Quantitative measurement & implications of race-based health disparities

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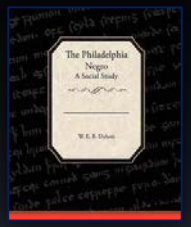
Introduction

- Since the nineteenth-century, there have been community, academic, philanthropic, and government efforts to better understand the black-white gap in health status

- The progress and direction of health disparities research that has been guided and encouraged by community, academic, government and philanthropic leaders has produced several reports and established major offices that have helped to structure how we understand this field

- For well over two decades the public health community has undertaken a broad range of initiatives to identify and eliminate health-related disparities.

Health Disparities Timeline 1899-2020



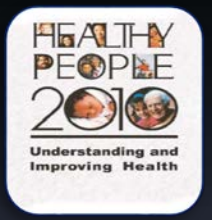
The Philadelphia Negro
1899

Black and Minority Health "Heckler Report"
1985

CDC Office of Minority Health
1988

Racial and Ethnic Approaches to Community Health (REACH)

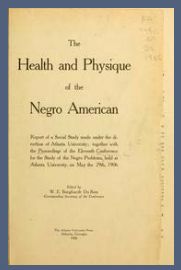
The Unequal Burden of Cancer: An Assessment of NIH Research and Programs for Ethnic Minorities and the Medically Underserved
1999



Healthy People
2010

1899 1906 1915-1951 1985 1986 1988 1990 1999 2000 2002 2010 2020

The Health and Physique of the Negro American
1906



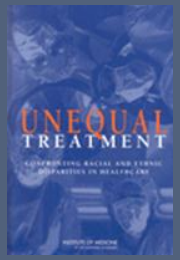
National Negro Health Movement
1915-1951

Office of Minority Health
1986

Office of Minority Programs at NIH
1990

Healthy People
2000

Unequal Treatment: Confronting Racial & Ethnic Disparities in Health Care
2002



Healthy People
2020

Definitions of Disparity

Healthy People 2020

- A particular type of health difference that is closely linked with social, economic, and/or environmental disadvantage

Dictionary

- Difference
- lack of similarity or equality; inequality; difference

Whitehead, 1992

- Differences in health that are not only unnecessary and unavoidable but, in addition are considered unfair and unjust

Health disparities adversely affect groups

- who have systematically experienced greater obstacles to health based on their
  - Racial or ethnic group
  - Religion
  - Socioeconomic status
  - Gender
  - Age
  - Mental health
  - Cognitive, sensory, or physical disability
  - Sexual orientation or gender identity
  - Geographic location
  - Other characteristics historically linked to discrimination or exclusion
  - Intersection of multiple characteristics

National Focus on Disparities

Healthy People 2000

- 3 overarching goals for the year 2000
- Increase the span of healthy life
- ***Reduce health disparities***
- Provide access to preventive health services

Healthy People 2010

- 2 overarching goals for year 2010
  - Increase the span of healthy life
  - ***Eliminate health disparities across the categories of gender, race or ethnicity, education or income, disability, geographic location, and sexual orientation***

Healthy People 2020

- 4 overarching goals for year 2020
  - Attain high-quality, longer lives free of preventable disease, disability, injury, and premature death
  - ***Achieve health equity, eliminate disparities, and improve the health of all groups***
  - Create social and physical environments that promote good health for all
  - Promote quality of life, healthy development, and healthy behaviors across all life stages

Government Agencies Define Disparities

CDC Office of Minority Health

- "Differences by gender, race or ethnicity, education or income, disability, geographic location or sexual orientation"

NIH 2005

- "differences in the incidence, prevalence, mortality and burden of disease and other adverse health conditions that exist among specific population groups in the United States"

NCI

National Center to Reduce Cancer Health Disparities

- "Disparities or inequities occur when members of certain population groups do not enjoy the same health status as other groups"

DISPARITIES MEASUREMENT GUIDELINES & MEASURES

Measuring Progress Toward the Goal of Eliminating Disparities

Conceptual Issues

- Despite increased attention to social disparities in health, no clear framework exists to define and measure health disparities

