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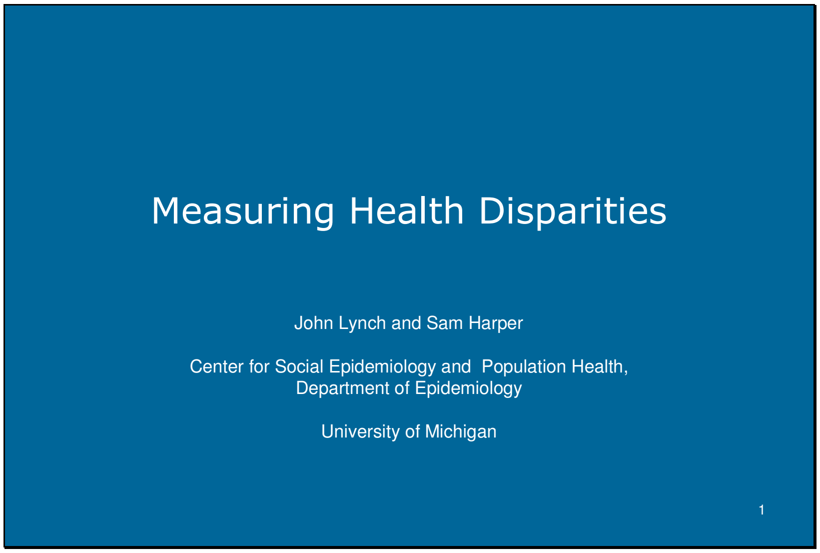
University of Michigan

Welcome



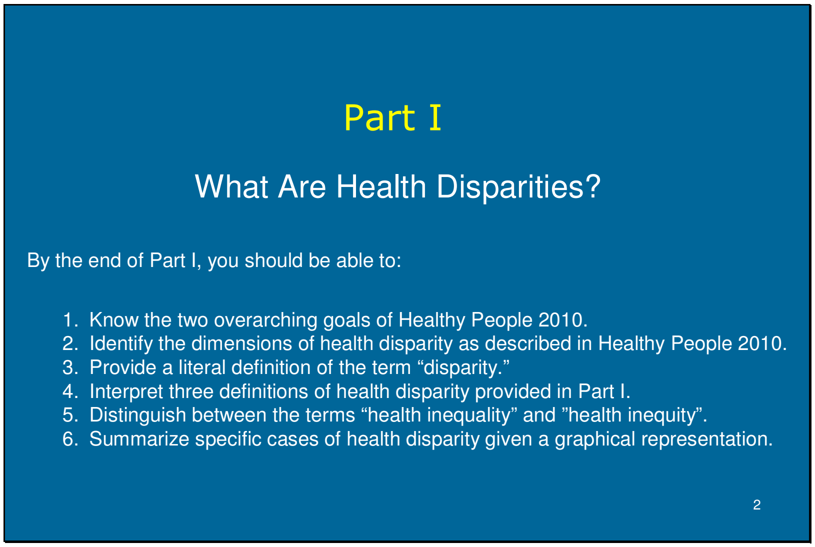
This CD-ROM addresses some conceptual and methodological issues in measuring health disparities. We will begin by examining some of the language used to discuss health disparities, to come to a common understanding of the ways different terms are used. Next, we will discuss some of the issues that arise when choosing a measurement strategy to assess the extent of health disparity, and then we will demonstrate some of the technical details of how to calculate different measures of health disparity.

One important objective for this CD is to highlight how different measures of health disparity can implicitly reflect different ethical perspectives and values as to what is important to measure about health disparities.

In this CD, we do not explore the causes of health disparity, although that is an important endeavor. Instead we focus on some basic issues for public health practice—how to understand, define, and measure health disparity.

We will walk through the steps of calculating common health disparity measures and describe the implications, strengths, and weaknesses of choosing one measure over another. In doing so, we hope to provide you with a durable tool that will be useful to you in your daily work. To effectively reduce health disparities in our communities, it is important that we are able to accurately measure the extent of health disparity.

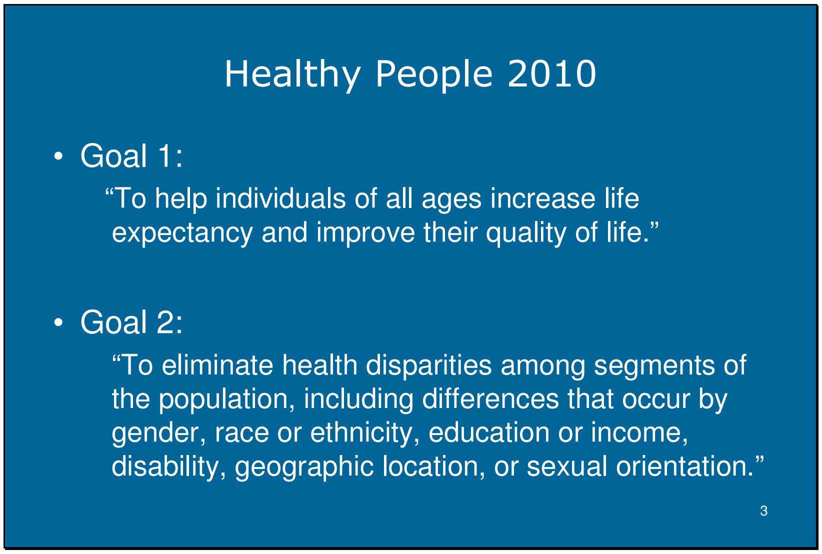
Part I – What are health disparities?



Part I: What are Health Disparities? By the end of Part I, you should be able to:

1. Know the two overarching goals of Healthy People 2010.
2. Identify the dimensions of health disparity as described in Healthy People 2010.
3. Provide a literal definition of the term “disparity.”
4. Interpret three definitions of health disparity provided in Part I.
5. Distinguish between the terms “health inequality” and ”health inequity,” and
6. Summarize specific cases of health disparity given a graphical representation.

Healthy People 2010



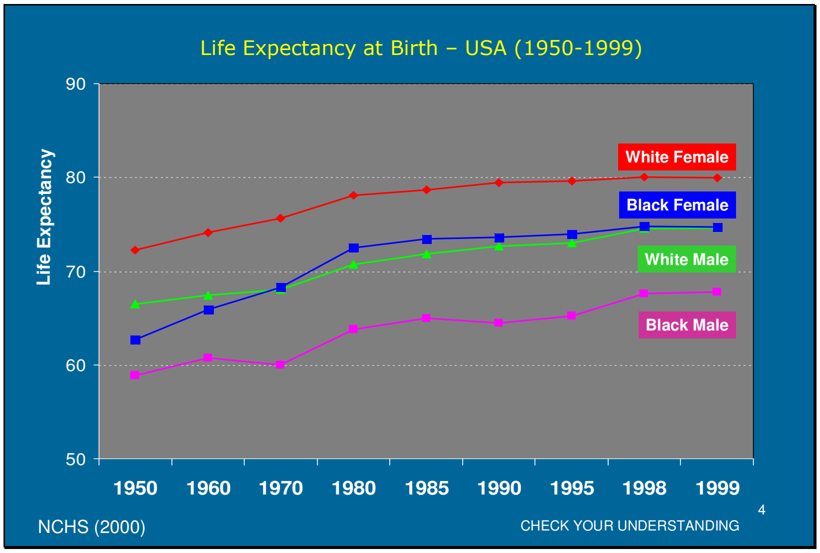
Healthy People 2010 (HP 2010) is a statement of objectives published by the United States Department of Health and Human Services. Recognized as one of the most important public health documents in the nation, it states the overarching national goals for public health to be achieved by the year 2010.

The first goal is *"to help individuals of all ages increase life expectancy and improve their quality of life."*

The second goal is *"to eliminate health disparities among segments of the population, including differences according to gender, race or ethnicity, education or income, disability, geographic location or sexual orientation."*

In other words, there would be no health disparity between or among groups within these social categories of gender, race/ethnicity, education, income, disability, geography or sexual orientation. So as you can see, health disparities are high on the public health agenda.

Examples of health disparities



How do we know a disparity exists?

How can disparity be depicted?

This graph illustrates the typical sort of data we use to document health disparities. In this graph we are looking at life expectancy over time, comparing life expectancy among white and black males and females since 1950.

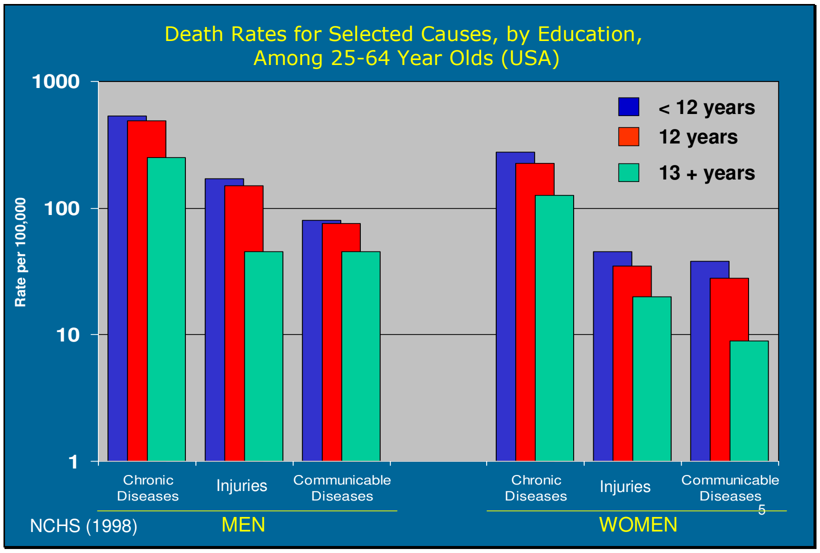
You can see life expectancy at birth has been increasing for all groups, but you can see differences in life expectancy by race and by gender.

These kinds of disparities motivate our concerns about how to reduce them. It offends our sense of justice that blacks have lower life expectancy than whites.

Check Your Understanding:

Between 1950 and 1999, which of the four groups consistently had the lowest life expectancy at birth?

Examples of health disparities



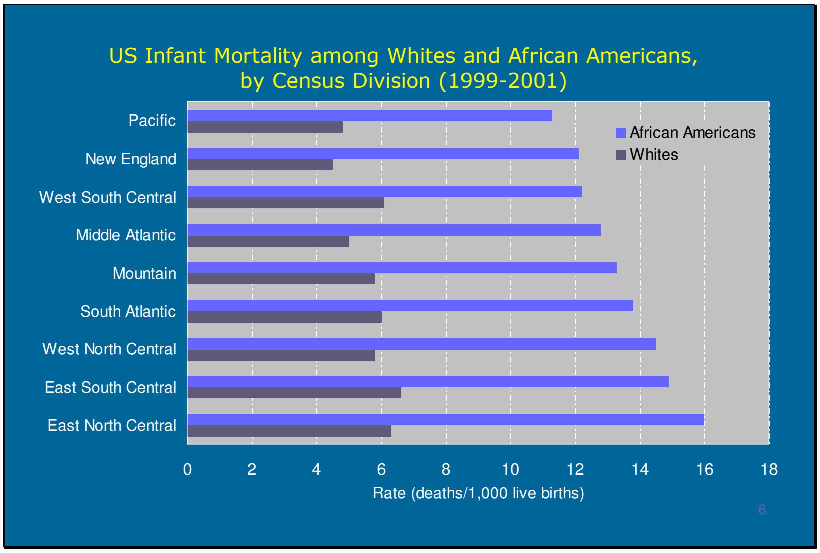
This is another example of the type of data used to illustrate health disparities. This time, it is not race/ethnic groups, but rather, social groups defined by their education. The different education groups are represented from least to most by the blue, red, and green bars.

You can also see different rates of mortality from different causes—chronic diseases, injuries, and communicable diseases—for men on the left and women on the right.

Notice the educational gradients such that those who have the least education (less than twelve years) have the highest death rates from chronic diseases, injuries, and communicable diseases.

Notice that the least educated men have the highest death rates.

Examples of health disparities



As another example, here we see infant mortality rates among African-Americans and whites across regions of the U.S.

First, let's look at the light blue bars. You can see that infant mortality for African-Americans varies substantially across the U.S., with approximately 11 deaths per 1,000 live births in the Pacific area, yet almost 16 per 1,000 in the East/North Central region.

What do you notice about the dark blue bars? Yes that's right. There is much less regional variation in infant mortality for white infants.
What you might also notice is that the infant mortality rate among whites is lower in *all* of those regions, but it does not follow the same pattern of difference.

In this graph, two categories of disparities are clear.

There is a black/white difference in infant mortality in the U.S.
Additionally, the difference varies by region of the country, so both a race/ethnic and geographic disparity exist.

Examples of health disparities

Recently, efforts to monitor health disparities have grown significantly. We have already talked about the Healthy People 2010 goals, but there are others worth noting.

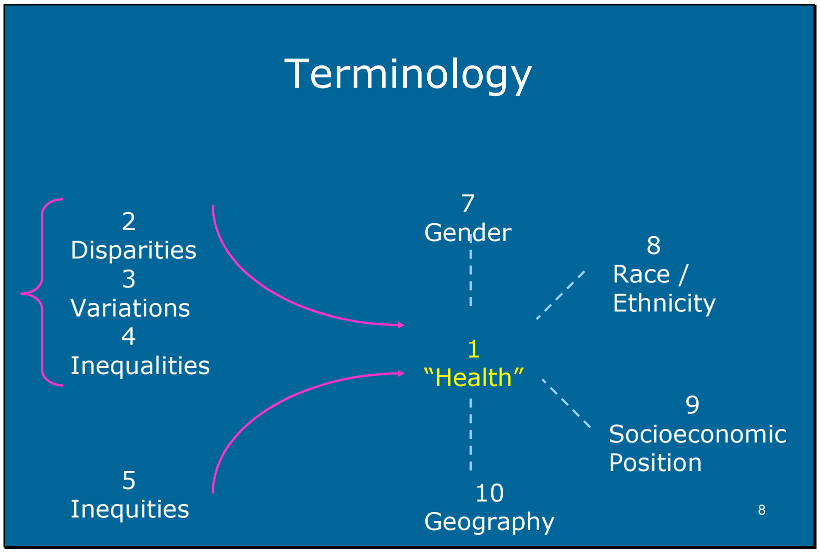
The National Center for Health Statistics is currently producing a handbook to measure health disparities.

There are also various initiatives across the National Institutes of Health. The National Cancer Institute, in particular, has a major initiative on health disparities.

The Health Resources and Services Administration, the Institute of Medicine, and many other bodies have produced documents and sponsored conferences and workshops focused on reducing or eliminating health disparities in the U.S.

In addition to these, there are many Healthy People 2010 efforts at the state level, such as Michigan's task force on health disparities. We have provided Internet links to these websites in the *Resources* section of this CD ROM.

The language of health disparity



The language of health disparities is varied, and different terms are used in different parts of the world.

In the United States we usually talk about "disparities."

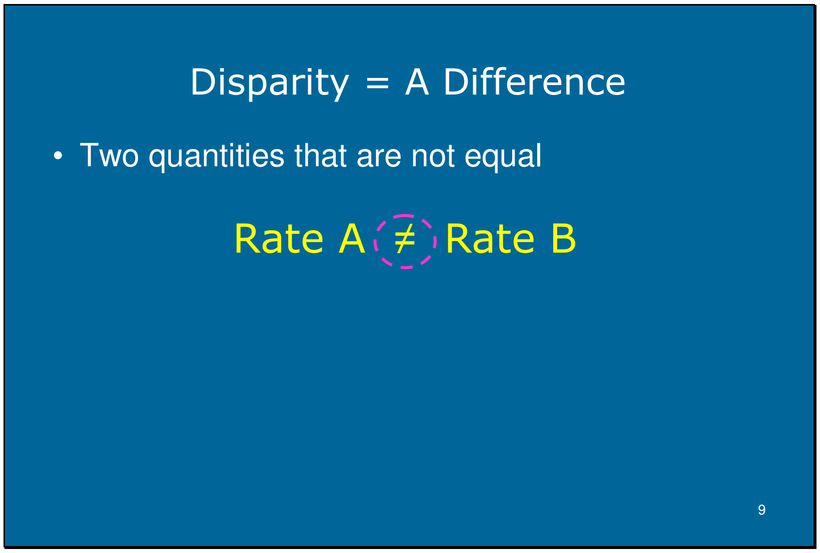
In England they sometimes use the word "variations"

Throughout Europe they talk about "inequalities" in health.

You will also see the term "inequities" being used; specifically, you will hear it in the phrase: "inequities in health."

We can think about disparities, variations and inequalities as being very similar terms; whereas, the term "inequity" implies something different. We'll explore that distinction in a moment. But for now, you can think about inequalities, variations, or disparities or inequities in health according to gender, race/ethnicity, socioeconomic position, and geography. Note that these are some of the social categories that are reflected in HP 2010 Goal #2.
Now let's consider the word "disparity."

The language of health disparity

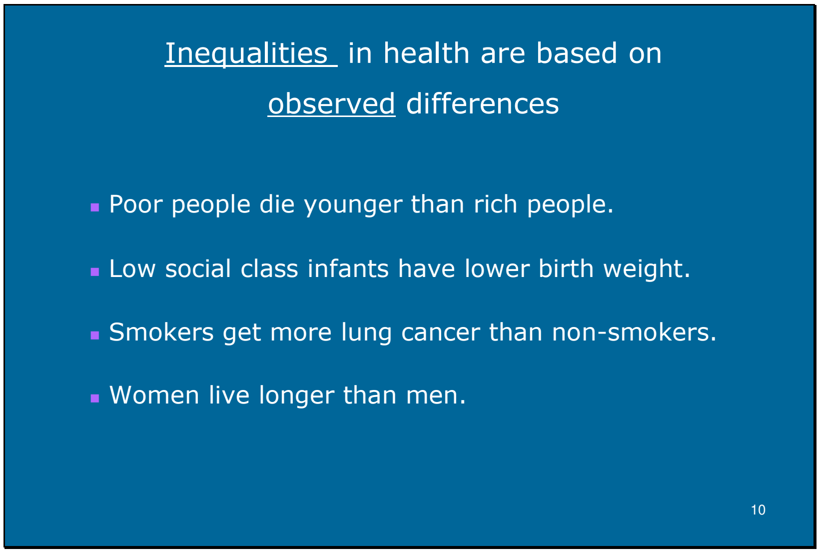


The dictionary defines ***disparity*** as ***a difference***, which means two quantities are not equal. We have a mathematical symbol for that.

It is very easy to decide when two things are not equal. We can easily say that a rate in Group A is not the same as—or is not *equal to*—a rate in Group B.

This provides a workable definition of health disparity that we will use from this point forward. According to this simple definition, a disparity is just a difference. In this sense, the word *disparity* has the same meaning as the word *inequality*—two quantities are not equal.

The language of health disparity



Now that we've defined disparity, let's move on to the next step—understanding what the inequalities in health are based upon. Inequalities in health are based on ***observed differences*** or ***disparities*** in health.

For example to conclude whether "poor people die younger than rich people," we simply compare death rates in the two groups and we find out whether they are the same.

If they are different, then an inequality exists—a disparity exists.

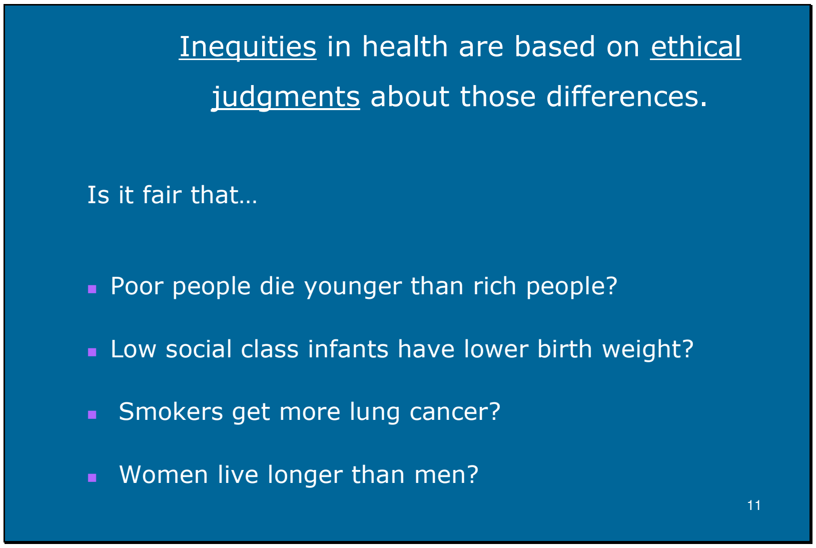
Infants born into a low social class have lower birth weight.

Smokers get more lung cancer than non-smokers.

Women live longer than men.

These statements can be made from simple, unambiguous observations of the relevant data.

The language of health disparity

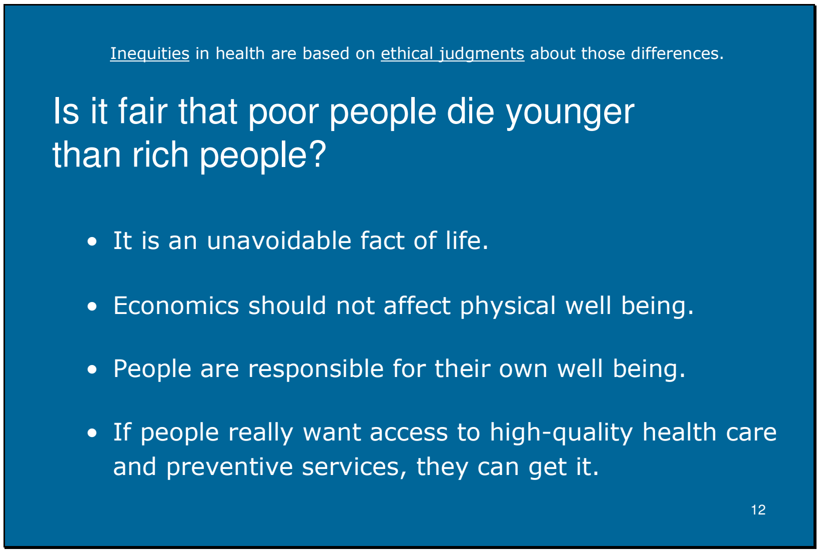


When we begin to discuss inequities in health, things get a little more complicated. Deciding if something is an "inequity" means we have to make an ethical judgment about the fairness of the health differences we observe.

This extends beyond recognizing that things are different. You need to get to the point of thinking, "It is true poor people die younger than rich people, but should they – is it fair? Should infants born into a low social class have a lower birth weight? Should smokers get more lung cancer? Should women live longer than men?"

Here is a question for you to think about:
Are all health *inequalities*, also health *inequities*? In other words, are all the observed health differences among social groups unfair? Are health inequalities always health inequities?

The language of health disparity



In this interactive exercise, you have an opportunity to decide which inequalities may also be inequities. Decide and indicate your level of agreement with the following statements by sliding the tear-drops to the right or left with your mouse. The bar along the top measures the sum of your responses suggesting an answer to the question “Is it fair that poor people die younger than rich people?” When you have finished, you will have the chance to think about the answer to several other, similar questions.

The language of health disparity

Inequities in health are based on ethical judgments about those differences.

Is it fair that low social class infants have lower birth weight?

- Preventing lower birth weight among low social class infants should be a top priority for society.
- Low birth weight is an indicator of irresponsible parenting.
- Babies are innocent. Their health should not be determined by the social class of their parents.
- It would cost society too much to prevent all undesirable birth outcomes.

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The language of health disparity

Inequities in health are based on ethical judgments about those differences.

Is it fair that smokers get more lung cancer?

- Smoking is a choice.
- Smokers are victims of the tobacco industry.
- If people were not so stressed, they would not smoke as much.
- Smokers understand the health risks of smoking, and should be held accountable for their behavior.

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The language of health disparity

Inequities in health are based on ethical judgments about those differences.

On a lighter note, Is it fair that women live longer than men?

- Men could really use the extra life years to mature.
- Women deserve the extra time for all the barriers they endure in reaching their full potential.
- Men deserve to live longer for the emotional haranguing they endure.
- Tips in Cosmo and Glamour magazines add years to women’s lives.

