

# Monitoring Social Inequalities in Health: Integrating Measurement and Value Judgments

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PAHO Technical Review Group Meeting  
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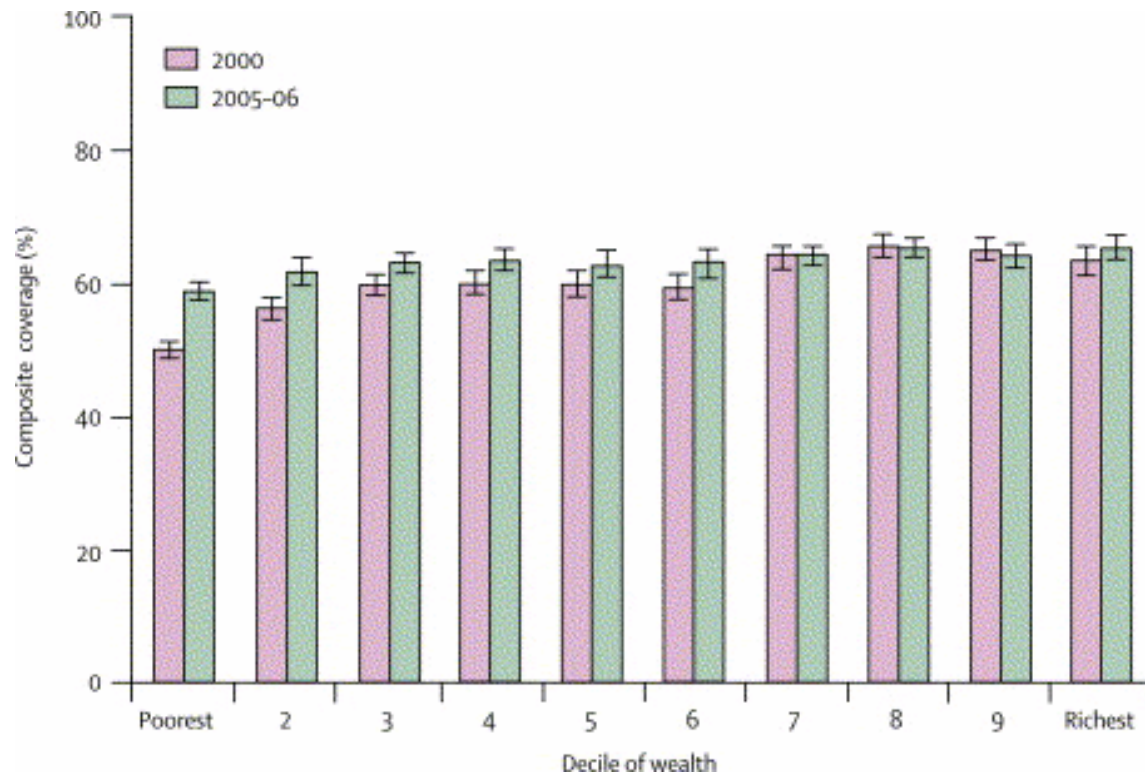
# Why Monitor Health Inequalities?

- 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)



# The Need for Health Inequality Monitoring

Health21 targets:

“By the year 2020, the health gap between socio-economic groups within countries should be **reduced by at least one fourth** in all member states, by substantially improving the level of health of disadvantaged groups.”

-European Regional Office of the WHO (1999)

“To protect the [health] gains attained, it will be necessary to...monitor and analyze health inequities.”

-Health in The Americas (2007)

# Healthy People 2010 Goals, United States

## Goal 1:

“to help individuals of all ages increase life expectancy and improve their quality of life.”

## Goal 2:

“to **eliminate** health disparities among segments of the population, including differences that occur by gender, race or ethnicity, education or income, disability, geographic location, or sexual orientation.”

# Measuring and Monitoring Health Inequalities

Two overarching issues:

1. What aspects of inequality are important?
2. How do existing measures of inequality incorporate the different aspects of inequality?

# “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

Health Inequalities:  
What Aspects of Inequality are Important?



## Summary Table of Advantages and Disadvantages of Potential Health Disparity Measures

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

<sup>a</sup>All those better off.

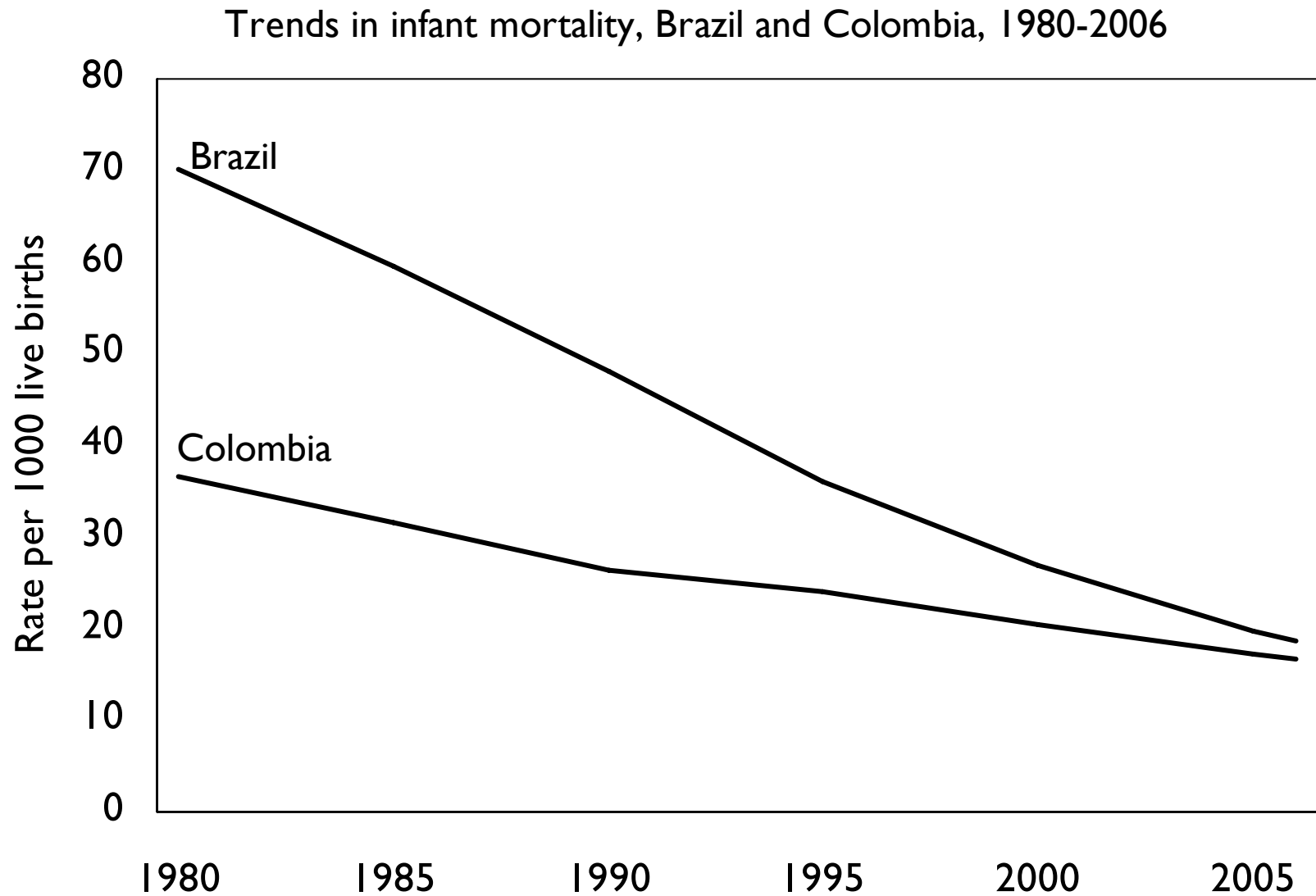
<sup>b</sup>In the case of regression-with grouped data.

## Four Questions to Ask:

1. Are summary measures of inequality necessary?
2. Is inequality relative or absolute?
3. Should we count individuals equally or social groups equally when evaluating inequality?
4. Do we care where changes in health inequality come from?

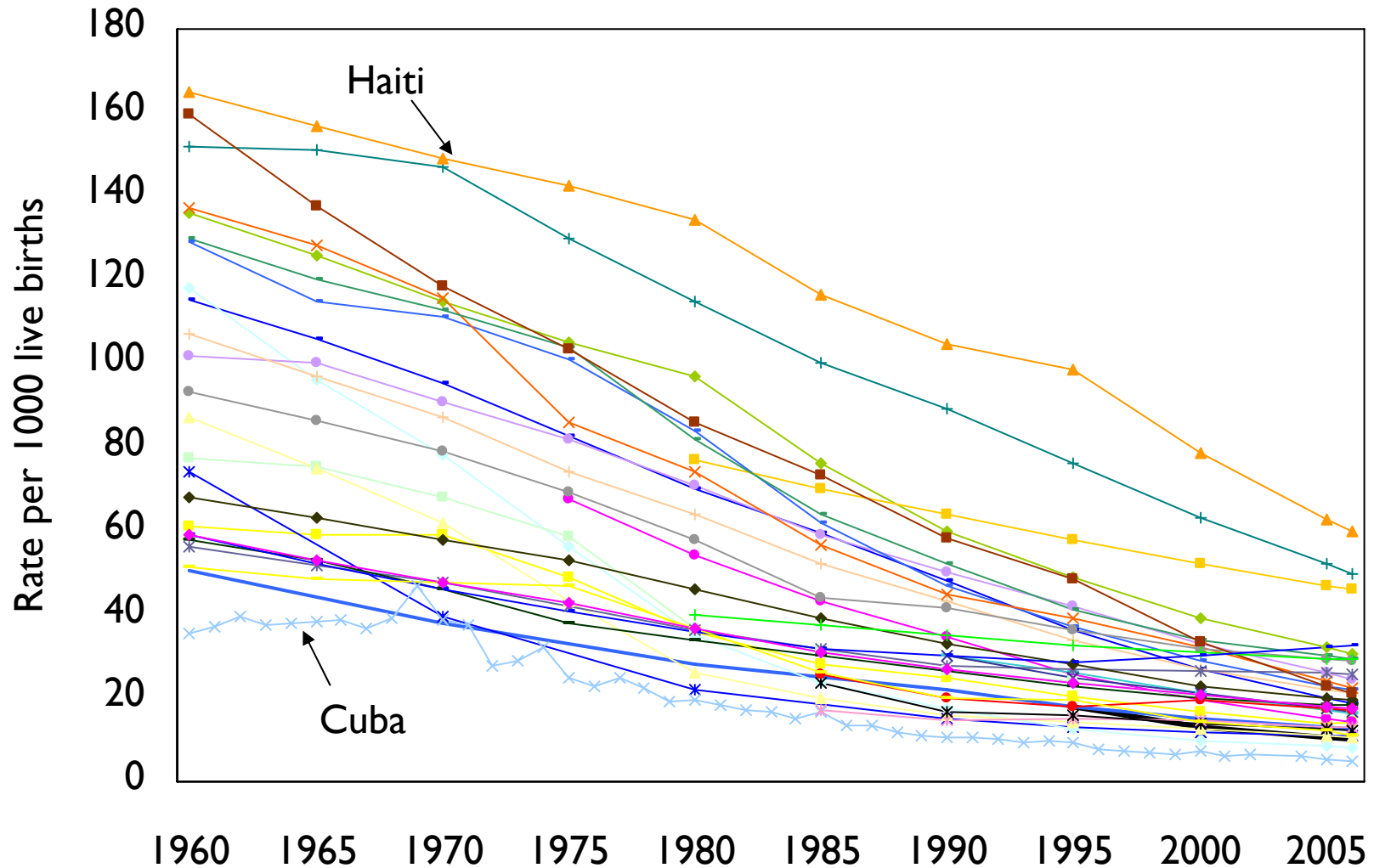
# I. Are Summary Measures of Health Inequality Necessary?

# The Easy Case: Two Groups

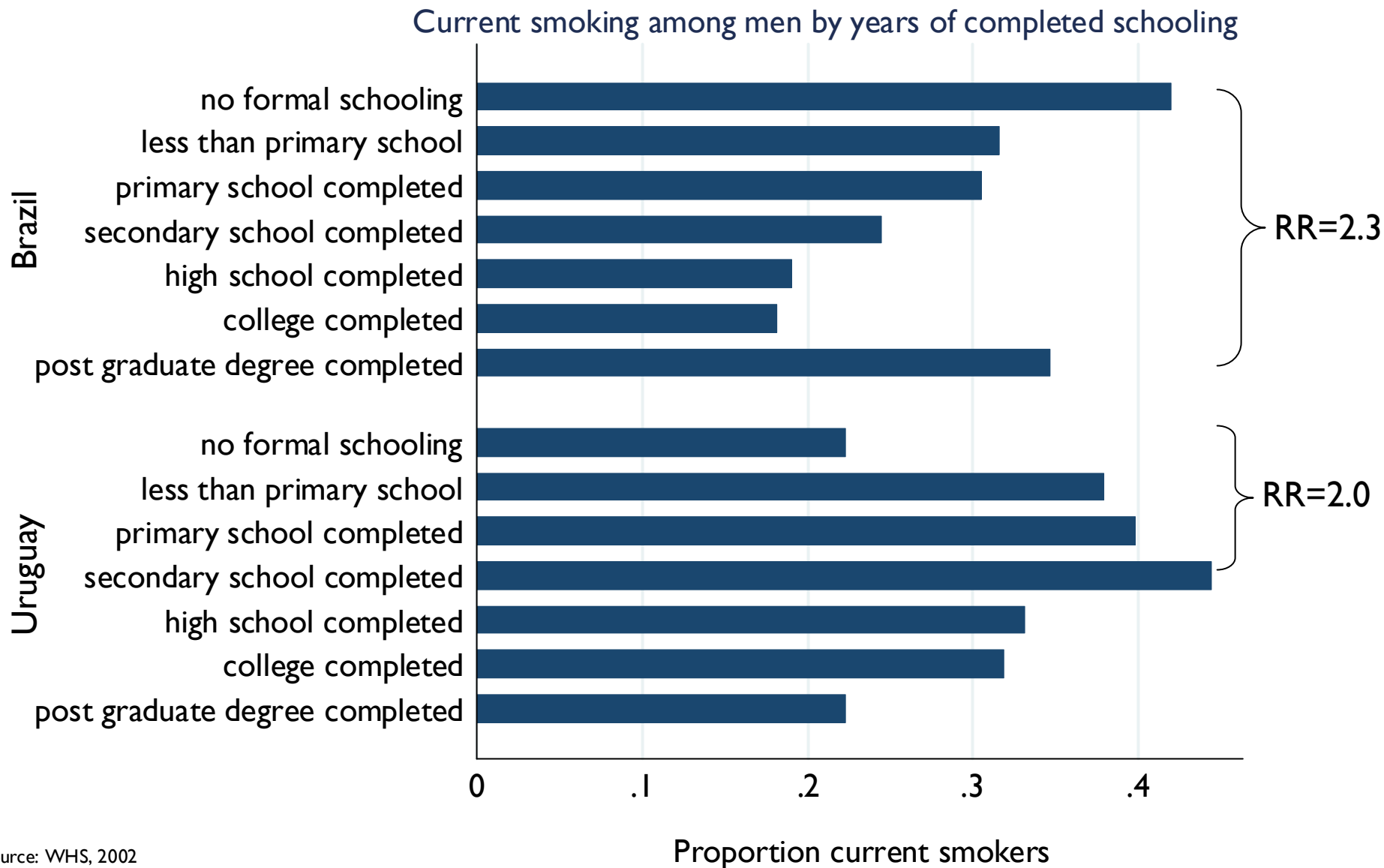


# The Need for Summary Measures of Health Inequality

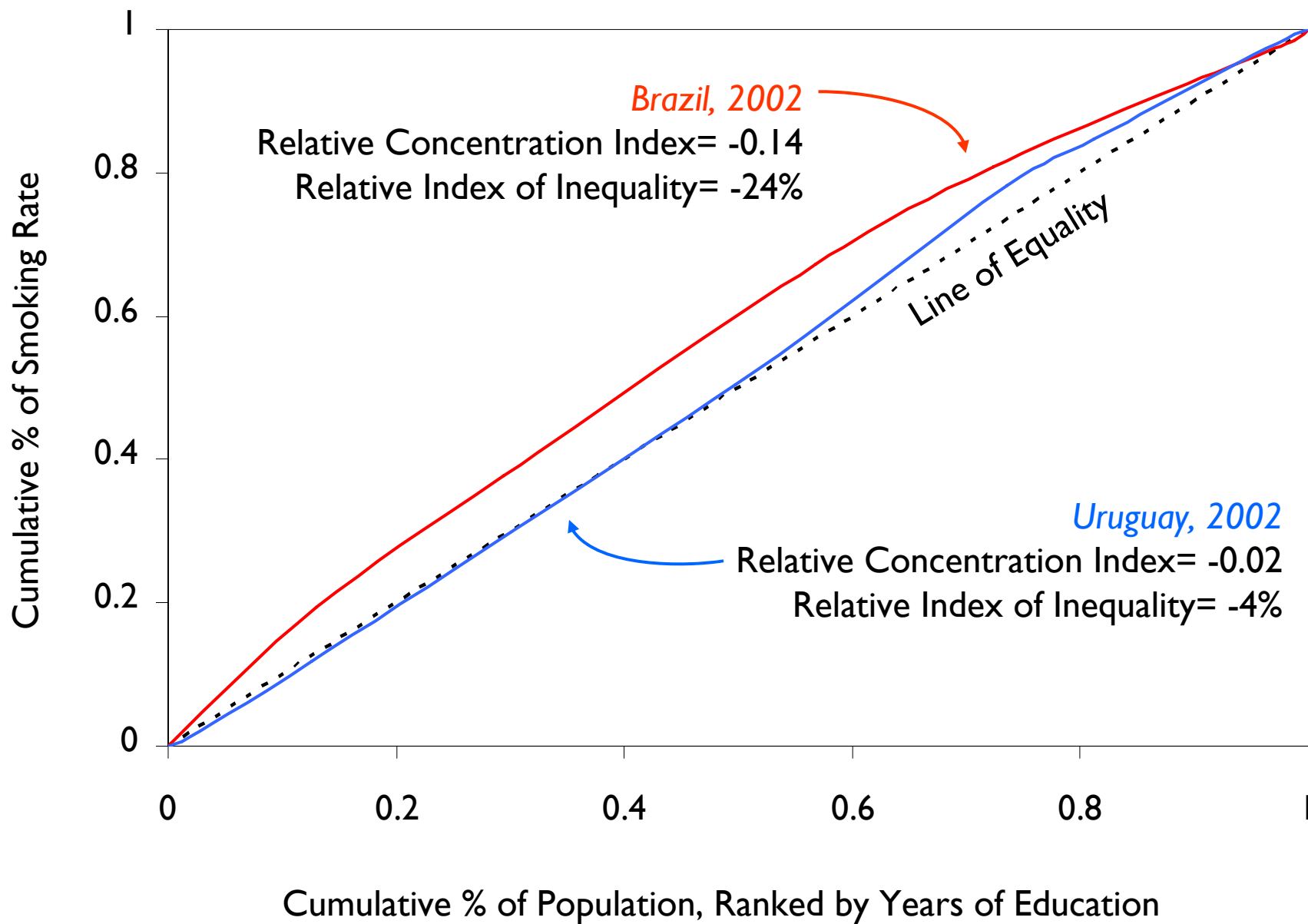
Trends in infant mortality, Latin American/Caribbean Region, 1960-2006



