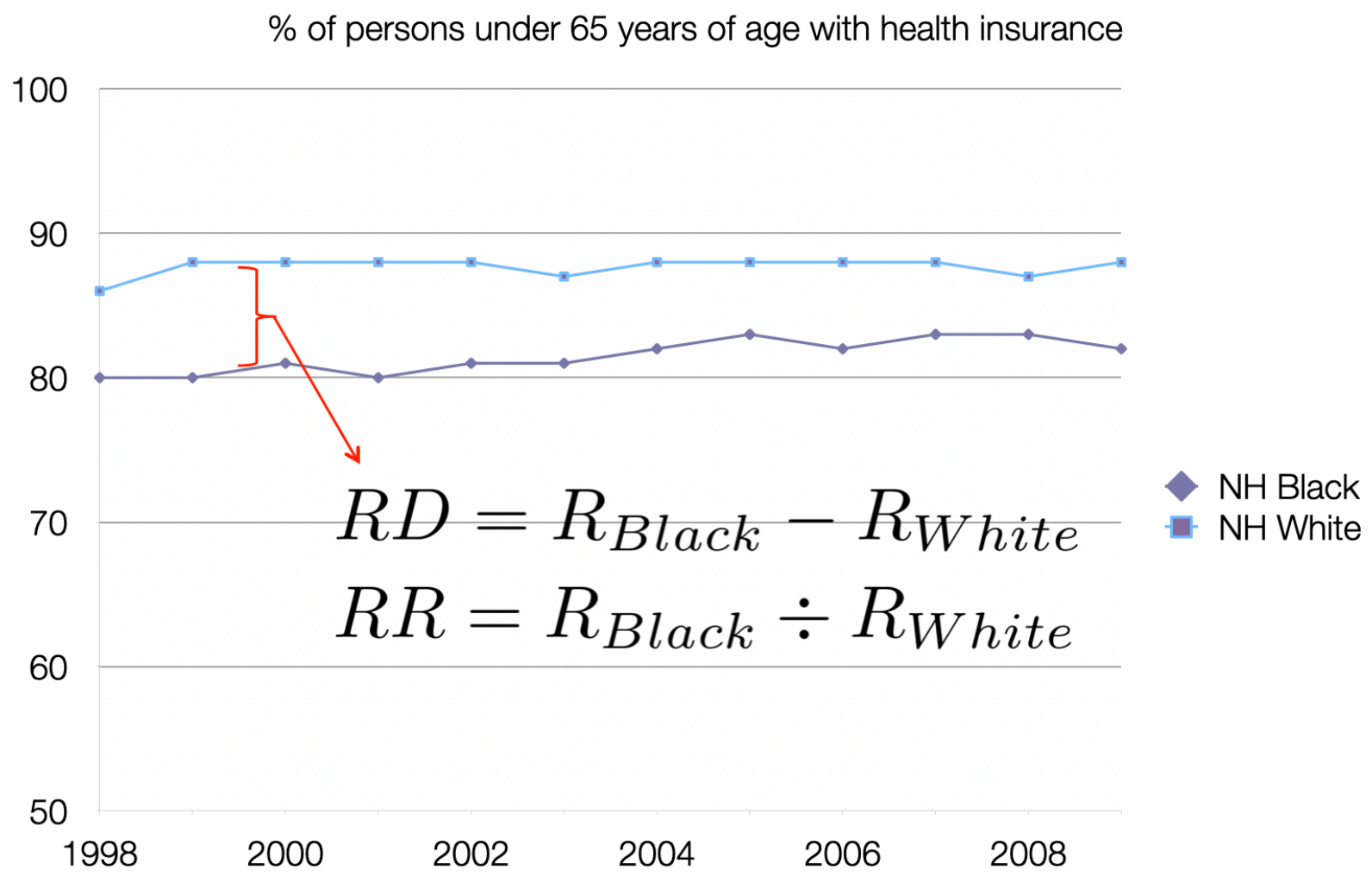
2 Absolute and Relative Inequality

3 Simple vs. Complex Measures

4 Weighting

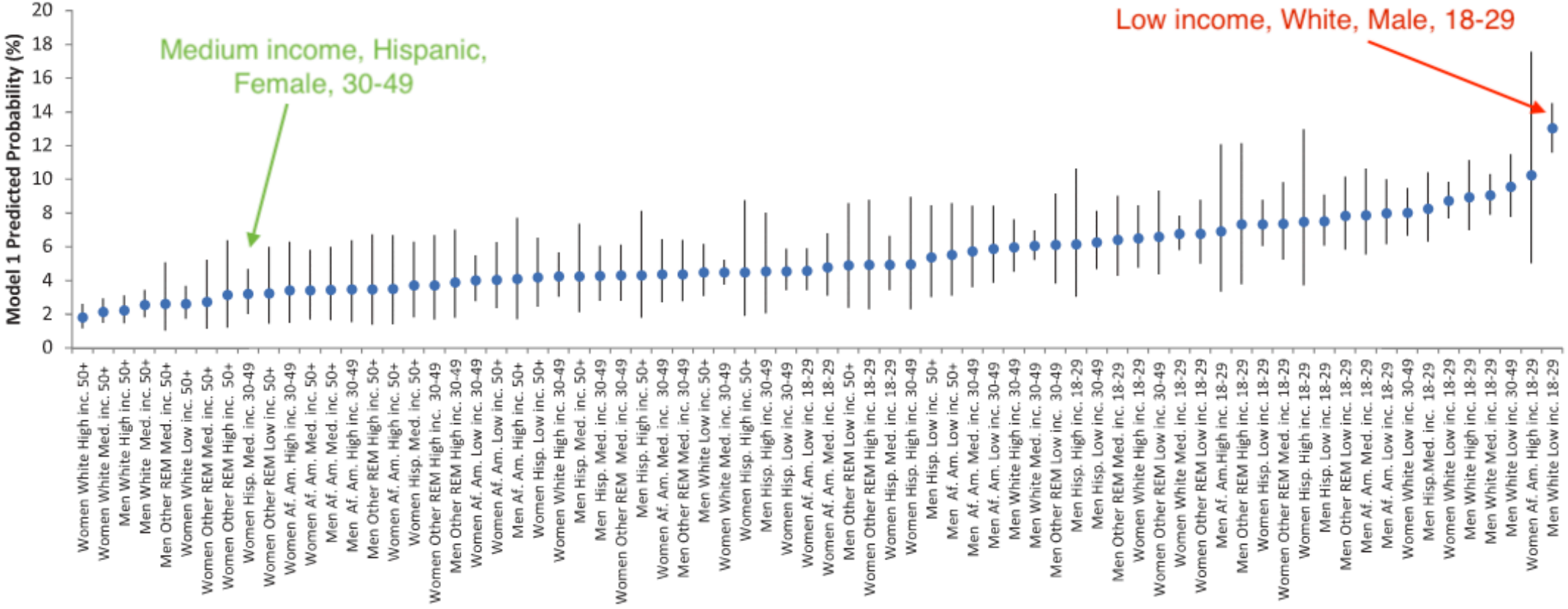
5 Reference Points

Pairwise comparisons work well for a few groups



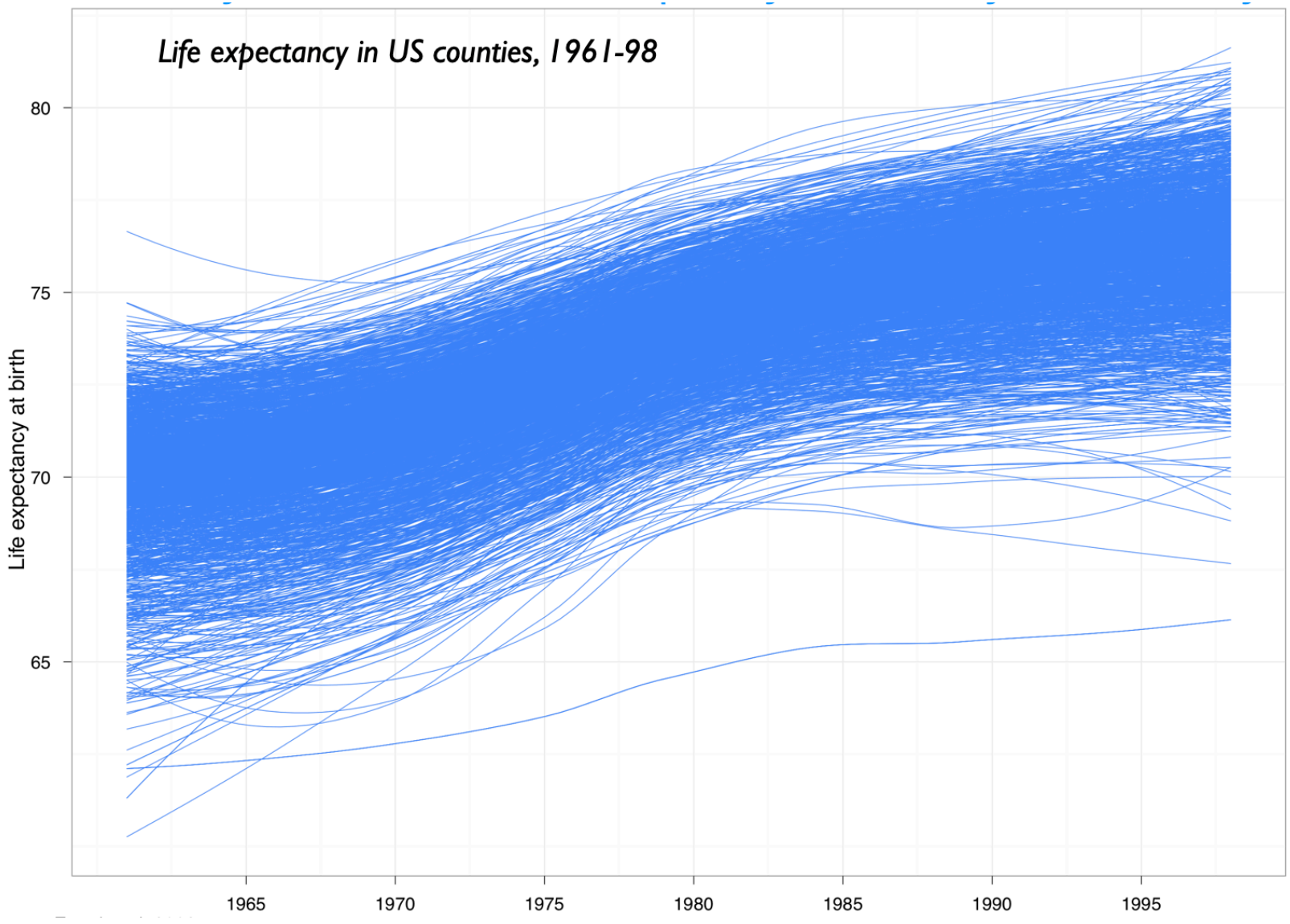

Source: Data2010