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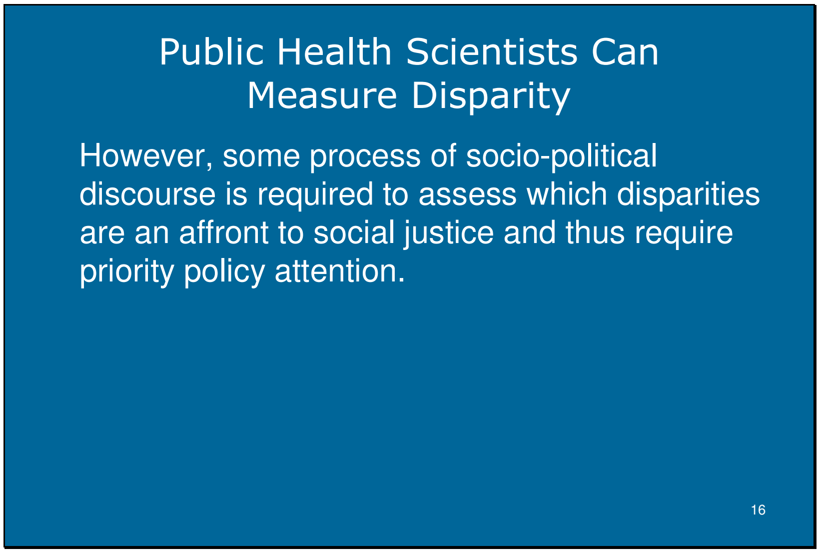
The language of health disparity

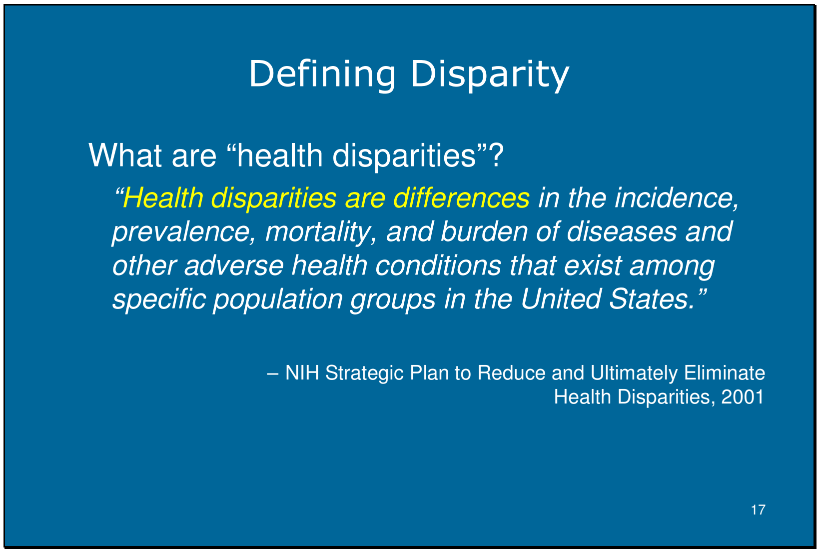


Public health scientists can measure differences or inequalities or disparities in health. We can measure differences in health status between groups. However, as you have just seen, we require some process of social and political discourse to assess which disparities—which differences—are unjust and intolerable in our society. Which disparities are unfair and thus require priority policy attention?

As you will see, one of the challenges in addressing health disparities lies in moving beyond the drawing board. Different endeavors to reduce health disparities have frameworks and approaches that complicate interpretation.

Next we will discuss some examples of how the conceptualization of health disparity differs.

The language of health disparity

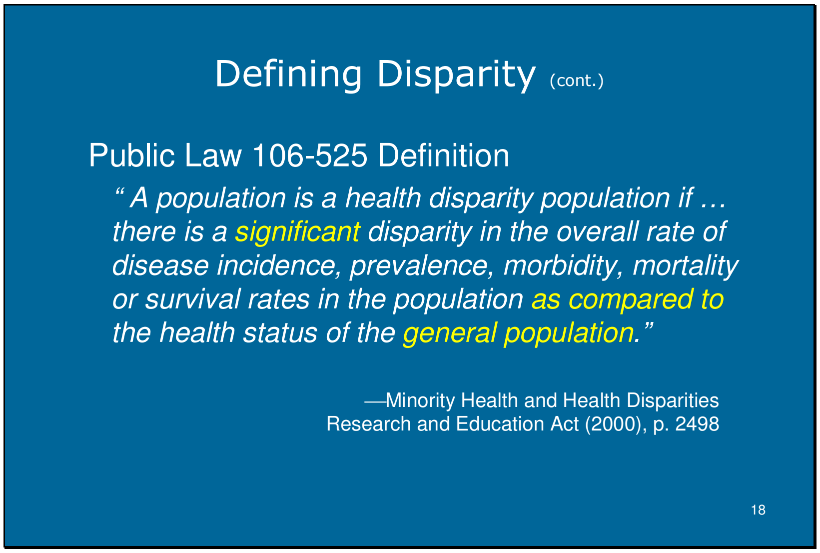


…the National Institutes of Health (NIH) Strategic Plan to Reduce and Ultimately Eliminate Health Disparities—the plan that guides NIH research—defines health disparities in this way:

It says, "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."

Note that this definition is very similar to the one we agreed upon earlier—a disparity is a difference.

The language of health disparity

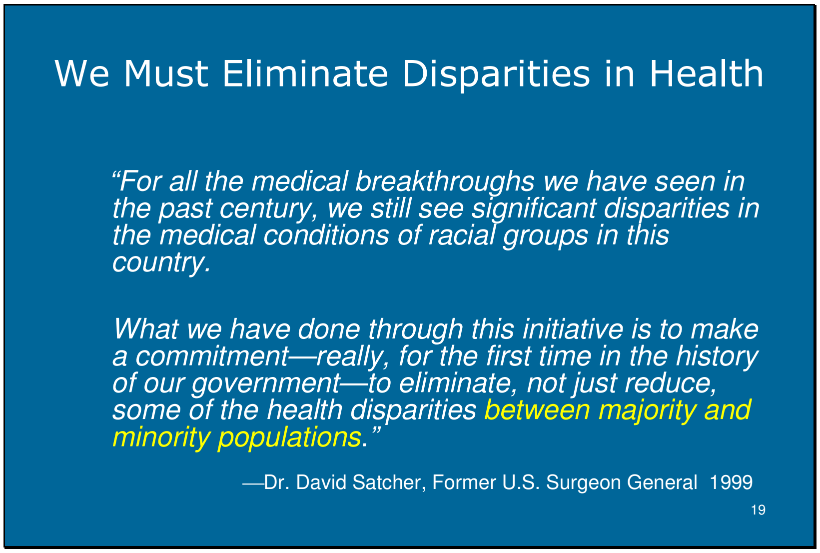


By contrast, the Act that actually set up some of these research endeavors—the Minority Health and Health Disparities Research and Education Act of 2000—states:

"A population is a health disparity population if there is a significant disparity in the overall rate of disease incidence, prevalence, morbidity, mortality, or survival rates in the population as compared to the health status of the general population."

Comparing the two definitions for disparity, you may note that the first one just says that ***disparity is a difference,*** without indicating from where the difference should be measured. The second definition, on the other hand, says that a disparity has to be ***significant*** when ***compared*** to the general population.

The language of health disparity



Former U.S. Surgeon General, David Satcher, has written about the importance of disparities, and he offers a third perspective. He argues that we must **eliminate** disparities in health.

The central part of his statement is the aim "to eliminate, not just reduce, some of the health disparities between majority and minority populations."

How does this statement differ from the earlier definitions? Dr. Satcher explains that the disparity of concern exists between **the majority** and the **minority populations**. The previous definition we saw stated that differences should be compared to the **general population**, not to the majority population.

As you can see, differences in language reflect different understandings about 1) which elements are most important in assessing the extent of health disparity and 2) which groups are of concern.

How do we summarize health disparity?

HEALTH DISPARITIES OF CERTAIN CONDITIONS IN SELECTED POPULATIONS					
	INDEX IN SELECTED POPULATIONS				
HEALTH CONDITION AND SPECIFIC EXAMPLE	WHITE	AFRICAN AMERICAN	HISPANIC or LATINO	ASIAN or PACIFIC ISLANDER	AMERICAN INDIAN or ALASKA NATIVE
Infant mortality rate per 1000 live births[1]	5.9	13.9	5.8	5.1	9.1
Cancer mortality rate per 100,000[2]	199.3	255.1	123.7	124.2	129.3
Lung Cancer - age adjusted death rate[3]	38.3	46.0	13.6	17.2	25.1
Female Breast Cancer age adjusted death rate	18.7	26.1	12.1	9.8	10.3
Coronary Heart Disease mortality rate per 100,000[2]	206	252	145	123	126
Stroke mortality rate per 100,000	58	80	39	51	38
Diabetes diagnosed rate per 100,000	36	74	61	DSU	DSU
End-Stage Renal Disease rate per million[2]	218	873	DNA	344	589
AIDS – diagnosed rate per 100,000[4]					
Female	2	48	13	1	5
Male	14	109	43	9	19

NIH Strategic Plan 2003

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This data table is from the NIH strategic plan to reduce health disparities. To review this table, read across the rows, as we've highlighted here.

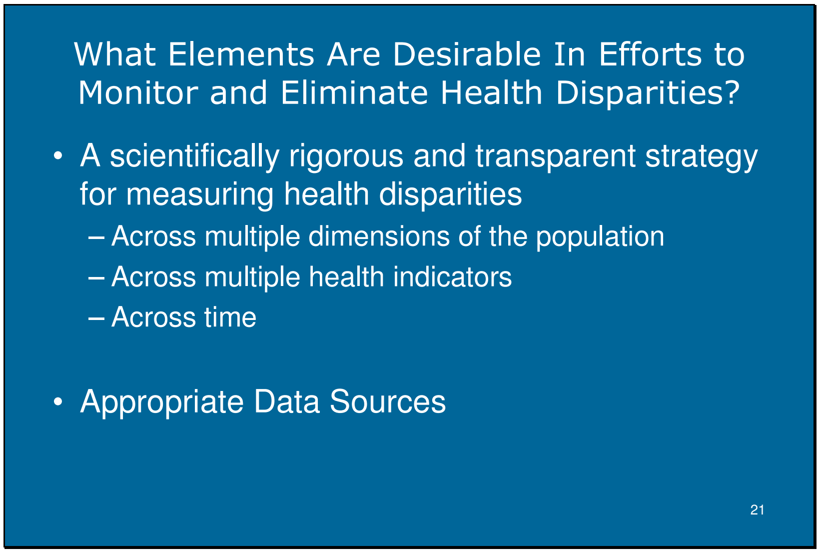
For example, when assessing the impact of health disparities on the infant mortality rate, we can see that the rates differ in each of the selected populations. Whites experience an infant mortality rate that is 5.9 per 1000, while African-Americans experience a rate that is 13.9 per 1,000, and so on. From this information we can infer that there are differences, or disparities, in the rates across selected populations, but it is hard to know the size of these disparities in total.

You may also want to compare the size of the disparity in infant mortality to the size of the disparity in cancer mortality or the female breast cancer death rate. How should we do this when they are measured on different scales? In judging these health disparities, we are expected to draw our conclusions by simply eyeballing these numbers. There is no assessment here of the size of the infant mortality disparity compared to the size of the disparity for cancer mortality or breast cancer. The only conclusions we can deduce are based on inspection across the rows and noticing that these differences exist.

To allocate resources and plan programs to monitor and eliminate health disparities, we may want to know the size of the disparity to be addressed and how it compares across different types of health indicators.

The rest of this CD-ROM describes methods for measuring health disparities more systematically.

How do we summarize health disparity?

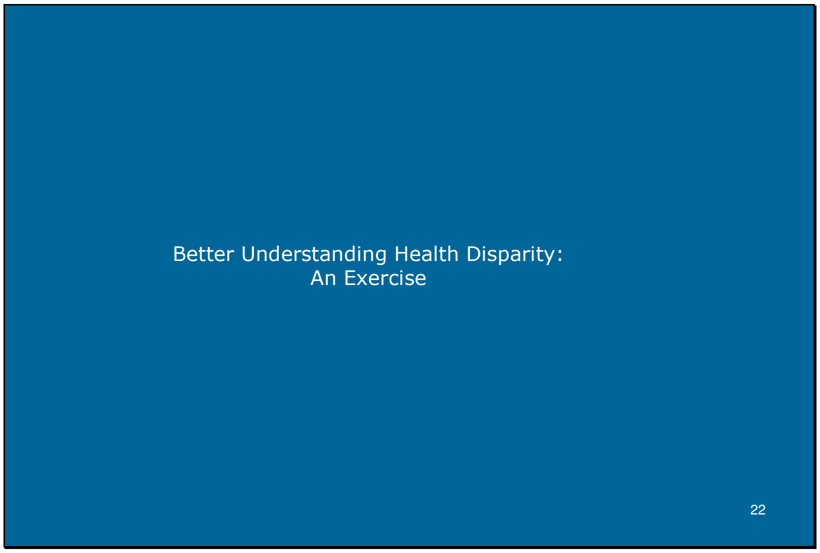


To intervene to reduce health disparities, it would be useful to have a scientifically rigorous and transparent strategy for measuring disparities across multiple dimensions of the population, such as race/ethnic groups or socioeconomic groups, and across multiple health indicators.

This is necessary if we are going to evaluate whether the disparity in infant mortality is larger than the disparity in prostate cancer, or in depression, for example. We also must consider monitoring these conditions over time. Presumably, if we want to intervene to eliminate or at least reduce disparities, we need to monitor our progress. We need to be able to show that our measure of disparity at one point in time is comparable to the measure of disparity at a later point in time, if we hope to determine that our intervention was effective.

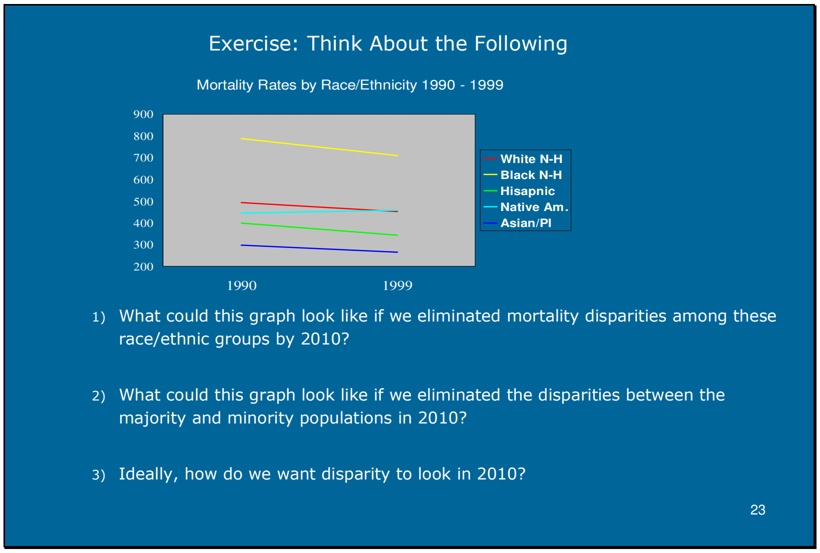
Of course, all this assumes that the relevant data exists for us to monitor disparities in this way.

Better understanding health disparity – an exercise

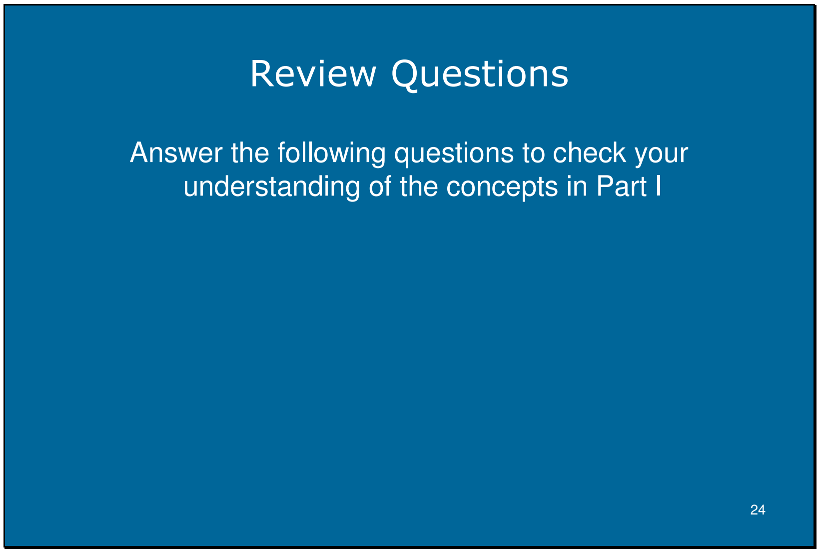


Let's do an exercise to reinforce your understanding of the core material we have just covered. The exercise gives you an opportunity to apply these concepts we're discussing to a problem.

Better understanding health disparity – an exercise

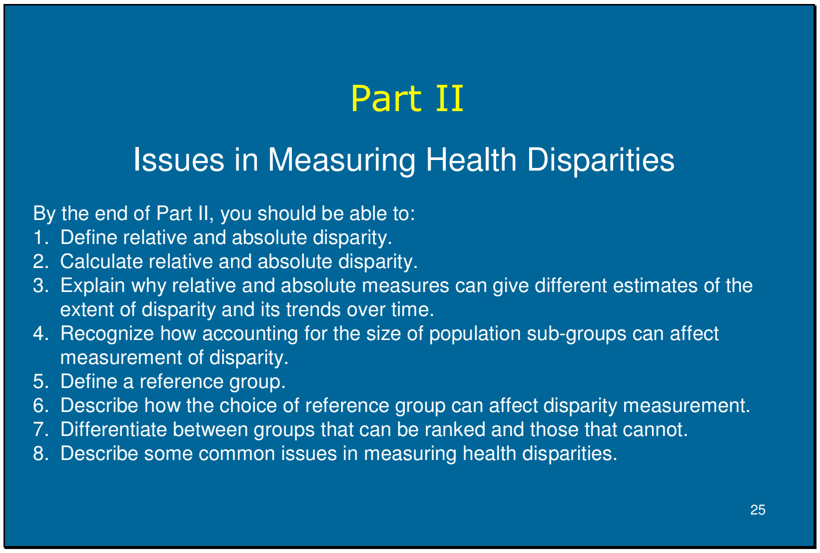


Review – Part I



At the conclusion of each part of this CD-ROM, you will be provided with questions to reinforce your understanding of the concepts presented.

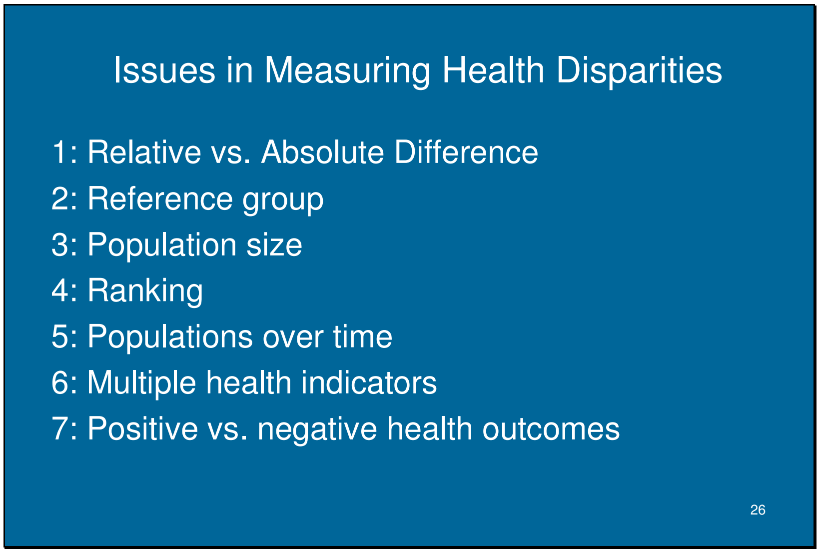
Part II – Issues in Measuring Health Disparities



Part II. In this section, we review the main issues you need to consider when measuring health disparities. By the end of Part II, you should be able to:

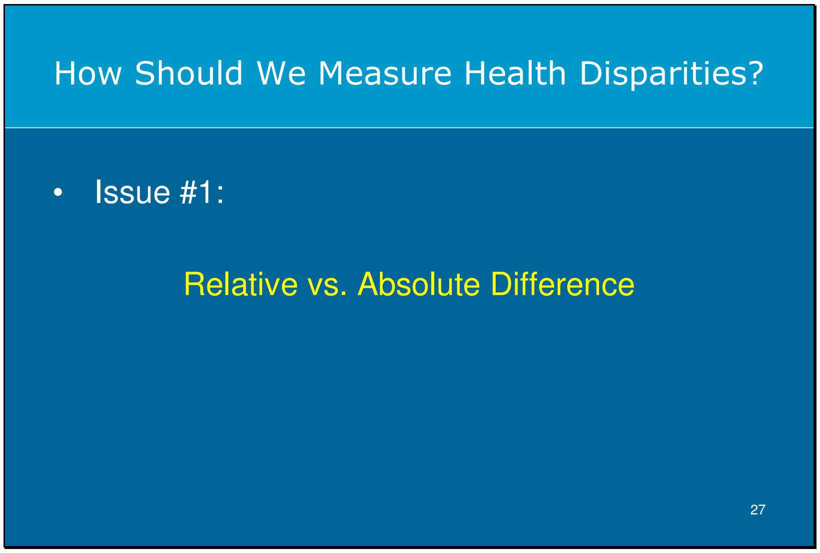
1. Define relative and absolute disparity.
2. Calculate relative and absolute disparity.
3. Explain why relative and absolute measures can give different estimates of the extent of disparity and its trends over time.
4. Recognize how accounting for the size of population sub-groups can affect measurement of disparity.
5. Define a reference group.
6. Describe how the choice of reference group can affect disparity measurement.
7. Differentiate between groups that can be ranked and those that cannot.
8. Describe some common issues in measuring health disparities.

Issues to consider in measuring health disparity



We will discuss in detail each of seven issues.

Relative vs. absolute difference



Issue #1: Relative versus Absolute Difference.

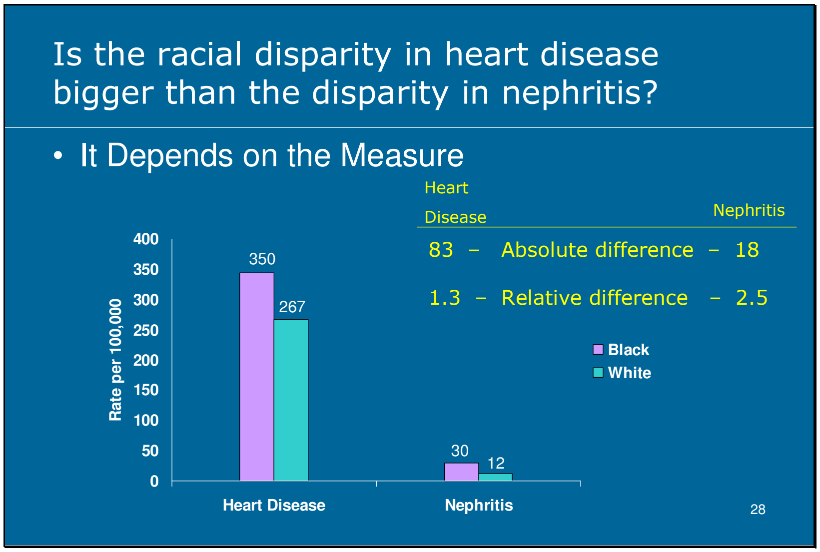
When using data to compare two or more groups, we focus on the differences in the data values. These disparities are expressed in either relative or absolute terms.

A ***relative difference*** is a ratio or fraction that results from dividing one number by another.

An ***absolute difference*** is a subtraction of one number from another. Choosing one type of measure over another can influence the apparent difference between groups; therefore, we need to be aware of the distinction between the two measures.

It is critical to note with absolute and relative measures that the terms difference, risk and disparity may be used interchangeably.

Relative vs. absolute difference



This graph contains data on the rates of heart disease and nephritis (a type of kidney disease) among blacks and whites.

First let's examine absolute difference and heart disease. If we compare the absolute difference in the rates of heart disease between blacks and whites, there is an arithmetic difference of 83 deaths per 100,000. To determine this number, we take the rate for blacks, which is 350, and subtract the rate for whites, 267. The difference is 83.

Next, examining relative difference and heart disease: alternatively, we can express that difference in relative terms as a ratio by dividing 267 into 350. We find that the ratio of black-to-white rates is 1.3. In other words, blacks have a 30% higher rate of heart disease.

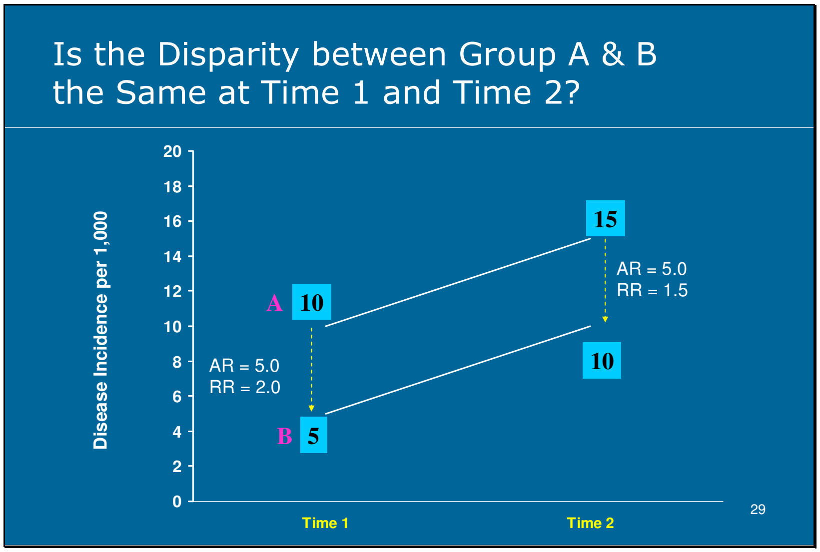
When we look at the absolute and relative difference for nephritis, we find that the absolute difference in the rates of nephritis between blacks and whites is 18 deaths (30 minus 12), but the relative difference is 2.5 (30 divided by 12). Blacks are 250% more likely to die as a result of nephritis than whites.