# Measuring educational inequalities in smoking using the extreme groups



# Health Concentration Curves



## 2. Absolute or Relative Inequality?



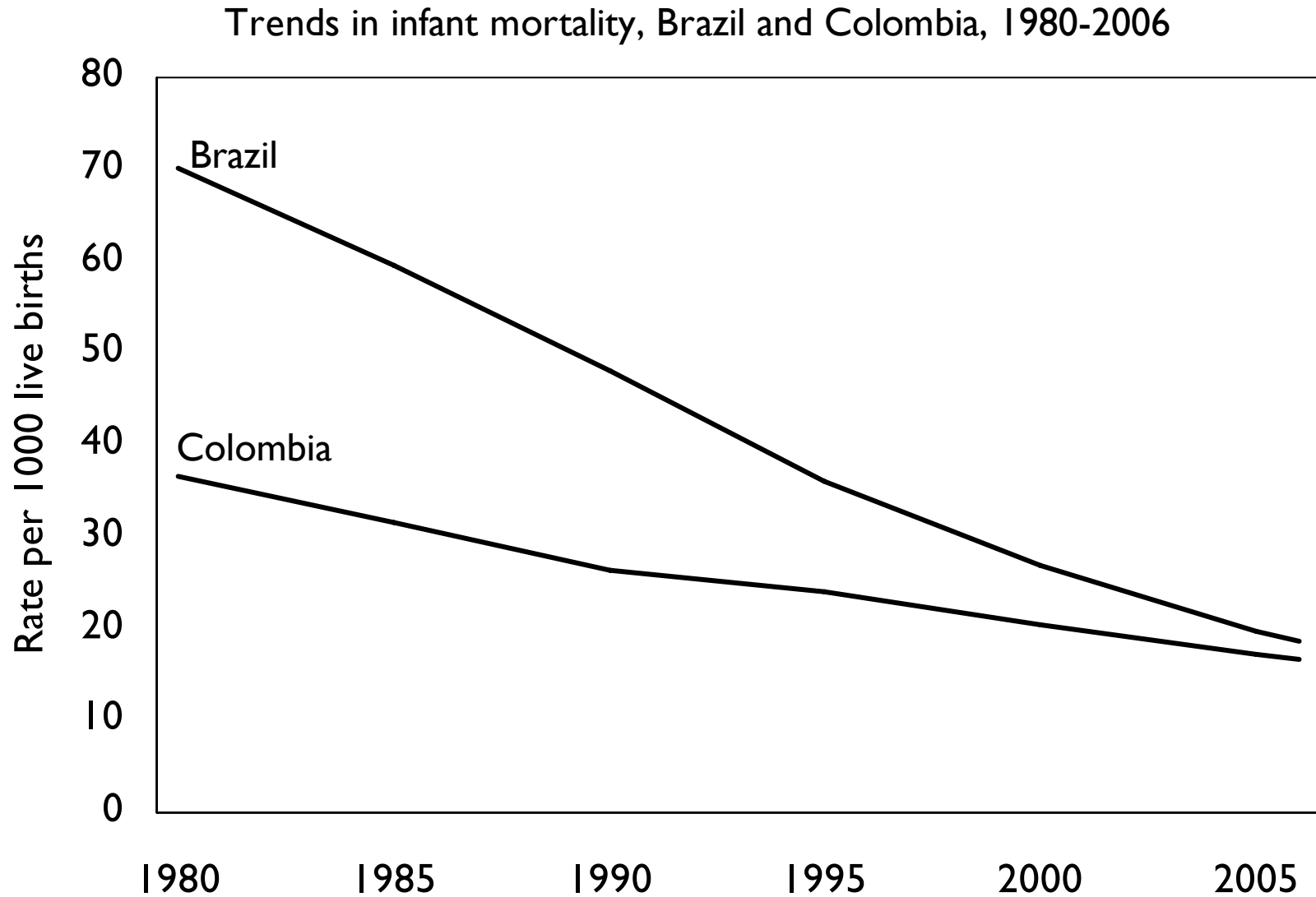
# Recommendations of WHO Expert Group on Measuring Health Inequalities

“The discussion on which summary measure of a distribution to use as the measure of inequality did not arrive at a concrete conclusion... One proposal was that WHO should calculate and report both relative and absolute indices of health inequality.

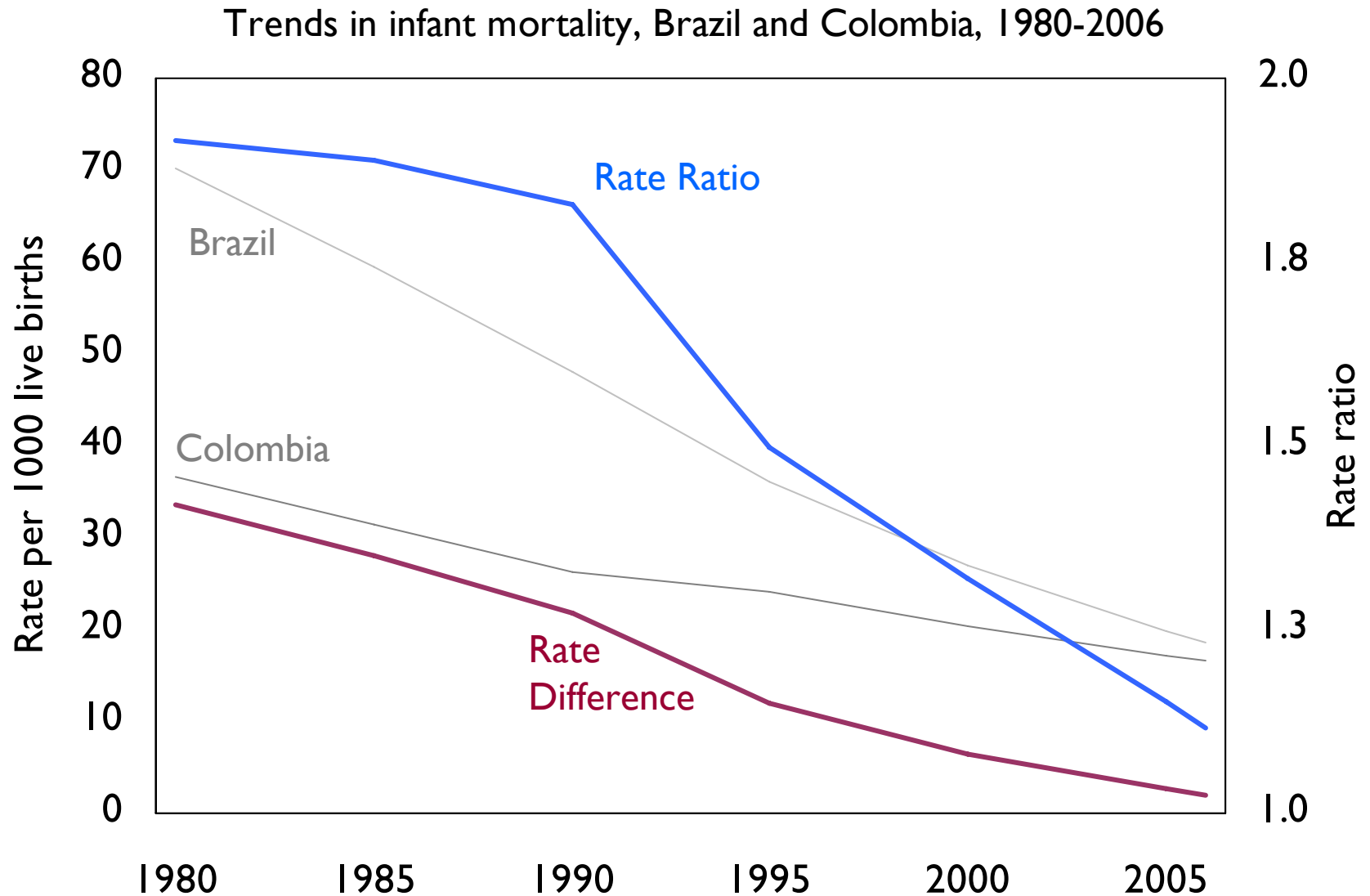
It was agreed that in the context of health system performance assessment, one measure of inequality had to be selected for the calculation of the index of attainment. Any single measure should be accompanied by complementary measures (for example, indices of both absolute and relative inequalities).”

-WHO Technical Consultation on the Measurement of Health Inequalities, (2003)

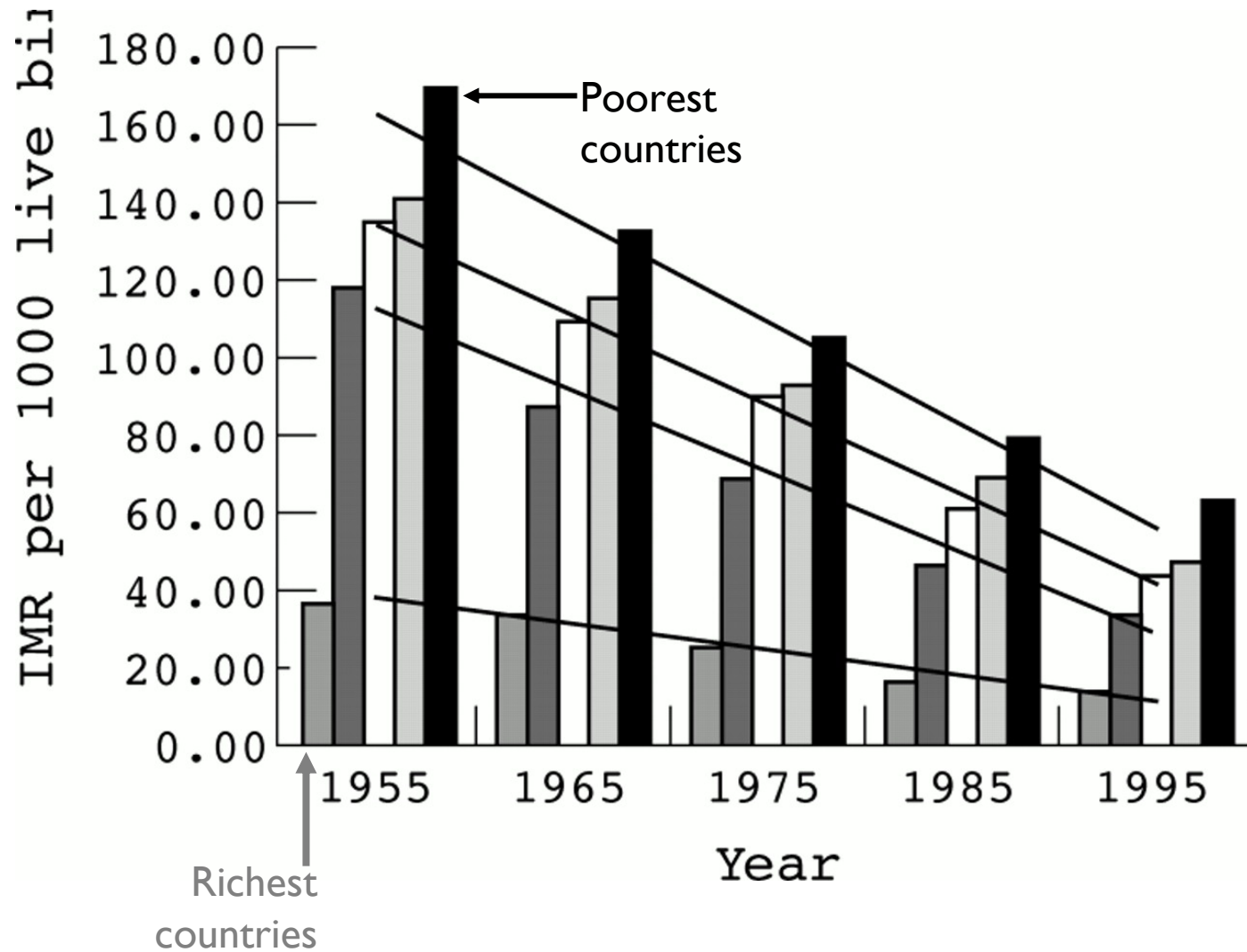
# The Easy Case: Evidence of clear progress



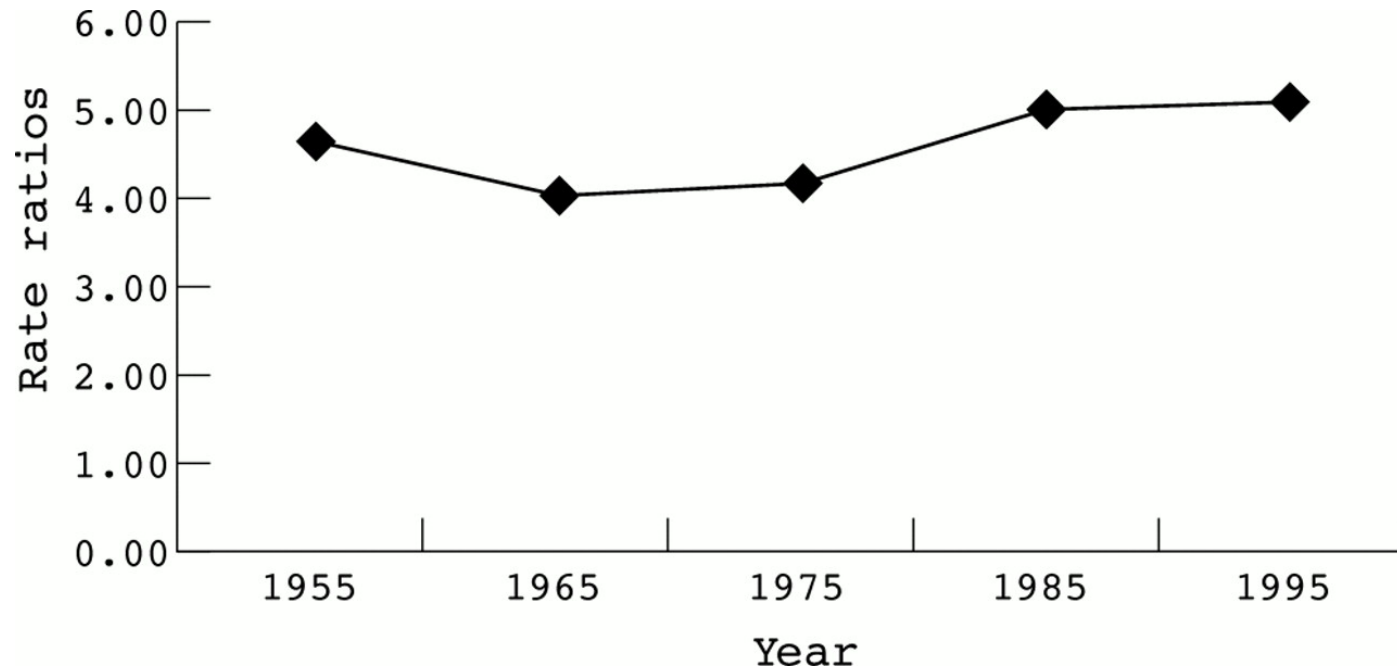
# The Easy Case: Evidence of clear progress



# Trends in the infant mortality rates in 25 countries grouped by gross national product adjusted by purchasing power parity in 1975; Region of the Americas, 1955-1995.

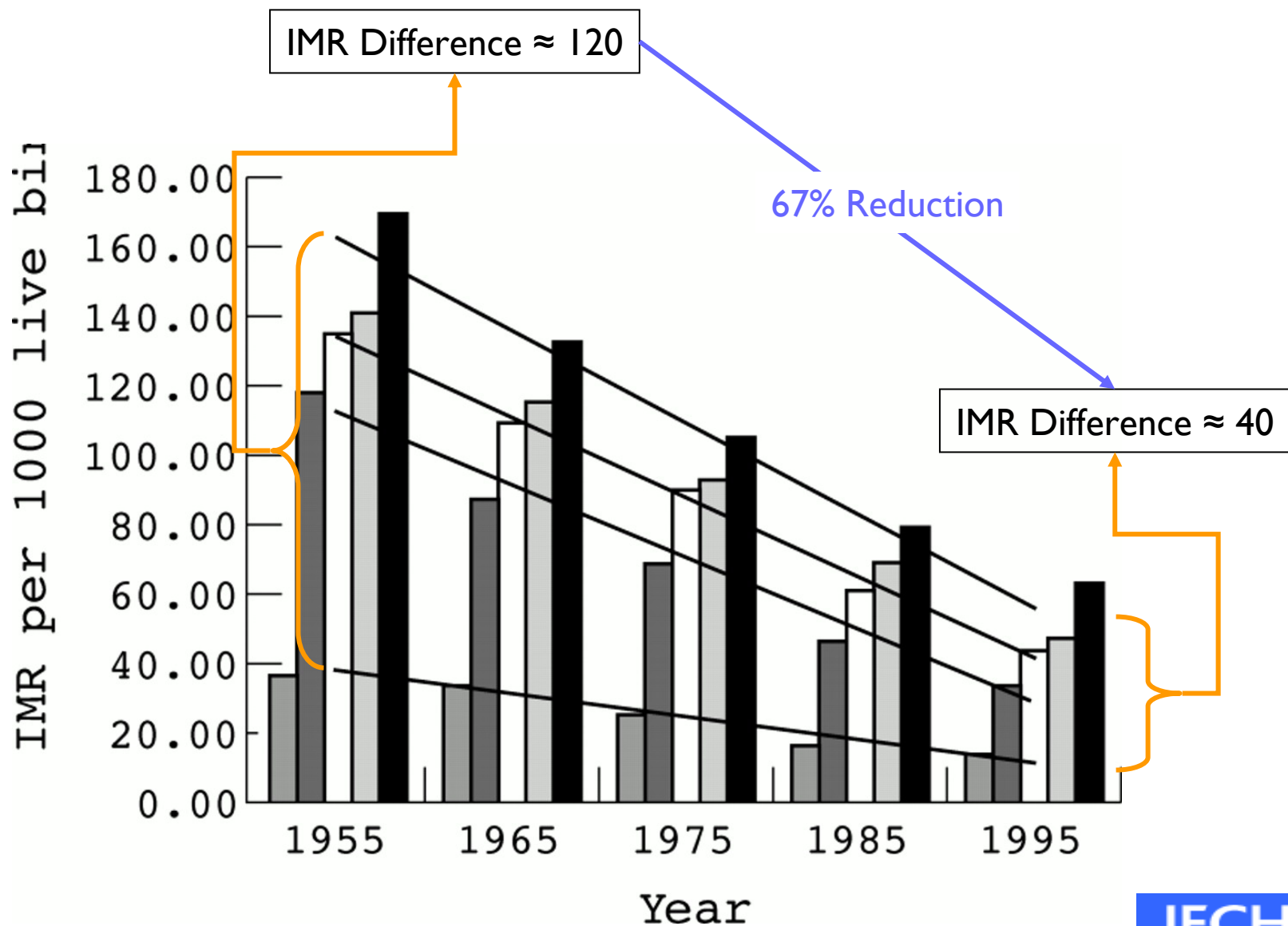


# Trend of the rate ratio of infant mortality between groups of countries (25 countries in this analysis) at the extreme quintiles of gross national product adjusted by purchasing power parity in 1975; Region of the Americas, 1955-1995.