# Additional groups make summary measures appealing




Source: Persmark (2020)

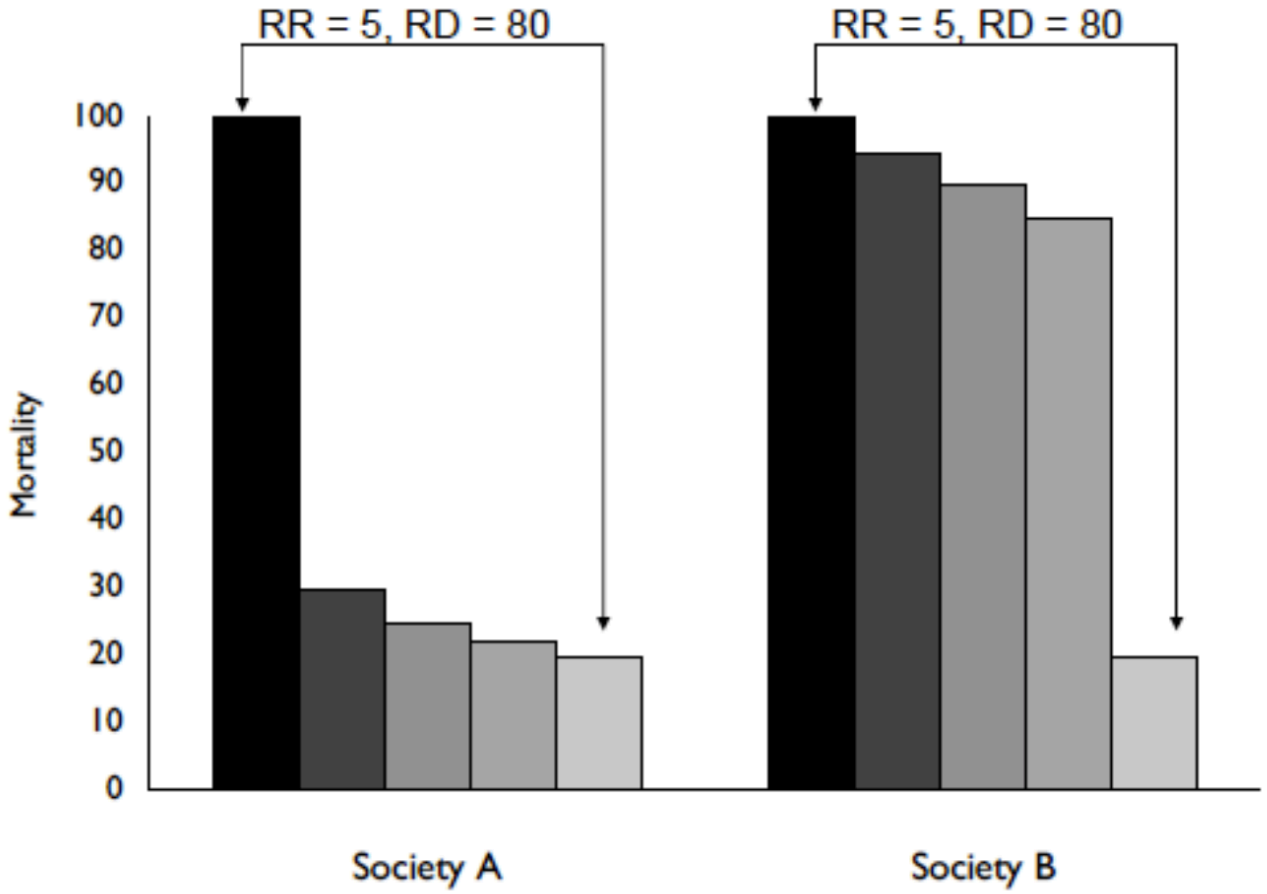
# Summary measures definitely needed




Ezzati et al. (2008)

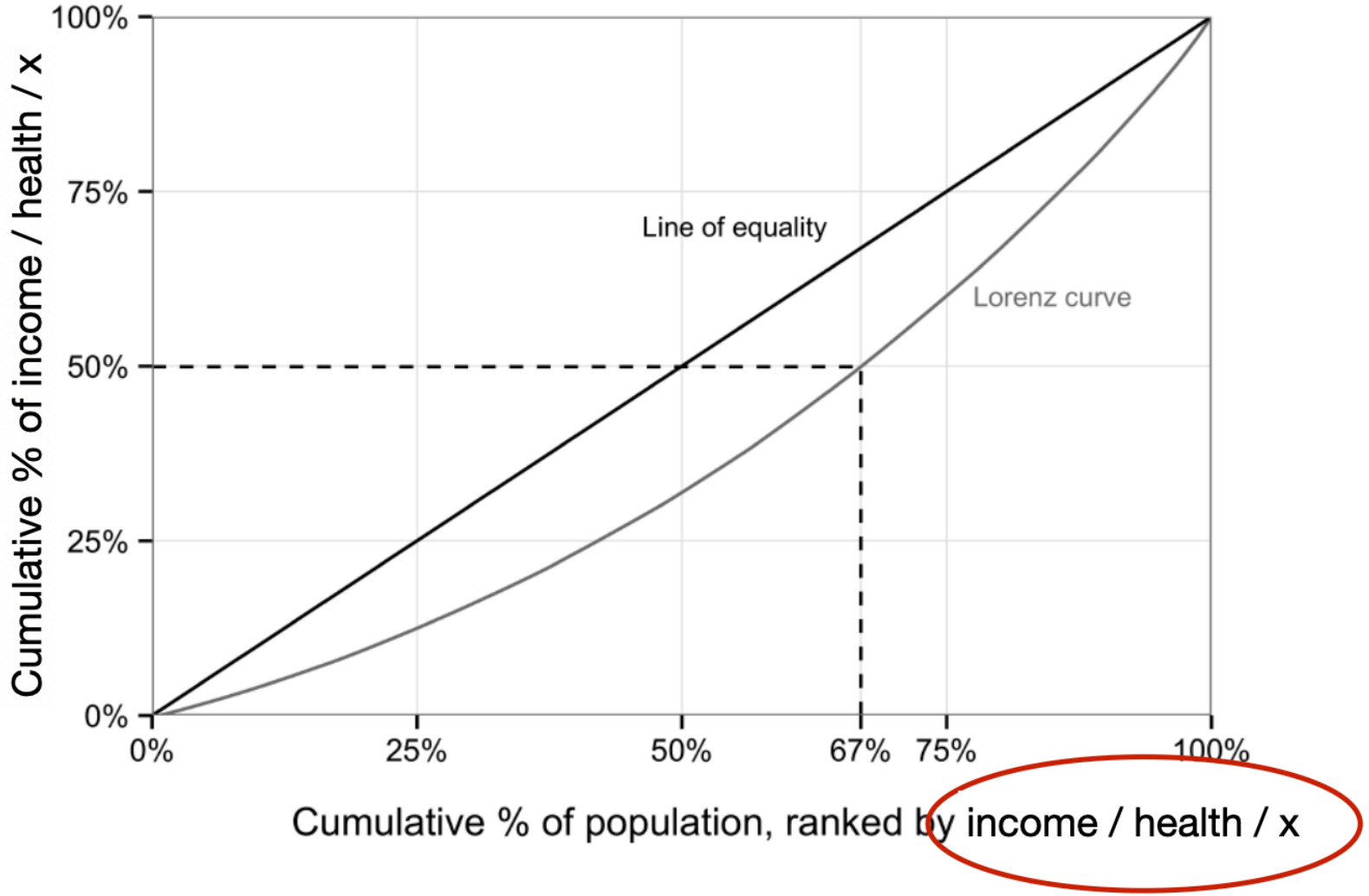
# Range-type measures: ignore the entire distribution

- Does A or B have 'more' inequality?
- Do you have a preference for A or B?