Now, if we want to compare the disparity in heart disease to that of nephritis, we can ask the question: Is the racial disparity in heart disease bigger than the disparity in nephritis? Clearly it depends on how we measure it.

If we use an absolute measure, the disparity in heart disease is larger.

If we use a relative measure, the disparity in nephritis is larger.
Using either measure is valid, but there is no way to say which disparity is larger because it depends on which method we choose to calculate it.

Relative vs. absolute difference



Let's look at this another way: Let's look at absolute risk and relative risk. Absolute risk (AR) or absolute difference refers to the absolute value of the subtraction of rates of disease incidence between two groups

Relative risk (RR) or relative difference refers to the ratio of the rates of disease incidence between two groups.

Here are two time points for two social groups: A and B.

At Time 1, the rate in Group A is 10 and the rate in Group B is 5.

At Time 2, the rate in Group A is 15 and the rate in Group B is 10.

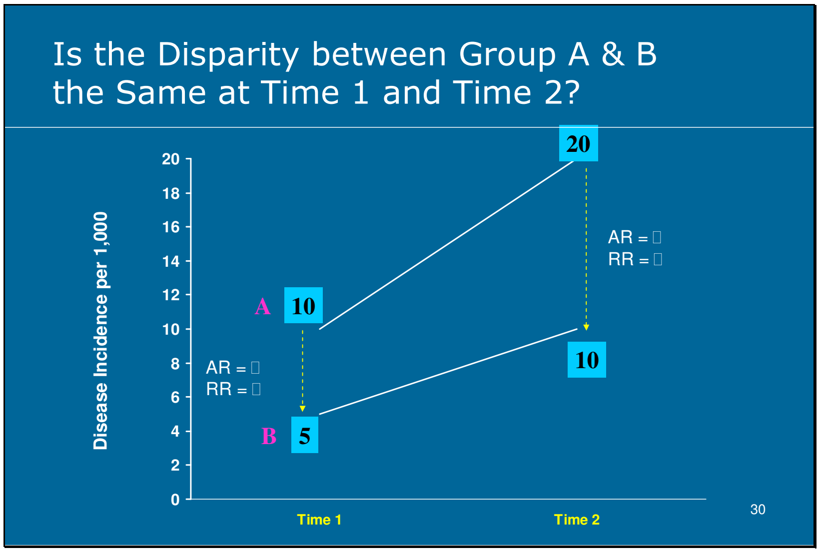
The absolute risk (AR) difference is the same at Time 2 as it is at Time 1 since 15 minus 10 equals 5 (for Time 2) and 10 minus 5 equals 5 (for Time 1).

In this example, the relative risk differs between the two groups at Time 1 and Time 2. The relative risk at Time 1 is 2 (or 10 divided by 5) and the relative risk at Time 2 is 1.5 (or 15 divided by 10).

In this example, there is no difference in the absolute risk over time, but the relative risk over time gets lower.

Now ask yourself: Is the disparity between Group A and Group B the same over time? This example again demonstrates that it depends on which measure you use—absolute risk or relative risk.

Relative vs. absolute difference



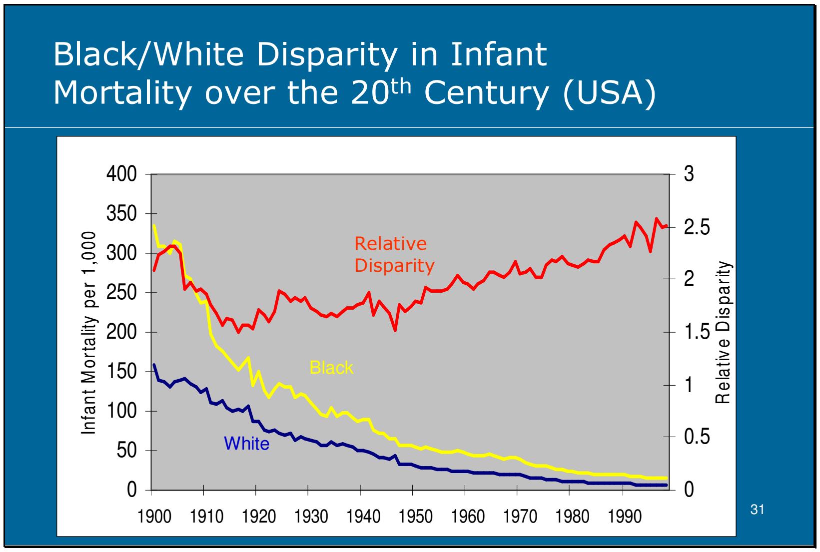
In this example, the relative risk remains constant over time, but the absolute risk changes from Time 1 to Time 2.

At Time 1, the rates are 10 and 5 for groups A and B respectively.
At Time 2, the rates are 20 and 10 for groups A and B respectively.
Calculate the absolute risk (AR) and relative risk (RR) at Time 1 and Time 2 by typing your answers in the empty boxes.

Here the relative risk is 2, calculated by dividing the rate at Time 1 for Group A by the rate at Time 1 for Group B. The relative risk is also 2 at Time 2.

However, the absolute risk is 10 minus 5 equals 5 at Time 1 and 20 minus 10 equals 10 at Time 2. Suppose this was our data pattern and we were asked if the disparity between Group A and Group B was the same. As in the previous example, the answer still remains: It depends on how you measure it.

Relative vs. absolute difference



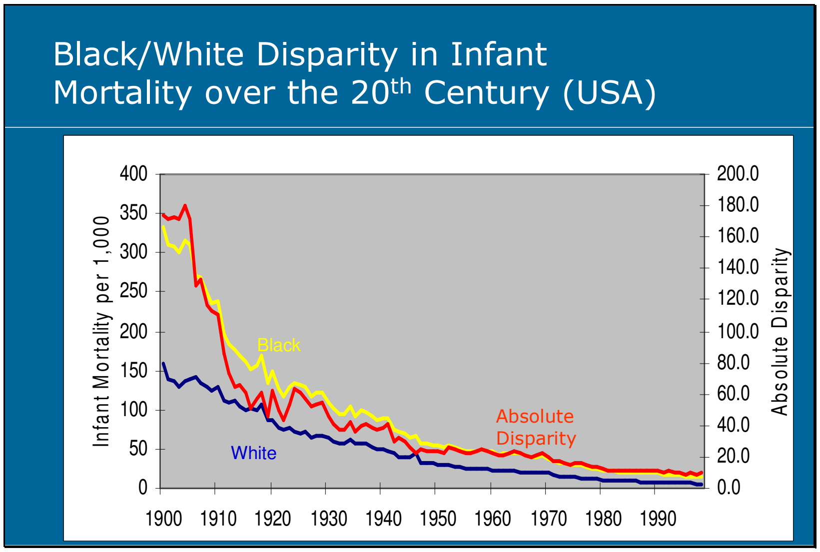
Let's look at an example using real data to illustrate again that the size of the disparity depends on the measure used.

Here's the black/white disparity in infant mortality across the Twentieth Century in the U.S.

The yellow line is the rate for black infants.
The blue line is the rate for white infants.
You can see continuous declines in infant mortality over the 20th Century.

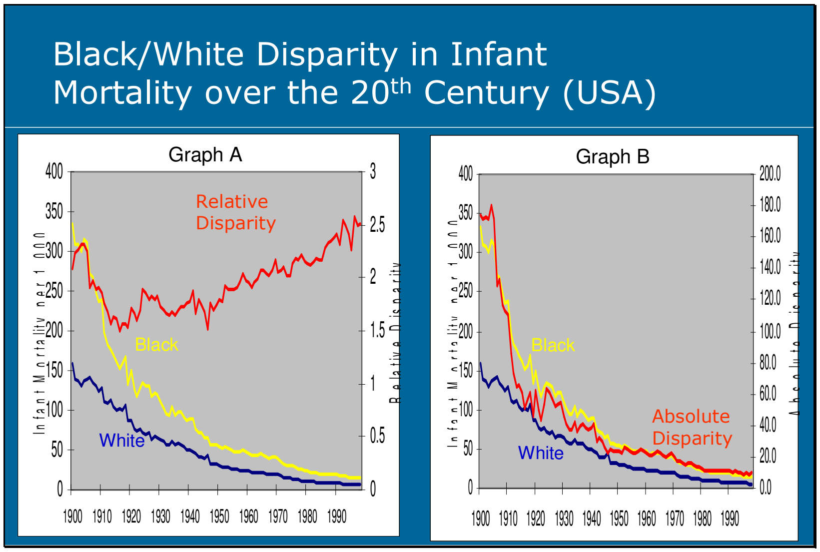
The red line in this graph is calculated as the ***relative disparity or relative risk***, that is, the ratio of the black to the white rate. You can see that, from about the 1920s, it has steadily increased over time.

Relative vs. absolute difference



However, if we look at the ***absolute disparity or absolute risk*** in this graph, the difference between the black and the white rate declined steadily over the century.

Relative vs. absolute difference



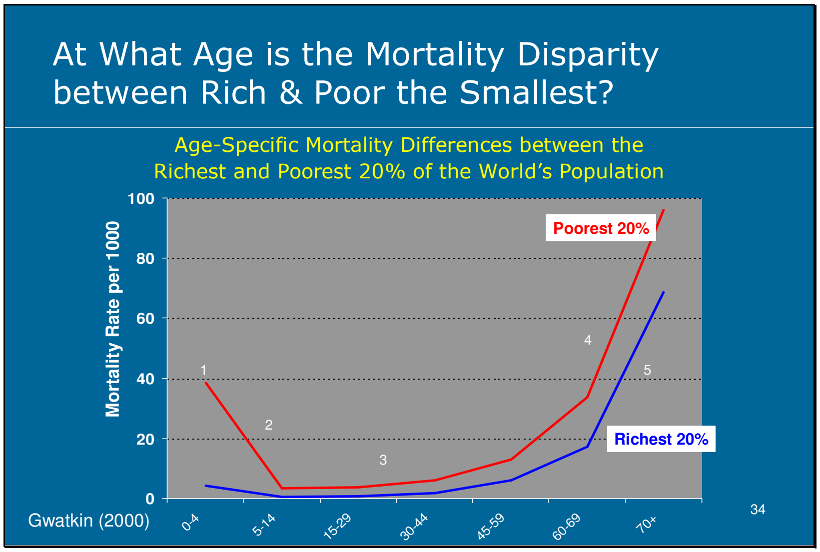
What has happened to black/white infant mortality disparity over the century?

Has it gone up?

Has it gone down?

Once again, the answer depends on which measure you use.

Relative vs. absolute difference



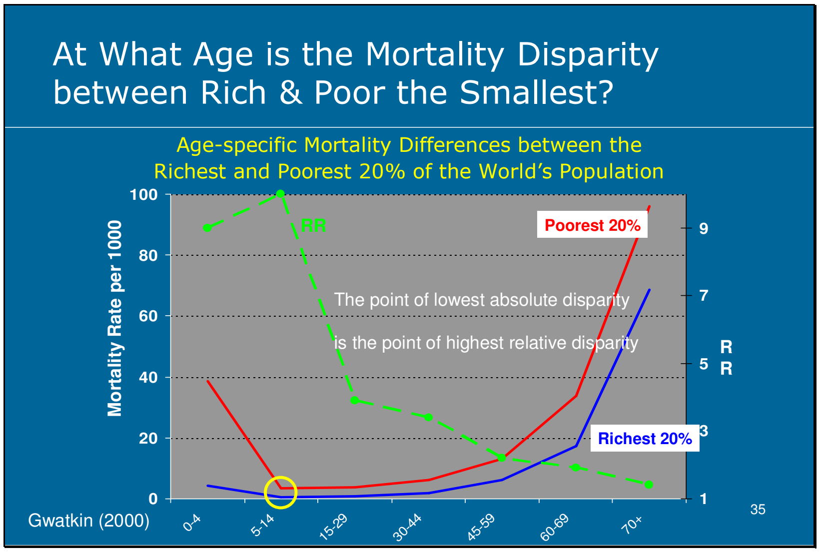
We are going to examine simulated, age-specific death rates for the poorest 20% (in red) and the richest 20% (in blue) of the world's populations, from birth to over seventy years of age.

You can see a large gap on the X-axis, at the age of 0 to 4, between the infant mortality rates of the richest 20% as compared to the poorest 20%. Those rates decline as children reach the ages of 5 to 14. The mortality rates remain very low in both groups, until we reach ages 45 to 59. The rate then climbs most steeply among the poorest 20%, but the rate also increases in the richest 20%.

Visually inspect those two curves—the red curve and the blue curve.
For which age group would you say the mortality disparity between rich and poor is the smallest? It seems natural that our eyes go to that point where those lines are closest together so you are probably looking at the 5 to 14 age group. This point represents the smallest absolute difference.

What happens if we plot the relative difference?

Relative vs. absolute difference

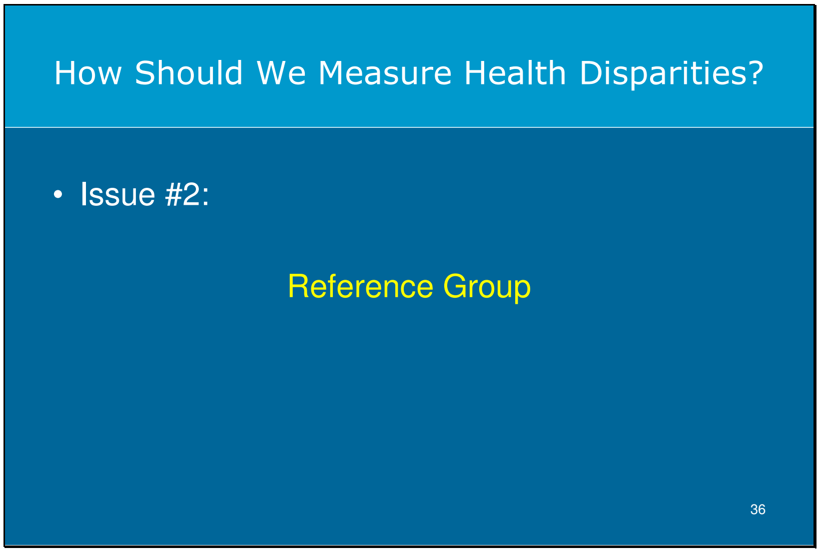


We find that the relative risk or difference between the richest 20% and the poorest 20% is highest at exactly the point where the absolute risk or difference is lowest.

This will not always be the case. It is true here because the mortality rate is so low among the richest 20% that, mathematically, it is very easy to generate a high relative risk. The denominator is very small, so the ratio is likely to be high.

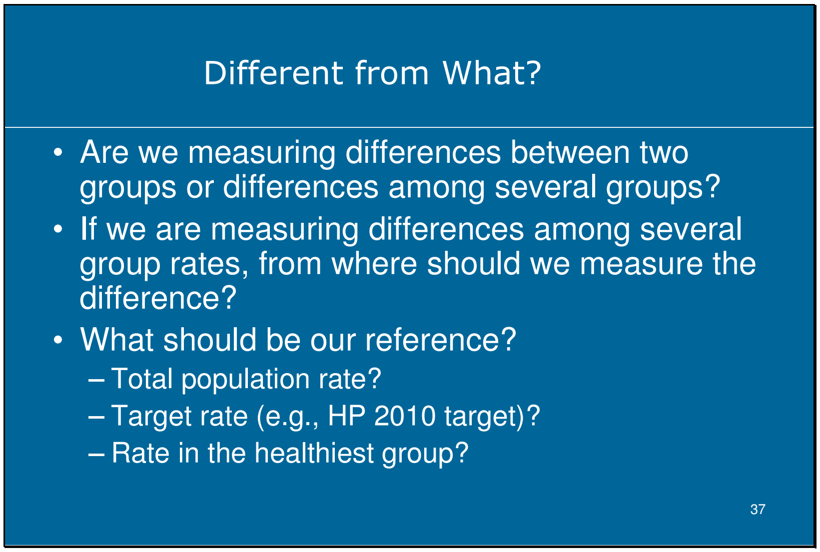
This is yet another example to sensitize you to the fact that sometimes the relative difference and the absolute difference give you different answers about which disparity is larger. We will return to this important point in Part III.

Reference group



Issue #2: Does it matter which reference group we choose for measuring disparities?

Reference group



Do you remember former Surgeon General Satcher's statements about health disparities? He talked about a comparison to the ***majority*** population. The NIH Strategic Plan talked about a comparison to the ***general*** or ***whole*** population.

When we talk about a health disparity as a difference, we must define "different from what group?" In other words, we have to define a reference group in the population. Are we measuring differences between two groups or differences among several groups? It's easy if there are just two groups. Then we know exactly whom we're comparing.

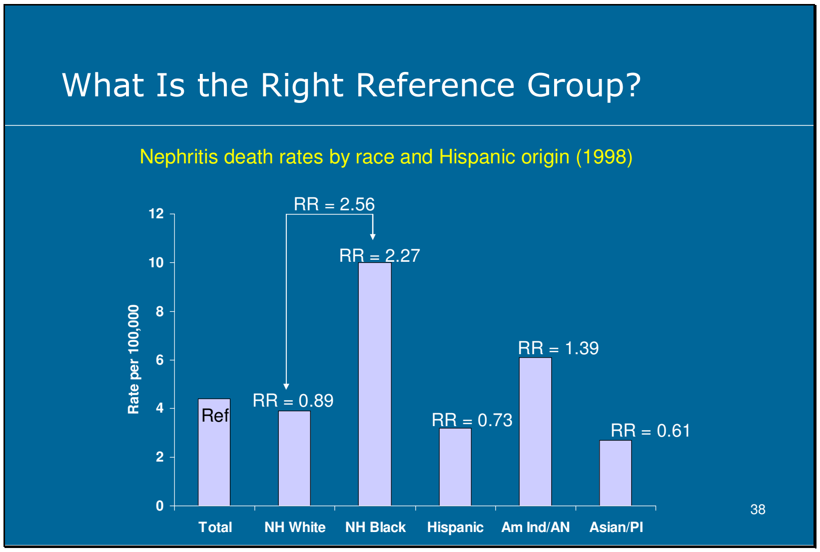
But what if we look at a category with a broad range of groups? What, exactly, are we comparing? What should be our reference point? There are different arguments for different reference groups.

Possible reference groups are: The total population rate or a target rate that has been established by an external standard. Healthy People 2010 has set target rates based on the notion that we should do "better than the best," by attaining gains in health status across all groups.

A third possibility is to choose the rate in the healthiest group as the reference point.

Again, there is no “right choice” but be aware that the choice of reference group will affect the size of the disparity.

Reference group



Here is an illustration of how the choice of reference group can affect the size of the disparity. This graph illustrates the rates of nephritis from different race/ethnic groups. The first bar on the left shows the Total rate, which is a weighted average, accounting for different sizes of the population groups. Because size is a factor, the total rate doesn't look much different than the non-Hispanic white rate (NH White). Why? Because that is the majority group in the total population and the largest in size of the five groups.

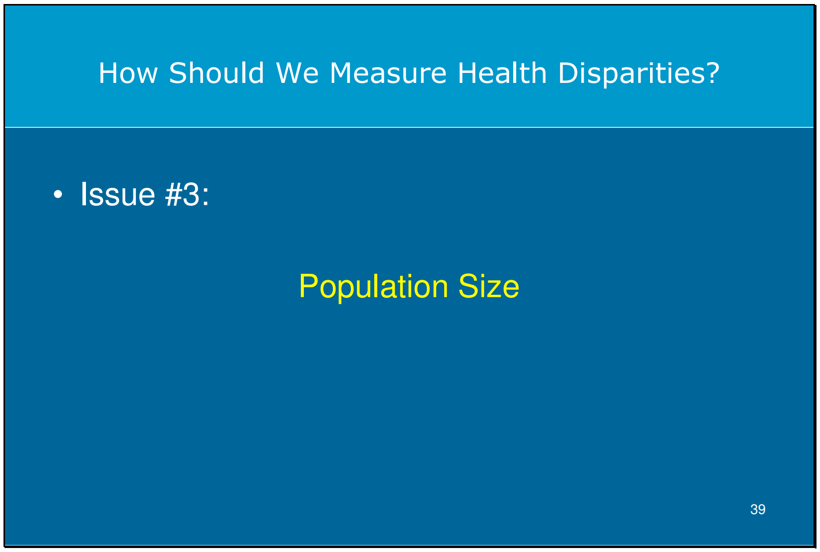
Using the Total rate as the reference group, the relative risks across the social groups are displayed at the top of each bar. Compared to the total population rate, non-Hispanic black (NH Black) experience 2.27 times the rate of nephritis deaths whereas, Asian/Pacific Islanders experience .61 or a 39% lower risk as compared to the total population.

If, however, we didn't use the total population, but instead used the non-Hispanic White (NH White)—the majority group—as the reference group, that comparison changes the relative risk between the groups. Click on the NH White bar to see the change in relative risk. Now we would say, compared to the majority non-

Hispanic White population, non-Hispanic Black experience 2.56 times the rate of nephritis deaths. In other words, they have a 256% higher risk of dying from nephritis. Changing the reference group makes the disparity look larger. Using the total population as the reference group, the relative rate difference was 2.27. Now, using the non-Hispanic White population as the reference group, it is 2.56.

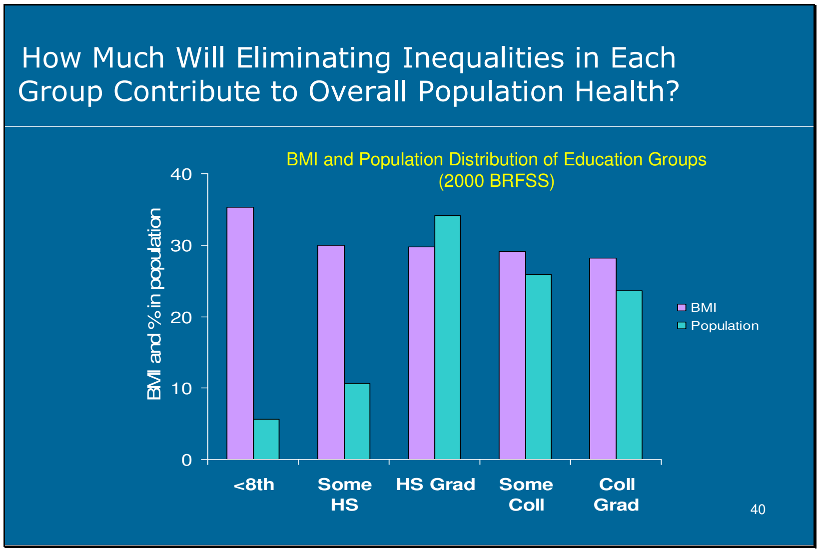
Click on the bar representing the healthiest group, Asian/Pacific Islander (Asian/PI) to see the change in relative risk using this reference group.

Population size



Issue #3: Does the size of the population groups matter when measuring disparities?

Population size



This graph shows, in purple, the distribution of body mass index (BMI) across educational categories in the United States, based on Behavioral Risk Factor Surveillance Survey (BRFSS) data. Here you can see the average BMI, by educational group. The green bars represent the percentage of the U.S. population in each educational group. Note that college graduates have a BMI of just under 30; whereas, those with less than an eighth-grade education have a BMI of around 35.

How much will eliminating disparities between each of the groups contribute to improving overall population health?

The tendency might be to think, “Well, the group that is the worst-off is the group containing those people with less than an eighth grade education. They are the ones we should target because they have the highest adverse rate—the highest BMI.”

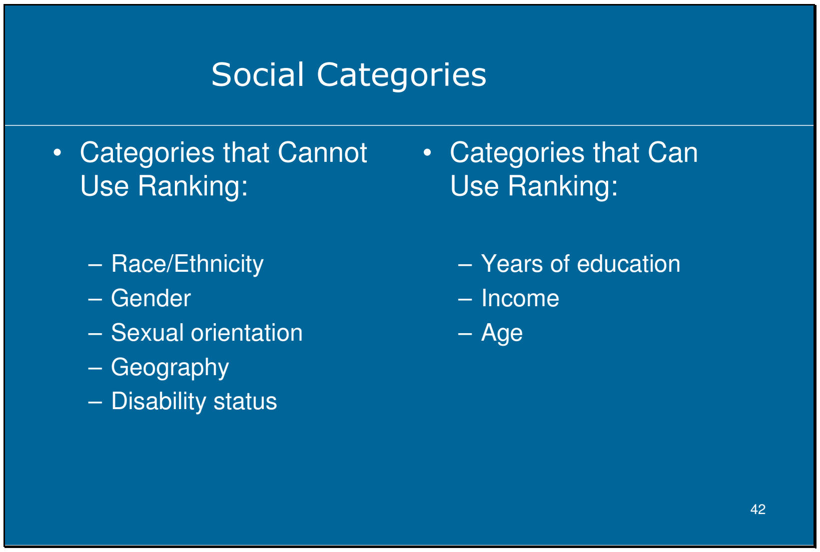
However, if you look at how large that group is in size, you quickly realize that this is, by *far*, the smallest population group. The question then becomes: When planning a health intervention, do we just consider the fact that the rate is high in a particular group, even though it comprises a small proportion in the population?