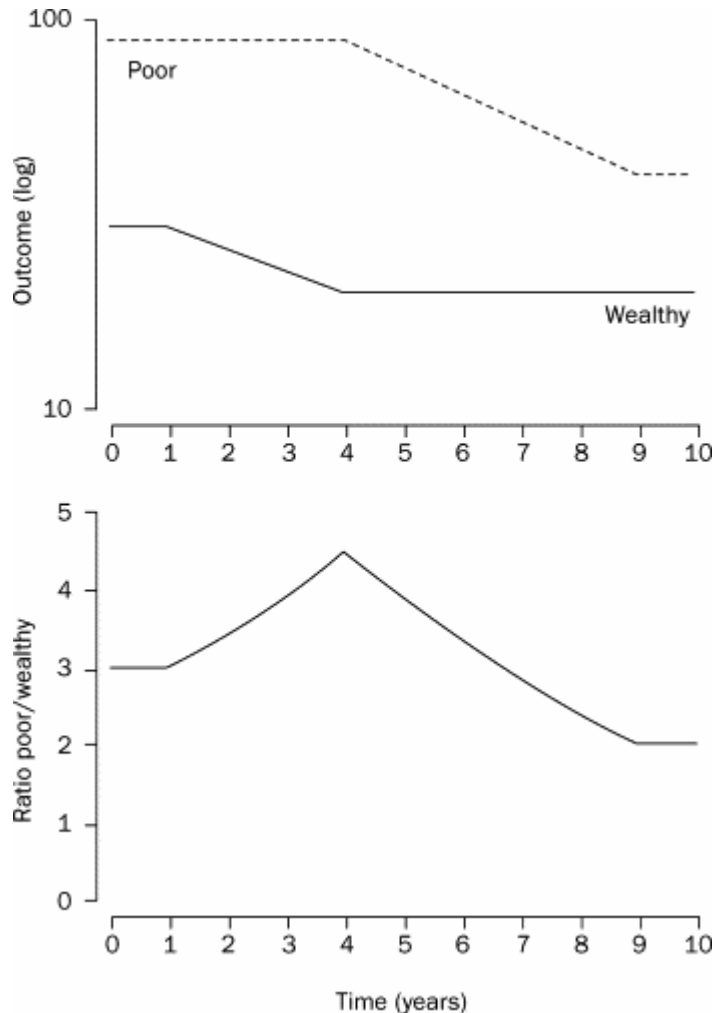


“Despite a sizable reduction in the infant mortality, whether or not income related, levels of IMR inequality among countries have remained almost constant in this period.”

# Trends in the infant mortality rates in 25 countries grouped by gross national product adjusted by purchasing power parity in 1975; Region of the Americas, 1955-1995.



# The Inverse Equity Hypothesis

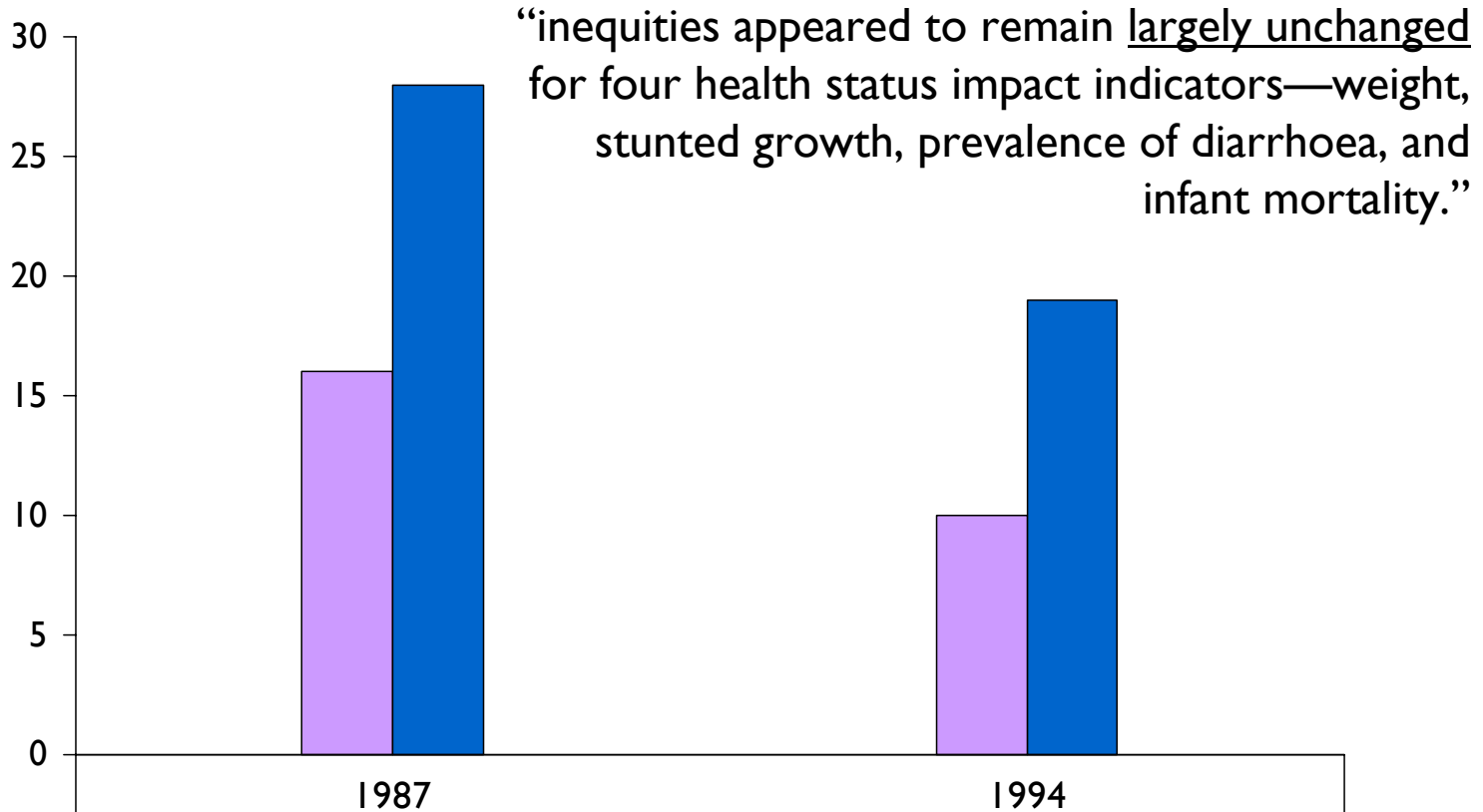


“[F]ollowing the introduction of new public-health interventions, **inequities** in infant and child health status between richer and poorer groups in society **usually widen** before they get smaller and improve. We have called this the “inverse equity hypothesis”.

-Victora et al. (2000)

# 'Inverse equity': Relative or Absolute?

% of children with diarrhoea in the previous 2 weeks



Rich	16	10
Poor	28	19
Poor-rich difference	9	6 → -33%
Poor-rich ratio	1.5	1.6 → +20%



# Justification for measures of relative inequality

“In these analyses, we have used ratio measures of inequity, rather than absolute or difference measures. Difference measures will almost inevitably lead to an apparent reduction in equity gaps, because baseline rates tend to be already low in absolute terms among the wealthiest. Ratio scales, however, take baseline levels into account and are thus more appropriate for deciding whether or not inequity is decreasing. This is consistent with the use of ratio measures in epidemiological research.”

-Victora et al. (2000)

# Challenges of Ratio Measures: Not Just for Health Inequalities

“The RR of myocardial infarction **in the hour** after coffee intake was 1.49 (95% CI = 1.17-1.89).”

-Baylin et al. *Epidemiol.* (2006)

BUT...

Average **10-year** risk of MI is 10%, so the 1-hour risk is approximately 1/1,000,000. The RR of 1.5 above implies 1 extra hourly MI for each 2,000,000 cups of coffee.

“researchers should routinely provide this kind of information to readers: the absolute differences that are implied by the ratios of risks, rates, and prevalences we typically estimate.”

-Poole, *Epidemiol.* (2007)

# Trends in the Black-White Life Expectancy Gap in the United States, 1983-2003

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Sam Harper, PhD

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John Lynch, PhD

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Scott Burris, JD

---

George Davey Smith, MD

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“Between 1993 and 2003...the decline in the life expectancy gap was larger among males, declining by 25% (from 8.44 to 6.33 years).”

“Rapid mortality declines in blacks from homicide and HIV accounted for 55% of the overall decline.”

“The steep declines in HIV mortality were due to the widespread and rapid introduction of highly-active antiretroviral therapy (HAART). ”

# Black–White Mortality From HIV in the United States Before and After Introduction of Highly Active Antiretroviral Therapy in 1996

Robert S. Levine, MD, Nathaniel C. Briggs, MD, MSc, Barbara S. Kilbourne, PhD, William D. King, MD, JD, Yvonne Fry-Johnson, MD, Peter T. Baltrus, PhD, Baqar A. Husaini, PhD, and George S. Rust, MD, MPH

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“National Black-White disparities **widened significantly** after the introduction of HAART, especially among women and the elderly...In no case was there overlap in the age-specific 95% confidence intervals for the pre-HAART versus post-HAART period.”

“These data show that Black–White **risks** increased after the introduction of HAART.”

-Levine et al. (2007)

HAART and US Black-White Mortality Inequality:  
Contrasting evidence or contrasting perspectives?

# Evidence of Increasing Black-White Inequalities

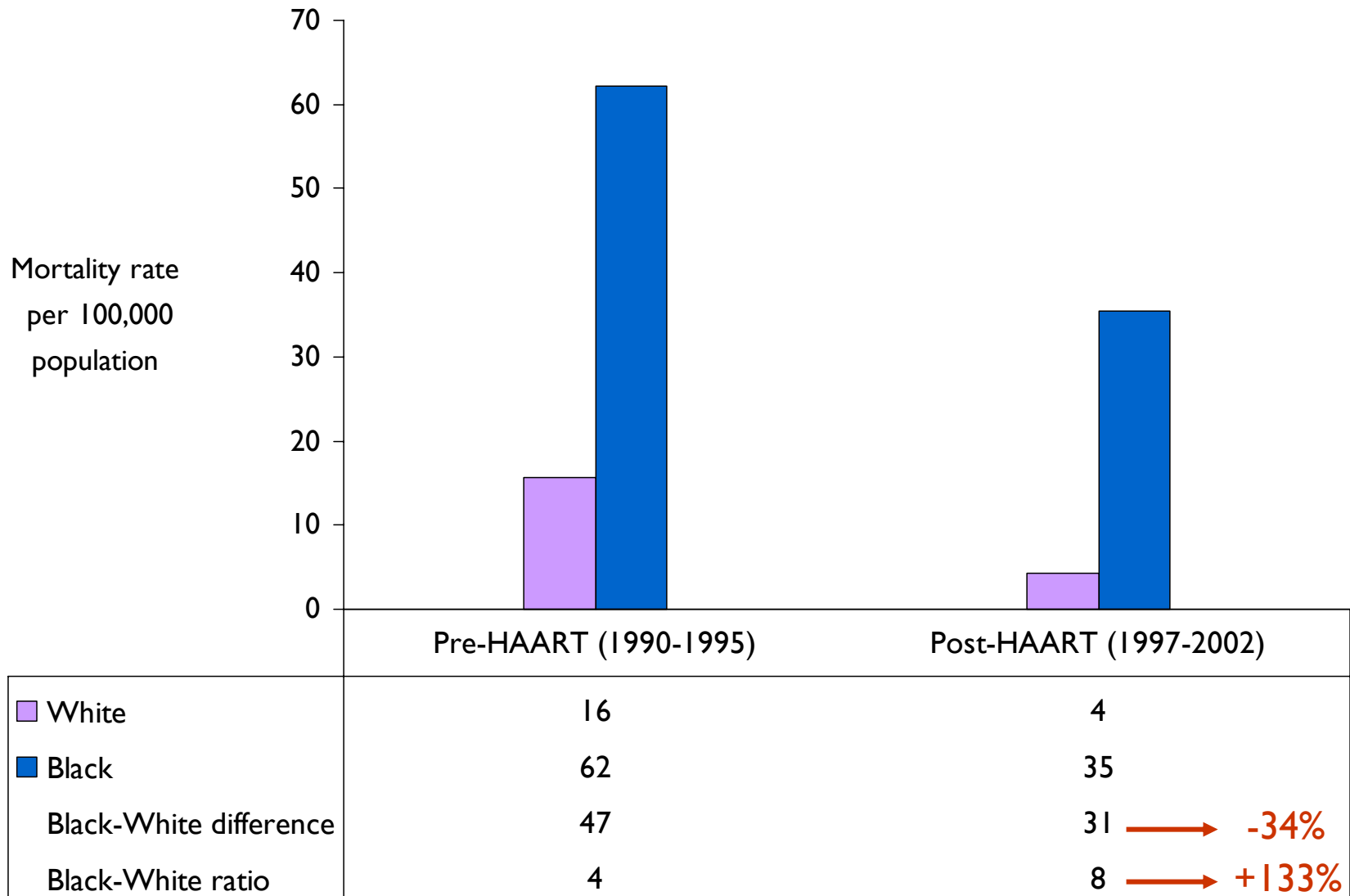
**TABLE 1—US Black-to-White Mortality Rate Ratios (MRRs) for HIV Before (1990–1995) and After (1997–2002) the Introduction of Highly Active Antiretroviral Treatment (HAART), by Age and Gender**

Age and Gender	Before Introduction of HAART (1990–1995)					After Introduction of HAART (1997–2002)				
	Blacks		Whites		Black:White MRR (95% CI)	Blacks		Whites		Black:White MRR (95% CI)
	Deaths	Person-Years	Deaths	Person-Years		Deaths	Person-Years	Deaths	Person-Years	
<b>Men, y</b>										
25–34	16993	15734471	36309	106813720	3.18 (3.12, 3.24)	5522	15603347	6491	98616176	6.36 (6.12, 6.60)
35–44	25212	13323431	52501	101552210	3.66 (3.61, 3.72)	12990	16029902	14424	110854080	6.23 (6.08, 6.38)
45–54	9864	7953764	22517	71497724	3.87 (3.77, 3.96)	9479	11495762	8932	92797298	8.57 (8.32, 8.82)
55–64	3036	5454510	6584	52777418	4.46 (4.27, 4.66)	2887	6478328	2820	60215541	9.52 (9.03, 10.03)
65–74	869	3836740	1660	44085986	6.02 (5.53, 6.53)	946	4099302	803	44148054	12.69 (11.54, 13.96)
75–84	106	1717205	224	22026171	6.07 (4.77, 7.68)	184	1978148	160	26331726	15.31 (12.32, 19.04)
<b>Women, y</b>										
25–34	5672	17569200	4072	104089262	8.25 (7.93, 8.59)	3401	17294748	1406	94635076	13.24 (12.43, 14.09)
35–44	6930	15356318	4411	101213489	10.35 (9.97, 10.76)	6007	18151026	2730	109713087	13.30 (12.71, 13.92)
45–54	2110	9511830	1581	73336535	10.29 (9.64, 10.98)	3233	13432221	1430	94357256	15.88 (14.92, 16.91)
55–64	701	6967552	584	57389348	9.89 (8.85, 11.05)	851	8075059	464	64191326	13.57 (12.11, 15.23)
65–74	255	5484261	333	55117359	7.70 (6.51, 9.09)	311	5812723	126	52826054	22.43 (18.24, 27.59)
75–84	51	3110854	114	35903451	5.16 (3.64, 7.24)	70	3527517	58	40063530	15.90 (10.90, 23.34)

Note. CI = confidence interval. Reporting is restricted to 10-year age groups for which reliable data for all years were available.