# Moving beyond simple comparisons

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



# Moving Beyond Binary Comparisons

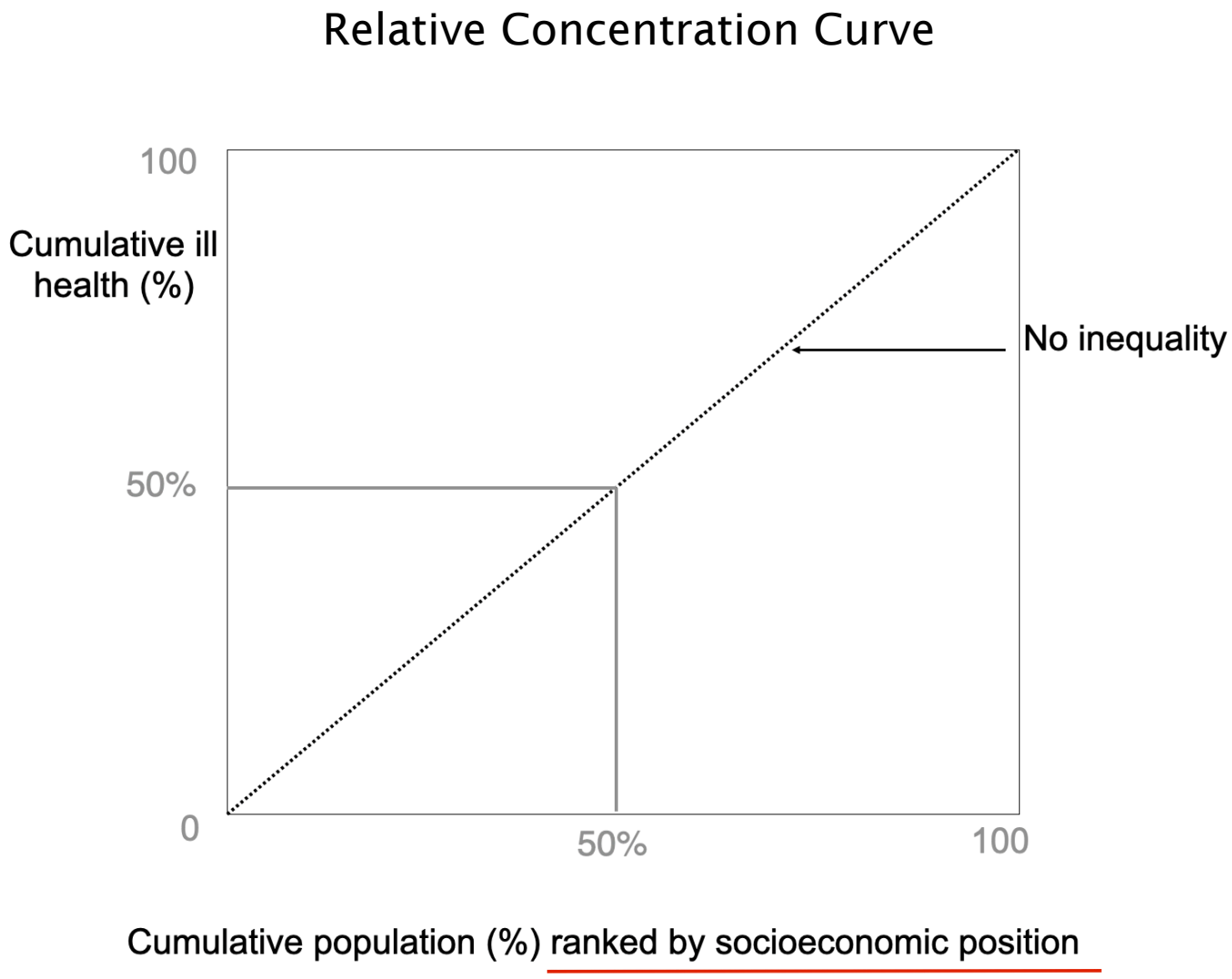
## Rank each education group by position in the population distribution

Distribution of Socioeconomic Position in a Hypothetical Population

| Education Level | % | Cumulative % | Range | Midpoint |
|---|---|---|---|---|
| None | 11.93 | 11.93 | 00.00 – 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 |
| Beyond Secondary | 30.12 | 100 | 69.88 – 100.0 | 84.94 |

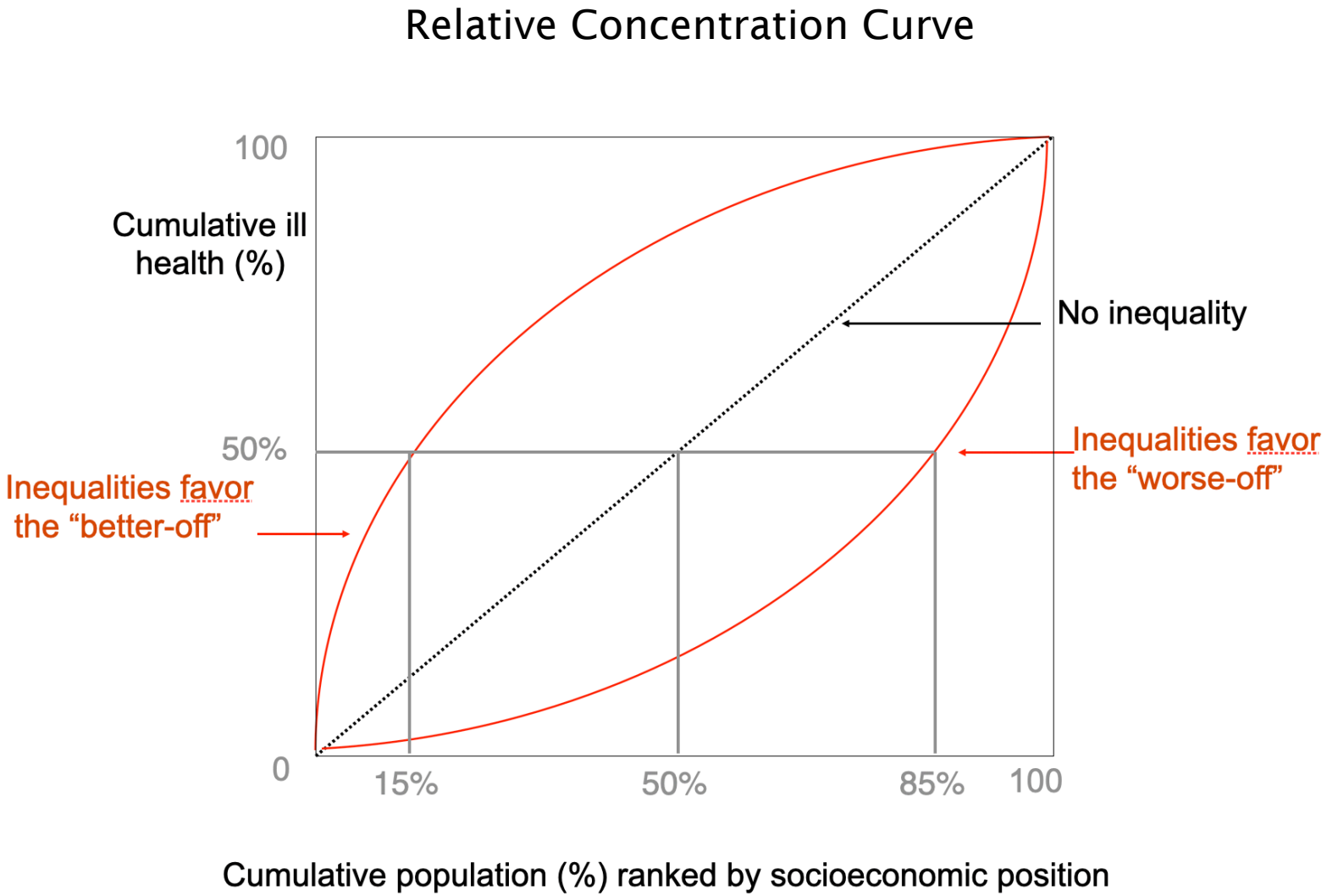
# Summarizing across SEP

- First rank the population by SEP
- Then count up the proportion of disease each group accounts for.