Different Methodological Approaches

- Choosing a particular measure of health disparity reflects, implicitly or explicitly, different perspectives about what quantities or characteristics of health disparity are thought to be the most important to capture

Choosing a Reference

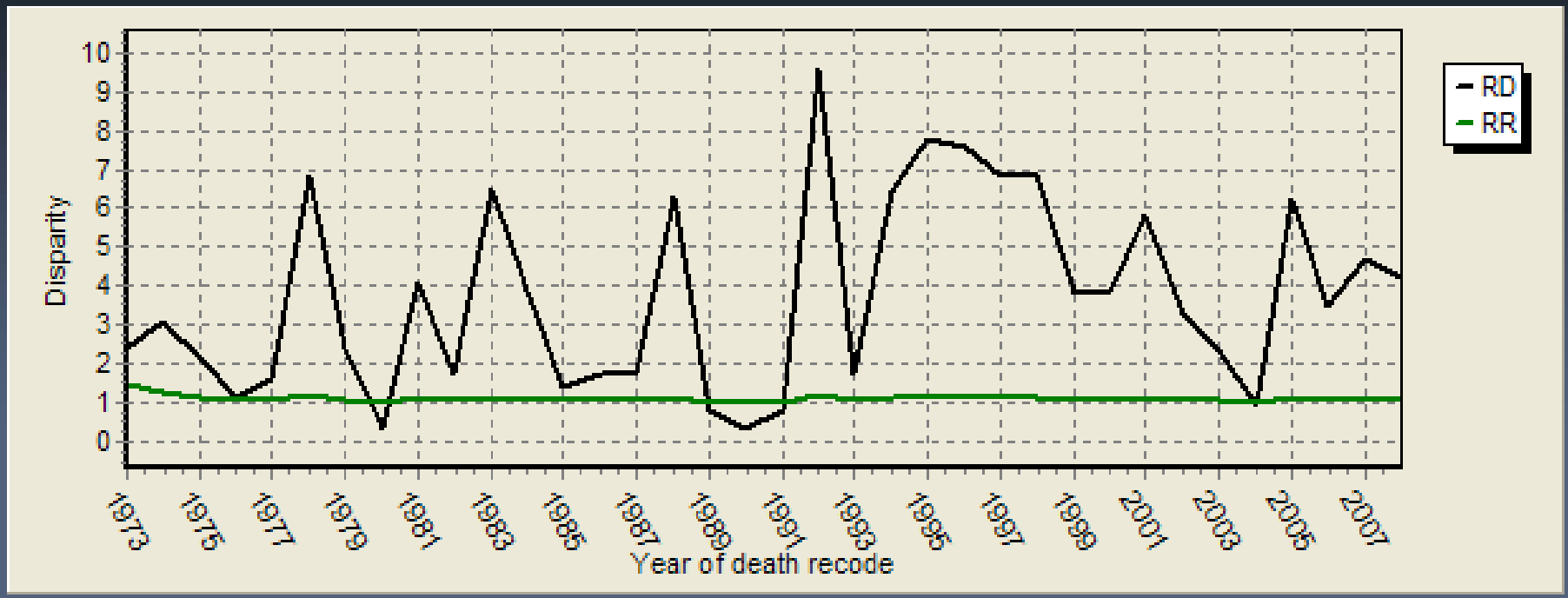
- **Guideline 1**: When disparities are measured, the reference point should be explicitly identified and the rationale for choosing a particular reference point should be provided.

- **Guideline 2**: If comparisons are made between two groups, the more favorable group rate should be used as the reference point
    - This would be the lowest rate assuming that rates are expressed in terms of adverse event

Source: http://www.cdc.gov/nchs/data/series/sr_02/sr02_141.pdf

Absolute Versus Relative Disparity

- **<u>Guideline 3</u>**: Disparities should be measured in both absolute and relative terms in order to understand the magnitude especially when making comparisons over time, across geographic areas, populations, or indicators.



- Absolute and relative measures of disparity can provide contradictory evidence concerning changes in disparity over time.