While there is no correct answer to this question, it is important to consider this issue explicitly. Make sure you think about the size of population subgroups, in addition to their rates of disease or poor health.

Ranking

Issue #4: Does it matter if the groups we are trying to compare are ordered or unordered? Do they have a quantifiable ranking?

Ranking

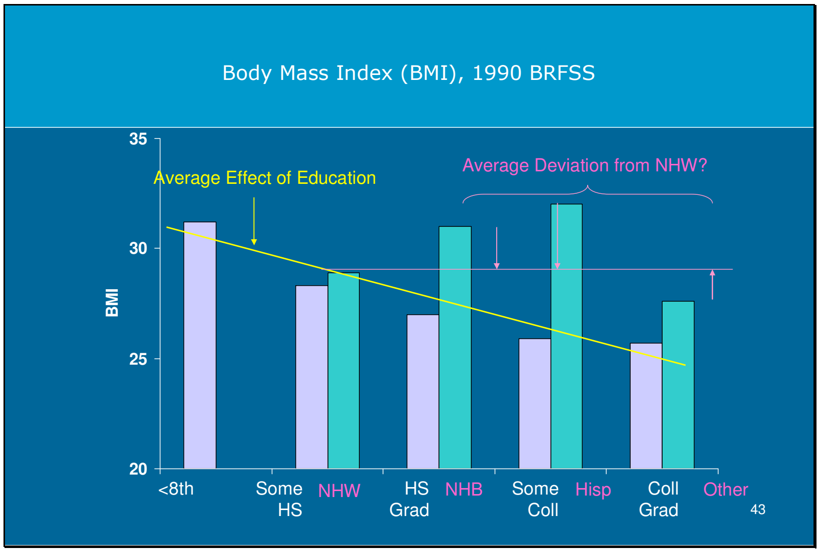


Categories that have a quantifiable order can be ranked. For categories like education groups can be ranked according to their level. We know that obtaining a college degree takes more years than a high school education. Income and age are other categories you can rank.

What about social groups you cannot order, groups where there is no quantifiable ranking? One of the most important disparities we're trying to understand and measure in the U.S. is across race/ethnic groups. There is no order for those groups so that one is higher or better than another. This is also true for gender, sexual orientation, geography and disability. Most of the social groups—in fact, all of the social groupings other than the socioeconomic ones—cannot be ordered.

This is important because some measures of disparity can not be used with groups that cannot be ordered.

Ranking



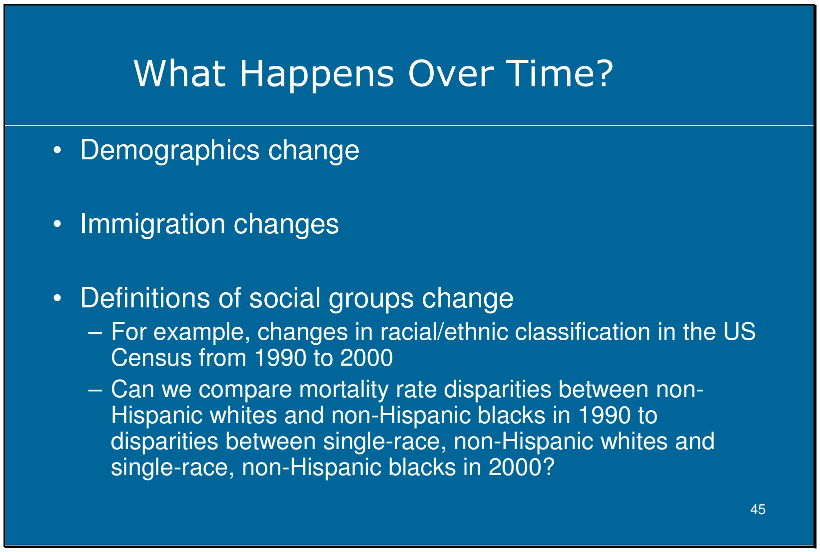
Let's look at body mass index (BMI) again, across different educational groups. This data is from the 1990 BRFSS. These are the BMI levels for college graduates versus the other educational groups. Because education can be ranked, we can calculate the average effect on body mass index from increasing or decreasing education from a regression equation.

We can not calculate the average effect on body mass index for different race/ethnic groups because we cannot order them from high to low. All we can do is measure their average deviation from a selected comparison group such as Non-Hispanic Whites.

Populations over time

Issue #5: Does it matter whether we are measuring disparity at a single point in time, or over time?

Populations over time

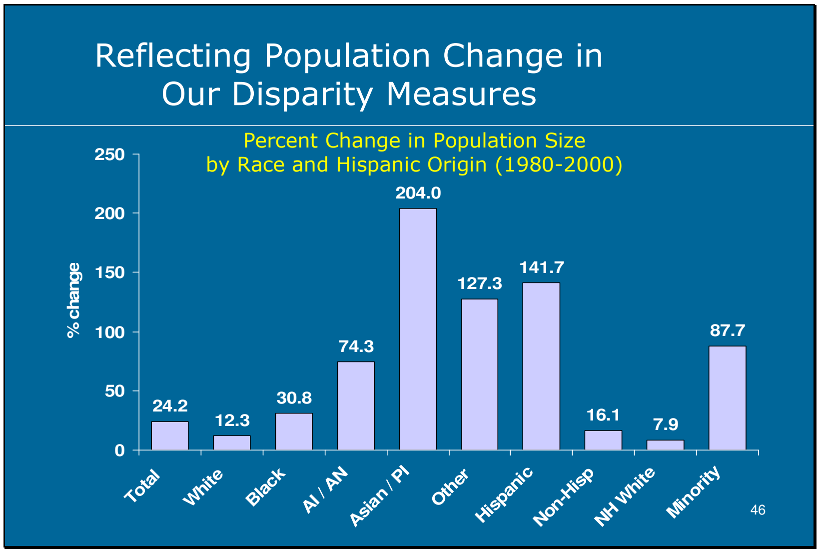


What changes occur over time that impact efforts to monitor and measure health disparities? Demographics change. The size of different educational groups, for example, changes over time. The size of the group of people with less than eight years of education in our society is getting smaller and smaller over time. Should our measure of disparity reflect the changes in the population size of those groups?

Immigration patterns also shift over time. As a result, population, race, and ethnic subgroups also change. Additionally, the definitions of those social groups change. This occurred in the race/ethnic classification in the Census from 1990 to 2000.

Some problems emerge in tracking outcomes and trends in health disparities from changes over time: Can we compare mortality rate disparities between non-Hispanic whites and non-Hispanic blacks in 1990 to disparities between single-race, non-Hispanic whites and single-race, non-Hispanic blacks in 2000? Any changes in the definitions or characteristics of these groups make that task very difficult.

Populations over time



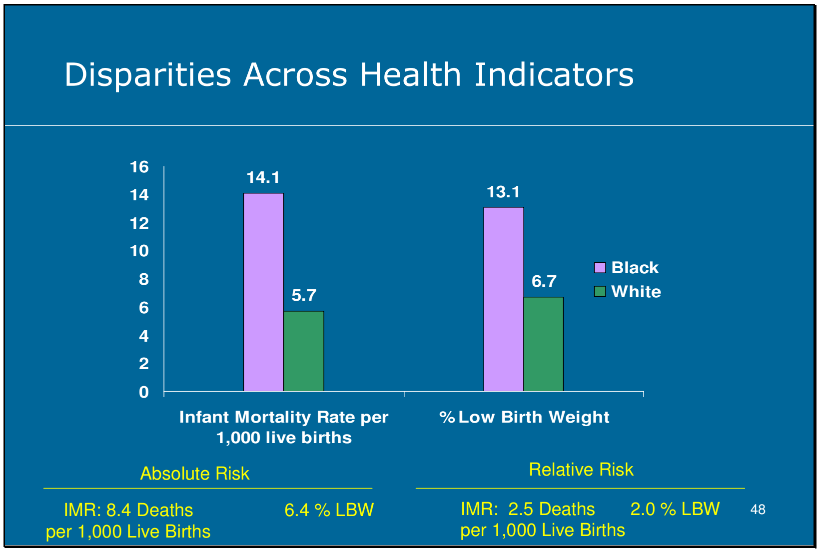
Here we see the percent change in population size by race and Hispanic origin from 1980 to 2000.

Over this twenty-year period, we see an enormous increase in the Asian/Pacific Islander and Hispanic groups in particular. Now, suppose we are going to monitor disparities in health in these race/ethnic groups. We need to consider this: A disparity between the Asian/Pacific Islander population and the total population increases in importance over time as the size of the Asian/Pacific Islander population increases. Should we reflect this important change over time in our disparity measure?

Multiple health indicators

Issue #6: Does it matter if we compare the size of disparity across different health indicators?

Multiple health indicators



We will confront situations in which we want to measure the size of the disparity across two or more health indicators.

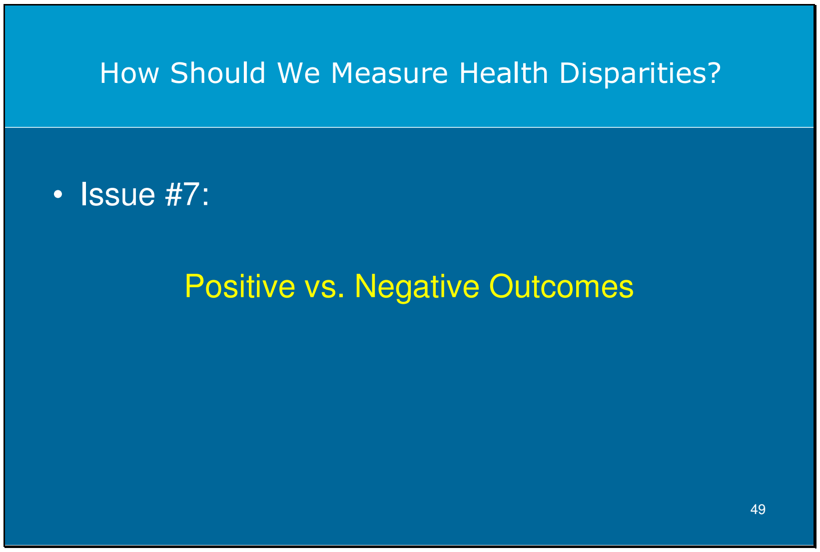
For example, let's examine a black/white disparity in infant mortality rate using this chart.

The absolute risk in infant mortality is 8.4 deaths per 1,000 live births.
The absolute risk in the percentage of low birth weight is 6.4%.
However, there is not a straightforward way to compare whether 6.4% is bigger than 8.4 because these absolute differences are expressed in different units.

Relative risk ratios, on the other hand, are useful across health indicators since these differences are unit-less. As indicated, blacks are 2.5 times more likely to experience infant mortality over whites and 2 times more likely to experience low birth weight.

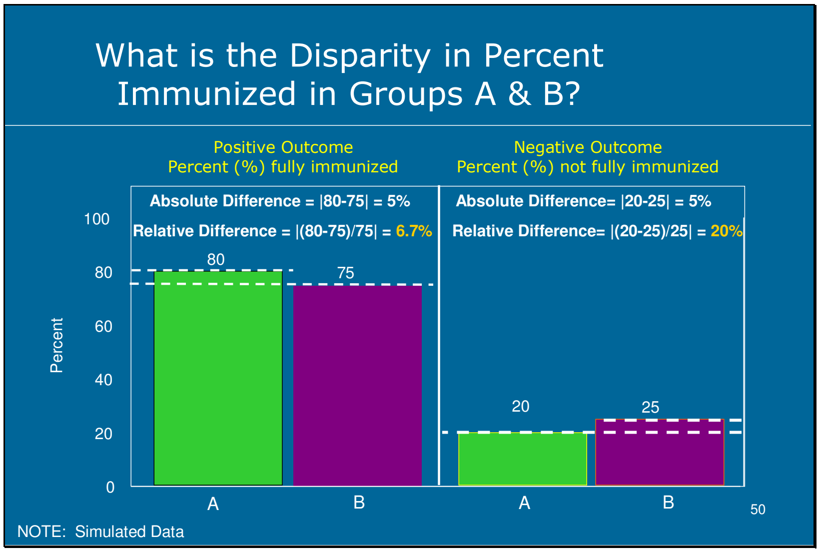
In general, we need a relative indicator to make sense of comparisons across outcomes that are measured on different scales. When the units of measurement are different, you cannot compare absolute measures in a meaningful way.

Positive vs. negative health outcomes



Issue #7: Does it matter if we use a positive or a negative outcome to measure health disparity?

Positive vs. negative health outcomes



In the previous example, we talked about infant mortality, a negative outcome. We could also talk about infant survival, which is the inverse of mortality and which is a positive outcome.

To illustrate the impact of using positive or negative outcomes on disparity measures, let's review these data and bar charts on immunization coverage. This is simulated data.

Using the positive outcome called Percent Fully Immunized (the chart on left):

In group A, 80% are fully immunized.

In group B, 75 % are fully immunized.

Using the negative outcome called Percent Not Fully Immunized (the chart on right):

In Group A, 20% are not fully immunized.

In Group B, 25% are not fully immunized.

For each group, the positive and negative outcomes add up to 100%

80 + 20 for group A.

75 + 25 for group B.

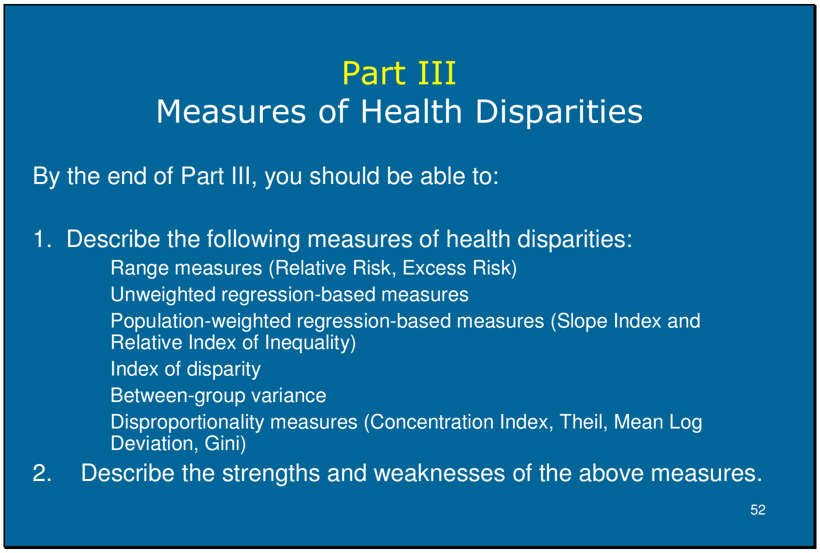
The measure of absolute difference is the same for each group when expressed either for a positive or negative outcome. The absolute risk, or difference, is 5%
For the positive outcome 80 - 75
For the negative outcome 20 - 25
When using percentages that add up to 100, the absolute difference is always the same for positive and negative outcomes between two social groups.

Notice that absolute and relative difference are expressed here as an absolute value, not as a negative number.

Using a relative measure, we see that the absolute value of the relative difference is not the same when calculated for positive and negative outcomes. For percent fully immunized the relative difference is 6.7%; for percent not fully immunized, the relative difference is 20%.

In looking at measures of disparity, it is important to choose either positive or negative outcomes consistently and to be aware of the influence on calculations of absolute and relative measures. Positive and negative outcomes should not be mixed. Generally speaking, the Healthy People 2010 goals are expressed in negative outcomes, such as mortality rather than survival; percent without health insurance, rather than with.

Part III - Measures of Health Disparities

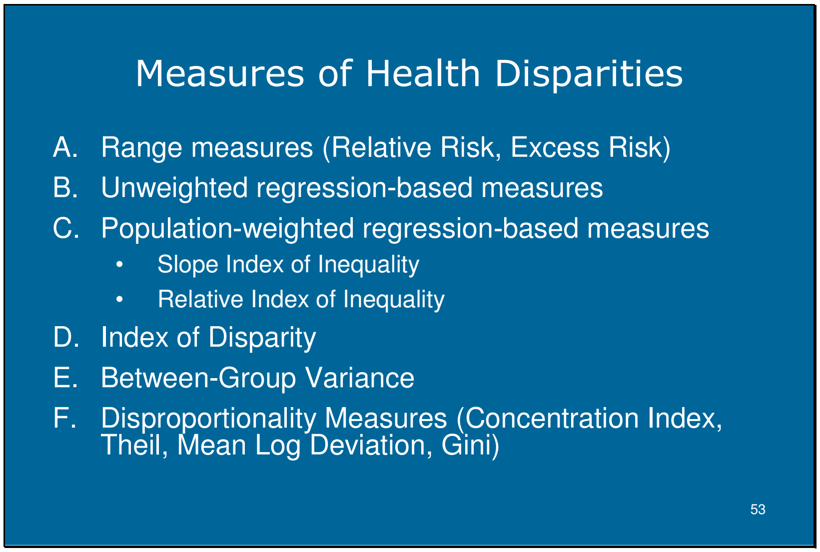


In Part III we review the most commonly used measures of health disparity.

By the end of Part III, you should be able to:

1. Describe the following measures of health disparities:
   - Range measures (Relative Risk, Excess Risk)
   - Un-weighted regression-based measures
   - Population-weighted regression-based measures (Slope Index and Relative Index of Inequality)
   - Index of disparity
   - Between-group variance
   - and Disproportionality measures (Concentration Index, Theil, Mean Log Deviation, Gini), and
2. Describe the strengths and weaknesses of the above measures.

Measures



Part III will give you an idea of the general characteristics of each of these measures. For those of you who want more technical detail and a better understanding of how these measures are used in research and practice, we have provided references in the *Resources* section to key articles from the health disparity literature. When possible, we have also provided the text of the articles in a pdf file.

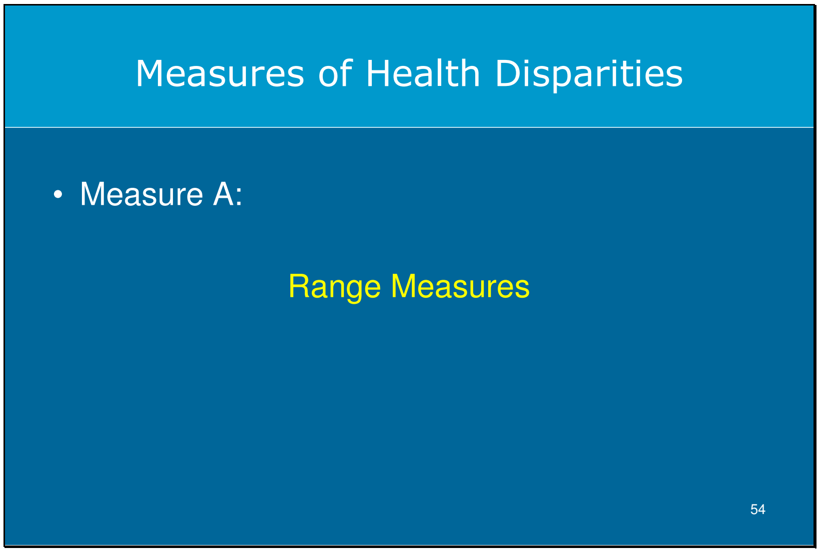
We will begin with the simplest measures:
Range measures
Un-weighted regression-based measures
Population-weighted regression-based measures
For many purposes, these will be all you need.

There may be situations, however, where you want to summarize disparities over time or across different groups, which can get technically more complicated. An overview of the following measures will provide you with a taste of what goes into these more complex calculations:
Index of disparity

Between-group variance

Disproportionality measures

Range measures



Range Measures typically compare two extreme categories.

Range measures

Range Measure Examples:
Relative Risk (RR), Excess Risk (ER)

Educational Disparities in BMI (1990 BRFSS)

Education Level	%	BMI	RR	ER
<8 years	5.66	26.6	1.09	2.2
Some High School	10.65	25.7	1.05	1.3
HS Grad / GED	34.10	25.1	1.03	0.7
Some College	25.95	24.6	1.01	0.2
College Grad	23.63	24.4	1.00	0.0

55

Using this table, let's examine Educational Disparity in Body Mass Index (BMI) according to the 1990 BRFSS. This is a typical data layout for examining disparities. Notice it contains a range of ordered educational groups, from less than eight years through college graduates.

In the first two columns, the table shows:

The percent of the population with less than 8 years of education (5.66%)

The percent of the population that has graduated from college (23.63%)

And so on.

The next column shows average levels of Body Mass Index within each educational group.

As you have seen before, we can easily calculate relative risks (RR in the chart). You can tell the reference group in this case is college graduates, since the relative risk value is equal to one (1) for that social group.

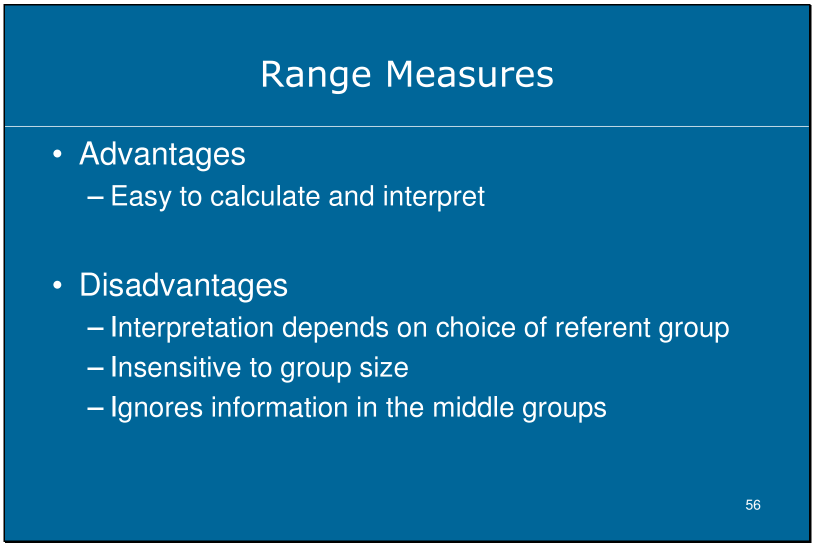
The disparity in terms of excess risk (ER in the chart), is displayed in the last column. Excess risk in this table has been calculated according to the absolute difference between BMI in the reference category, the college graduates, and in each of the education level categories. Relative measures of extreme groups are the ones typically used in epidemiology and public health.

Range measures typically compare the two extreme categories.
One of the extremes is used as the reference group, which is compared to the other extreme. In this case, the ratio of BMI among those with less than eight years (the least number of years of education) is compared to college graduates (the group with the most years of education).
The 26.6 BMI for those with less than eight years of education is divided by 24.4, which is the BMI for those in the reference group—college graduates—resulting in a relative risk of 1.09.

If we were to calculate excess risk as a measure of absolute disparity, we would subtract 24.4 from 26.6 and that absolute arithmetic difference is 2.2.

Notice is that we don't use *any* of the information about the groups in between. In other words, our measure of disparity, if we were to use a relative risk or an excess risk, is based only on information about the two extreme social groups. Notice also that in using these range measures we are not using any of the information in the first column on the relative size of the different educational groups.

Range measures



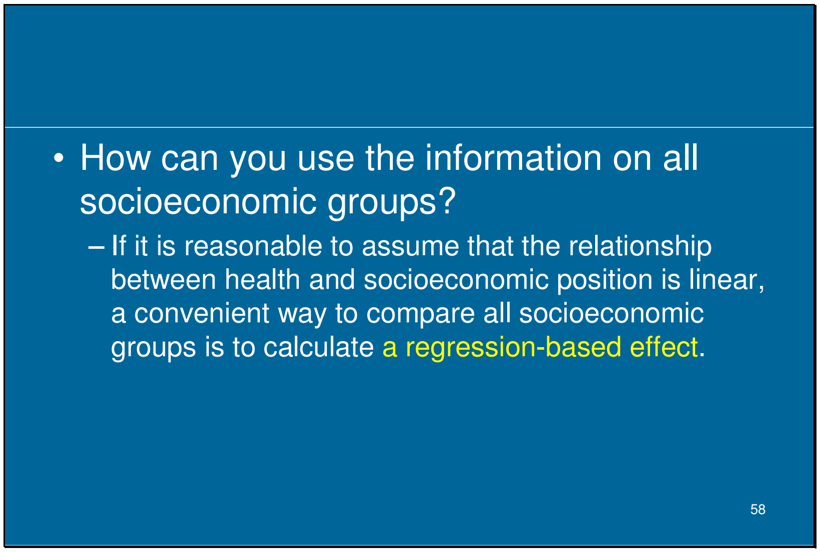
The advantage of range measures is that they are very easy to calculate and interpret since they are familiar to most people.