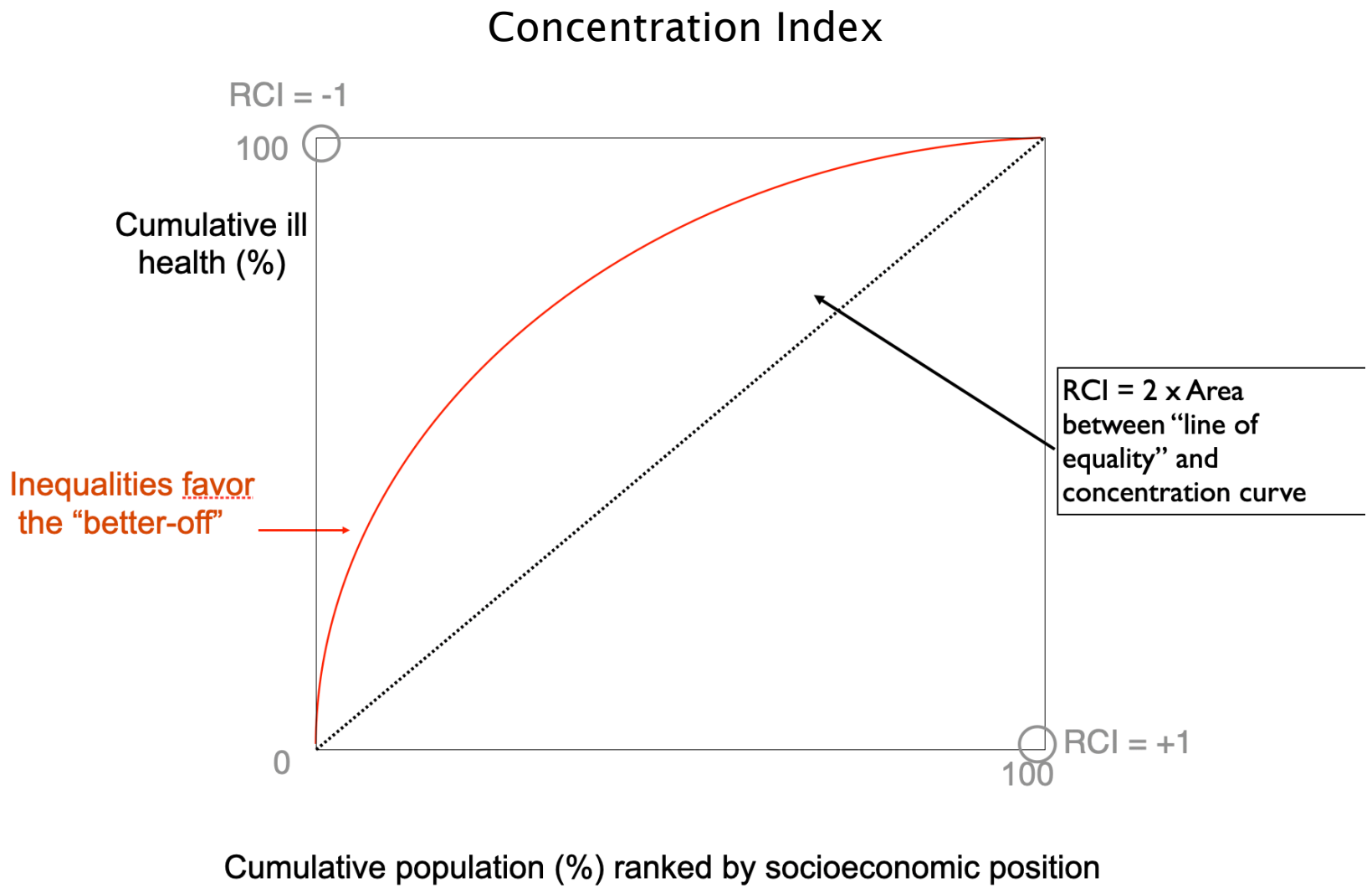
# Summarizing across SEP

- Diagonal = no inequality
- Curve above diagonal: ill-health concentrated among poorer.
- Curve below diagonal: ill-health concentrated among richer.



# Summarizing across SEP

- Concentration Index measures the extent to which disease is 'concentrated' among different SEP groups.



# Formula for writing the Concentration Index

One way of writing the CI is:

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

where $\mu$ is the mean of $y_i$ (e.g., smoking status), $R_i$ is the fractional rank of the *i*th person in the socioeconomic (i.e., income) distribution.

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

$$ACI = \mu * RCI$$

Kakwani et al. (1997)

# Example of Relative and Absolute CI

1965: Smoking increases with education = + RCI

2003: Smoking decreases with education = - RCI

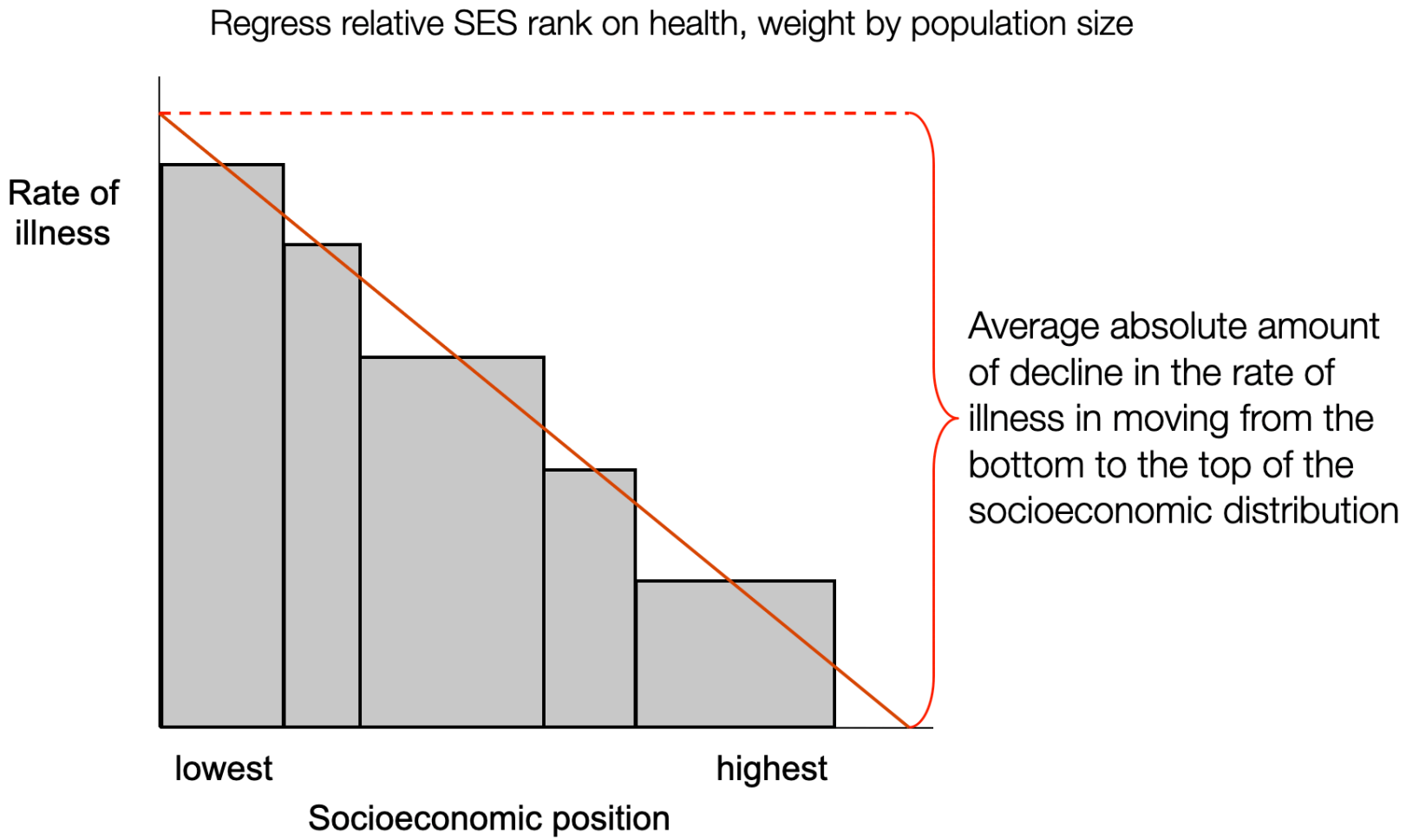
**TABLE 6.2. EDUCATIONAL INEQUALITY IN CURRENT SMOKING AMONG FEMALES, 1965 AND 2003.**

| 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.