Adverse or Favorable Events

- Most health-related indicators can be expressed either in terms of favorable events or adverse events.
- A favorable event or characteristic is considered desirable and is promoted through public health action.
- An adverse event or characteristic is considered undesirable, and reduction or elimination is promoted through public health action.
- The utilization of mammography, for example, can be expressed as a favorable event (the percentage of women who had a mammogram within the past 2 years) or as an adverse event (the percentage of women who did not have a mammogram within the past 2 years).

Source: http://www.cdc.gov/nchs/data/series/sr_02/sr02_141.pdf

Measure Disparities in Terms of Adverse Events

- The size of an absolute disparity between a group and a reference point is the same whether the indicator is expressed in terms of favorable or adverse events (although the sign differs).
- The magnitude of a relative disparity depends on whether the indicator is expressed in terms of favorable or adverse events.
- **Guideline 4**: When relative measures of disparity are employed to compare disparities across different indicators of health, all indicators should be expressed in terms of adverse events.

Source: http://www.cdc.gov/nchs/data/series/sr_02/sr02_141.pdf

Guidelines 5-8

- **Guideline 5**: Pair-wise comparisons are called for when the objective is to measure disparity for each racial/ethnic group.

- **Guideline 6**: Summary measures can be used to quantify the degree of disparity across all racial/ethnic groups.

- **Guideline 7**: Conclusions based on summary measures should always be interpreted in conjunction with the group-specific rates on which they are based.

- **Guideline 8**: The choice of whether to weight the component groups when summarizing disparity across a domain should take into consideration the reason for computing the summary measures. In addition, implications with respect to other types of decisions, such as the choice of a reference point, need to be considered.

Source: http://www.cdc.gov/nchs/data/series/sr_02/sr02_141.pdf

Guidelines 9-11

- **Guideline 9:** The size of the groups and the number of persons affected in each group should be taken into account when assessing the impact of disparities.

- **Guideline 10 (not applicable to race):** When the primary interest is in how health varies with the amount of the characteristic defining the domain rather than with the groups themselves, summary measures of disparity that take into account the order of groups should be considered

- **Guideline 11:** Whenever possible, a confidence interval should accompany each measure of disparity.

Source: http://www.cdc.gov/nchs/data/series/sr_02/sr02_141.pdf

Measures of Absolute Disparity

Rate Difference (RD)

Between-Group Variance (BGV)

Rate Difference (RD)

- $RD = r1 - r2$
- RD is often used to compare the health of less-advantaged social groups to more-advantaged
- *r1* and *r2* are indicators of health status in two social groups
- *r2* serves as the reference population
  - *r2* the healthiest group
- *r1* corresponds to the least healthy group

Between-Group Variance Measurement

- $$BGV = \sum_{j=1}^{J} p_j (y_j - \mu)^2$$
- p_j - group j's population size
- y_j - group j's average health status
- μ - the average health status of the population

Between-Group Variance interpretation

- *BGV is* interpreted as the variance that would exist in the population if each individual had the mean health of their social group (i.e., no within-social group variation)
- *BGV* weights by population group size and is sensitive to the magnitude of larger deviations from the population average

Measures of Relative Disparity

Rate Ratio(RR)

Index of Disparity (IDisp)

Theil Index (T)

Mean Log Deviation (MLD)

Rate Ratio (RR)

- *RR = r1 / r2*
- *r1* and *r2* are indicators of health status in two social groups
- *r2* serves as the reference population
- *r2* the healthiest group
- *r1* corresponds to the least healthy group
- RR measures the relative difference in the rates of the best and worst group at each time point

Index of Disparity (Idisp)

$$ID_{isp} = \left(\sum_{j=1}^{J-1} \left| r_j - r_{ref} \right| / J \right) / r_{ref} \text{ x } 100$$

- r_j indicates the measure of health status in the jth group
- r_{ref} is the health status indicator in the reference population
- J is the number of groups compared
- IDisp summarizes the difference between several group rates and a reference rate, and expresses the summed differences as a proportion of the reference rate