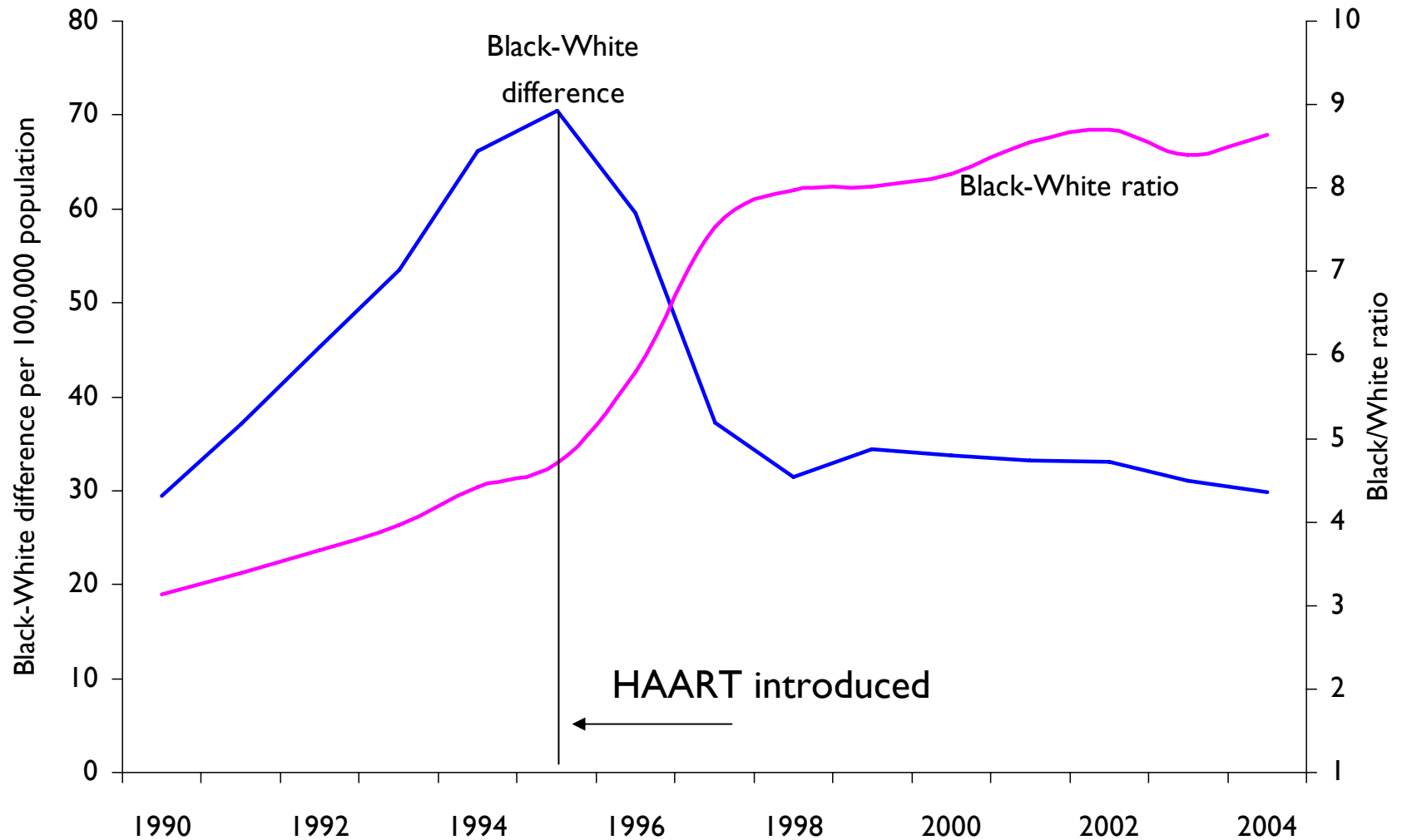
MRR = Mortality Rate Ratio

# Did HAART widen or narrow black-white inequalities?



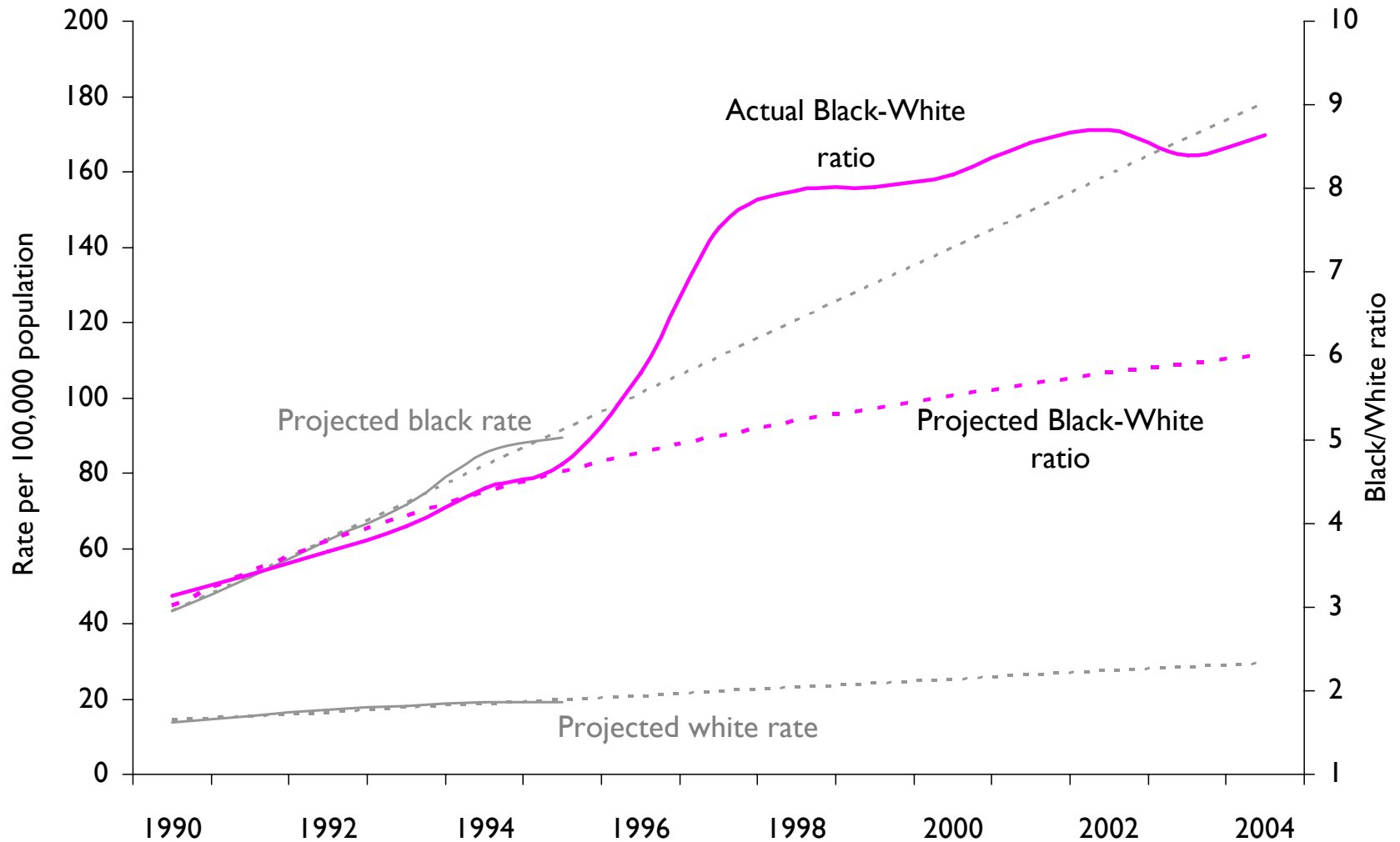
# Trends in black-white inequality in HIV mortality, US 1990-2004

## Absolute and relative perspectives





# What if HAART was never discovered?



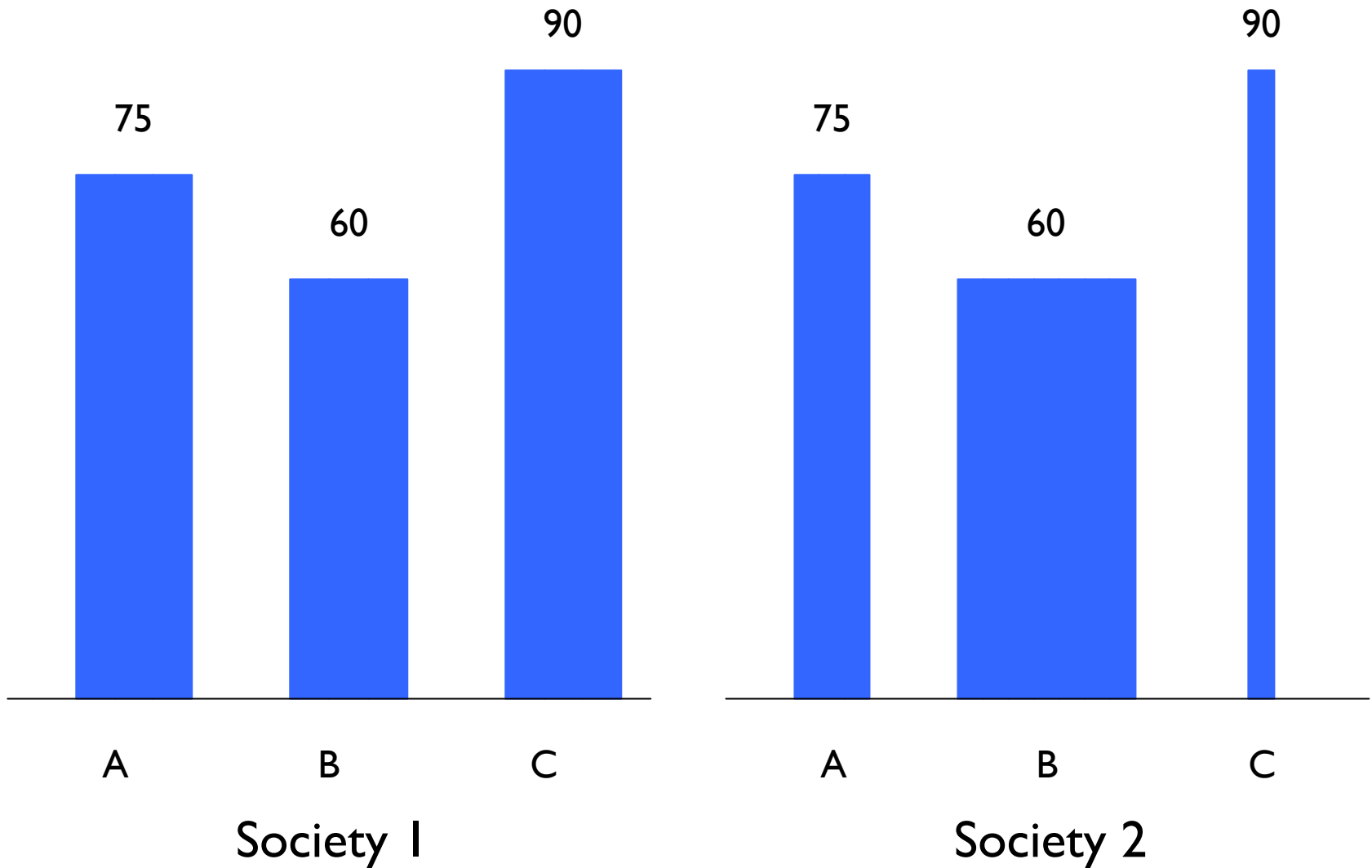
# “Inequality” is an ambiguous concept

“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.”

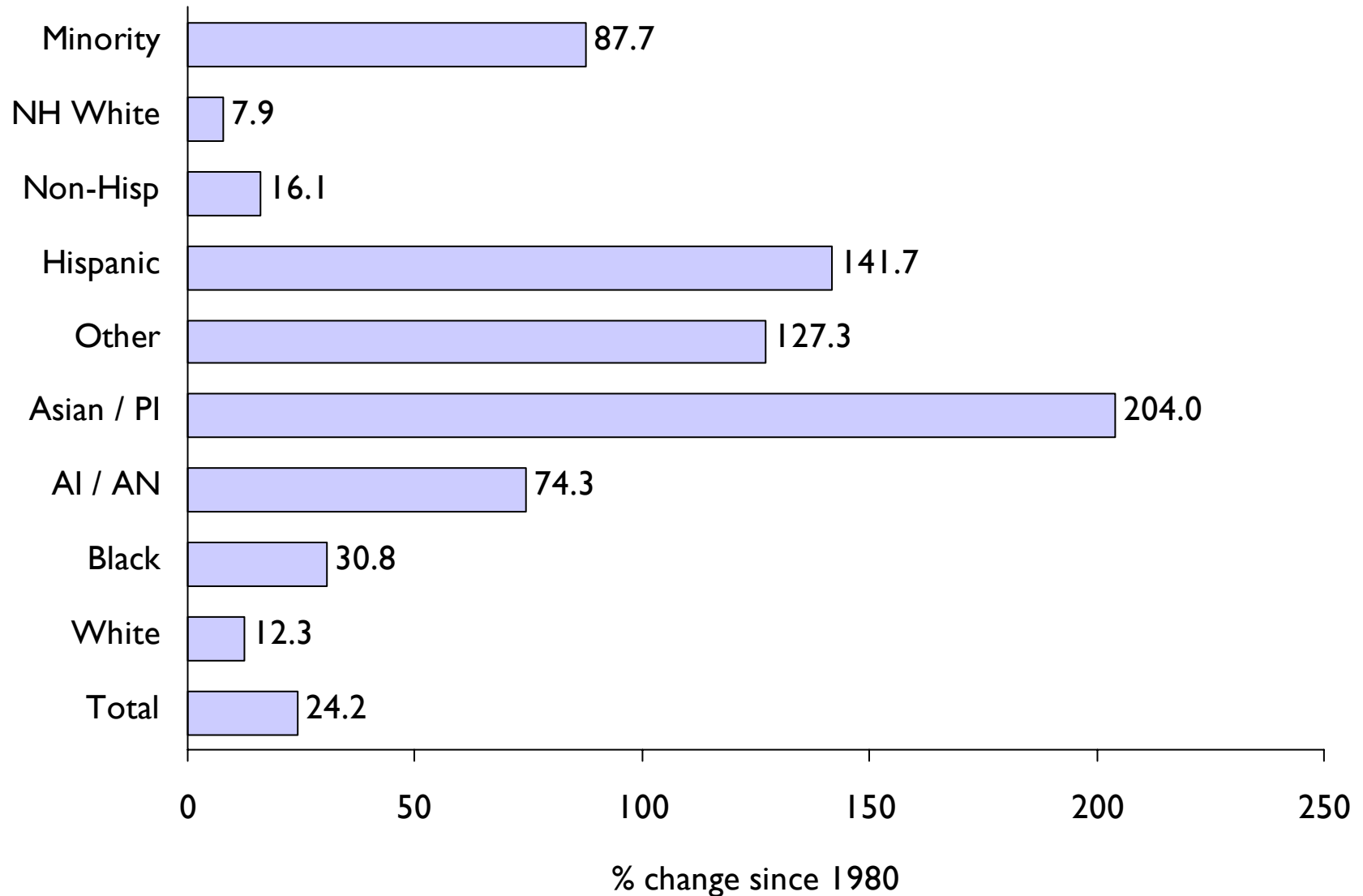
-Martin Ravallion, 2004  
World Bank Economist

3. Should we count individuals equally or social groups equally when evaluating inequality?

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



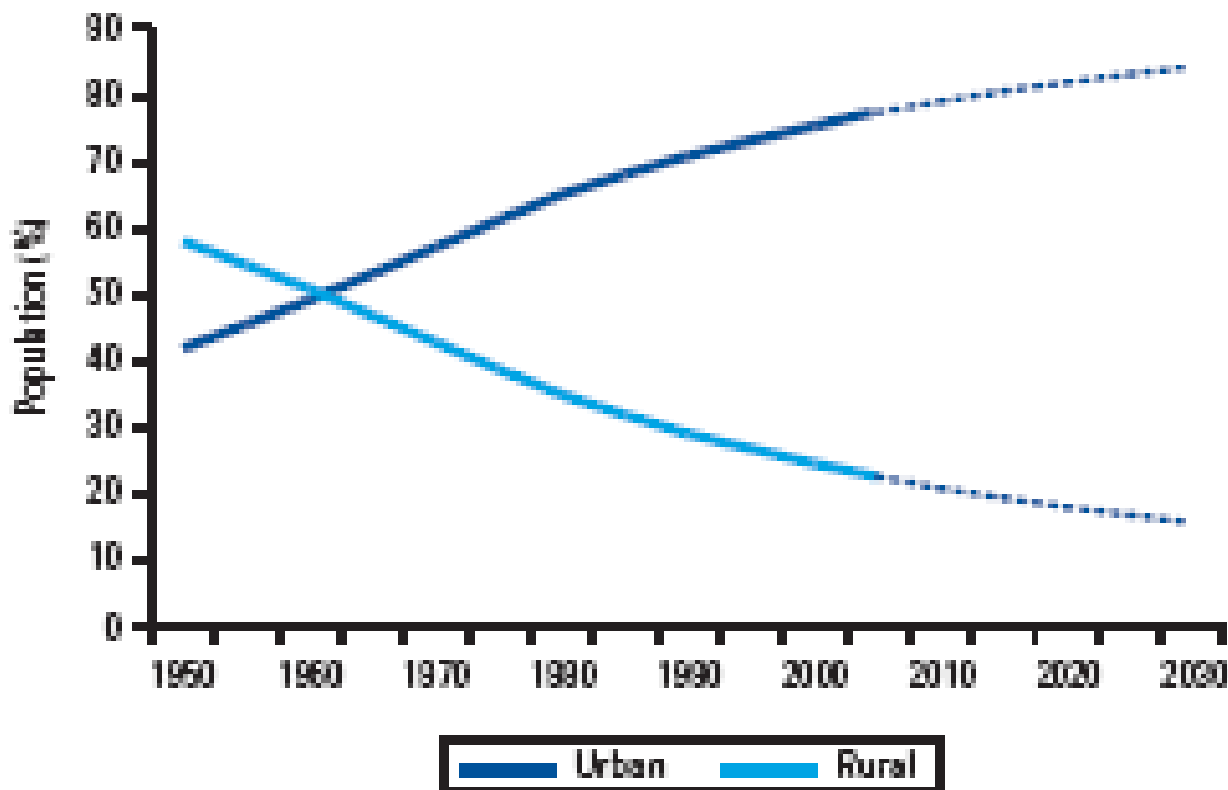
# Percent Change in Population Size by Race and Hispanic Origin: 1980-2000 USA



Source: Hobbs & Stoops, 2002

# Trends in Urban/Rural Population Distribution, 1950-2030

**FIGURE 2. Urban and rural population trends and projections in Latin America and the Caribbean, 1950–2030.**



Source: United Nations Population Division. *World Population Prospects: The 2006 Revision*. New York, 2007.