# Slope and Relative Index of Inequality

- Conceptually similar to CI
- Correlation between SEP rank and health.
- SII: Absolute difference
- RII: Relative difference (or ratio)



# The measure may matter!

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

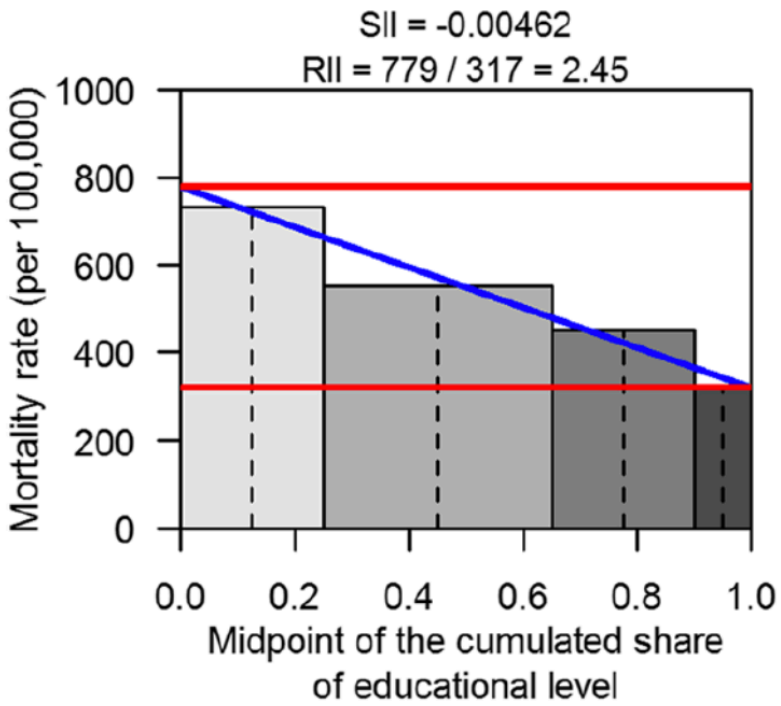
| Survey year | Simple measures of inequality | | Complex measures of inequality | |
|---|---|---|---|---|
| | Difference (secondary school or higher – none) (percentage points) | Ratio (secondary school or higher / none) | Slope index of inequality (percentage points) | Concentration index |
| 1993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

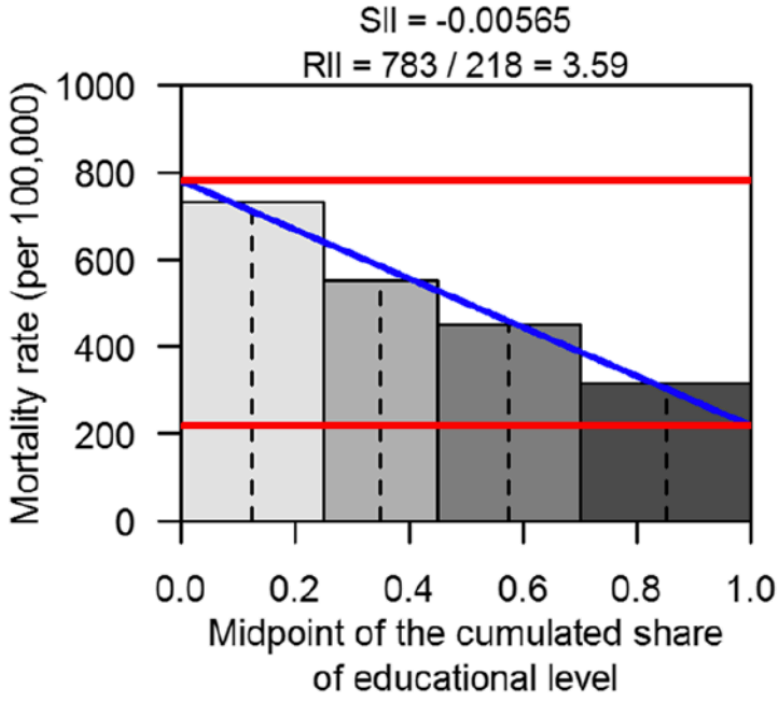
Using complex measures to account for population shifts is particularly important when health inequality monitoring is carried out to assess the effects of social policy. Broad social policies that are successful in alleviating poverty, increasing educational opportunities or creating jobs can result 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 (2013)

# Two mechanisms for 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 (2019)

# Measuring Inequality

1 Conceptual Issues

2 Absolute and Relative Inequality

3 Simple vs. Complex Measures

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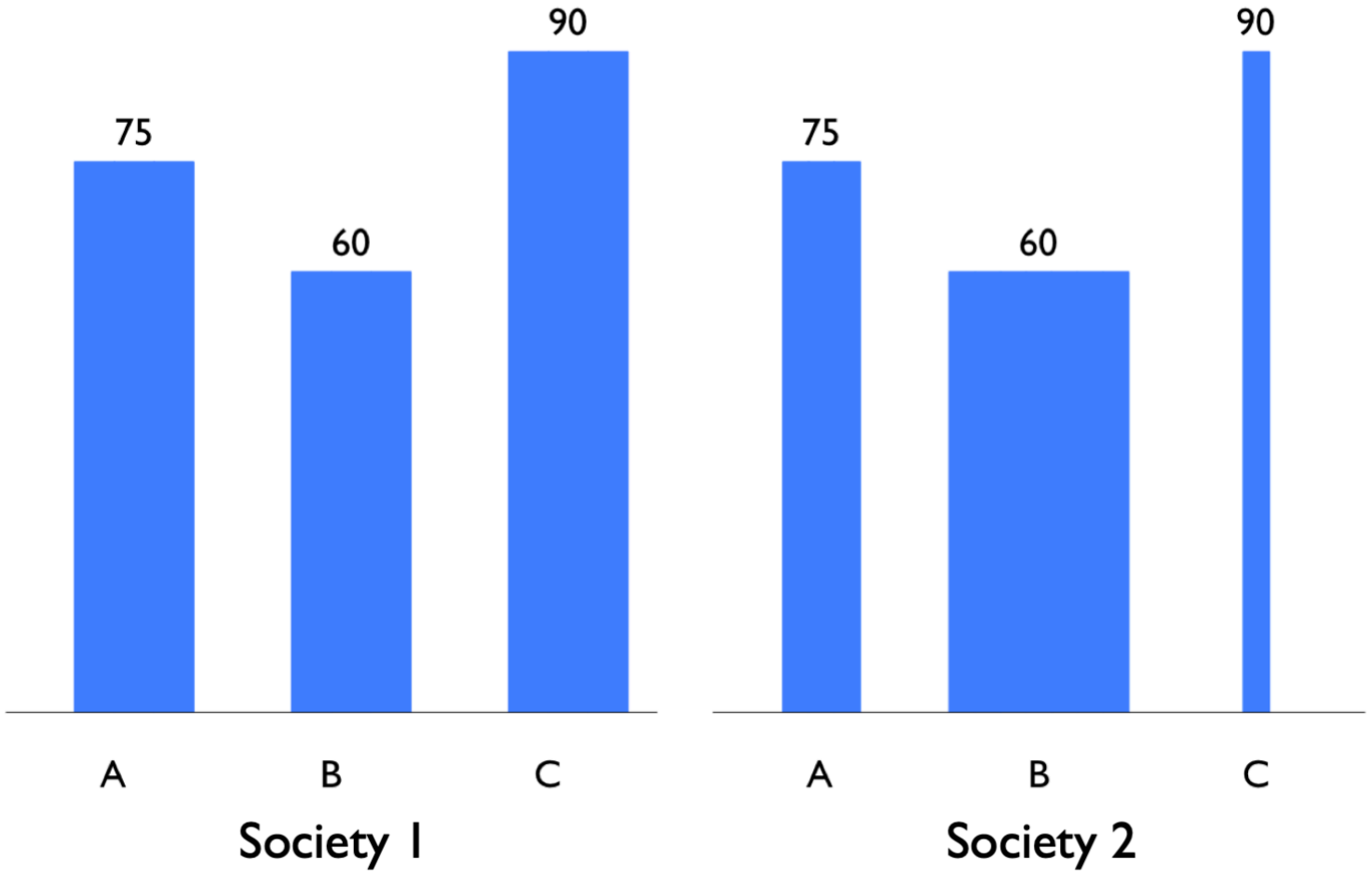
Is the amount of inequality the same in these two societies?



No way to 'rank' ethnicity

Groups differ in size

Should we account for it?

How to summarize this variation by ethnicity?