Theil Index (T) & Mean Log Deviation (MLD)

- $$T = \sum_{j=1}^{J} p_j r_j \ln r_j$$

$$MLD = \sum_{j=1}^{J} p_j \left(- \ln r_j \right)$$

• *pj* - proportion of the population in group *j*

•*rj* - the ratio of the prevalence/rate of health in group *j* relative to the total rate

• T and MLD are measures of general disproportionality

•Summaries of the difference between the natural logarithm of shares of health and shares of population, population-weighted, more sensitive to health differences, may be used for both ordered and unordered groups

Characteristics of health disparity measures

Disparity measure	Absolute or relative	Reference group	All social groups	Reflect SES gradient	Social group weighting	Inequality aversion parameter	Graphical analogue
Rate ratio	Relative	Best	No	Yes	No	No	Yes
Index of disparity	Relative	Best	Yes	No	No	No	No
Theil index	Relative	Average	Yes	No	Yes	Yes	No
Mean log deviation	Relative	Average	Yes	No	Yes	Yes	No
Rate difference	Absolute	Best	No	Yes	No	No	Yes
Between-group variance	Absolute	Average	Yes	No	Yes	Yes	No

Ordinal Measures of disparity

Used when the social groups have natural ordering

GO	NO
• Socioeconomic status • Income • Education • Age	• Race/ethnicity • Gender • Sexual identity • Religion • Sexual orientation • Geographic location

Absolute Ordinal Disparities Measures

- Absolute Concentration Index (ACI) is a measure of the covariance between social rank and health, derived by plotting the cumulative share of the population, ranked by social status, against the cumulative amount of ill health (i.e., the cumulative contribution of each subgroup to the mean level of health in the population)

$$\overline{y}_j = \beta_0 + \beta_1 \overline{R}_j$$

- Slope Index of Inequality (SII)
- j - social group, y - average health status, R_j - average relative ranking of social group j in the cumulative distribution of the population
- b_0 - estimated health status of a hypothetical person at the bottom of the social group hierarchy
- b_1 - difference in average health status between the hypothetical person at the bottom of the social group distribution and the hypothetical person at the top

Relative Ordinal Disparities Measures

- Relative Concentration Index (RCI) measures the extent to which health or illness is concentrated among particular social groups

$$RCI = 2\,\mathrm{var}(x)\left(\frac{\beta_1}{\mu}\right)$$

- Relative Index of Inequality (RII) measures the proportionate (in regard to the average population level) rather than absolute increase or decrease in health between the highest and lowest socioeconomic group

$$RII = \frac{\beta_1}{\mu}$$

Characteristics of Ordinal Health Disparity Measures

Disparity measure	Absolute or relative	Reference group	All social groups	Reflect SES gradient	Social group weighting	Inequality aversion parameter	Graphical analogue
Slope Index of Inequality	Absolute	Average	Yes	Yes	Yes	No	Yes
Absolute concentration index	Absolute	Average	Yes	Yes	Yes	Yes	Yes
Relative Index of Inequality	Relative	Average	Yes	Yes	Yes	No	Yes
Relative concentration index	Relative	Average	Yes	Yes	Yes	Yes	Yes

Choice of Disparity Measure

Does the choice of a measure of disparity matter?

- Yes! Substantively different interpretations concerning the level and trend in disparity can result from using different measures of health disparity on the same data

Why does the choice of disparity measure matter?

- Most of the disagreement between measures of disparity depend on two issues
  - Scale on which disparity is evaluated: relative/absolute
  - Do they weight social groups by population size: weighted/un-weighted