# Milanovic's Three Concepts of Inequality

## Three concepts of inequality illustrated

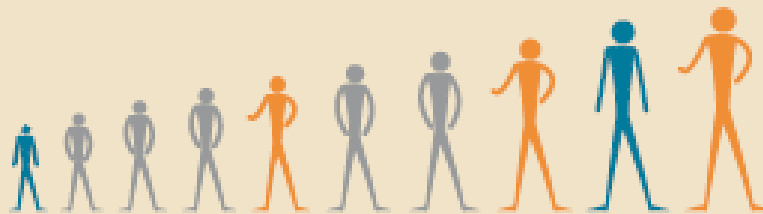
*Intercountry inequality:*  
Three countries and three representatives  
with mean incomes (height)



*International inequality:*  
Entire population included,  
but with mean incomes



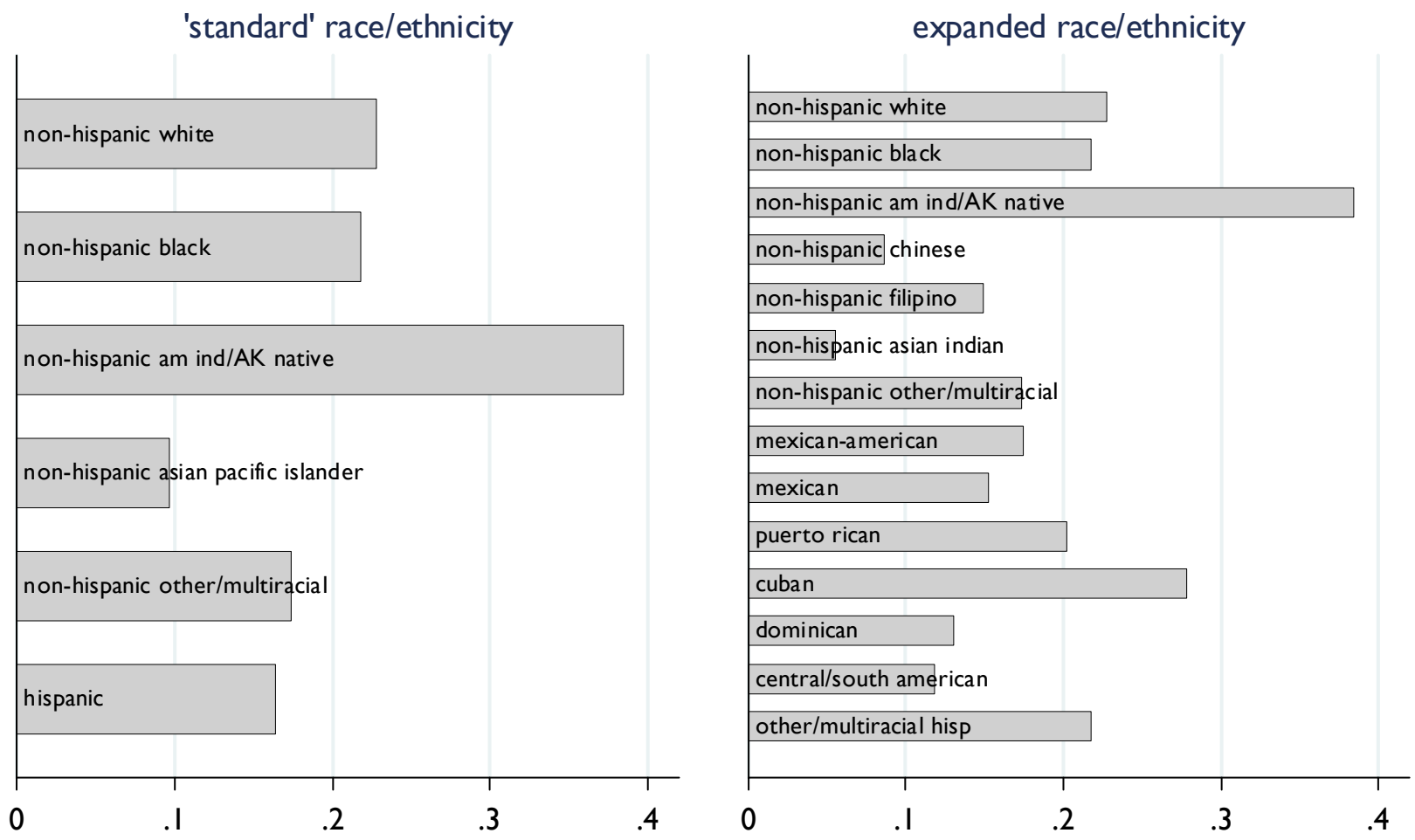
*Global inequality:*  
All individuals with their actual income



Sources: Milanovic (2005) and Ravallion (2004a).

# How large are race-ethnic inequalities in smoking?

## % of current smokers, 2003



Source: 2003 US National Health Interview Survey



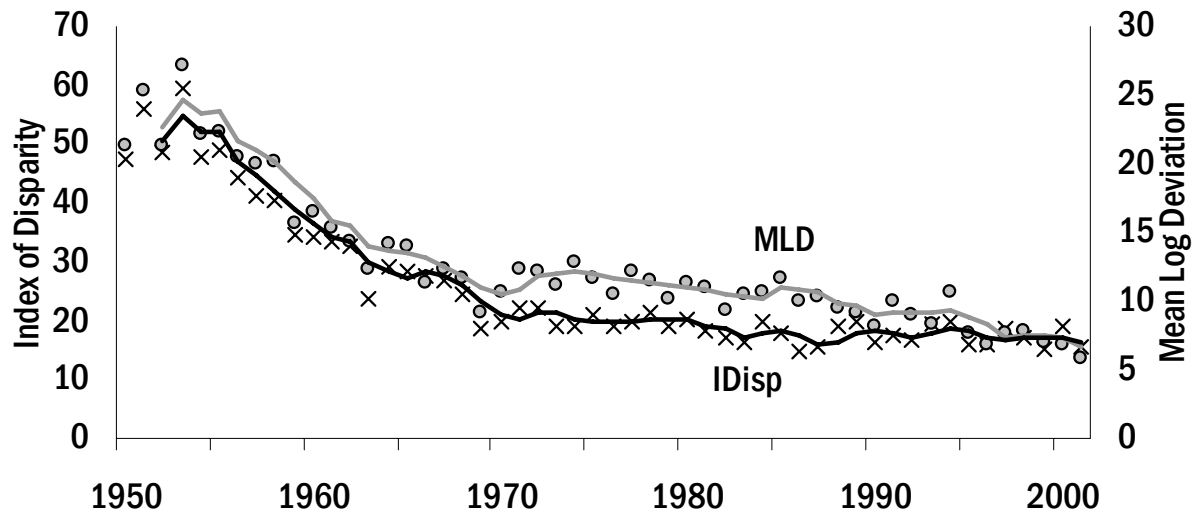
# How large are race-ethnic inequalities in smoking?

Race/ethnicity	Unweighted Measures of Disparity		Population Weighted Measure
	Rate Ratio (range)	Index of Disparity	Mean Log Deviation
'standard' (6 groups)	4.0	143.0	20.3
expanded (14 groups)	7.0	253.5	24.2
% change in inequality	101%	77%	26%

Source: 2003 US National Health Interview Survey

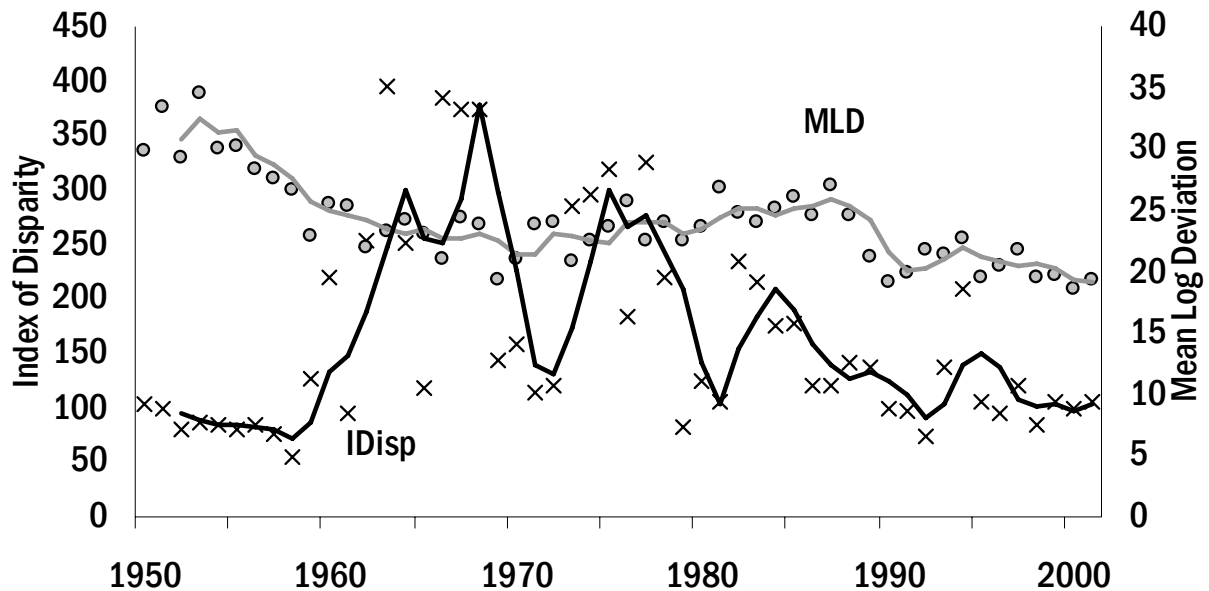
# Effect of Population Size on Geographic Inequalities in Stomach Cancer

## Relative Geographic Disparity by US Region



4 US Regions:  
Approximately equal  
population size

## Relative Geographic Disparity by US State

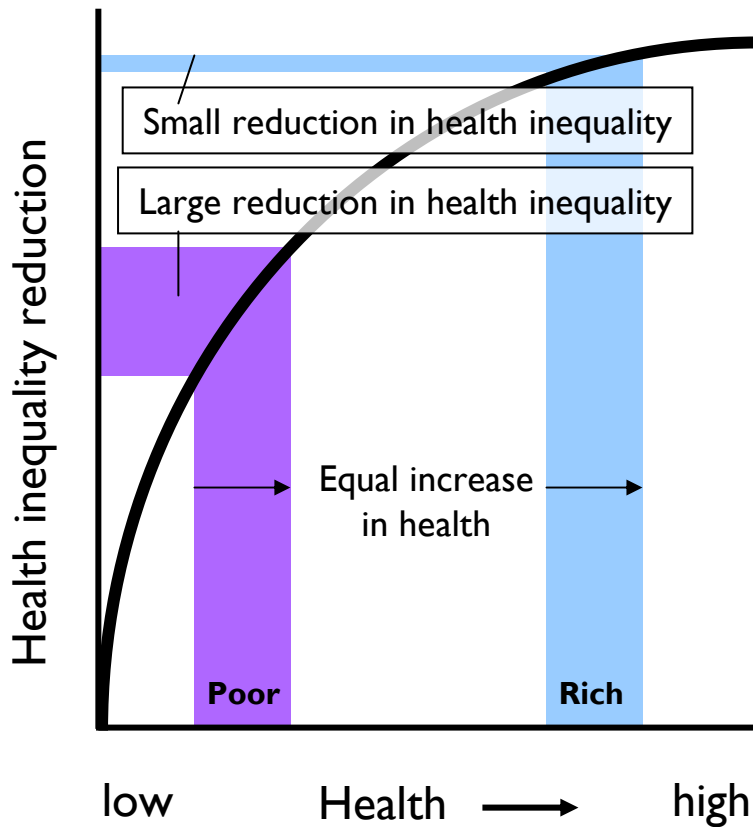


50 US States:  
Large variation in  
population size

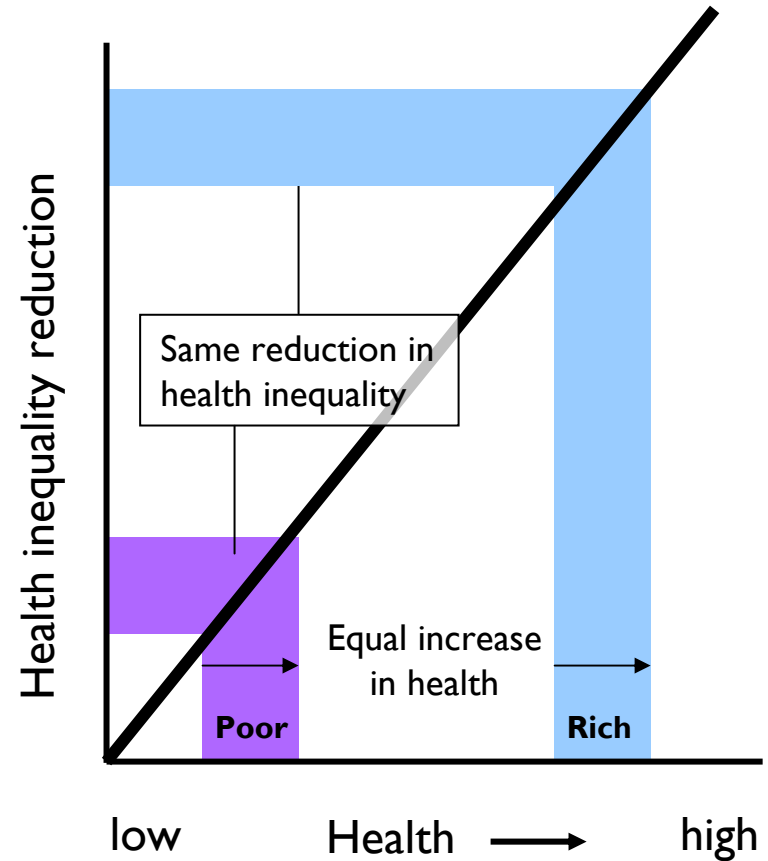
4. Do we care where changes in health inequality come from?

# Do we care where health improvements come from?

## PRIORITARIAN VIEW

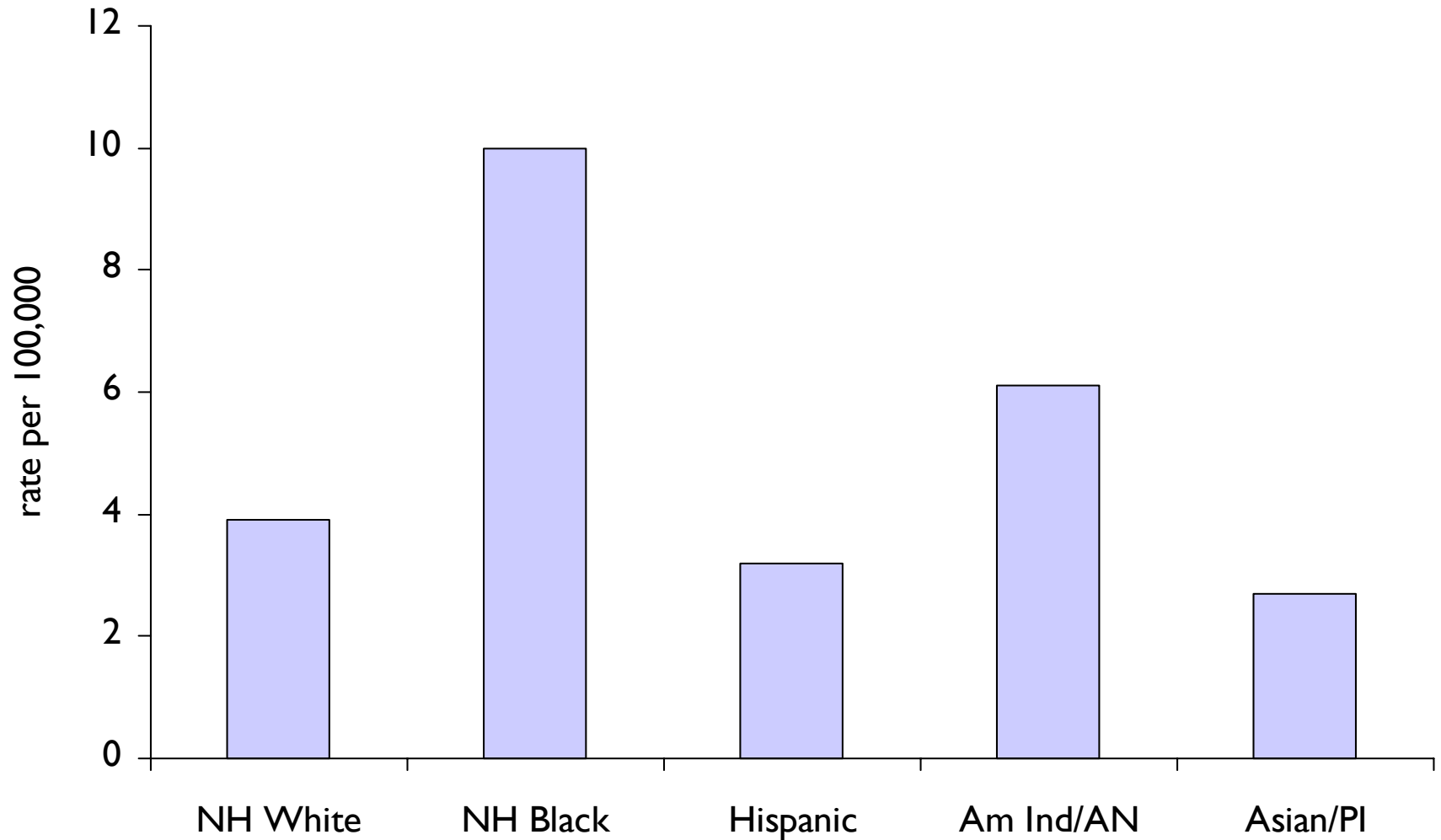


## UTILITARIAN VIEW



# Measuring Disparity Across Multiple Groups

## Do we care whose health improves?



# The Index of Disparity

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

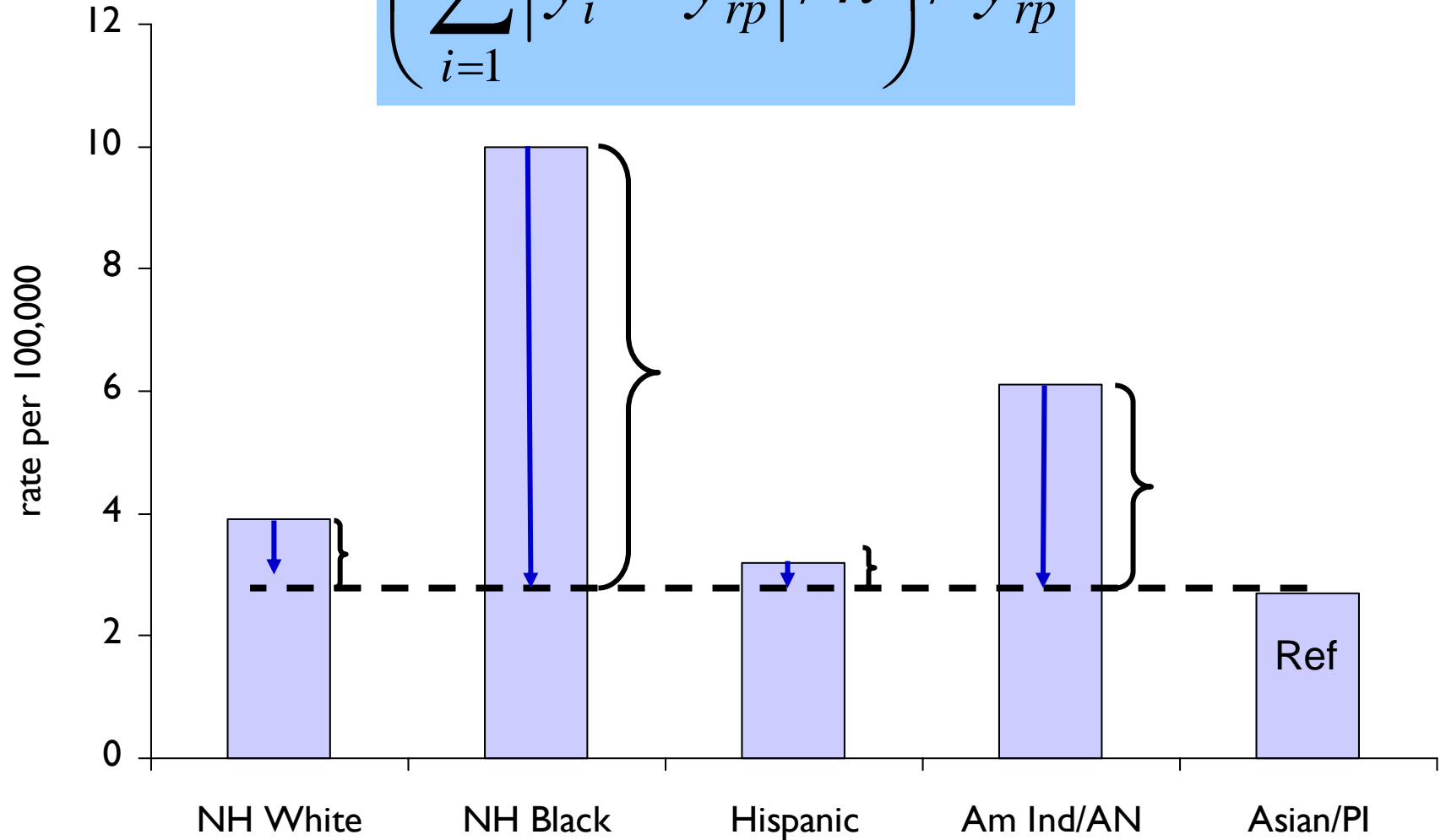
Formula:

$$\left( \sum_{i=1}^n |y_i - y_{rp}| / n \right) / y_{rp}$$

Where  $y_i$  is the rate in group  $i$ ,  $y_{rp}$  is the rate for the reference point, and  $n$  is the number of groups, or the number of groups minus 1 if one of the groups is the reference point

# Index of Disparity

$$\left( \sum_{i=1}^n |y_i - y_{rp}| / n \right) / y_{rp}$$



## Index of Disparity

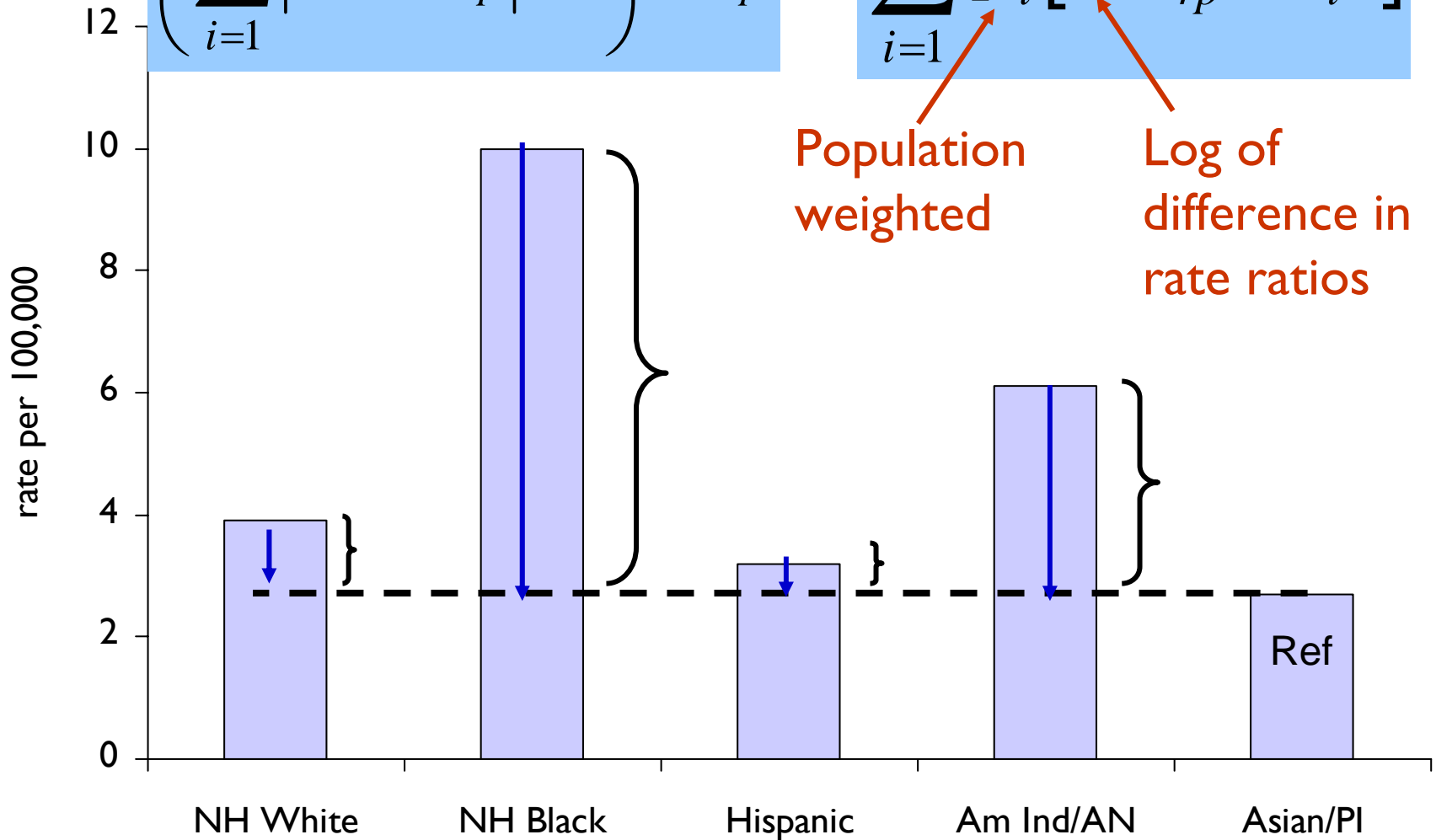
$$\left( \sum_{i=1}^n |y_i - y_{rp}| / n \right) / y_{rp}$$

## Mean Log Deviation

$$\sum_{i=1}^n p_i \left[ \ln(r_{rp} - r_i) \right]$$

Population weighted

Log of difference in rate ratios

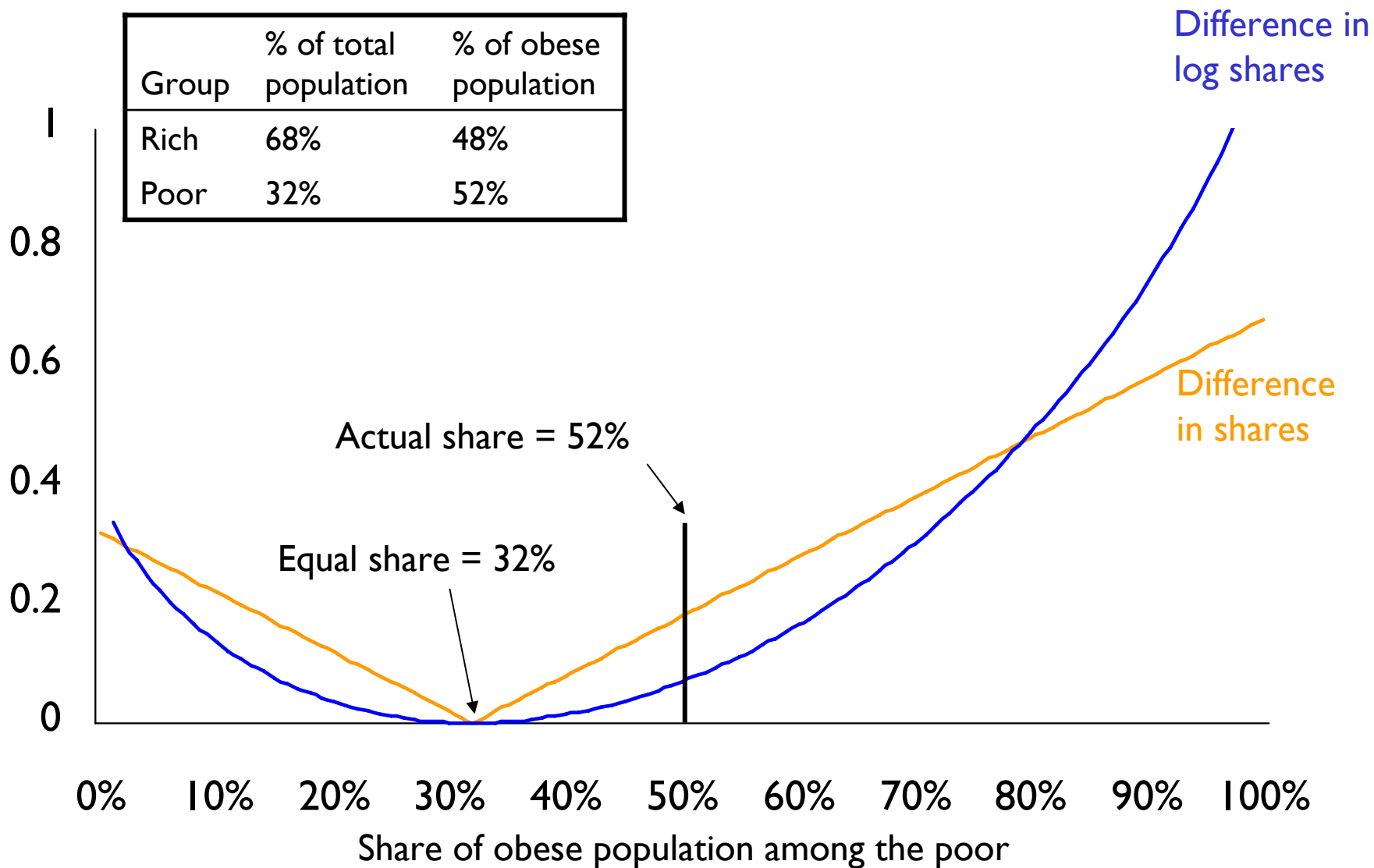




# Sensitivity to “Transfers”

Time I

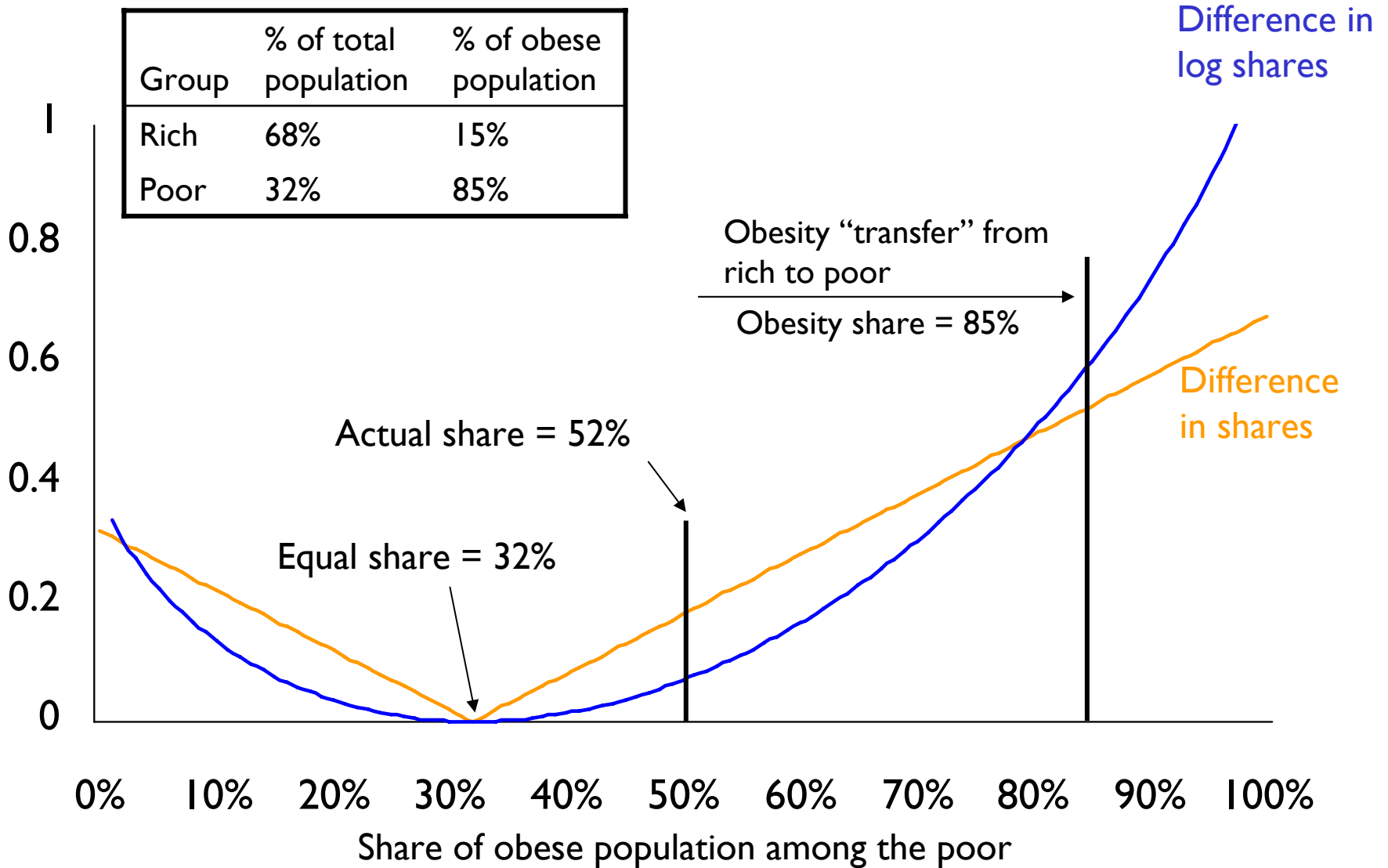
Group	% of total population	% of obese population
Rich	68%	48%
Poor	32%	52%