The disadvantages are several. The interpretation of range measures depends on the choice of the referent group. We discussed this in Part II.
When you change the reference category, the number you generate for the relative or the excess risk will differ.
These range measures are insensitive to the size of the groups. In the example of educational disparities in BMI, the measurement did not account in any way for the fact that only about 6% of the population has less than 8 years of education.
Range measures also ignore information on any group whose data falls in the middle range rather than the extreme.

Un-weighted regression measures

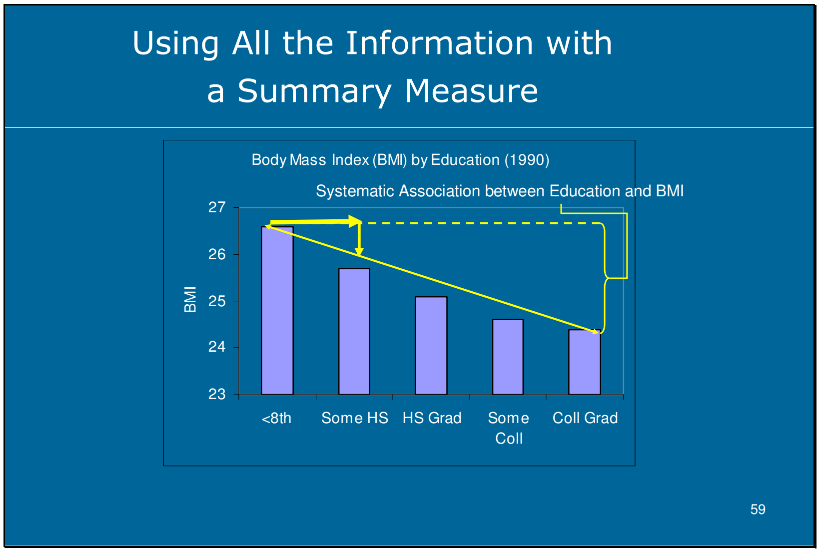
Un-weighted, Regression-Based Measures allow us to begin to incorporate information that exists in all groups, not just the two extremes, as in the range measures.

Un-weighted regression measures



As we just saw, it does not seem intuitively right to ignore all the information that exists in middle groups, and rely exclusively on two groups for a comparison. If we can assume a linear relationship between the health indicator of interest and the indicator of socioeconomic position (such as education or income), then a convenient way of using all information for all socioeconomic groups is to calculate a regression-based effect measure.

Un-weighted regression measures



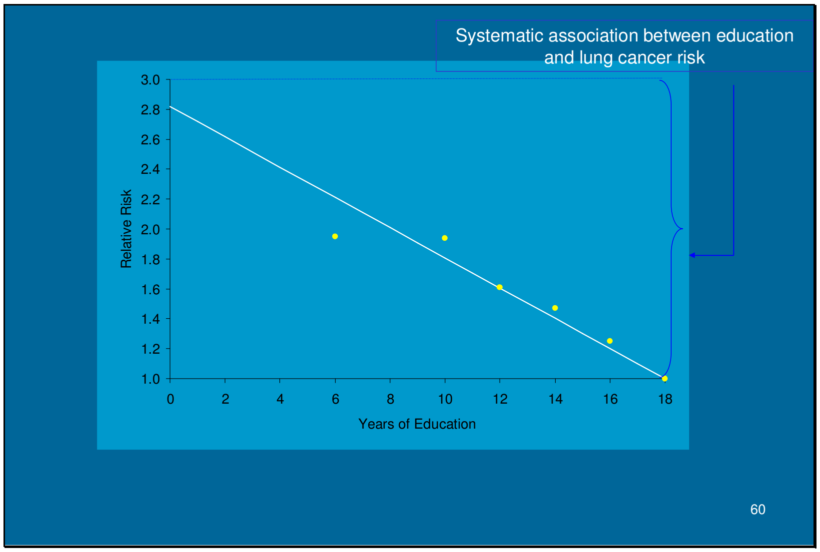
How is all the information used?

First, arraying the data allows you to ***regress*** (a statistical technique) the average BMI across the educational groups to calculate an average effect measure.

This difference between the college graduates and the less-than-8th-grade groups is expressed in a slope of the line, which represents the systematic association between education and BMI across all groups.
The interpretation of slope is that:
For an increase of one unit of education…
… the average decrease in BMI is a constant amount

In this case, a single number—the slope of a line—summarizes the data across the different groups rather than just using the information on the two extreme groups. How well this value summarizes a systematic association depends on various assumptions. The most important assumption is that the relationship between BMI and education is linear.

Un-weighted regression measures



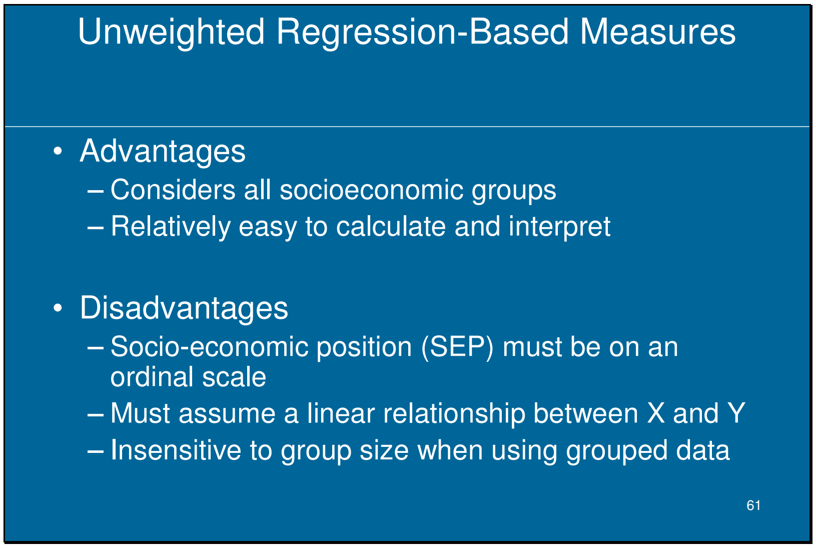
This example is from a paper by Steenland and colleagues that examines the systematic association between education and lung cancer risk.

In their study, the researchers calculated a set of relative risks using the highest education group (18 years) as their reference. In the graph, you can see the relative risk—or the association between education and lung cancer risk—for those with 16 years of education was about 1.3.

For those with only 6 years of education, there is approximately a twofold risk. If we want to summarize the information contained in the scatter plot, we could calculate and draw a regression line like the one shown. The slope of this line is the beta coefficient, described in discussion of the next measure, and the slope summarizes the information contained in all five of the data points into one number rather than five.

For more information about this particular study, refer to the *Resources* section.

Un-weighted regression measures



The advantages to un-weighted, regression-based measures are that they take into consideration information from all socioeconomic groups and they are relatively easy to calculate and interpret.

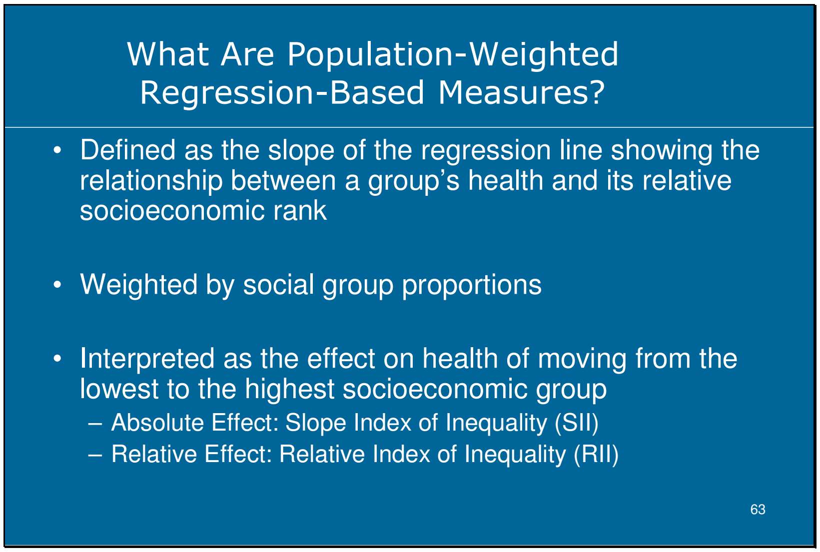
Like range measures, many people in public health are accustomed to seeing ***beta coefficients*** (that is, the slope of the line) that can be interpreted as a relative risk.

One of the disadvantages to un-weighted, regression-based measures is that our social grouping or socioeconomic position must be on an ordinal scale. In other words, the measures are valid only if you can order the groups. These measures also assume a linear relationship between the social group and the outcome. Lastly, they are insensitive to group size when using group data.

Population weighted regression measures

Population-Weighted, Regression-Based Measures allow us to incorporate information about the size of the social group by weighting.

Population weighted regression measures

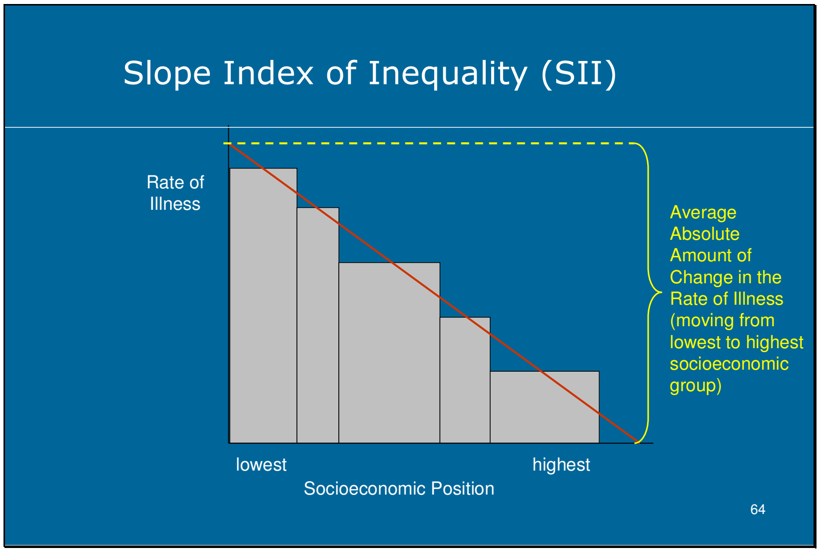


Population-weighted, regression-based methods are similar to the previous measures in that they involve finding the slope of a regression line, which measures the relationship between a group's health and its relative socioeconomic rank. Where population-weighted, regression-based methods differ from previous methods is that they enable us to incorporate information about the size of the social group by weighting.

These measures are interpreted as the effect on health of moving from the lowest to the highest socioeconomic group. In this section we look at two specific measures that account for the absolute and relative effects: the Slope Index of Inequality (the SII) and the Relative Index of Inequality (the RII).

Socioeconomic disparity as measured by the RII is becoming a more commonly used measure. The *Resources* section contains references to specific examples of how to use each of these measures in practice.

Population weighted regression measures



The approach to the Slope Index of Inequality (the SII) is similar to the one used for the un-weighted, regression-based measures.

We begin with a ranking of groups based on socioeconomic position, such as educational or income groups along the X-axis. We have also illustrated the size of the groups by adjusting the width of the bars as shown. (In the previous example, the width of the bars was all the same.) The X-axis depicts the relative rank of the socioeconomic group, with some indication of its size in the population, as expressed by the width of the intervals (bars).

Differing rates of illness are on the Y-axis.

If we use this data for regressing just like before, but weight the social groups by their population size, then the slope of the line indicates the average absolute amount of change in the rate of illness in moving from the lowest to the highest socioeconomic groups. It is the absolute amount because we are still using the same units we used in measuring the rate of illness. These units could have been infant mortality, heart disease, or any other rate of illness or health status indicator of interest. Note that this SII measure uses the information on all groups and information on the size of the groups.

Population weighted regression measures

SII Calculation

Distribution of Educational Position (1990)

Education Level	%	% Cumulative Population	Range % Cumulative Population	Midpoint
< 8 Years	5.66	5.66	0.0 – 5.66	2.83
Some High School	10.65	16.31	5.67 – 16.31	10.99
HS Grad / GED	34.10	50.42	16.32 – 50.42	33.37
Some College	25.95	76.37	50.43 – 76.37	63.40
College Grad	23.63	100.0	76.38 – 100.0	88.19

65

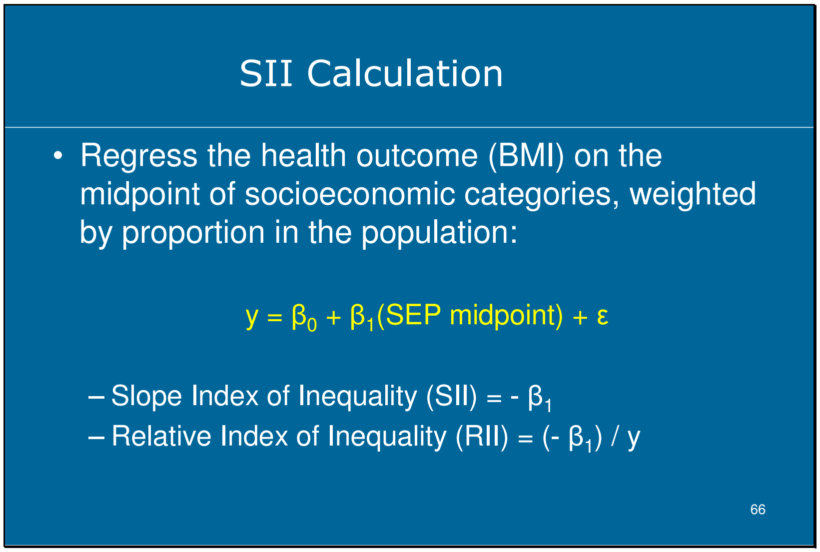
Let's take a closer look at the basic data setup behind the calculation of the SII.

Again, we start with the categories of education and the proportion of the population in each of these groups. The next column is the cumulative percent. For example, 16.31 is the cumulative percent of those with less than eight years of education and those with some high school, which is simply the sum of 5.66 and 10.65. Notice that the cumulative percentage adds up to 100.

The range expresses the cumulative distribution of the population according to the socioeconomic position that each group occupies. For example, the group with some high school education occupies the range of 5.67 to 16.31% of the population. In the table, the third column shows the range in the cumulative distribution of education that each educational group occupies.

We need to know the range in order to calculate its midpoint for each socioeconomic group. The range midpoint is the value used in the regression to calculate the SII. Please refer to articles in the *Resources* section for more technical details.

Population weighted regression measures



Once we know the midpoints, we can regress the health outcome (the BMI in this case) on the midpoint of the socioeconomic position (SEP) categories.

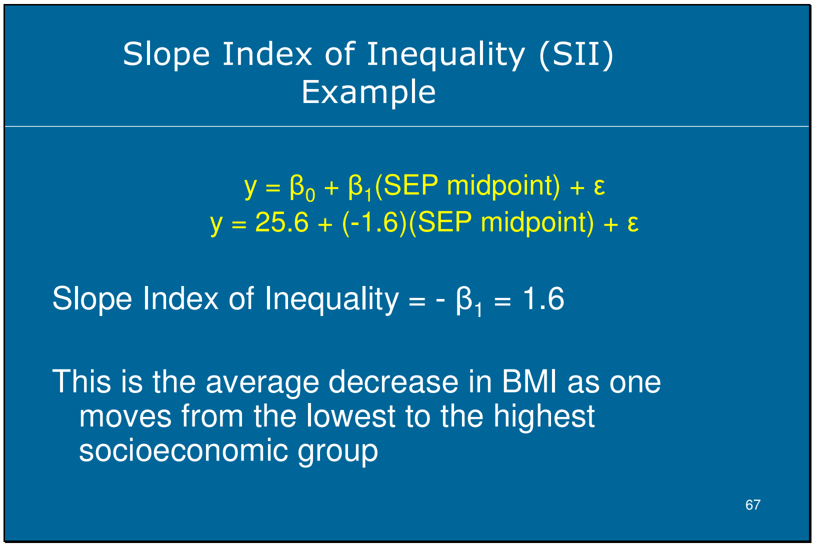
A typical linear regression model is used where:
Y is the outcome, BMI
Beta-naught is the intercept of the regression line and the Y-axis
Beta-1 is the coefficient that relates BMI to the midpoint of the range of the distribution of Socioeconomic Position (SEP) and
An error term, Epsilon

Remember that:
Beta-1 is just the slope of the regression line, or the average change in the BMI per-unit increase in education category.

The Slope Index of Inequality is negative beta-1. The SII is interpreted as the absolute change in BMI involved in moving from the lowest to the highest socioeconomic group.

The Relative Index of Inequality is negative beta-1 (or the Slope Index of Inequality) divided by the population average for the health outcome (in this case BMI). The RII is an expression of the absolute disparity in the health outcome relative to the average level in the population.

Population weighted regression measures



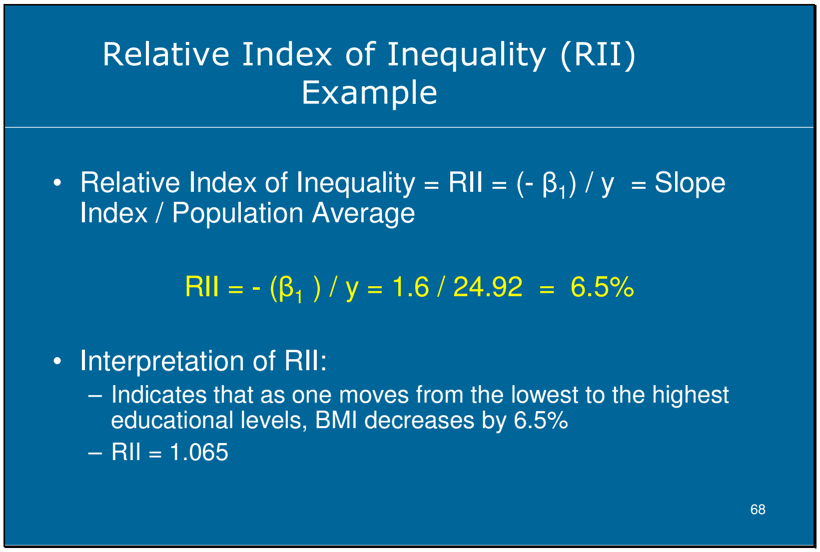
Let's see how this works with the data we have for BMI by years of education.

We'll start with the Slope Index of Inequality: $y = \beta_0 + \beta_1$ (SEP midpoint) + ε
This is the generic formula.

After performing the regression, we find that: y = 25.6 + (-1.6) (SEP midpoint) + the error term.

This suggests that there is a 1.6 unit decrease in BMI as you move from the lowest to the highest socioeconomic group. Therefore, beta-naught (or 25.6) is the BMI value of the hypothetically least-educated person. Beta-naught is the value of the BMI when the SEP midpoint equals zero and is the y-intercept of the regression line.

Population weighted regression measures



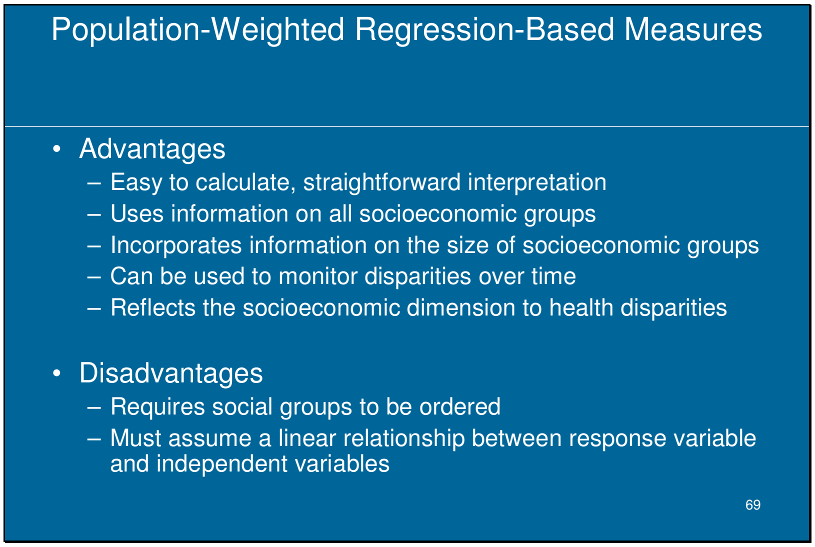
Once you know the Slope Index of Inequality, it is easy to find the Relative Index of Inequality (RII).

The RII is the SII divided by the mean BMI for the population. We can tell you, from calculations not shown, that the mean BMI value for the population is 24.92. Inserting these values into the formula gives you:
1.6 divided by 24.92 equals 6.5%

We can interpret this RII to mean that as one moves from the lowest to the highest educational group BMI decreases by 6.5%.

Applying the more commonly used rate ratio measures, an RII of 6.5% would be a rate ratio measure of 1.065.

Population weighted regression measures



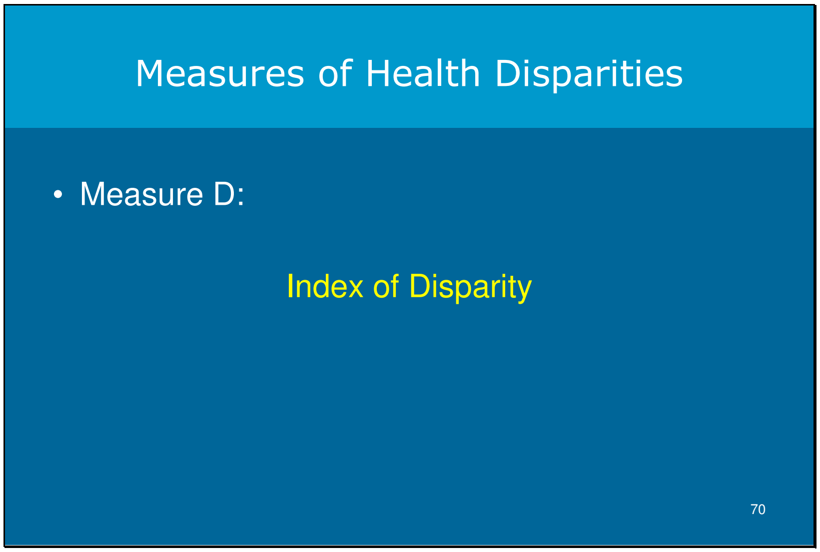
The advantages of the relative and slope indices of inequality include being fairly easy to calculate and having a reasonably straightforward interpretation, especially because they correspond to things that we're familiar with in the regression-modeling framework.

Most importantly, these indices use information on ***all*** the socioeconomic groups and incorporate information on the ***size*** of the socioeconomic groups. Also, you can use them to monitor disparities over time because they are sensitive to changes in the size of the socioeconomic groups, as well as changes in the rates of the health outcome. We think these are very important characteristics of a disparity measure.

Furthermore, these indices reflect the socioeconomic dimension to health disparities. The assumption is that we care more about a health disadvantage in a lower socioeconomic group than we do in a higher socioeconomic group. Some economists and philosophers argue that incorporating this concern is a desirable characteristic of a health inequality measure.

The major disadvantages to the SII and RII are that you can only use them when the social groups can be ordered. As we've seen before, many of the concerns of health disparities in the United States, as laid out in Healthy People 2010, do not involve ordered social groups.

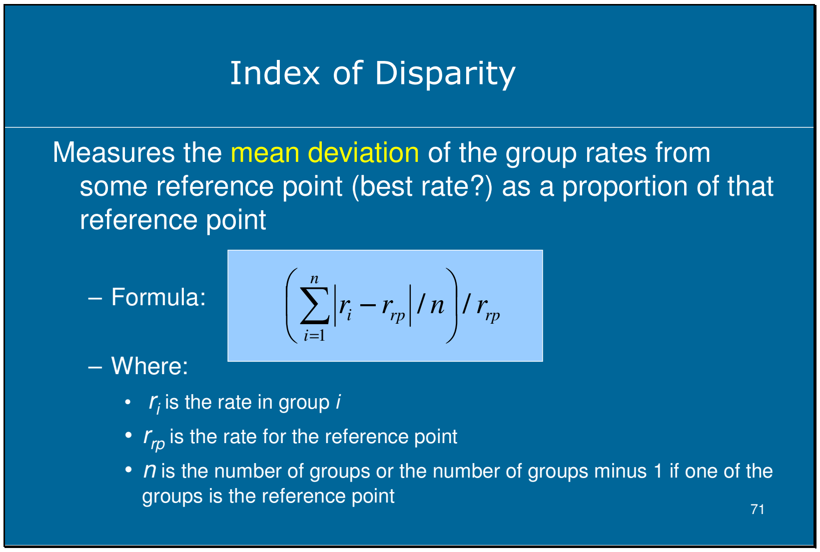
Index of disparity



Measure D: Index of Disparity.