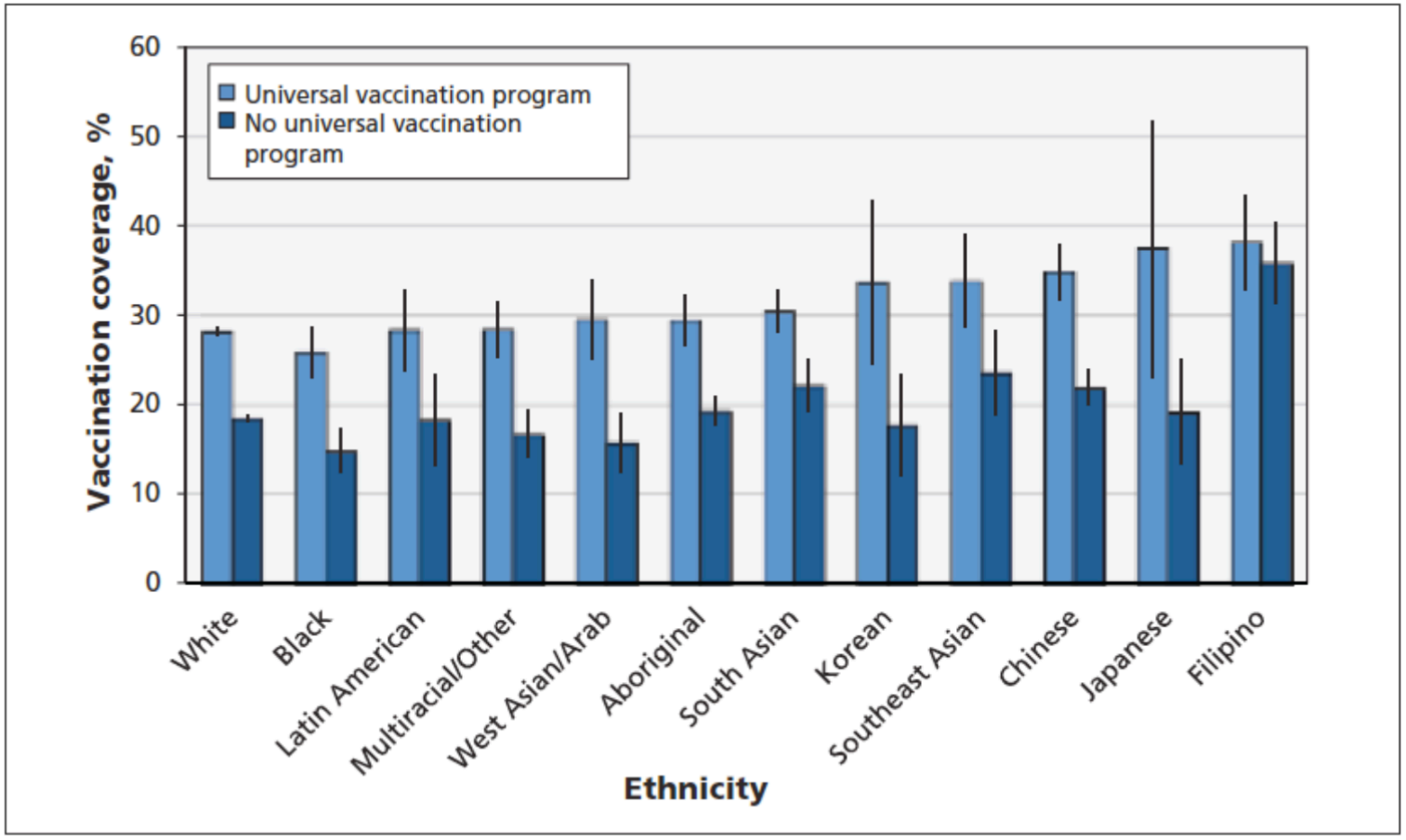



Figure 2: Influenza vaccine coverage, by ethnic group and availability of a universal influenza vaccination program, in Canadians aged 12–64 years without chronic diseases (2003–2009). Error bars represent 95% confidence intervals.

Quach et al. (2012)

# Index of Disparity

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

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

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.

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

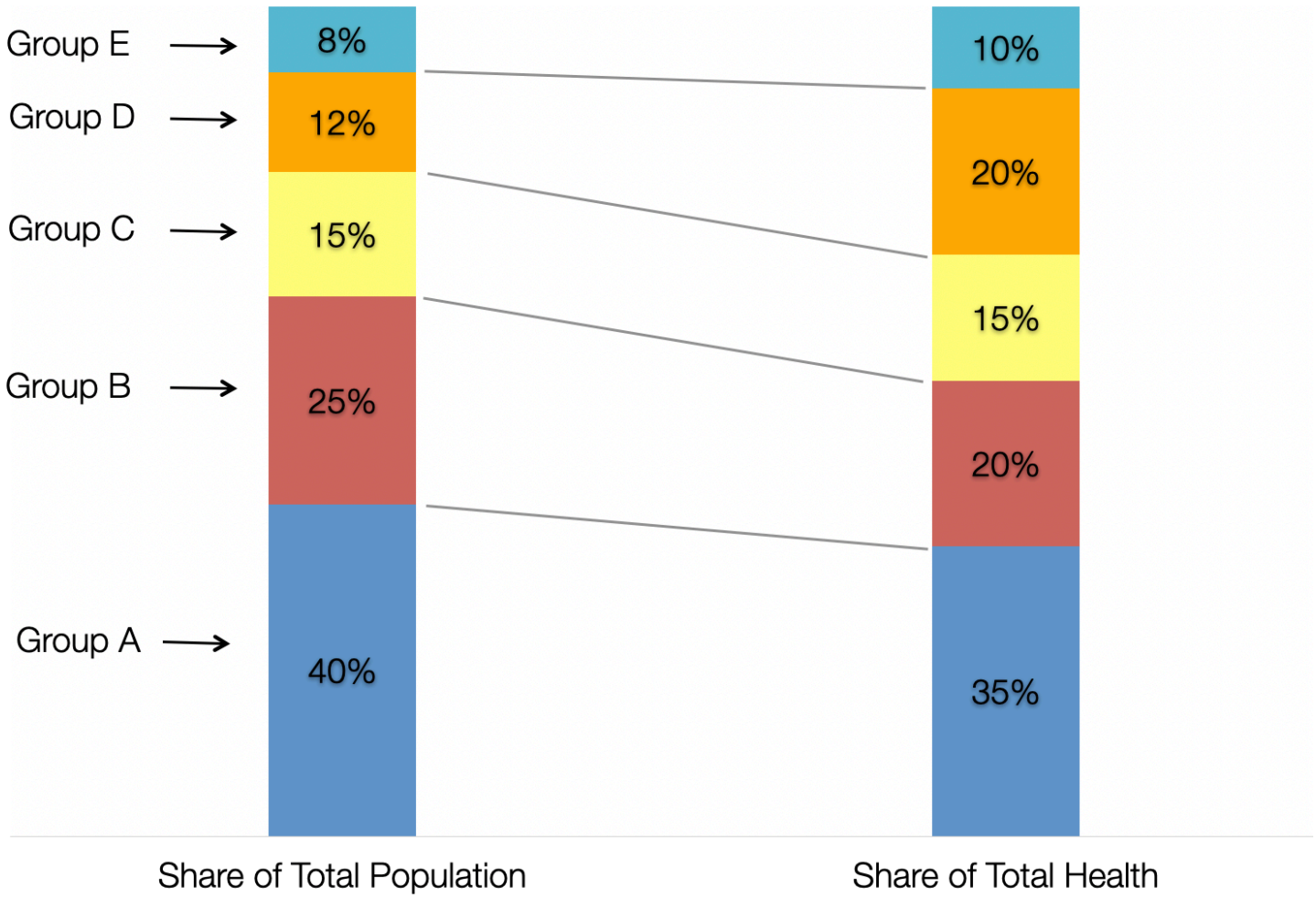
Are there alternatives?

Pearcy and Keppel (1999)

# Inequality as 'Disproportionality'

Compares shares of health or disease with shares of the population.

Perfect equality: %pop = %health



Alternative: Mean Log Deviation

- weights by pop
- measures difference in log shares

Sensitive to 'transfers' at different points of health distribution.