# Sensitivity to “Transfers”

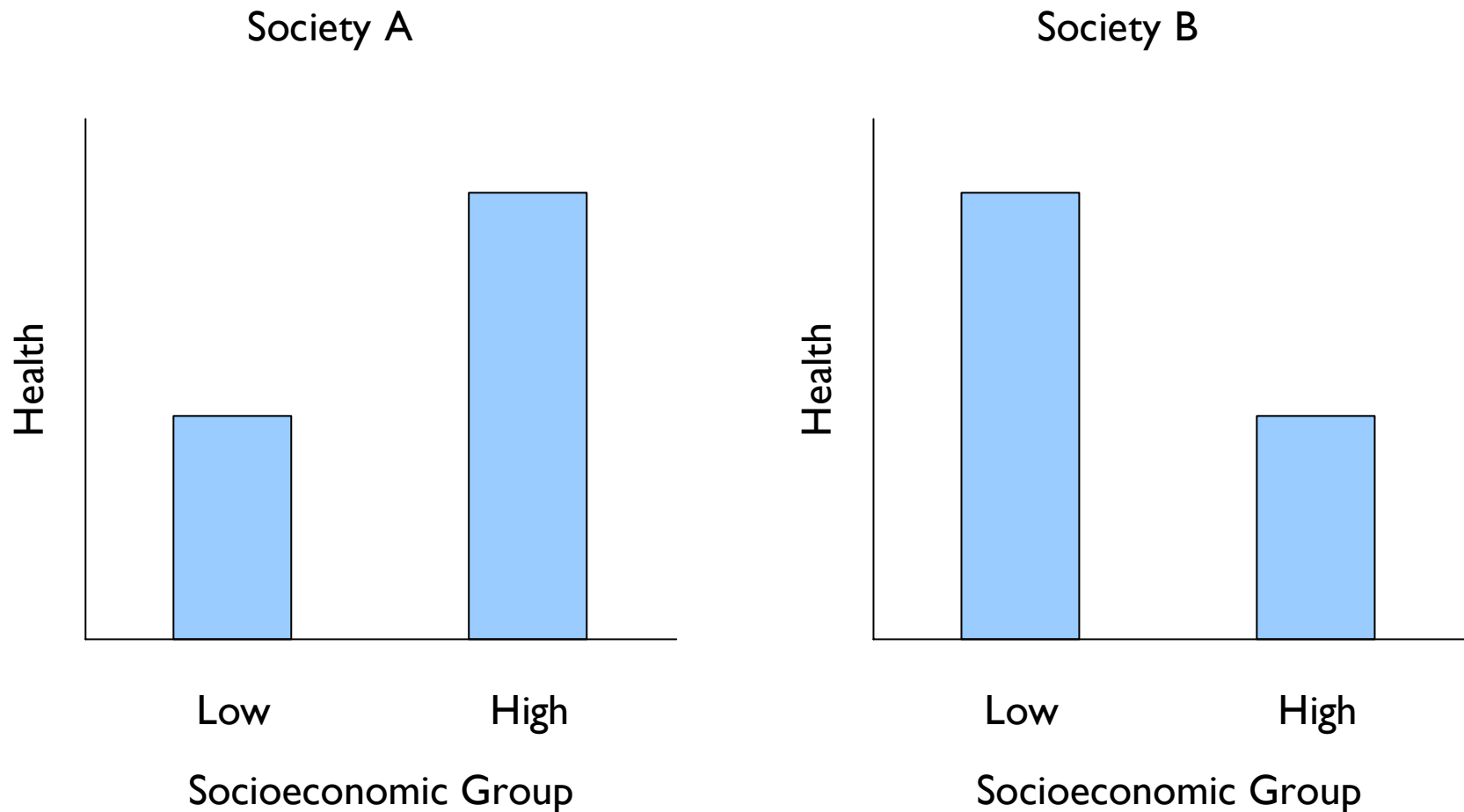
Time 2

Group	% of total population	% of obese population
Rich	68%	15%
Poor	32%	85%

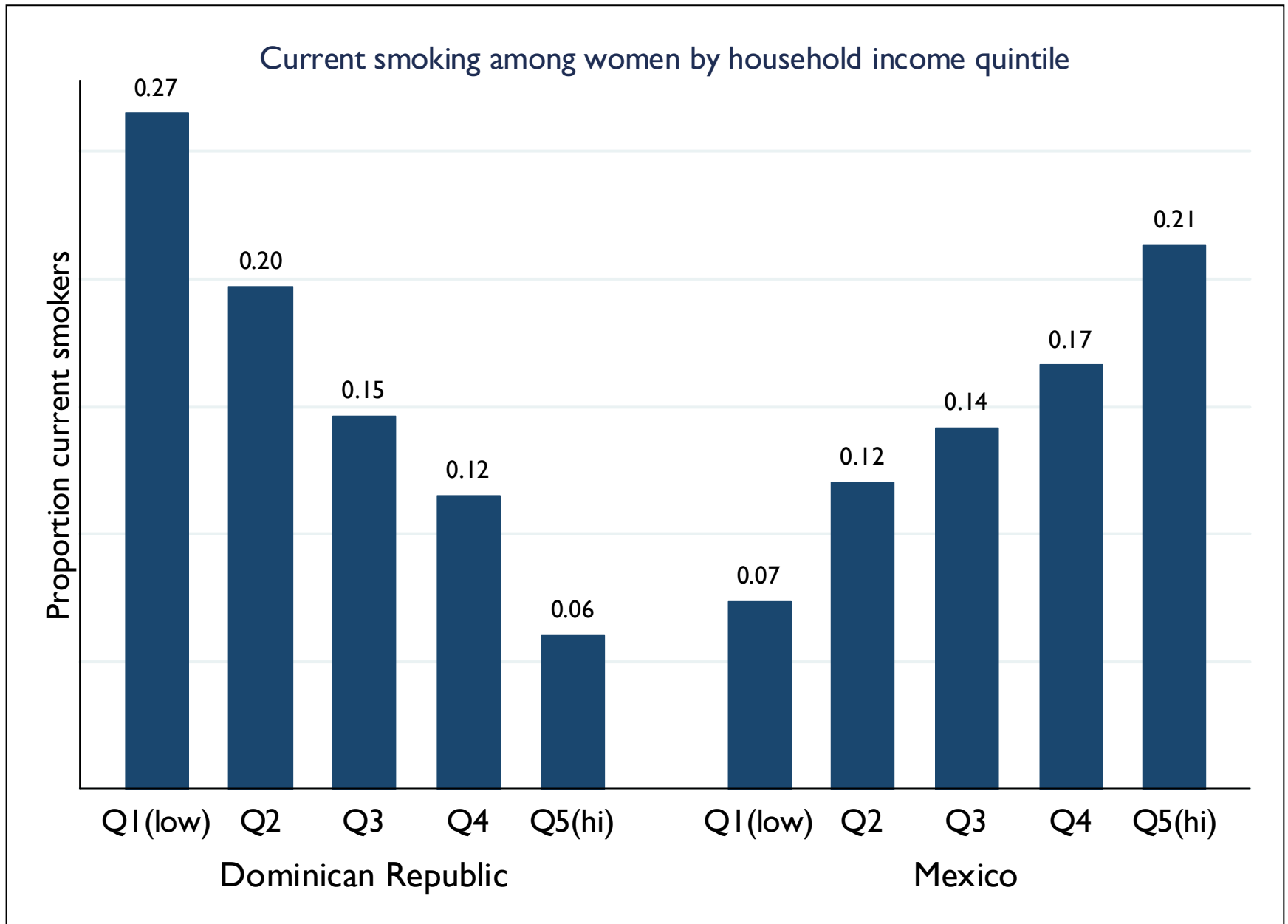


# Is the amount of inequality in A and B of equal concern?

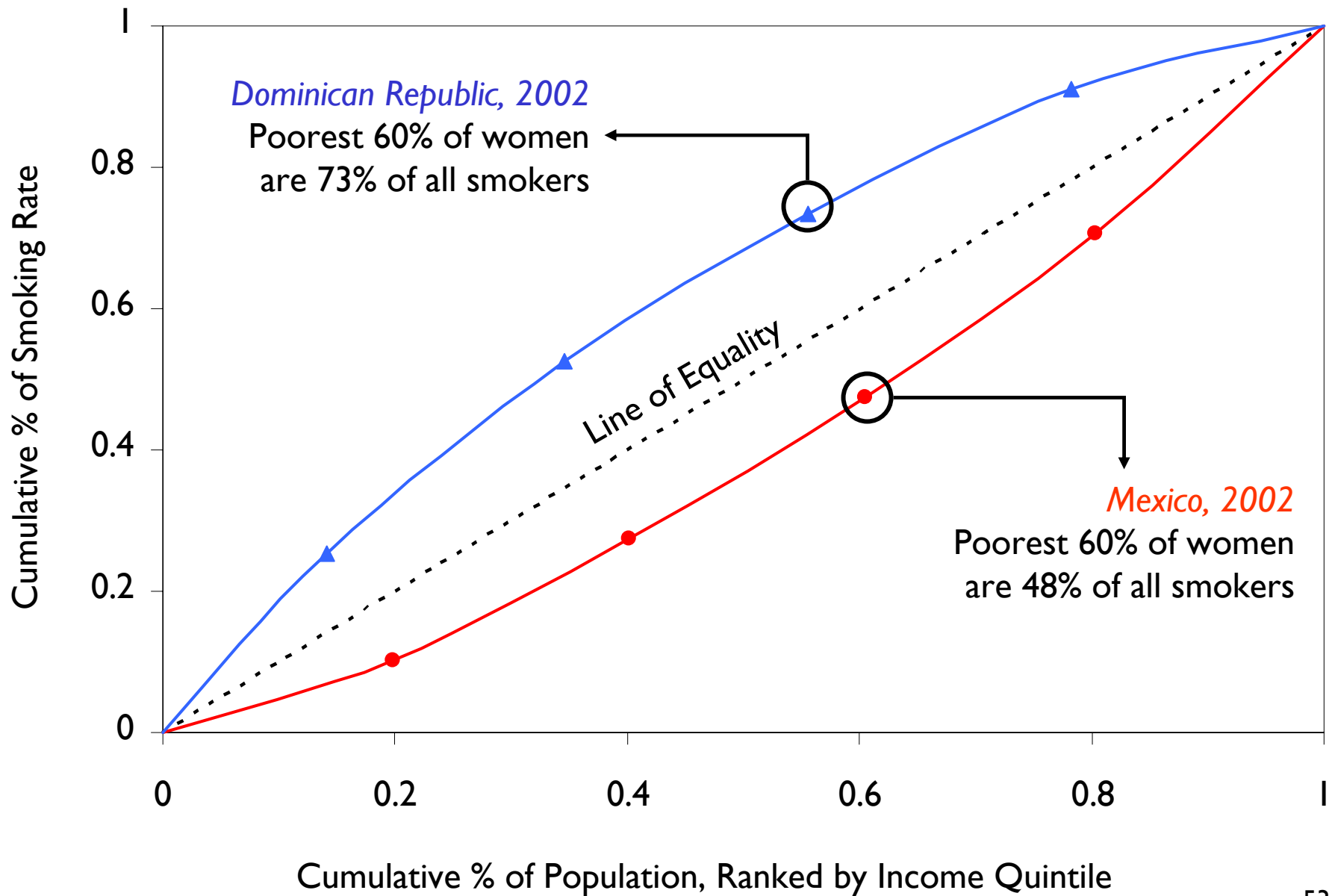
Is health inequality *larger* in A than in B?  
Is health inequality *worse* in A than in B?



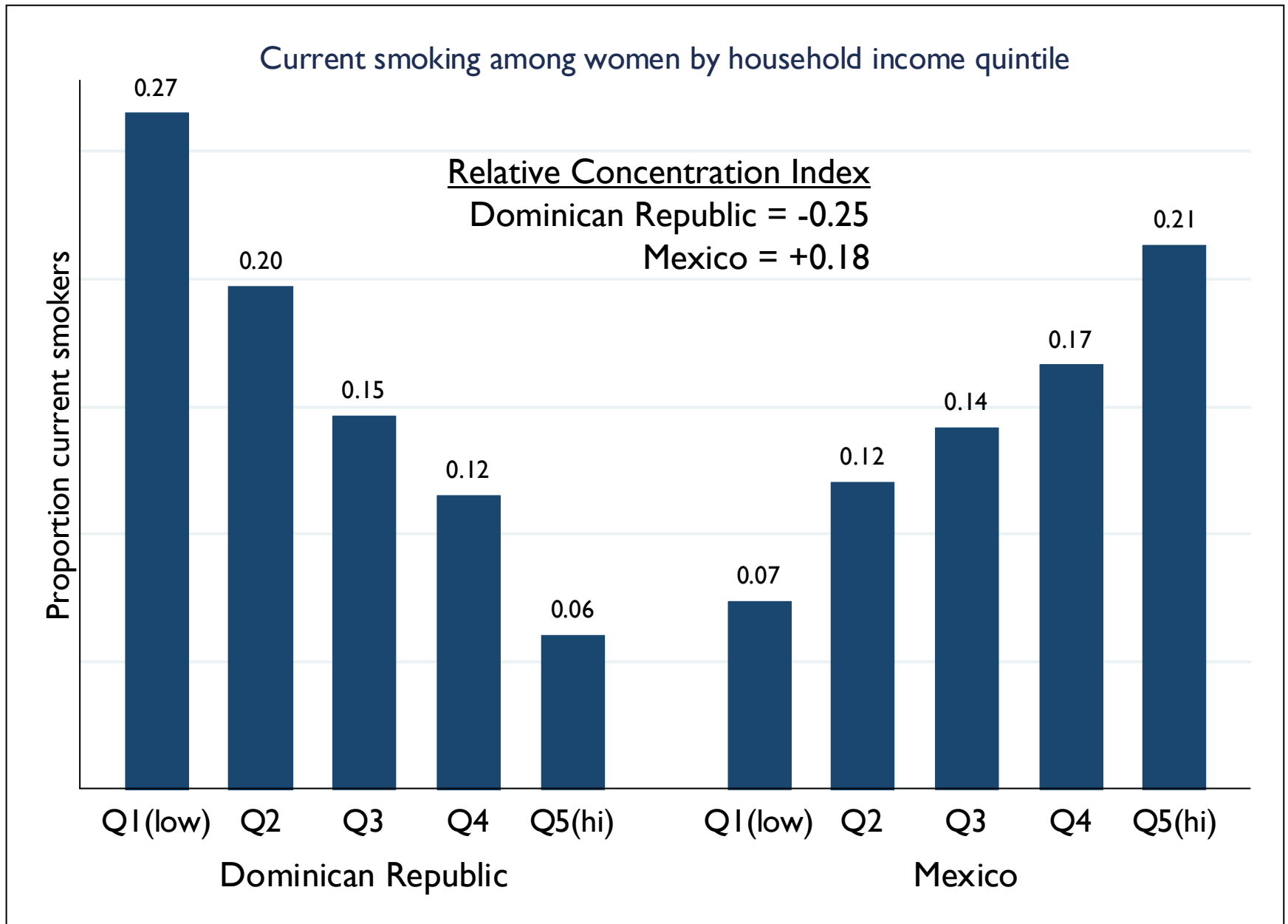
# How to summarize the amount of inequality?



# Health Concentration Curves



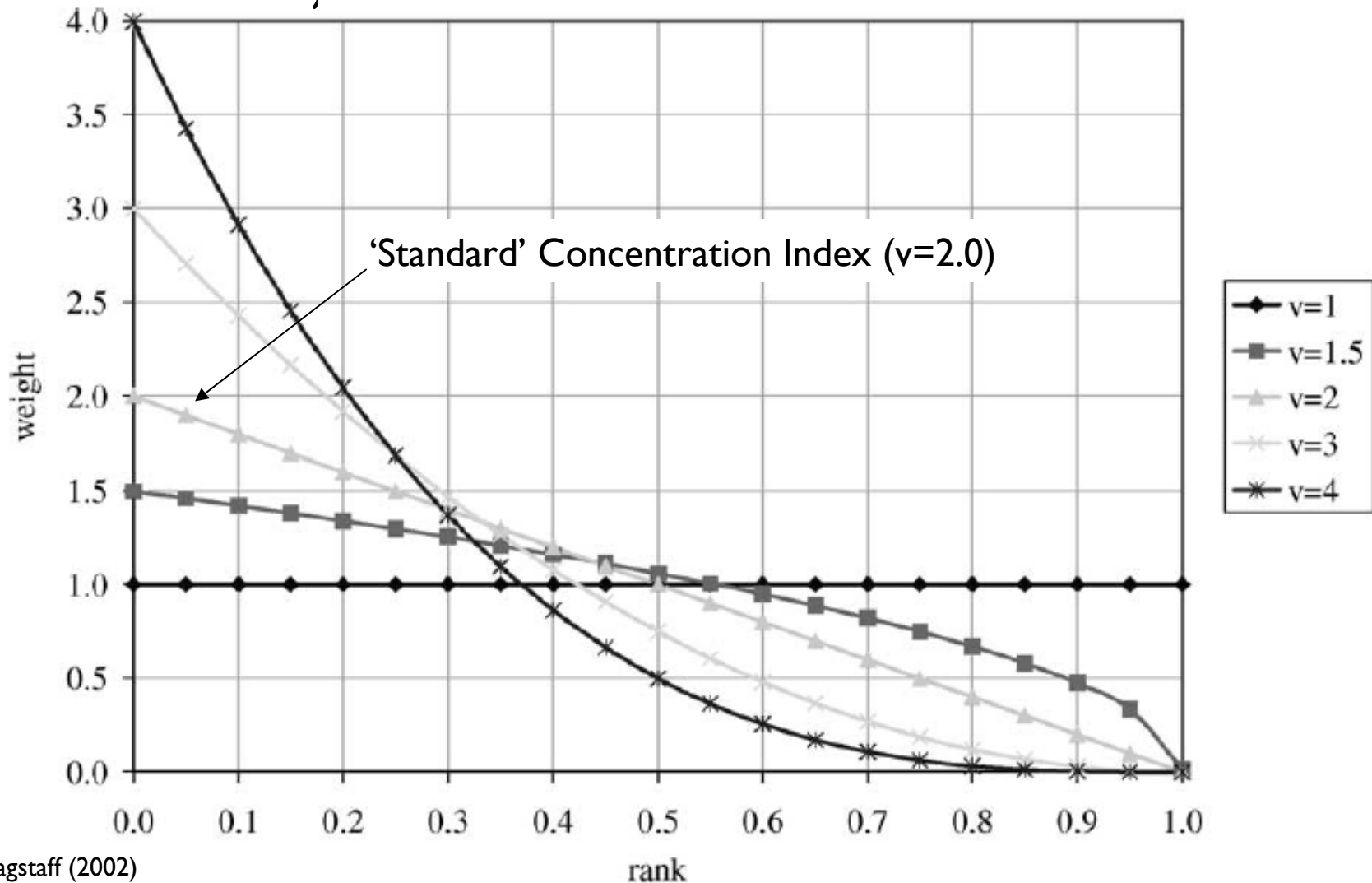
# Concentration Index gives the direction of the gradient?



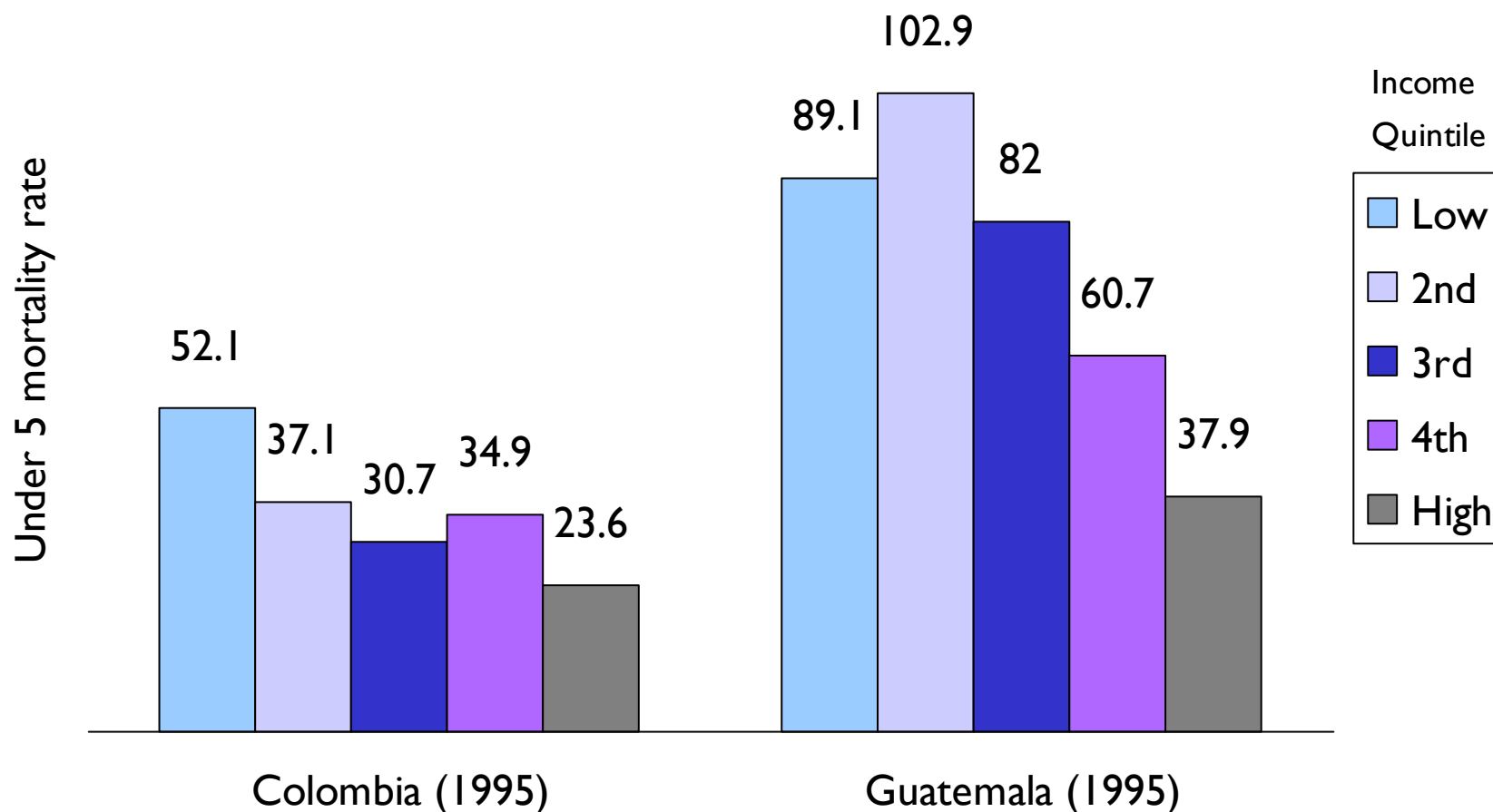
# Weighting scheme for the Concentration Index