Keppel and colleagues from the National Center for Health Statistics have recently proposed the ***Index of Disparity*** as a recommended means for measuring health disparities. You may see also see it in the academic literature.

Index of disparity



The index of disparity measures the mean deviation of several group rates from a given reference point (r_{rp}). The given reference point is usually the best group rate or total rate as a proportion of that reference point.

Keppel, et al., describe some of the more technical features of this measure in a paper cited in the *Resources* section. In essence, the calculation of the index of disparity simply involves the following process:

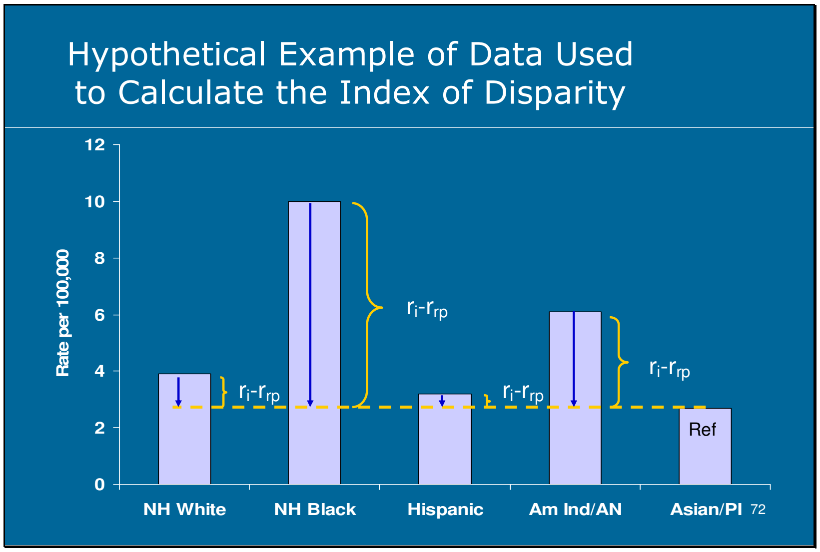
Subtracting each single group rate from the reference rate

Taking the absolute value of those differences

Summing all those differences, and

Expressing those differences as a proportion of the reference rate

Index of disparity



This is an example of what the index of disparity looks like in practice. Let's step through the process for determining this index.

1. Identify the reference rate. In this example, we want the best rate for this particular health outcome, which happens to occur among Asian/Pacific Islanders. The social groups deviate from this reference rate by different amounts. The largest deviation from this rate is among non-Hispanic blacks.

2. Sum up the deviations among all of the remaining social groups, as absolute values. In our example, that would mean summing up the deviations in rate from the reference group and the following:

Non-Hispanic whites

Non-Hispanic blacks

Hispanics

American Indians and Alaskan Natives

3. Average these deviations.

4. Divide the mean deviation we've just calculated by the reference rate, which is the rate among the Asian/Pacific Islanders.

Index of disparity

Index of Disparity: Calculation

How great is the mean deviation between race/ethnic-specific infant mortality rates and the total rate as a proportion of the total rate?

Mother's Race and Ethnicity	Infant Mortality Rate	$\lvert r_i - r_{rp} \rvert$
Non-Hispanic White, r_1	6.0	1.2
Non-Hispanic Black, r_2	13.9	6.7
Hispanic, r_3	5.8	1.4
Asian / Pacific Islander, r_4	5.5	1.7
American Indian / Alaska Native, r_5	9.3	2.1
Total Rate, r_{rp}	7.2	-
Sum of the Deviations $= \Sigma \lvert r_i - r_{rp} \rvert$		13.1
Mean Deviation $= \Sigma \lvert r_i - r_{rp} \rvert / n$		2.62
Index of Disparity = Mean Deviation / Reference Point $= (\Sigma \lvert r_i - r_{rp} \rvert / n) / r_{rp}$		0.36

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This table provides a new example, and more detail for calculating the index of disparity. The best rate is the lowest infant mortality rate, which is 5.5 among the Asian/Pacific Islanders. The highest rate, 13.9, is indicated in the non-Hispanic black row.

In this example, the total rate is the reference point.

The deviation from the total rate, among non-Hispanic whites, is 1.2, which is the absolute value of the rate among non-Hispanic whites minus the total rate.

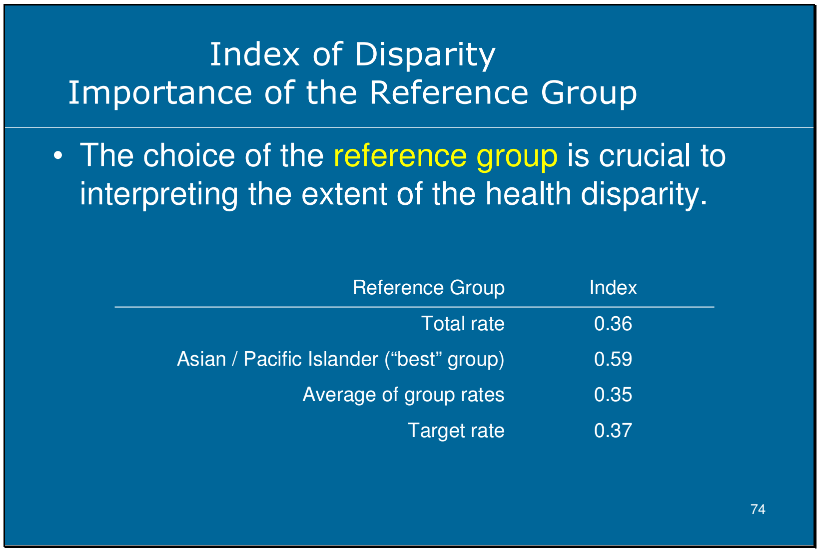
The deviation from the total among non-Hispanic blacks is 6.7, Hispanics 1.4, Asian / Pacific Islander 1.7, and American Indian/Alaskan Native 2.1.

If we sum all the deviations, we get 13.1.

The mean deviation, 2.62, is the sum divided by 5, the number of groups.

The index of disparity is .36, which is 2.62 (the mean deviation) divided by 7.2 (the total infant mortality rate) and is the mean deviation expressed in terms of the reference group rate.

Index of disparity



The size of the index of disparity depends on which reference group is chosen.

If we use the total rate as the reference group, as we did in the previous example, the index of disparity is 0.36.

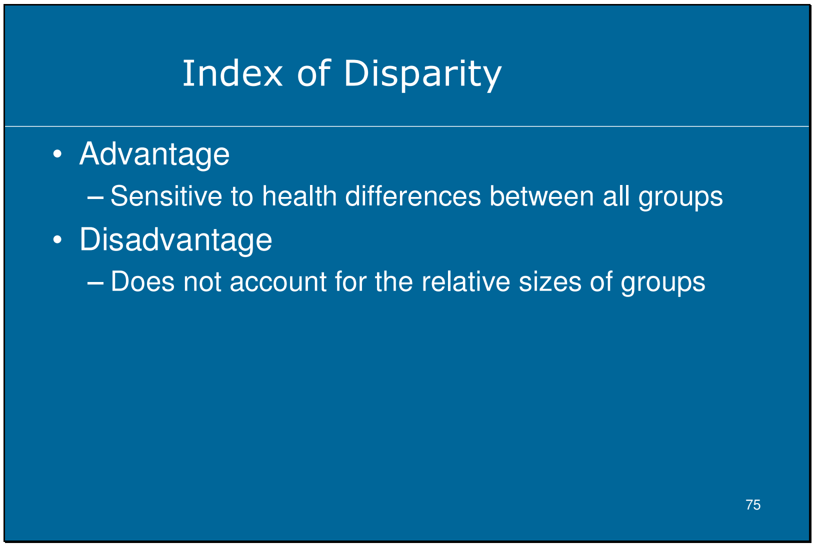
If we use the best rate, that of the Asian Pacific Islander, the index of disparity would seem to be much larger, at 0.59.

If we use the average of all the group rates, the value would be 0.35.

If we use the target rate, as laid out in Healthy People 2010, the index of disparity would be 0.37.

As you can see, the choice of reference group is crucial to interpreting the extent of health disparity. The authors of the Index of Disparity recommend choosing the best group rate as the reference rate.

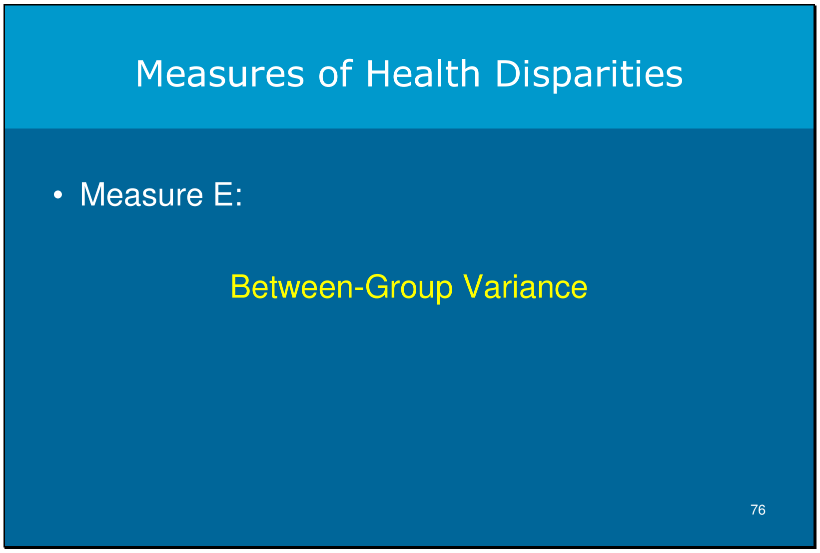
Index of disparity



The index of disparity only compares the rate or the prevalence. It is sensitive to health differences only, *not* the size of the groups experiencing those rates or the prevalence of the different health states.

The advantage of the index of disparity is its sensitivity to health differences between all groups. The disadvantage is that it does not account for the size of the groups, and it only compares rates or prevalence of health status.

Between-group variance



Measure E: Between-Group Variance

The Between-Group Variance measures the deviation of each group's rate from the population average and weights each group by its population size. This measure is similar to the index of disparity, except it has the desirable characteristic of including the size of the population.

Between-group variance

What is Between-Group Variance?

- Measures the deviation of each group's rate from the population average and weights each group by its population size
  - Formula:

$$\sum_{j=1}^{J} p_j \left(y_j - \mu\right)^2$$

  - Where:
    - y_j is the rate in group *j*
    - μ is the population average rate
    - p_j is the group's share of the total population

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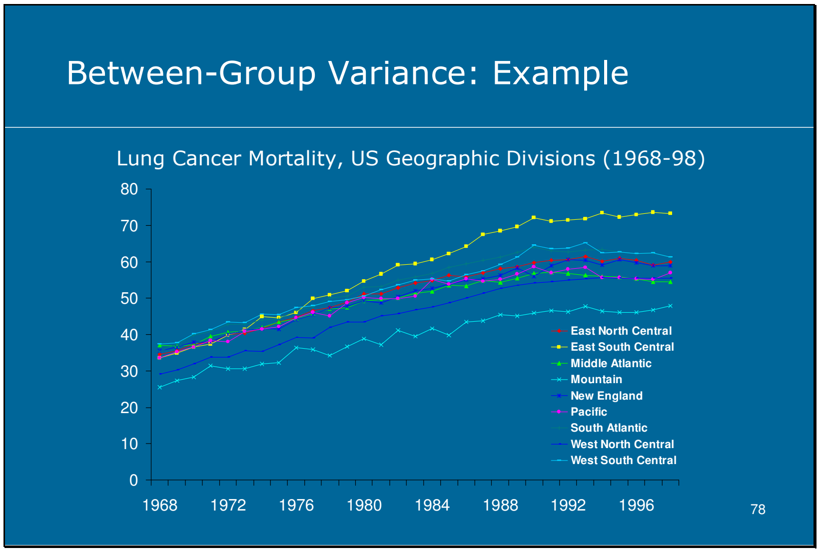
Notice in the formula that we use the squared difference of each group's rate and the population average. This means rates that are further from the population average will actually have a greater influence when we calculate the summary index.

For example, if the disparity between Group A and Group B is 4, the squared difference is 16. On the other hand, if the difference is only 2, then the squared difference is 4.

Even though the difference between the two groups is double (2 vs. 4) their contribution to the disparity measure is much larger (4 vs. 16) because the values are squared. By *squaring* the difference, we are implicitly saying greater disparities should be weighted more than smaller disparities. This is an excellent example of how our values and ideas about disparities may or may not be reflected in the measure of disparity.

The index of disparity we discussed earlier does not use a squared term in its calculation. In that measure, all deviations from the reference have the same "weight." Between-Group Variance, which uses a squared term, implicitly reflects a belief that groups further away from the reference group should get higher weighting when calculating the size of disparity.

Between-group variance



This is an example of data we might use if we wanted to answer the question, *"Have regional differences in lung cancer mortality increased over the last 35 years?"*

This is a typical question for health disparities investigators. But, where to begin?

In this example, nine different regional groups are represented. It is very hard to summarize the differences between all of them unless we use eight numbers to compare the mortality rates one-by-one, and group-by-group, and that does not take into consideration trying to analyze them over time.

A procedure like this would not be very efficient. In this type of situation, summary measures like the Between Group Variance are helpful.

Between-group variance

Between-Group Variance: Calculation

$$\sum_{j=1}^{J} p_j (y_j - \mu)^2$$

	1968			1998		
Region	% Pop	Rate	BGV	% Pop	Rate	BGV
New England	5.9	35.0	0.0	5.0	56.3	0.0
Middle Atlantic	18.5	37.0	0.9	14.2	54.0	1.3
East North Central	20.0	34.5	0.0	16.2	59.6	1.0
West North Central	8.1	29.2	2.5	6.9	54.8	0.4
South Atlantic	14.8	35.3	0.1	18.2	60.0	1.7
East South Central	6.3	32.6	0.3	6.1	70.1	10.4
West South Central	9.4	36.8	0.4	11.1	62.1	2.9
Mountain	3.9	27.5	2.1	6.3	46.2	7.4
Pacific	13.0	36.1	0.3	15.9	50.7	6.4
Total	**100.0**	**34.7**	**6.5**	**100.0**	**57.0**	**31.5**

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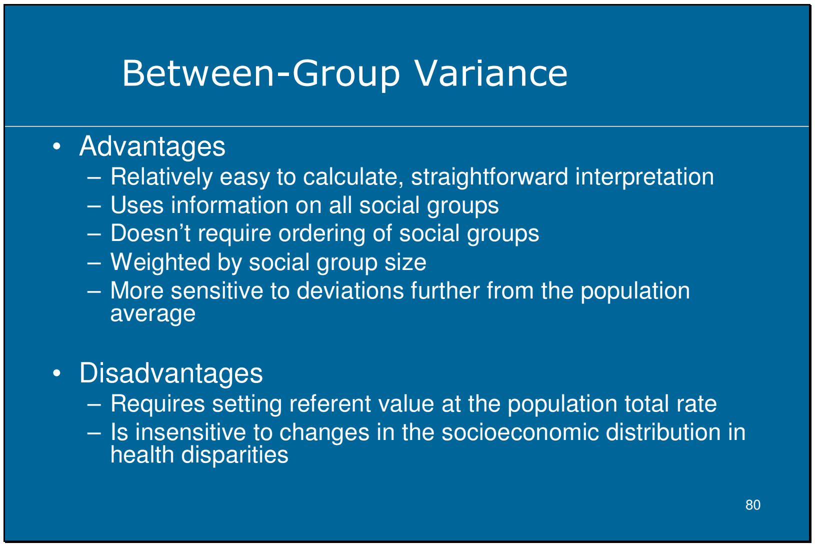
In this example, we are using graphical data from a spreadsheet to help us calculate the Between-Group Variance.

Applying the formula for the Between-Group Variance to the information provided in the columns “Percent Population” and “Rate” gives us the Between-Group Variance (the “BGV”) for each group in 1968 and 1998. In 1968, the total Between-Group Variance was **6.5 deaths per 100,000**. By 1998, BGV increased to **31.5 deaths per 100,000**.

Compared to the average rate in the population, much larger differences existed among the regions in 1998; the size of the difference increased about fivefold to over 30. The regional disparity is increasing over time.

This conclusion is supported by what we see when we look at the graph again. We see the disparities spreading out across the regions over time. The advantage of measures like the Between-Group Variance is that it provides a quantifiable number for the change in disparity.

Between-group variance

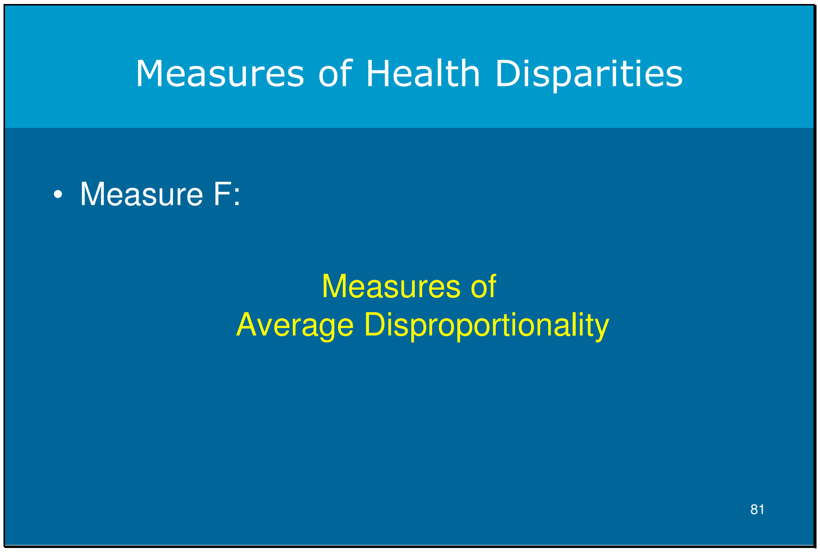


The advantages of the Between-Group Variance (BGV) include that it is relatively easy to calculate and is fairly straightforward in interpretation. It uses information on all social groups. It does not require ordering of social groups. (We just calculated Between-Group Variance for regions, which cannot be ranked). This measure is weighted by the group's size and is more sensitive to deviations further from the population average.

Disadvantages of the Between-Group Variance include that it requires setting a referent value at the total population rate. Also, BGV is insensitive to changes in the socioeconomic distribution in health disparities since it describes the change in the variation across social groups. It does not point to particular social groups that are experiencing improvements or declines.

The Between-Group Variance simply summarizes the amount of variation without regard to patterns of disparity between particular social groups.

Disproportionality measures



Measure F: Average Disproportionality

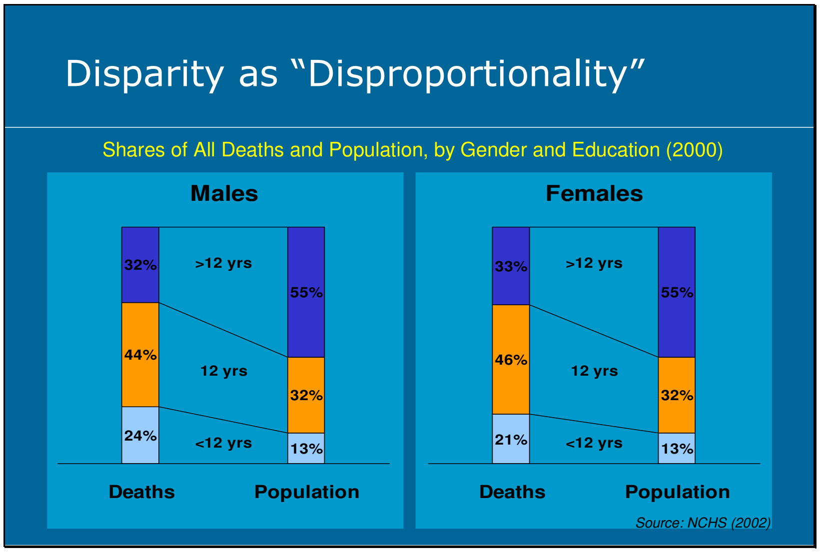
Like lots of things in life, there's no free lunch—the same is true in measuring health disparity.

The following measures are specifically designed to be like the other summary measures of health disparity, but they are somewhat more complicated in their calculation and interpretation.

These measures are more often used in disciplines like demography and economics. They are very rarely used in epidemiology and public health applications. However, they do have certain characteristics that make them attractive for the measurement of health disparities and they are more complicated to calculate.

To understand the application of these more complicated measures, which have some desirable characteristics but are not commonly used in public health, we'll begin with a discussion of disproportionality. After that, we'll work through examples of the Gini Index (or coefficient), Health Concentration Index, Theil Index, and Mean Logarithmic Deviation.

Disproportionality measures



We frequently use the language of disproportionality in health disparities research, intervention, and policy.

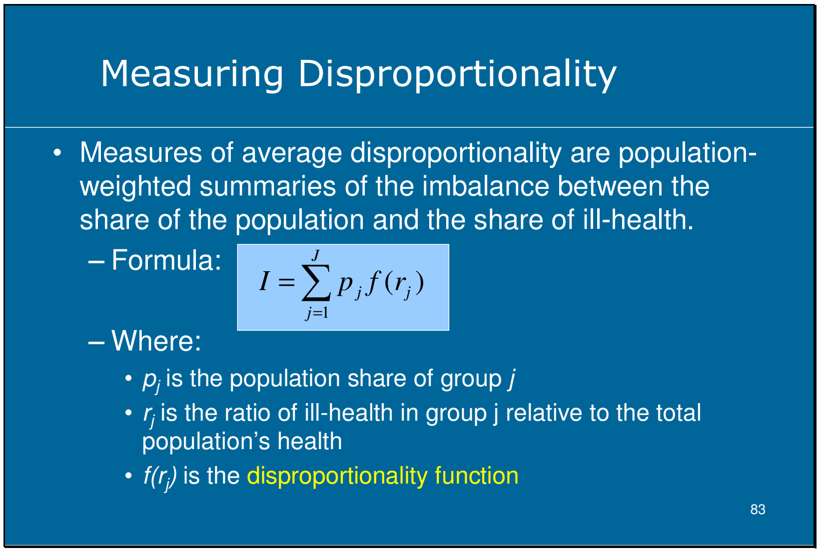
For example, we often hear that certain social groups bear a *disproportionate* burden of ill health. How would this concept be incorporated into a specific measurement? Literally, the measure would show there is a disproportionate burden of ill health borne by a group, relative to its size in the population.

If a population subgroup comprises a given percentage of the population, then the disease burden of this population should be equivalent.

Let's start on the right-hand side of this graph, with those females having less than 12 years of education. In the population, these females comprise 13% of the population, and yet they comprise 21% of the deaths attributed to disease. This is disproportionate. If it was proportional, they would have 13% of the deaths.

Notice that women with more than 12 years of education comprise 55% of all females in the U.S. Yet, they experience only 33% of the deaths. This is also disproportionate.

Disproportionality measures



Measures of disproportionality are population-weighted summaries of the imbalance between the share of the population and the share of ill health. In other words, if a population group represents 10% in the population, it should experience 10% of the share of ill health for there to be *no* disproportionality.

These measures take a generic form, as shown in the formula. It is a summary measure of a function of the ratio of ill-health in each subgroup (r_j) relative to the total population's health, weighted by the population share of that subgroup, (p_j).

The key difference between the types of disproportionality measures is how they express the ***f***, the mathematical function.

Disproportionality measures

Commonly Used Disproportionality Functions

Index Name	*Disproportionality Function $f(r_j)$*
Gini Index or Coefficient (*G*)	Individual-level data: $\| r_i - r_j \| / 2$ Grouped data: $r_j(q_j - Q_j)$, where q_j is the proportion of the total population in groups less healthy than Group *j*, and Q_j is the proportion of the total population in groups healthier than Group *j* (i.e., $p_j + q_j + Q_j = 1$)
Health Concentration Index (*HCI*)	Same as for G, but groups are ranked by social group position instead of by health, so that q_j is the proportion of the total population in groups less advantaged than Group j, and Qj is the proportion of the total population in groups more advantaged than Group j (i.e., $p_j + q_j + Q_j = 1$)
Theil Index (T)	$r_j \ln(r_j)$
Mean Logarithmic Deviation (MLD)	$\ln(1/r_j) = -\ln(r_j)$

Adapted from Firebaugh, 2003.

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Several commonly used measures use this general form, especially in economics, demography, sociology, and increasingly in epidemiology.