Choosing a Suite of Disparity Indicators

1. Visually inspect tables and graphs of the underlying "raw" data

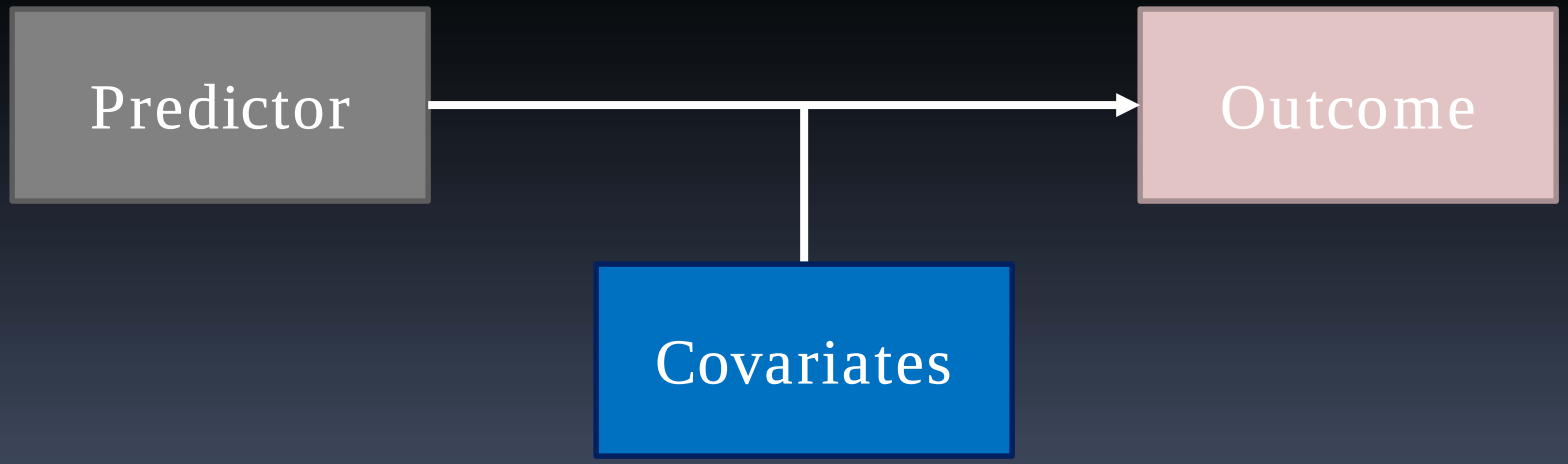
2. Comparisons of specific groups then pairwise absolute and relative comparisons

3. Use summary measures of health disparity when objective is to provide a summary across all groups

4. Comparisons across multiple groups that have no natural ordering (e.g., race/ethnicity) or the social group has a natural ordering (e.g., education and income)