Mean Log Deviation

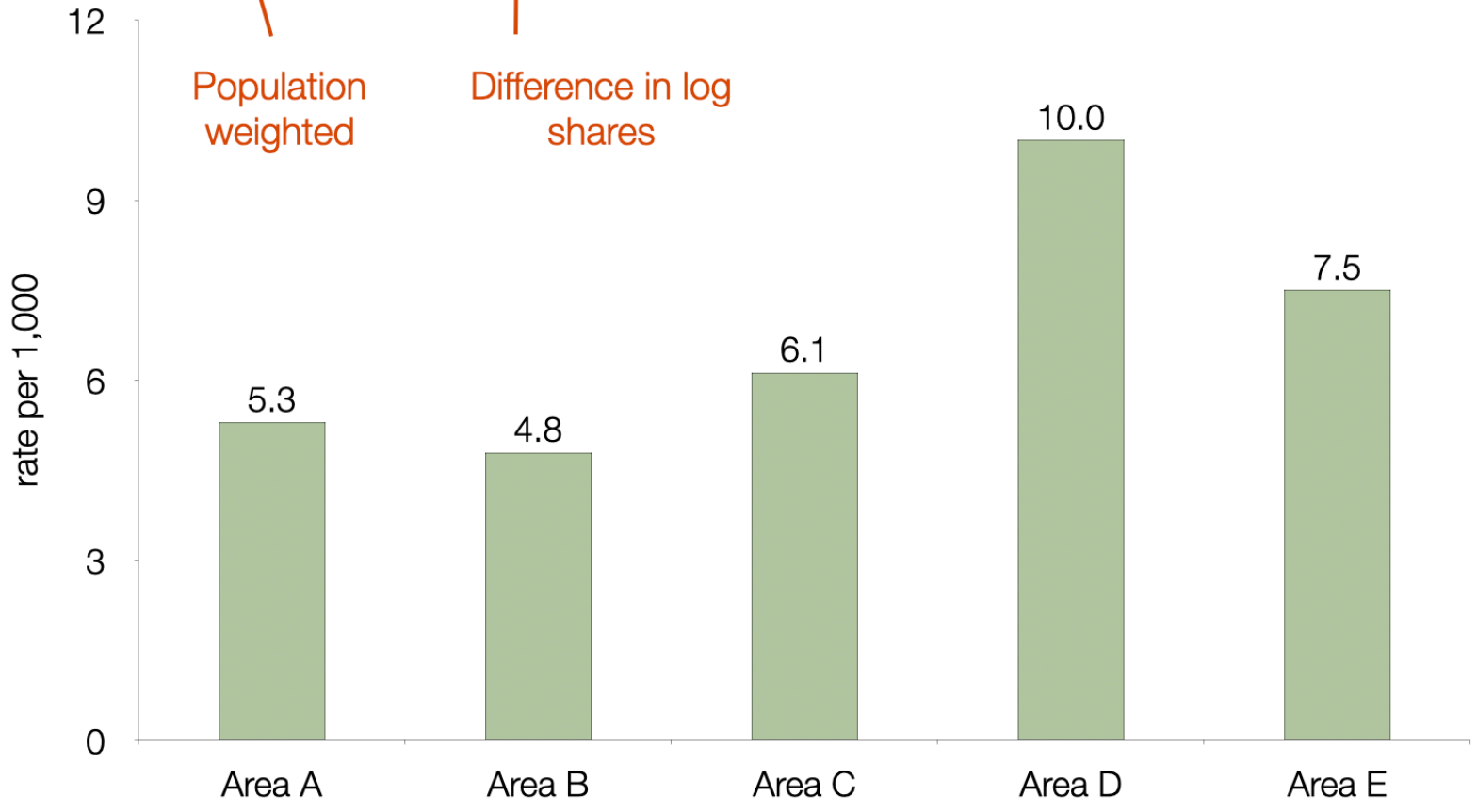
$$\sum_{j=1}^{J} p_j \left[ ln\left(p_j\right) - ln\left(s_j\right) \right]$$

Population weighted

Difference in log shares

Index of Disparity

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



Does it matter?

Ezzati et al.:
"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."

## Geographic inequalities in life expectancy

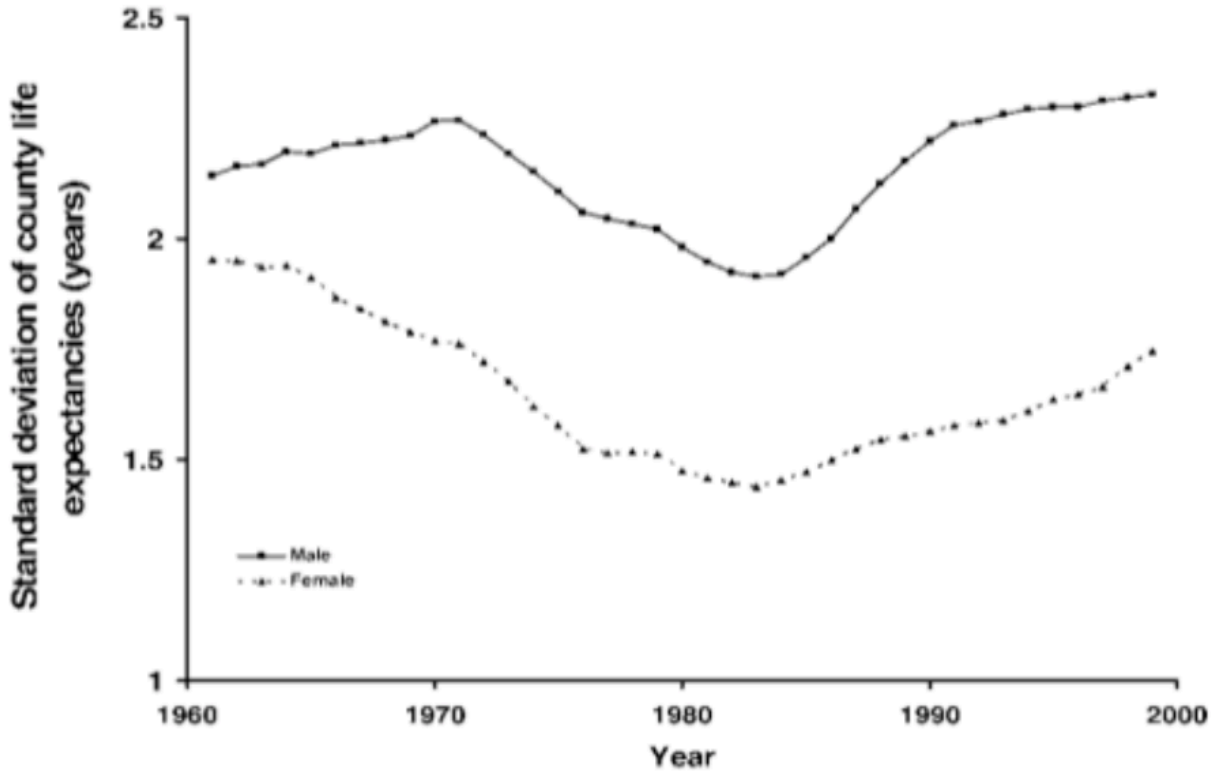



**Figure 1.** SD of Life Expectancies of the 2,068 County Units in the United States by Sex

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

Compared weighted to unweighted inequality measures

Across:

- counties
- states
- regions

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!

Harper et al. (2010)