These measures include all of the following:

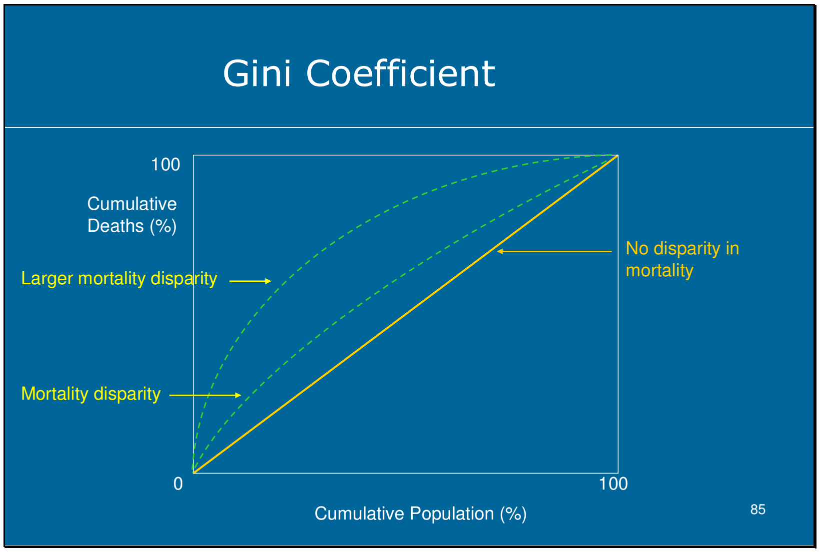
- The Gini Index
- The Health Concentration Index
- The Theil Index
- The Mean Logarithmic Deviation

Each differs in how it is constructed and each incorporates a particular view for how to express this function of disproportionality. Nevertheless, they all take the general form of trying to summarize the amount of disproportionality across population share and share of ill health.

We will provide an overview of these measures. Explaining the technical details of these measures is beyond the scope of this CD-ROM. However, you should be aware these measures of disproportionality exist.

For more details on how to calculate these measures, refer to the technical papers referenced in the *Resources* section.

Disproportionality measures – The Gini Coefficient



The Gini Coefficient can be depicted graphically. To start with, let's review the X and Y axes:
The cumulative proportion of the population, from 0 to 100%, is along the X-axis. The cumulative percentage of deaths (or another measure of disease burden) is on the Y-axis.

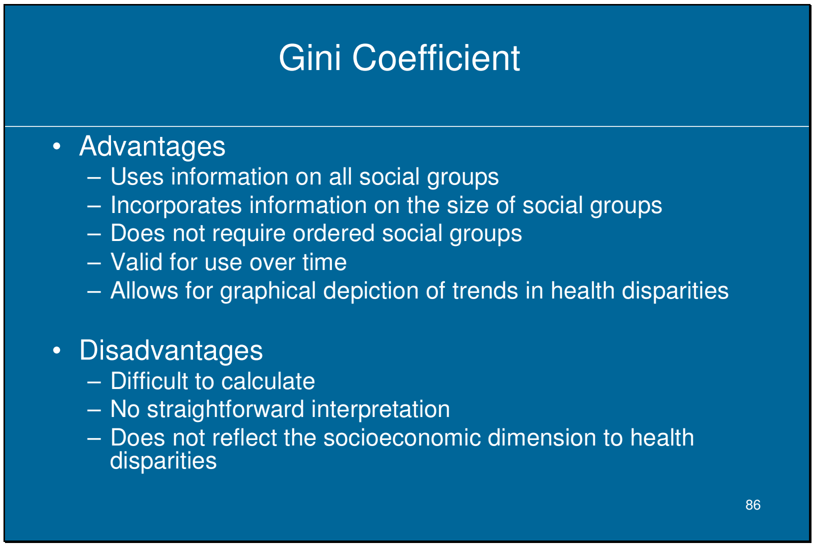
If no disproportionality in deaths exists, the Gini Coefficient equals 0 and 50% of the population would experience 50% of mortality, 10% of the population would experience 10 % of mortality, et cetera.

The diagonal line represents a population with no disproportionality between the cumulative proportion of the population and its cumulative experience of death.

When there is disproportionality, the ratio between cumulative proportion of the population and its cumulative experience of mortality is no longer 1 to 1. The Gini Coefficient, then, is represented as a curve and can range in value from -1 to 1, depending on which side of the diagonal it falls. As you can see, the depth of that curve indicates the depth of the disparity.

Frequently, the Gini Coefficient is used to measure income distributions, but it is not often applied to distributions of health in populations.

Disproportionality measures – The Gini Coefficient



There are several advantages to using the Gini Coefficient as a measure of disparity.

First, it uses information on all social groups so everyone in the population is represented.

Second, the size of the social groups are represented in the measure.

Third, it does not require social groups to be ordered.

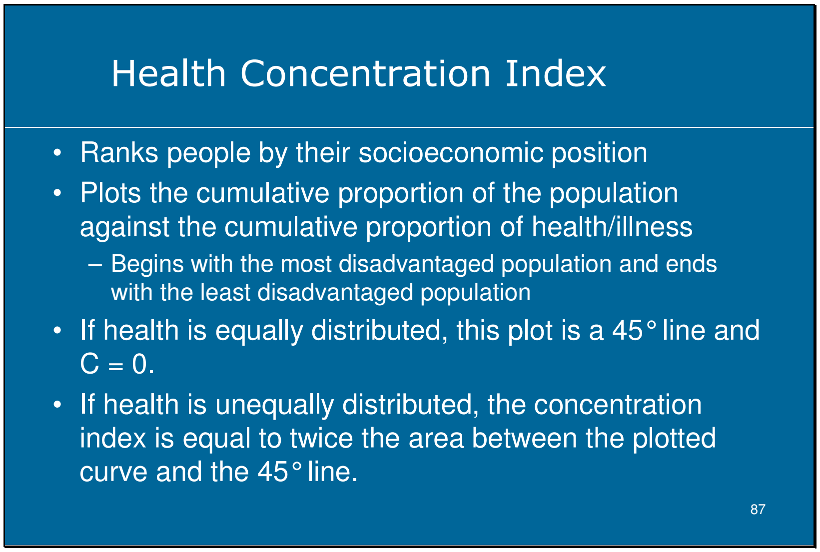
Fourth, it is valid for use over time.

And, finally, you can graphically depict this measure, which is often good for communicating with policymakers and the community.

There are disadvantages for using the Gini Coefficient as a measure of disparity. For example, it is somewhat difficult to calculate and its interpretation is not one to which we are commonly accustomed, especially as compared to relative risk. Another disadvantage is that it doesn't reflect the socioeconomic dimension of health. The basis for comparison is merely the cumulative proportion of the population against the cumulative proportion of the particular outcome of interest.

The Gini Coefficient is a measure of pure variation in health that does not explicitly include a consideration of social groups.

Disproportionality measures – The Health Concentration Index (HCI)



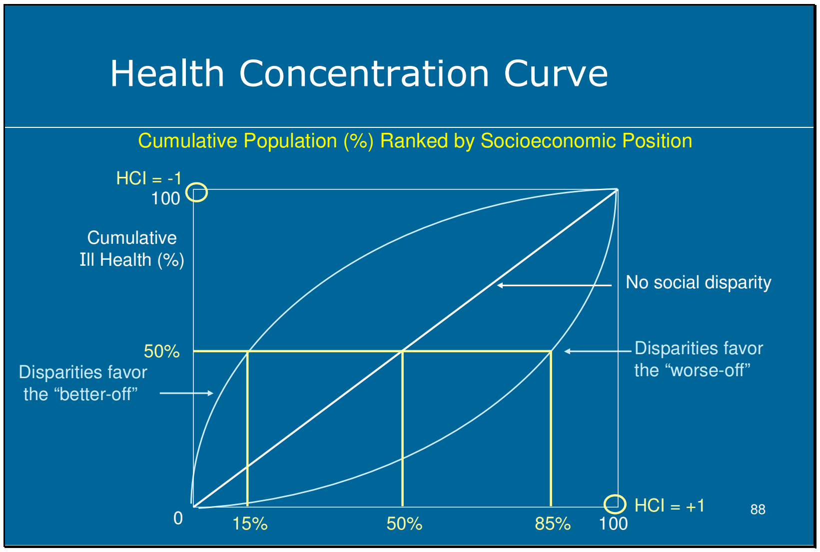
Another disproportionality measure used increasingly in public health is the Health Concentration Index (HCI).

Think of this index as an extension of the Gini Coefficient, but instead of using the cumulative proportion of the population, the HCI also arrays the population according to rankings by socioeconomic position. In this sense, it is like the RII we previously discussed and, in fact, the HCI is mathematically related to the RII.

Like the Gini Coefficient, the HCI is usually depicted graphically:
Plot the cumulative proportion of the population, starting with the most disadvantaged group and ending with the least disadvantaged, against this cumulative proportion of illness along the X-axis.
Graph the cumulative percentage of disease burden along the Y-axis, as we did previously.

Like the Gini coefficient, if health is equally distributed, the diagonal at 45° shows the concentration index to be 0, and no social group disparity in health will be apparent.

Disproportionality measures – The Health Concentration Index (HCI)



This is what a Health Concentration Index will look like.

The X-axis ranks the cumulative population by socioeconomic position, such as the cumulative proportion of the population by education, by income, or by some variable that can be rank-ordered.

The Y-axis plots the cumulative share of health.

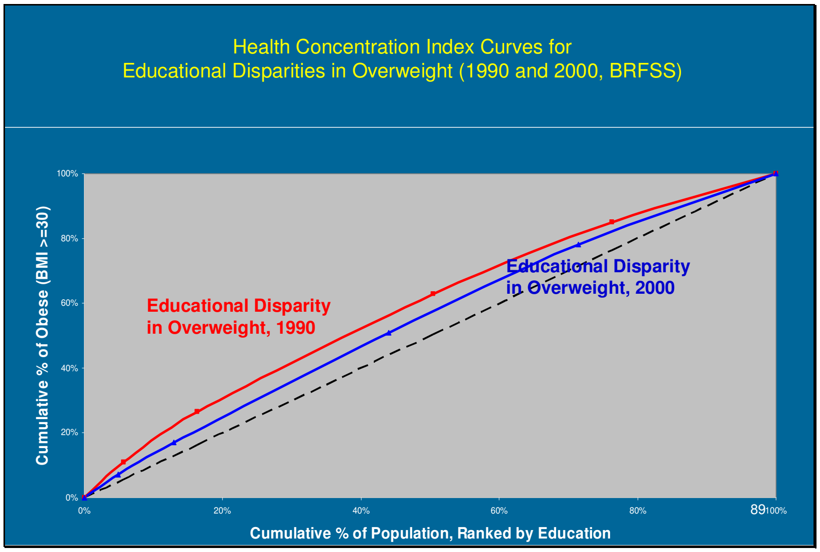
The line along the diagonal represents the situation in which 50% of the population ranked by the socioeconomic indicator encounters 50% of the ill health. In other words, ill health is equally shared by each socioeconomic group. Along the diagonal, the concentration index is equal to zero and the interpretation is that there is no social disparity.

But what if we had a curve that looked like this?

In this case, the 15% of the population that is the least-well-off in terms of socioeconomic position accounts for half of all the ill health in the population.

This is typical of what we see in health disparity situations in the U.S.: The least-advantaged groups suffer a disproportionate burden of ill health and disparities tend to favor the better off. It is possible for you to see this kind of curve in other situations, since not all health outcomes involve worse health among the disadvantaged. Some health outcomes are experienced disproportionately among advantaged groups. If this were the case, we might see that the most disadvantaged 85% of the population have 50% of the cumulative burden of ill health. Disparities would favor the worse off. For example, we might expect this if looking at socioeconomic differences in breast cancer incidence or melanoma.

Disproportionality measures – The Health Concentration Index (HCI)



This is an example using the Health Concentration Index as a measure, based on data from the 1990 and 2000 Behavioral Risk Factor Surveillance Survey. Here we are interested in educational disparities in the proportion of the total population that is overweight.

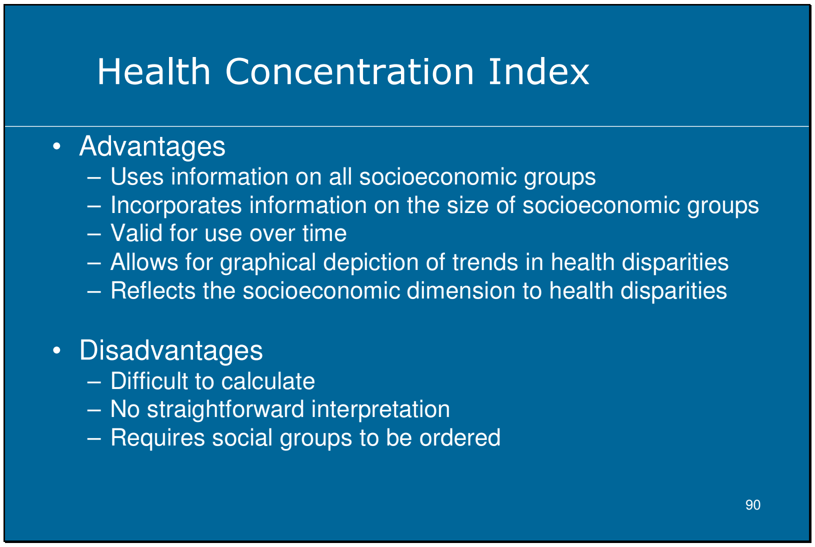
On the X-axis is the cumulative percentage of the population as it ranked by education. On the Y-axis is the cumulative percent of obesity (a BMI greater than or equal to 30).

We can interpret that the educational disparity in obesity is smaller in 2000 as compared to 1990. In other words, we would say from this data that we have reduced the educational disparity.

Unfortunately, the reduction in educational disparity from 1990 to 2000 has occurred because all social groups are more overweight in 2000. This points to how important it is to understand that, while disparity is reduced, one still needs to understand *how* disparities are reduced to determine if the outcome is positive.

In this case, the disparity has lessened because the better educated are also becoming more obese, which is obviously not a desirable public health outcome.

Disproportionality measures – The Health Concentration Index (HCI)

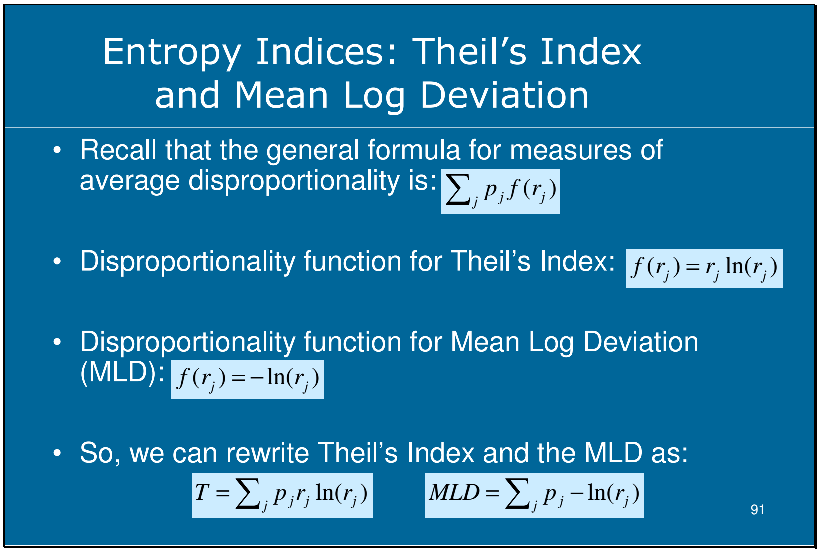


The advantages of the Health Concentration Index include the following. Like the Gini Coefficient, it uses information on all groups and accounts for the size of the groups.

It is valid for use over time because it can account for both changes in the health measure and changes in the composition of the social groups. It allows for graphical depiction of trends in health disparities. Unlike the Gini Coefficient, the Health Concentration Index has the advantage of reflecting the socioeconomic dimension to health.

The HCI does have disadvantages. For example, it is somewhat more difficult to calculate and has no straightforward interpretation, as does a relative risk. Unlike the Gini Coefficient, it requires the social groups to be ordered. As a result, you cannot use a concentration index to examine geographic or race/ethnic differences where there is no natural ordering or ranking of the groups.

Disproportionality measures – Theil's Index and Mean Log Deviation



The entropy indices like Theil’s Index and the Mean Log Deviation (MLD) are the most complicated measures we will discuss. However, we’re not going to spend a great deal of time describing these. Examples of the more technical details of these indices are referenced in papers included in the *Resources* section.

We need measures like Theil’s Index and Mean Log Deviation in disparities research so we can account for unordered groups.
These are some of the best measurement options we have when we want to have summary measures of race/ethnic disparity, for example.
These are measures that can summarize disparity over a large number of groups and do so over time in a reliable way.

Despite this, for a majority of people monitoring disparity in public health, this level of complexity may not be necessary. We present them to you for completeness.

Next, we will describe the sort of data that is used to derive Theil’s Index.

Disproportionality measures – Theil's Index and Mean Log Deviation

Example of Theil's Index and the Mean Log Deviation
Applied to the Racial Disparity in Colorectal Cancer Mortality (2001)

	(a) Colorectal Cancer Mortality Rate	(b) Population (%)	(c) Rate Relative to the Total Rate	(d) Theil Index	(e) Mean Log Deviation
American Indian/ Alaska Native	10.4	0.009	0.541	–0.0029	0.0053
Asian / Pacific Islander	12.1	0.040	0.629	–0.0116	0.0184
Black	30.0	0.109	1.559	0.0751	–0.0482
White	18.3	0.843	0.950	–0.0410	0.0431
Total	19.2			***0.0198***	***0.0186***

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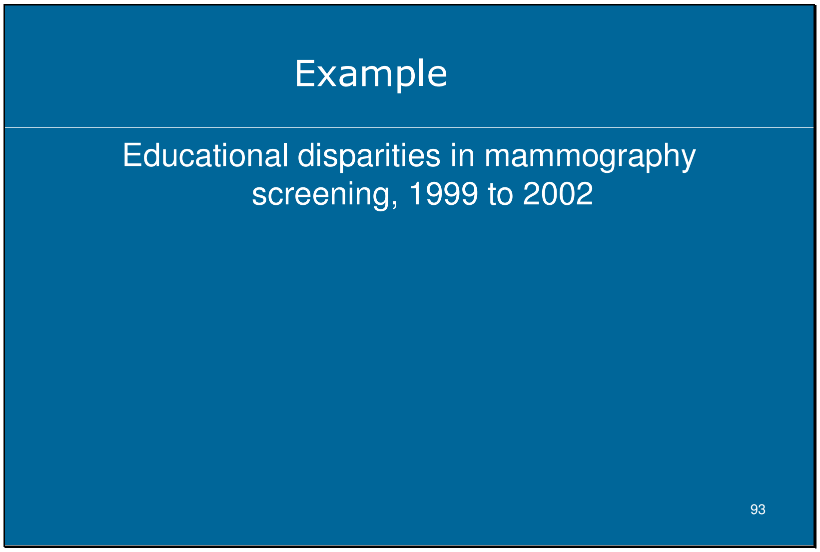
This table shows rates of colorectal cancer mortality by race in the year 2001. Column (a) shows the colorectal cancer mortality rate in each race/ethnic group. You can see that 10.4 is the rate per 100,000 among American Indian and Alaskan Natives.

Column (b) shows the population proportion, which is 0.009 (or .9%) for American Indians / Alaska Natives.

Column (c) shows the colorectal cancer mortality rate in each group relative to the rate in the total population. The mortality rate for American Indian / Alaska Natives is 10.4; dividing that by the total rate, which is 19.2 yields 0.541.

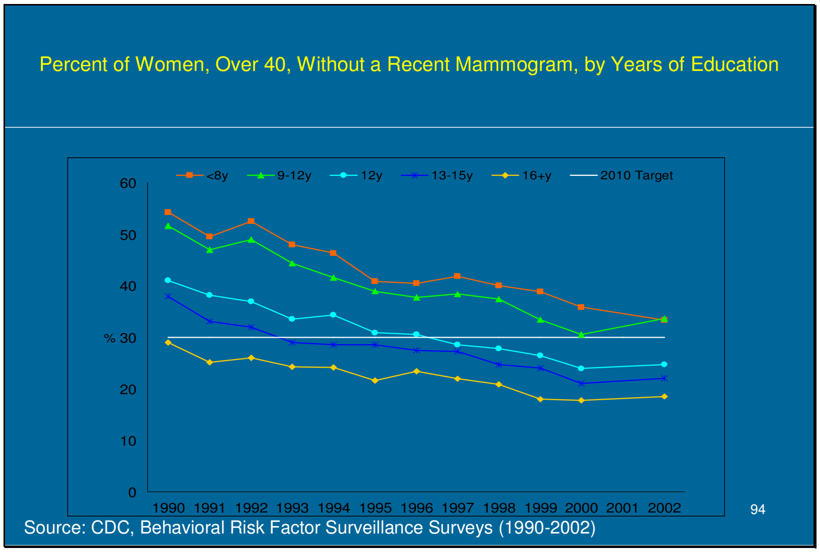
Columns (d) and (e) show Theil's Index and the Mean Log Deviation respectively. These values are generated by applying the formula for average disproportionality using the disproportionality functions for Theil's Index and Mean Log Deviations. When summarized across all race groups, we get a value of .0198 for Theil's Index and .0186 for Mean Log Deviations. Note that the value is slightly higher for Theil's index; this is because it uses a slightly different disproportionality function that gives more weight to the rate differences in each group while the Mean Log Deviation accords more weight to the population size of each group.

Example. Educational disparity in mammography



Let’s look at an example using the Health Concentration Index to monitor the change in educational disparities in mammography screening from 1990 to 2002.

Example. Educational disparity in mammography



To begin, plot the underlying rates for different educational groups to get a sense of the pattern of disparity.

Here, we've plotted the percent of women over forty who haven't had a recent mammogram, grouped by years of education. The white line represents the Healthy People 2010 target rate. The way this underlying data is characterized—using group-by-group comparisons, using relative risks, using a total summary measure like concentration index, or using another summary measure—will depend on the purpose in analyzing the data. Whatever the choice, you should always plot the underlying data first to provide an idea of the problem you are investigating.

What can we conclude when we look at this data?

First, the slopes of the lines show us that the rates of lack of mammography screening are going down in all groups

The change in slopes indicates that rates are decreasing faster in recent years.

The rates seem to be going down a little faster among the least educated as compared to the more educated.

We could also conclude from the data that the absolute disparity between the highest- and the lowest-educated has reduced, as indicated by the smaller gap between the two groups in 1990 as compared to 2002.

How can we summarize this story?

Example. Educational disparity in mammography

Calculate the HCI

Education	Rate	Pop %	Cumulative Pop %	Midpoint	HCI
1990					
<8 years	54.2	0.09	0.09	0.05	4.8756
9-11 years	51.6	0.14	0.24	0.17	6.1429
12 years	41.1	0.36	0.60	0.42	8.6579
13-15 years	38.0	0.22	0.82	0.71	2.4226
16+ years	29.0	0.18	1.00	0.91	0.4762
Total	41.0				22.5752
			Health Concentration Index→		***-0.1025***
2002					
<8 years	33.3	0.06	0.06	0.03	1.8212
9-11 years	33.7	0.08	0.13	0.10	2.4003
12 years	24.7	0.34	0.47	0.30	5.7839
13-15 years	22.1	0.27	0.74	0.61	2.3366
16+ years	18.6	0.26	1.00	0.87	0.6289
Total	23.6				12.9709
			Health Concentration Index→		***-0.0998***

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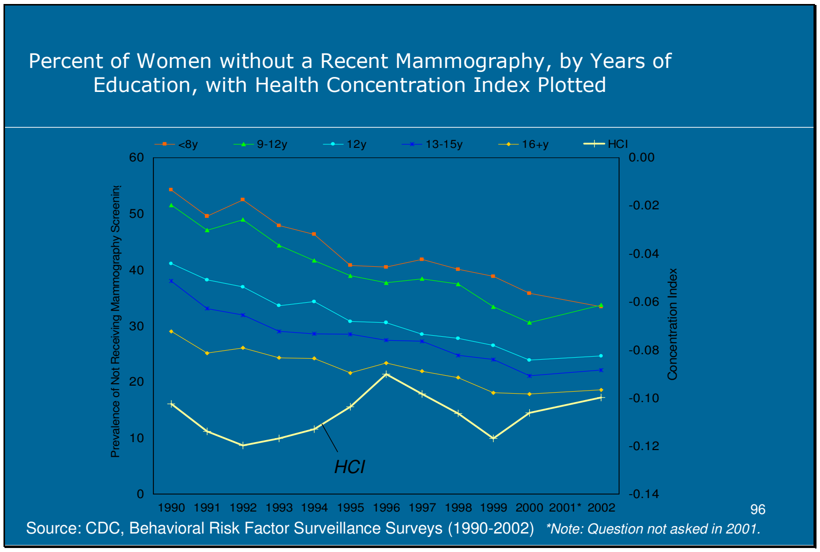
This is the data that would go into the calculation of the Health Concentration Index (HCI). It is evident from our discussion of HCI and by looking at the table data here, that education is arrayed by different groupings, mammography screening rates in each of the educational groups, the proportion of the educational groups in the population, the cumulative population proportion, the midpoint of that, and the actual calculation of the Health Concentration Index itself.