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

'Aversion' to inequality parameter



# 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

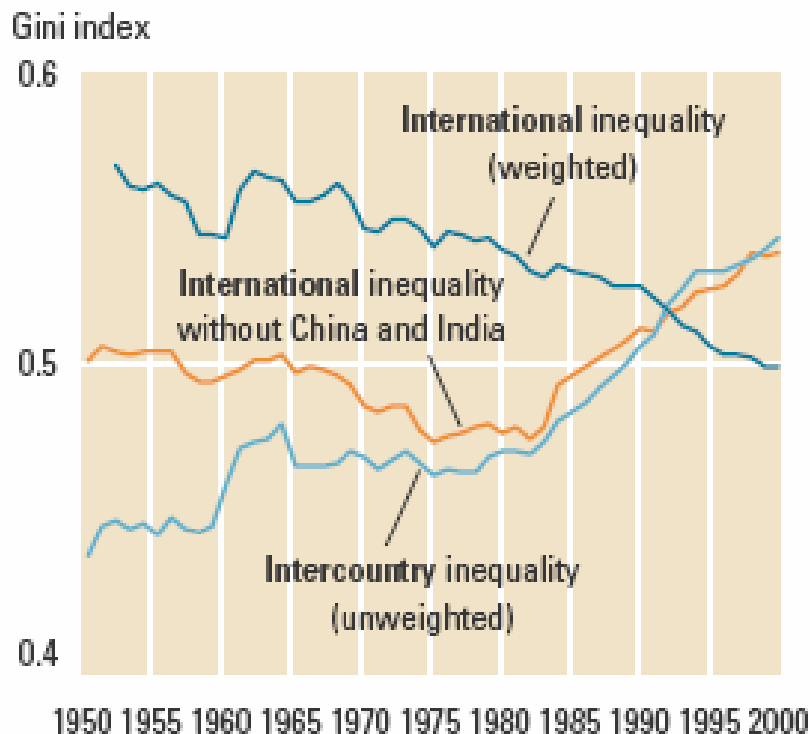


“[T]he implicit values in empirical work matter greatly to the conclusions drawn about the distributive justice of current globalization processes. And arguments can be made both ways.”

-Martin Ravallion, 2004  
World Bank Economist

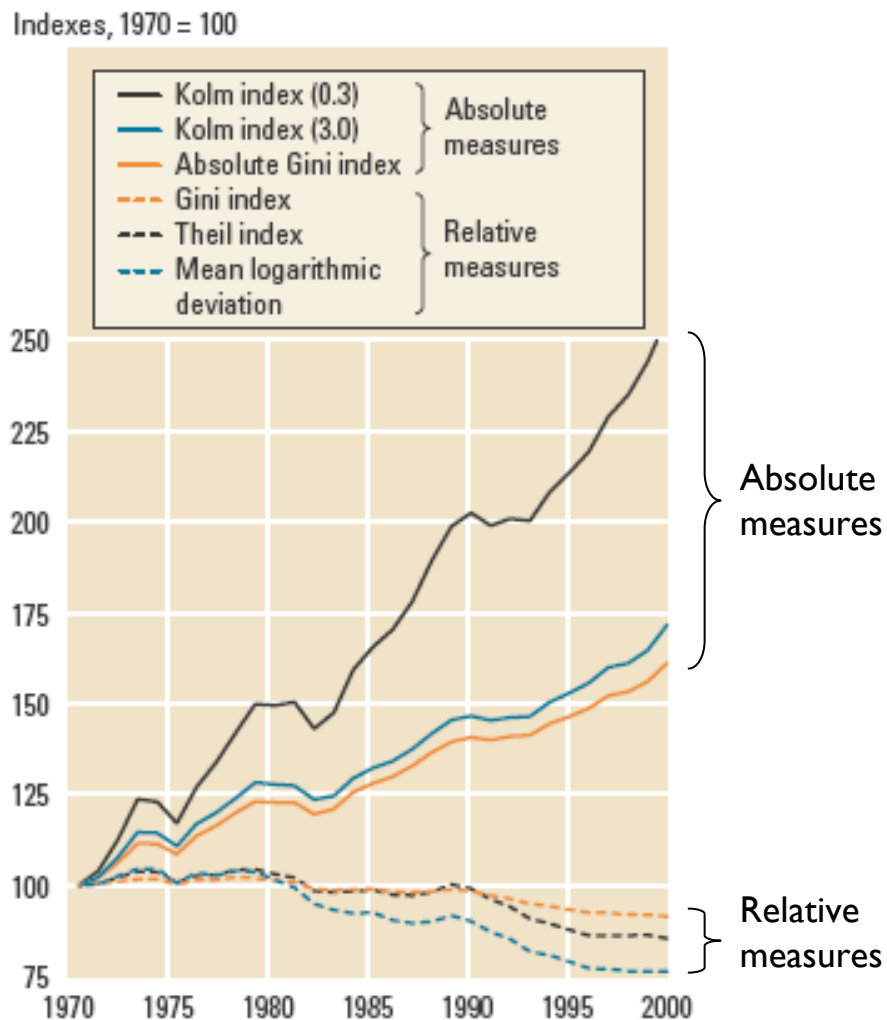
# Understanding inequality is not only challenging for health

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



Source: Milanovic (2005).

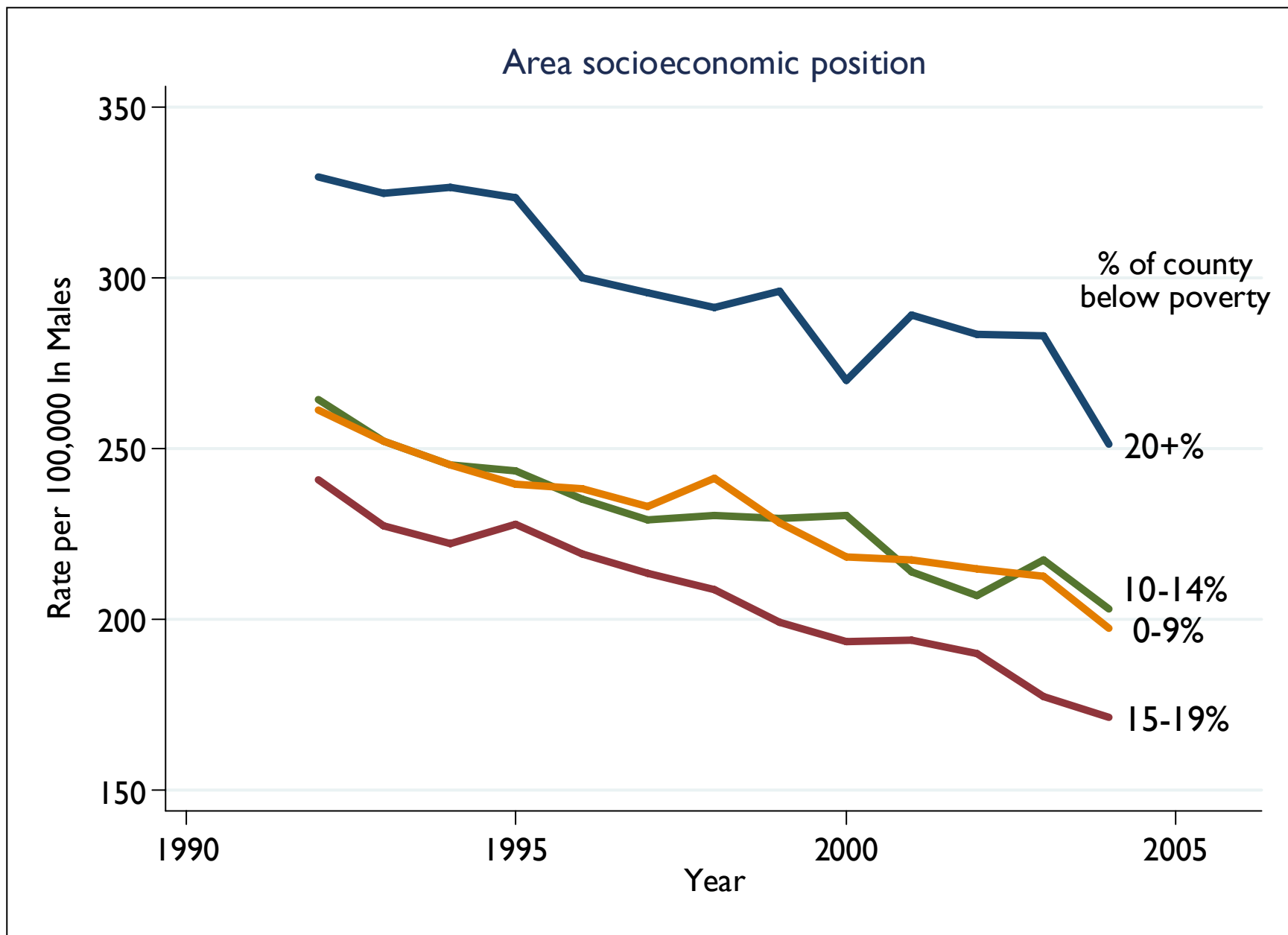
**Figure 3.8 Unlike relative inequality, absolute inequality has been steadily increasing**



Source: Atkinson and Brandolini (2004).

# An Empirical Evaluation of Multiple Measures of Health Inequality

# Trends in lung cancer incidence by area-socioeconomic position, US males 1992-2004



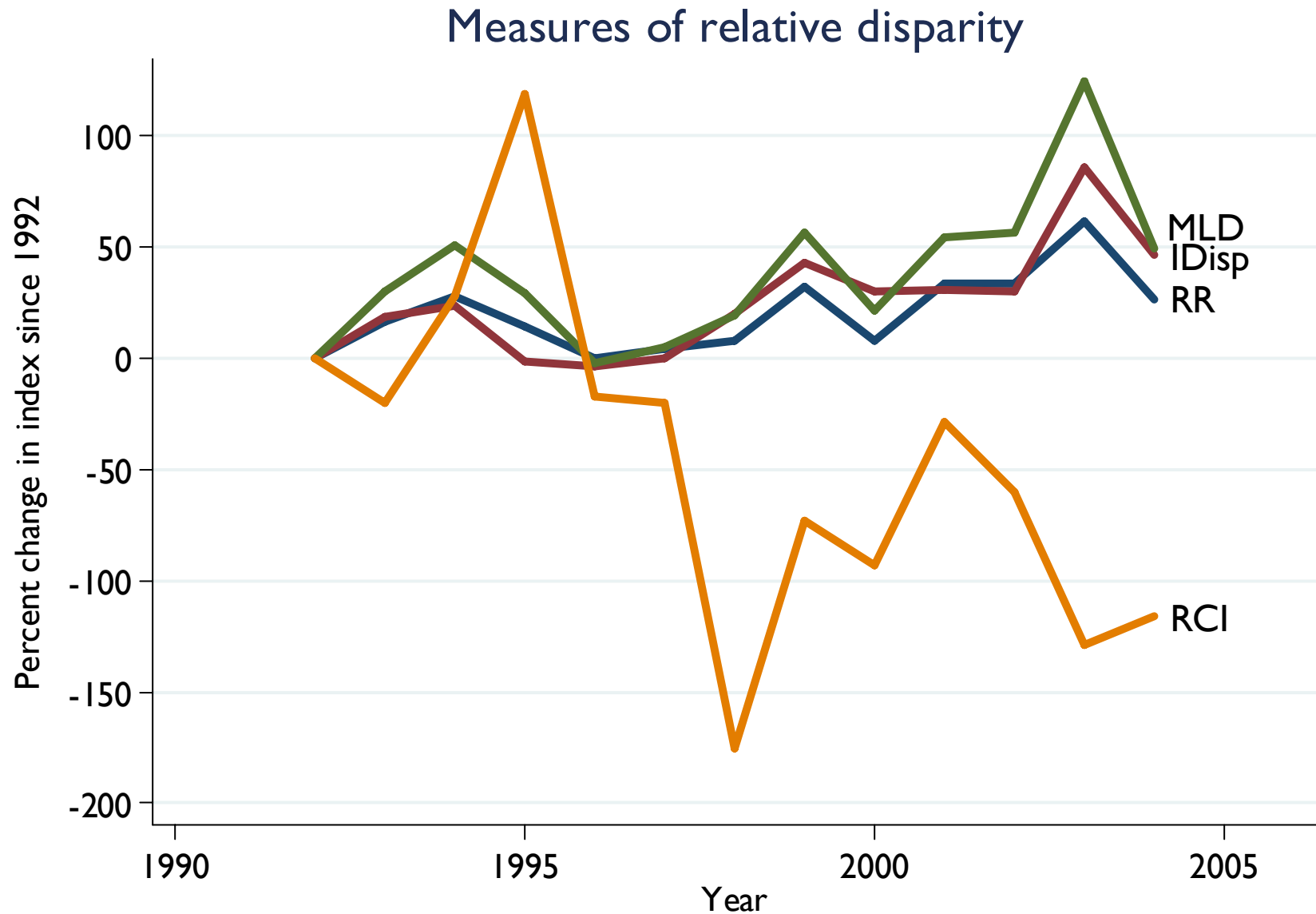
## Summary Table of Advantages and Disadvantages of Potential Health Disparity Measures

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

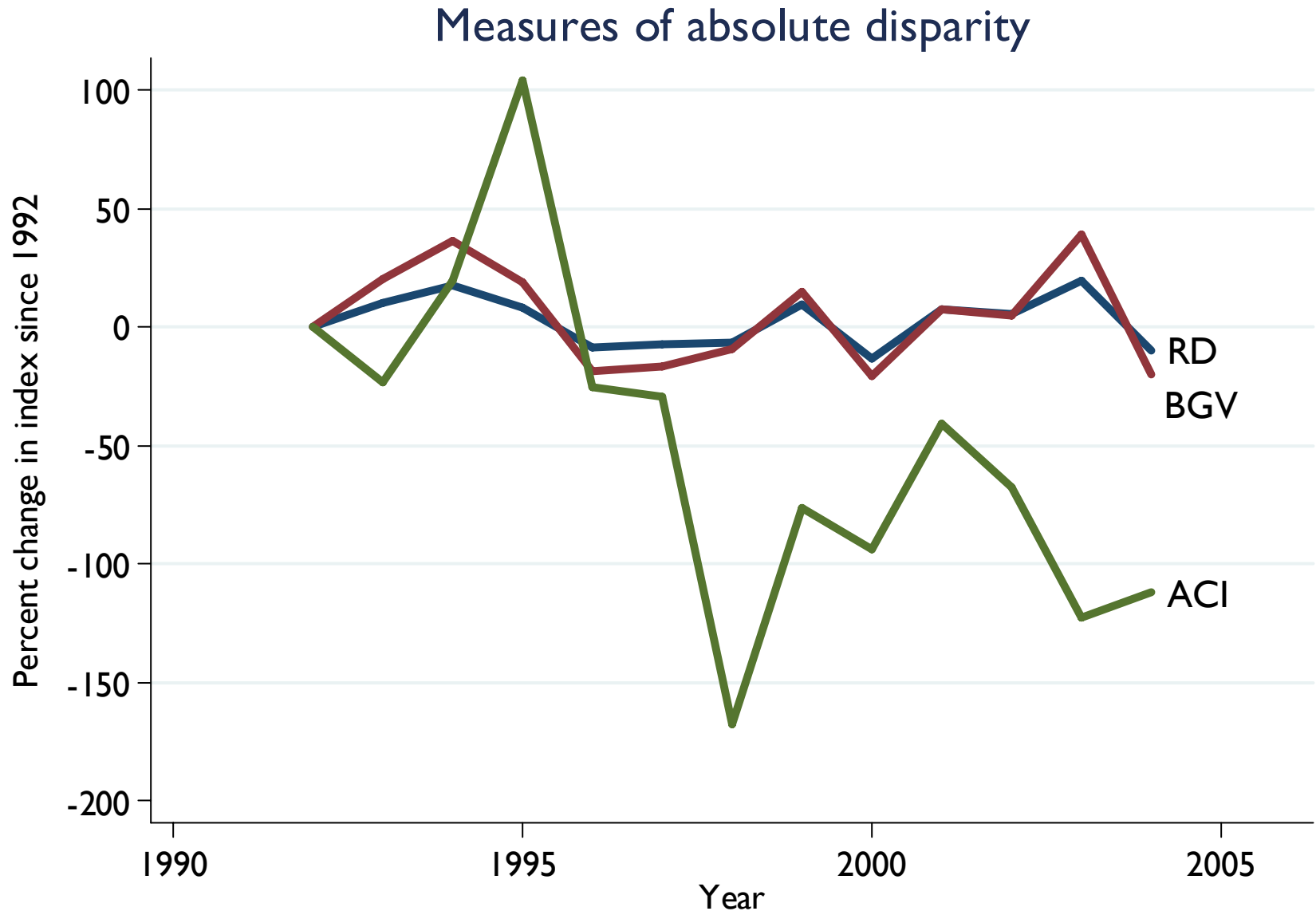
<sup>a</sup>All those better off.

<sup>b</sup>In the case of regression-with grouped data.

# Trends in area-socioeconomic inequalities in lung cancer incidence, US males 1992-2004



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# Selected Comparisons of Measures of Health Disparities Using Databases Containing Data Relevant to Healthy People 2010 Cancer-Related Goals

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“we 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 ”



# Conclusions

- Measures of health inequality are not value neutral
  - Scale of measurement
  - Weighting: how much and to whom?
- 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

“Even if we take inequality as an objective notion, our interest in its measurement must relate to our normative concern with it, and in judging the relative merits of different objective measures of inequality, it would indeed be relevant to introduce normative considerations. At the same time, even if we take a normative view of the measures of income inequality, this is not necessarily meant to catch the totality of our ethical evaluation.”

-Amartya Sen, *On Economic Inequality*, 1973

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Thank you

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