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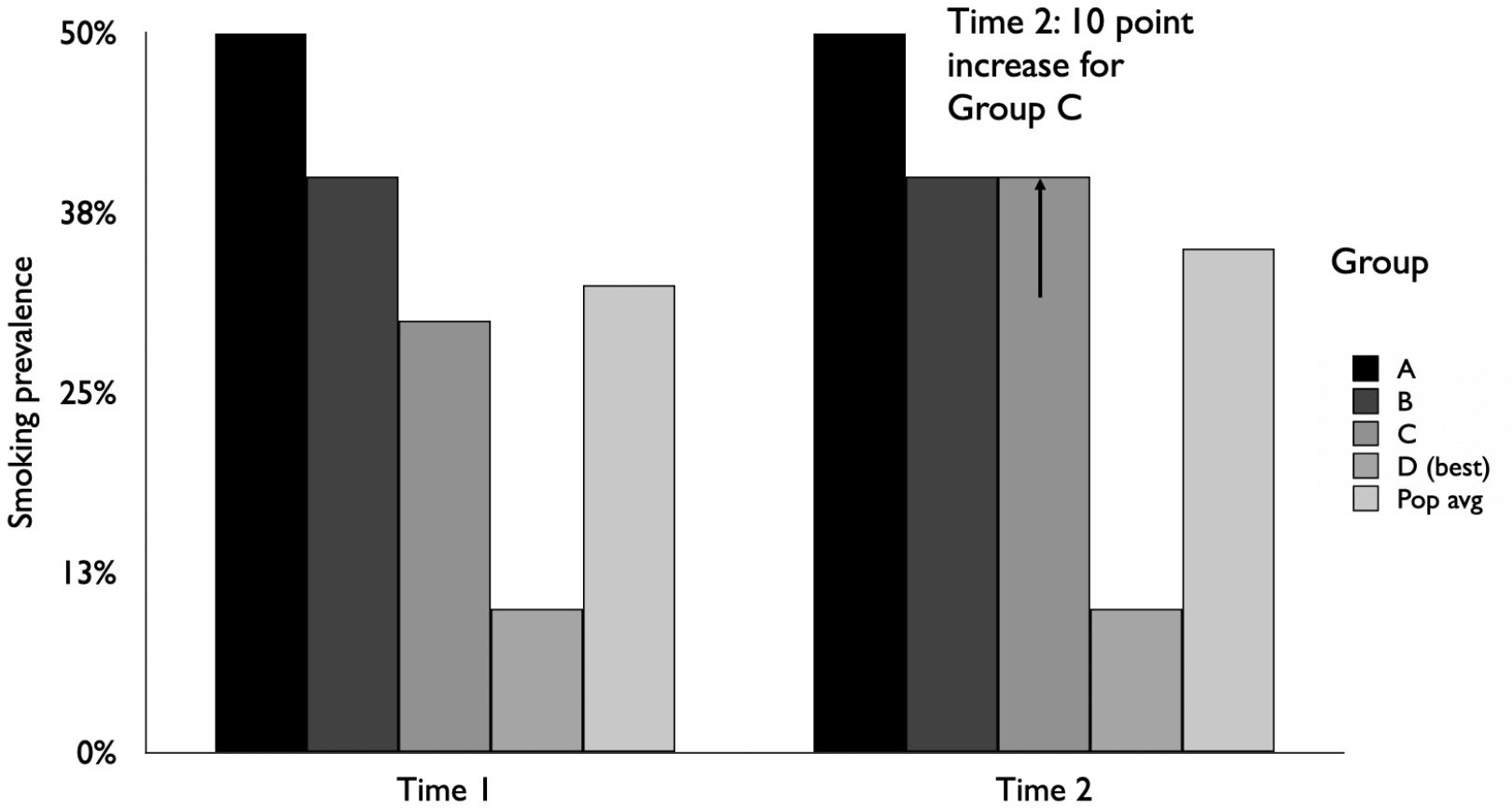
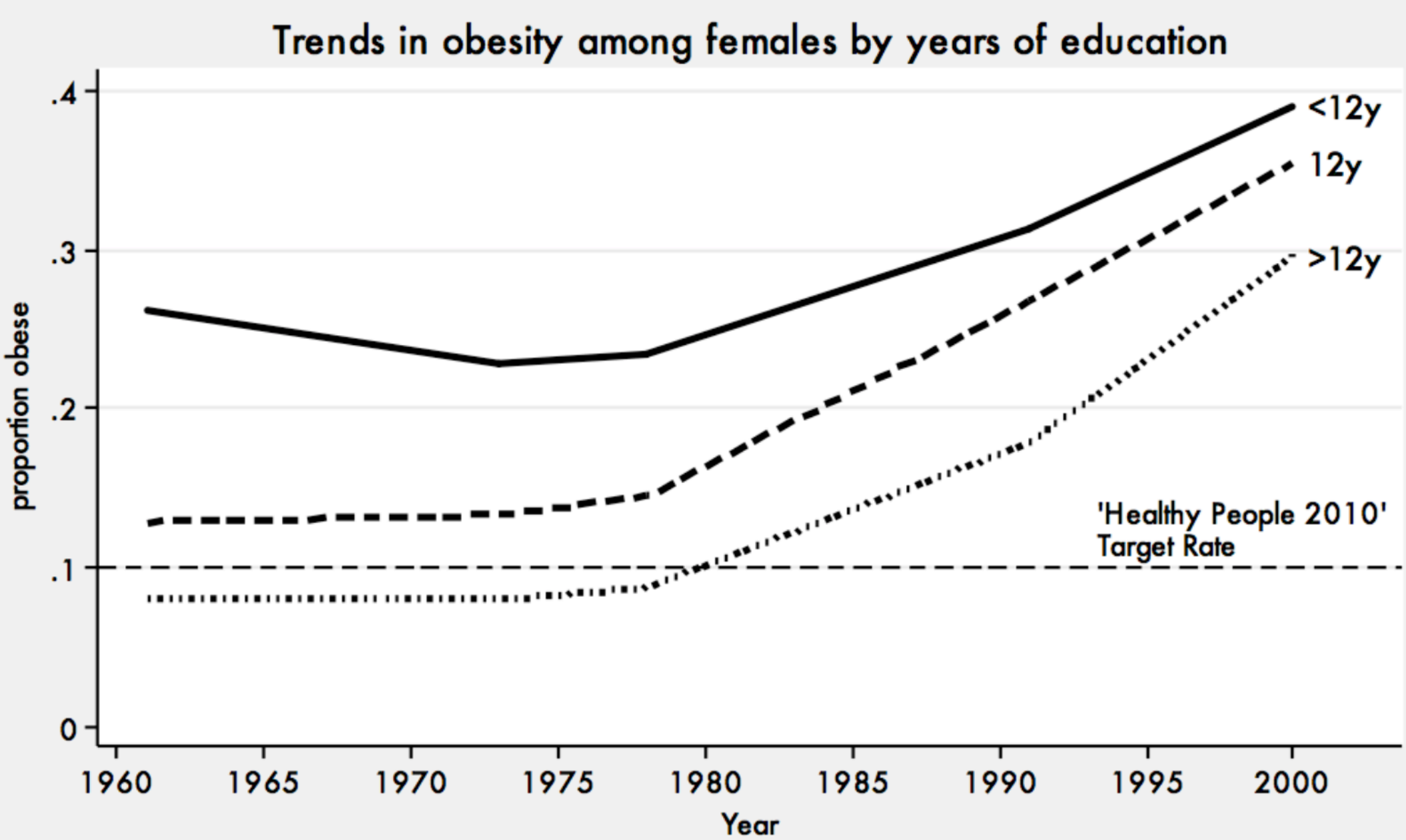
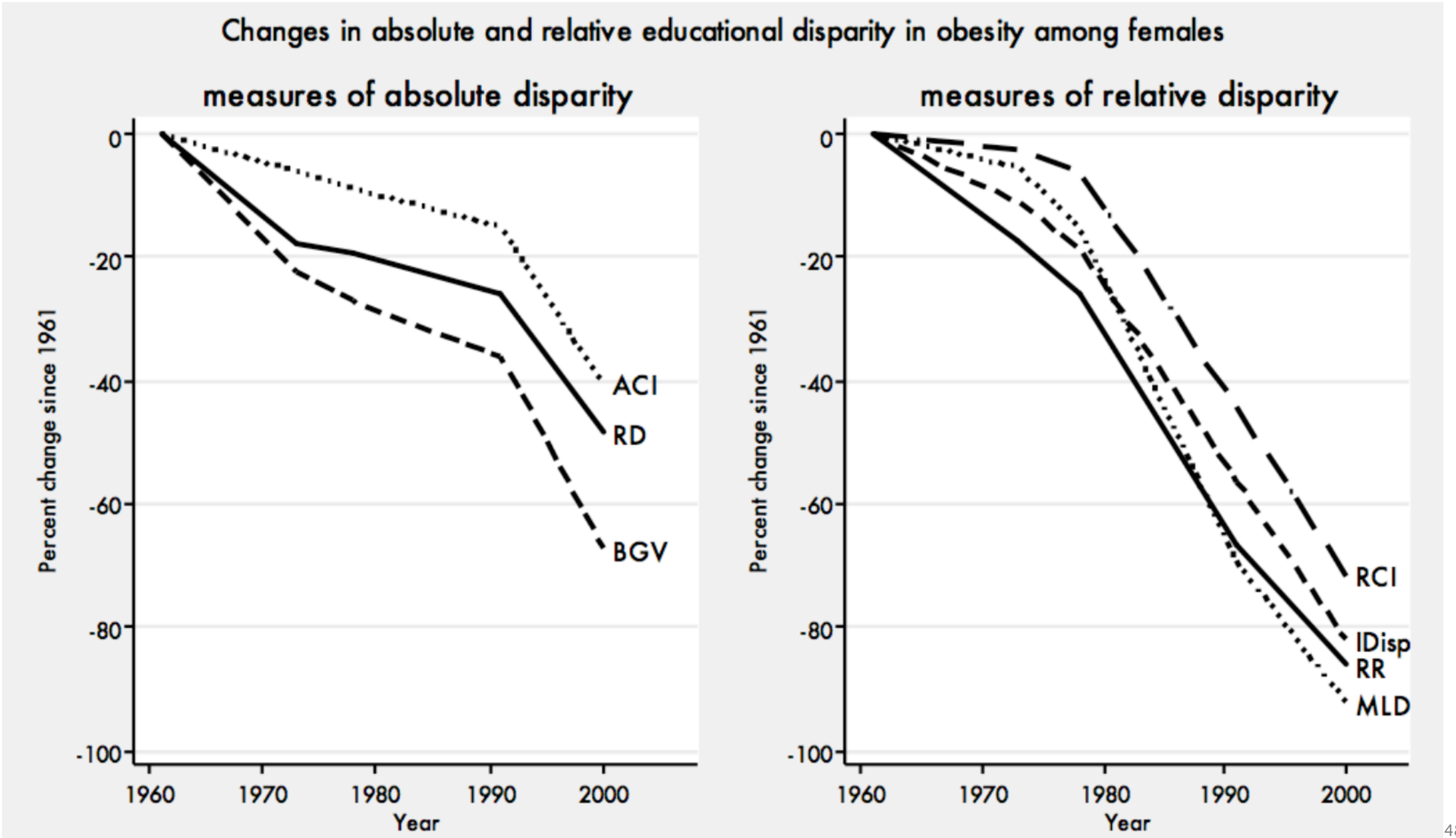
## Changes in Index of Inequality Using Different Reference Points

| | 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% |




Trends in obesity among females by years of education
proportion obese
.4
.3
.2
.1
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
Year
<12y
12y
>12y
'Healthy People 2010'
Target Rate


Changes in absolute and relative educational disparity in obesity among females
measures of absolute disparity
measures of relative disparity
Percent change since 1961
0
-20
-40
-60
-80
-100
1960
1970
1980
1990
2000
Year
ACI
RD
BGV
RCI
IDisp
RR
MLD

# 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.

# Launch of WHO book 'Health inequality monitoring: harnessing data to advance health equity'

11 December 2024 13:00 – 14:15 CET

**Register here**

Over the past decades there have been remarkable improvements to human health around the world. Yet, further progress remains hampered by persistent inequalities between and within populations. Robust health inequality monitoring systems and practices are needed to identify and address unfair differences in health and ensure no one is left behind in the pursuit of better health for all.

The forthcoming WHO book *Health inequality monitoring: harnessing data to advance health equity* is a comprehensive and contemporary resource for health inequality monitoring, consolidating foundational

# Break! ☕

15:00