In 1990 the Health Concentration Index was -0.1025 and in 2002 it was -0.0998, suggesting that the educational disparity in mammography screening had reduced, as suggested by our initial graph.

Because the HCI is negative, we know that the disparities favor the better off. In other words, there is a greater burden of disparity among the less educated. If there was a need to come up with a number for how much the educational disparity in mammography had reduced from the 1990 levels, you could calculate the proportionate change in disparity by first subtracting 0.1025 and 0.0998, which equals 0.0027, and then dividing this by 0.1025 and multiplying by 100 which equals 2.6 %.

Example. Educational disparity in mammography



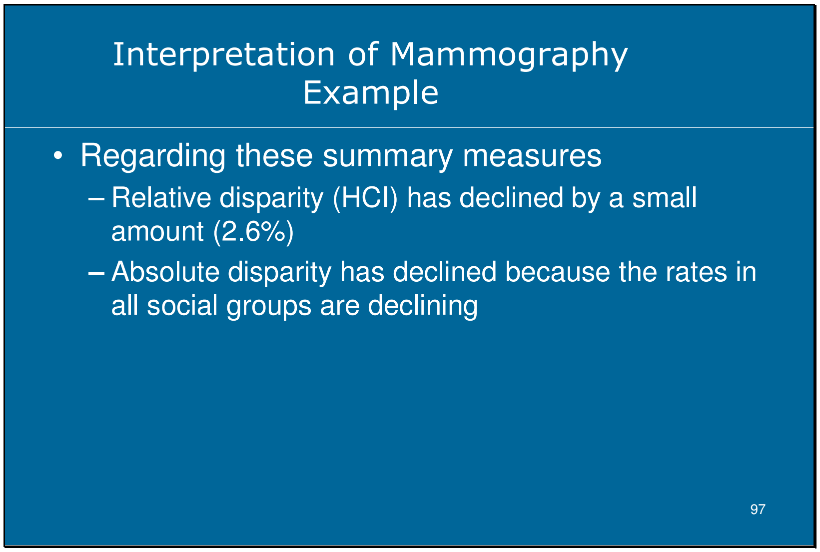
This graph again shows the underlying rates for not receiving mammography screening by the different educational groups, but it also plots the Health Concentration Index (HCI), a measure of relative disparity, over time.

You can see the increasing relative disparity from 1992 up to 1996 and then a decline to 1999.

Overall, however, there is a very small change, as indicated in that difference between -.10 (in 1990) and -.099 (in 2002) and the 2.6% reduction overall. Declines were seen in all groups such that the absolute disparity is reduced.

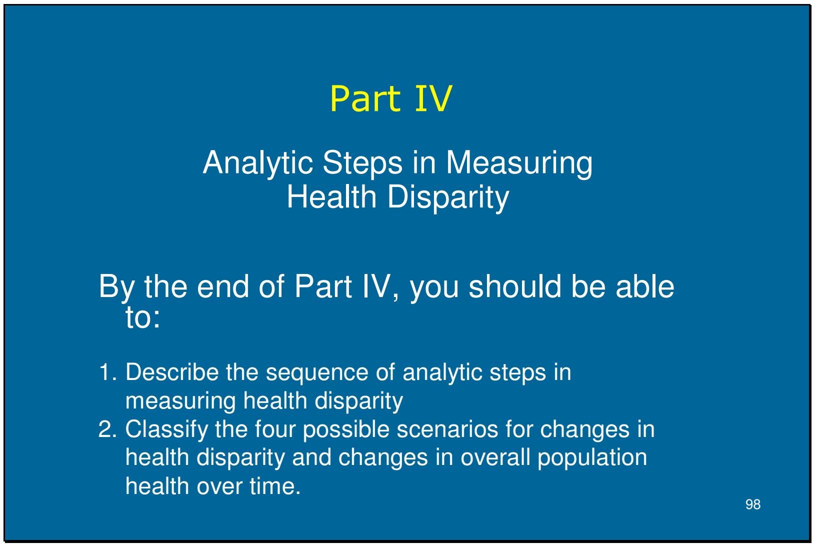
The combination of the graphical display of the underlying prevalence rates with some sort of summary measure like a Health Concentration Index allows for a more precise interpretation of the change in disparity.

Example. Educational disparity in mammography



The interpretation of the disparity, then, would be that, “In regard to these summary measures, relative disparity (HCI) has remained about the same, but absolute disparity has declined because the rates in all social groups are declining.”

Part IV – Analytic Steps in Measuring Health Disparity
Introduction

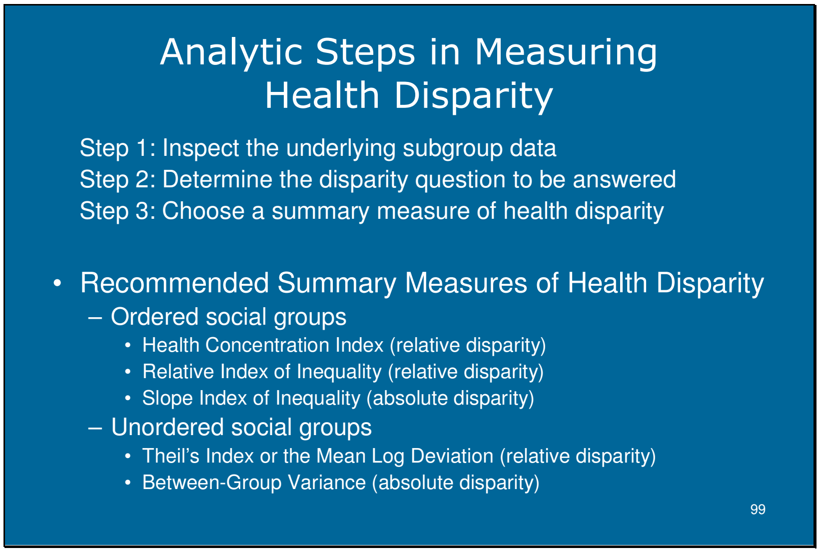


In Part IV, we will outline a set of analytic steps and recommendations in approaching measurement of health disparities. By the end of Part IV, you should be able to:

Describe the sequence of analytic steps in measuring health disparity, and

Classify the four possible scenarios for changes in health disparity and changes in overall population health over time.

Analytic steps - summary



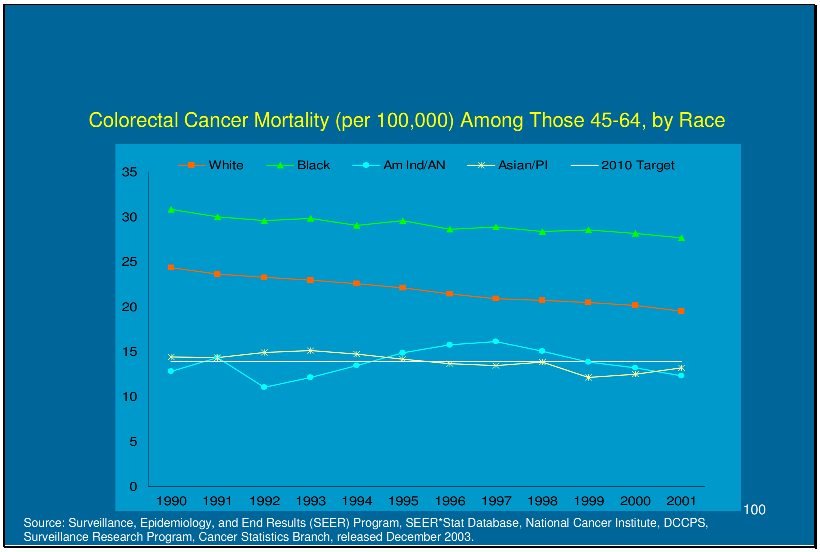
How does one get started using given data to characterize health disparity?

The first step is to inspect the underlying subgroup data. Look at the actual numbers that are going to be used in whatever measure will be chosen and graph them as we did before in the examples used in Part III. The purpose of this is to get a graphical feel for what you think the outcome will be.

The second step is to articulate the disparity question to be answered. Are you interested in comparing two groups? If that's all you're interested in doing, then a simple relative and absolute disparity comparison might be sufficient. It's not always necessary to use the most complicated measures. However, if your goal is to come up with a number that summarizes changes over time, including *all* social groups over time, then a summary measure is appropriate and you should choose the summary measure that is most suited to your data and your needs. For example, if you have data on ordered social groups, then you might use a relative disparity summary measure, like the Relative Index of Inequality or the Health Concentration Index. For a measure of absolute disparity, you would probably choose the Slope Index of Inequality.

For unordered social groups, use Theil's Index or the Mean Log Deviation as a measure of relative disparity or use the Between-Group Variance as a measure of absolute disparity.

Example. Racial disparity in colorectal cancer mortality



Let's use another example, one that involves a non-ordered social group like race to further explain these analytic steps. Specifically, we will look at racial disparities in colorectal cancer mortality from 1990 to 2001.

In the Theil's Index / Mean Log Deviation examples, we already showed you the cross-sectional 2001 data for colorectal cancer mortality per 100,000 among those ages 45-64 by race. In this graph, we can see what the colorectal cancer mortality rates look like in different race/ethnic groups over time, from 1990 to 2001. The white line is the target rate identified by Healthy People 2010.

How do we express the change in disparity among these groups?

Notice again, the first thing we did was plot the data. After reviewing the plotted data, our intuition is that not very much has changed, even though rates seem to be going down among whites and blacks. Note that rates are lower for other race/ethnic groups, like American Indians / Alaska Natives and Asian / Pacific Islanders, and these rates appear stable over time.

Example. Racial disparity in colorectal cancer mortality

Table A2: Example of Theil Index and the Between Group Variance Applied to the Change in Racial Disparity in Colorectal Cancer Mortality (1990 and 2001)

Education	Rate per 100,000 [μ_j]	Population share [p_j]	Rate relative to Total [r_j]	*T* [$p_j \times r_j \times \ln(r_j)$]	*MLD* [$p_j \times -\ln(r_j)$]	*BGV* $p_j\,[(\mu_j - \sum\mu_j)^2]$
1990						
Am Ind / AN	9.5	0.006	0.375	–0.0023	0.0062	1.607
Asian / PI	14.5	0.026	0.570	–0.0084	0.0147	3.130
Black	35.9	0.100	1.412	0.0486	–0.0344	10.979
White	24.7	0.868	0.970	–0.0255	0.0263	0.502
Total	25.5			***0.0124***	***0.0128***	***16.219***
2001						
Am Ind / AN	10.4	0.009	0.541	–0.0029	0.0053	0.672
Asian / PI	12.1	0.040	0.629	–0.0116	0.0184	2.018
Black	30.0	0.109	1.559	0.0751	–0.0482	12.561
White	18.3	0.843	0.950	–0.0410	0.0431	0.776
Total	19.2			***0.0198***	***0.0186***	***16.027***

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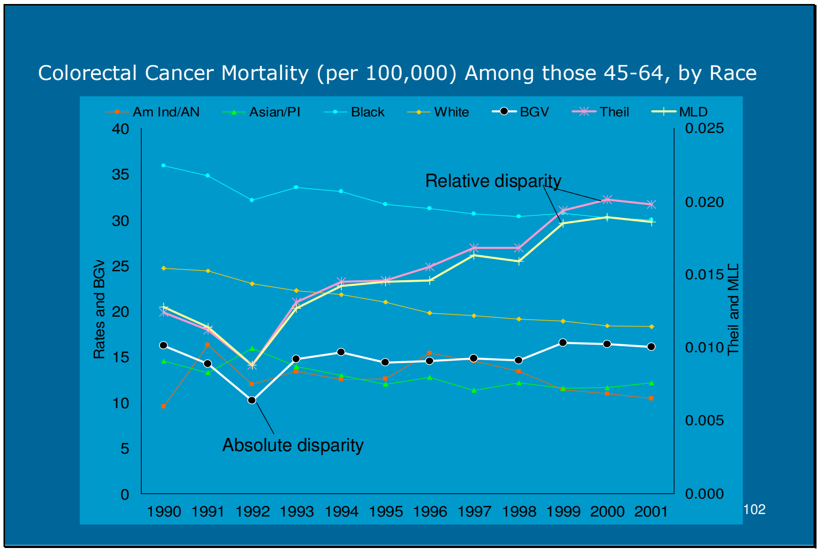
How is this disparity quantified? Can we calculate a single number to summarize this?

Here is the data we showed earlier when describing Theil's Index and the Mean Log Deviation. We have also included an absolute measure, the Between-Group Variance. We've done the calculations for these measures for 1990 and 2001. Once the calculations are completed, we plot the measures over time along with the underlying rates, just like we did previously for the Health Concentration Index of educational disparities in mammography screening.

Example. Racial disparity in colorectal cancer mortality



Looking at the Between-Group Variance over time, you don't see very much change in terms of absolute disparity.

However, for both measures of relative disparity, Theil's Index and the Mean Log Deviation, there is an increase from 1992 to 2001.

Example. Racial disparity in colorectal cancer mortality

Interpretation of Example

- Inspection of the graphs shows that most groups have retained their relative positions with only small fluctuations.
- In regard to these summary measures, relative disparity (T/MLD) has increased by a small amount, but absolute disparity (BGV) has remained almost constant.

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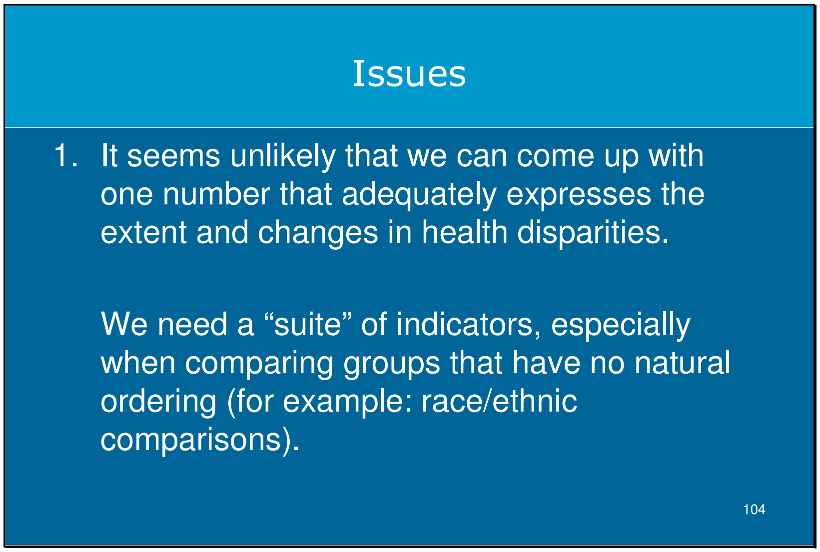
What is the interpretation of the increase in relative disparity?

Recognizing that it is somewhat difficult to interpret these changes in relative disparity because of the way the diagram is scaled, it looks like the relative disparity goes up enormously. Looking at the scale, we're talking about a change from .01 to .02. It's difficult to know how large that is in terms of a change in Theil's Index and the Mean Log Deviation. This rise in relative disparity is likely due to the rate for blacks, which is not decreasing as fast as it is in other groups. The rate for blacks is somewhat stagnated.

The interpretation of this colorectal cancer example would be that inspecting the graph shows most groups have retained their relative positions with only small fluctuations. With regard to these summary measures, relative disparity (as measured by Theil's Index or the Mean Log Deviation) has increased by a small amount, but the absolute disparity (as measured by the Between-Group Variance) has remained almost constant.

Integrating overall population health and health disparity



Please be aware that it is unlikely that we can come up with one single number that adequately expresses the extent and changes in health disparities.

In most cases we need a full “suite” of indicators, especially when comparing groups that have no natural ordering, such as race/ ethnic comparisons. Be creative in using different measures to give you different perspectives of the data.

At a minimum, you should usually take an absolute and a relative approach. In monitoring health disparities, the goal frequently is to be able to easily identify successes, failures, and trends in whatever the range of public health approaches we take. In so doing, it is important to involve an understanding of both the relative and absolute differences between groups and the overall population levels.

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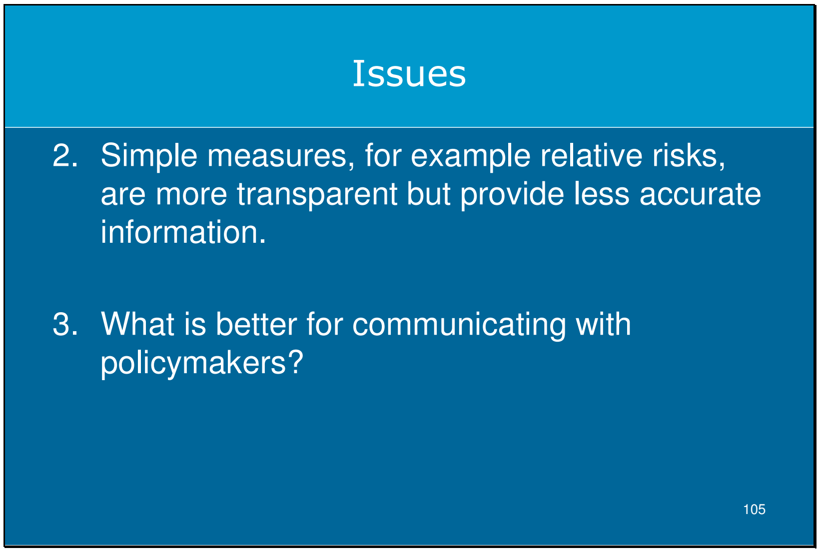
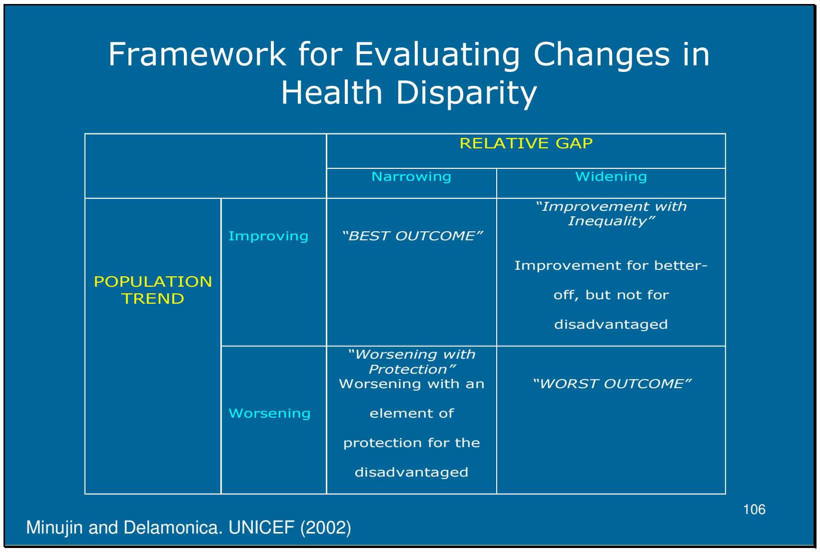
Integrating overall population health and health disparity



Simple measures, like relative risks, are much more transparent, but they can provide less accurate information. On the other hand, measures like the Health Concentration Index include more information about all socioeconomic groups and the size of them.

You should also consider which measure is easier for communicating with the public and with policymakers. We recognize that many of these less commonly used indices are not as easily understood and, in the short term, may not be as useful in facilitating communication.

Integrating overall population health and health disparity



We started with the idea that Healthy People 2010 has two goals: Improving the average level of health in the population and reducing disparity. These two aims need to be put together within a framework.

In one of the examples we used earlier that examined educational disparities in obesity, we saw that the disparity between the educational groups decreased, but they did at the expense of the entire population becoming more overweight. Clearly, that is not a desirable goal.

Here is a framework for thinking about the kinds of outcomes we would like to see in public health that relate to overall population trends, and also to gaps or disparity between groups.

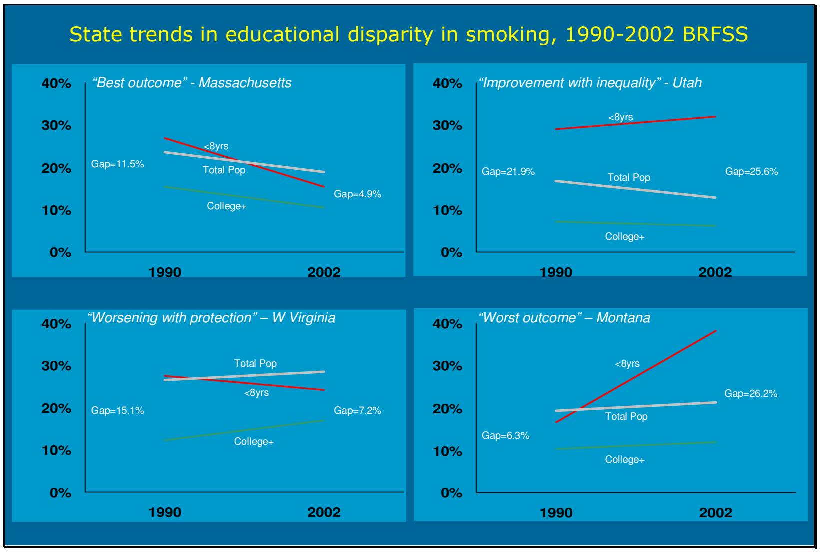
The best outcome cell of the table shows that the relative gap between social groups narrows, and the overall trend in the population improves.

It is also possible to see a widening of the relative gap, with an improving overall population trend. You would expect this when the more advantaged groups are improving faster than the disadvantaged groups. The relative gap would be widening, but overall the trend is improving. This situation might be expected with educational differences in smoking for instance.

In the third quadrant, there is an element of protection for the disadvantaged such that there is a worsening population trend, yet a narrowing of the relative gap. An example of this is the educational changes we saw in obesity where the overall population trend is worsening, but there is also a decrease in the relative disparity between social groups.

The worst outcome of all, of course, is that we have widening social group differences, widening of the relative gap, and a worsening population trend.

Integrating overall population health and health disparity



We will now show graphical examples of the four kinds of outcomes described by the framework for evaluating changes in health disparity. We will look at different states in the U.S. in terms of educational disparity in smoking from 1990 to 2002.

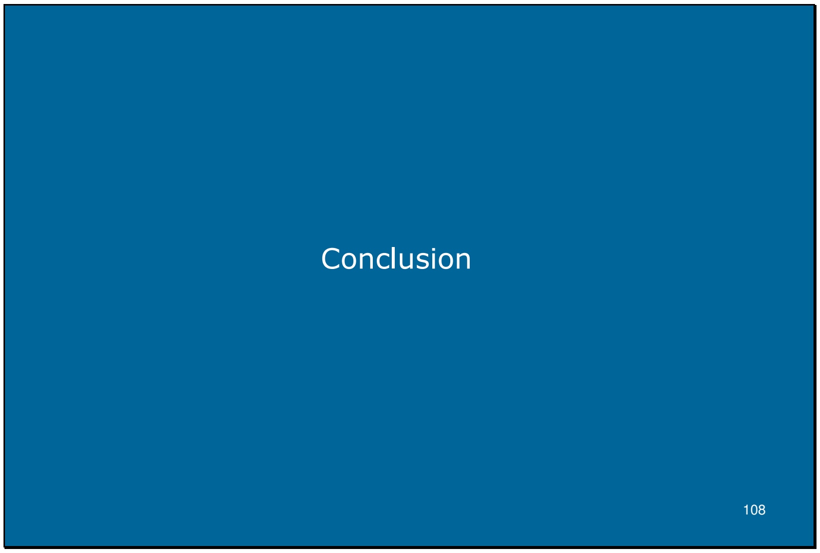
From a population health perspective, the optimal, or best, outcome occurs in a state like Massachusetts. The absolute educational gap in smoking from 1990 to 2002 got smaller, as shown by the red and green lines. The gap in smoking between the least and most educated was 11.5%, and decreased to less than 5% in 2002. Additionally, in the population overall, the rate of smoking is going down. That is the kind of picture we would like to see to be able to say we're achieving both Healthy People 2010 goals.

In Utah, we see "improvement with inequality." Here, the disparity widened, but the overall population rate went down. That probably reflects the small number of people in the least- educated group and its change over time. Nevertheless, there is something about being in the least-educated group in Utah that has worsened its relative position in terms of smoking during the period from 1990 to 2002.

In West Virginia, we actually see "worsening with protection." There is a decline in the relative gap because of an *increase* in smoking among the college-educated, but a *decline* among the least educated. This may be explained by the changing population distributions within educational groups over time. Also, we see an actual increase in smoking prevalence in the population as a whole.

In Montana, we see the worst outcome. In this situation the population smoking rate is going up and it is going up severely among the least-educated. The overall population health trend is poor and the situation among the least advantaged group is worsening over time.

Conclusion



This concludes "Measuring Health Disparities." We have examined the language of health disparity in an attempt to come to a common understanding of what the term means. We have also shown how to calculate different measures of health disparity and have highlighted how different measures implicitly reflect different perspectives on what it is about health disparity that is important to measure. We hope that this material provides a durable tool that will be useful to you in your daily activities.

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