RACE AS AN ANALYTIC VARIABLE

Creating an Analysis Plan

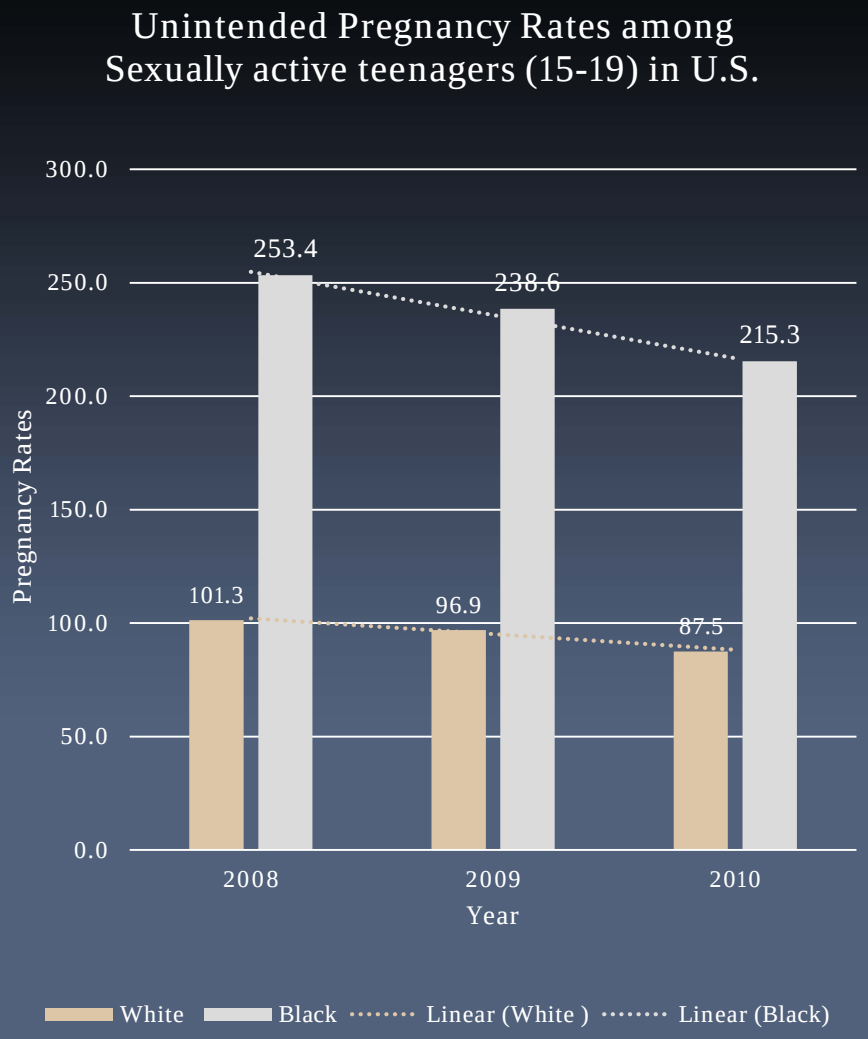


- There should be a conceptual framework for which hypotheses are based
- Statistical models should be developed to test theses hypotheses
- Other variables may be of interest because they affect the relationship between the predictor and outcome
- The role of the race variable in the model depends on the hypothesis being tested
  - main predictor, confounder, mediator, or effect modifier

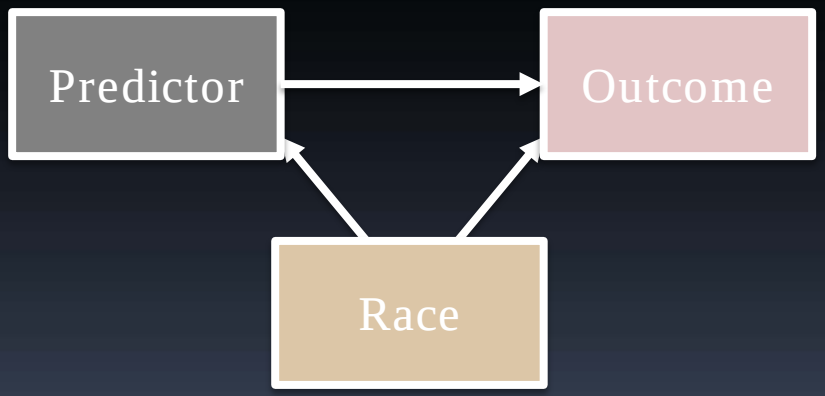
Race as a Primary Predictor

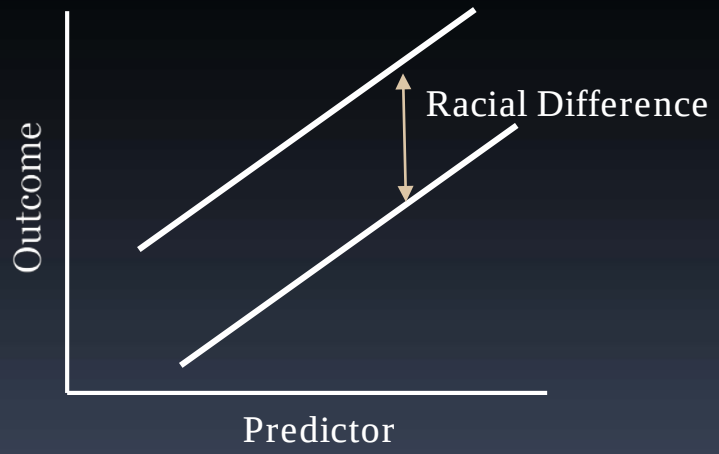
Hypothesis: There are racial differences in the outcome

- Include race as predictor in the model
- Control for confounding factors



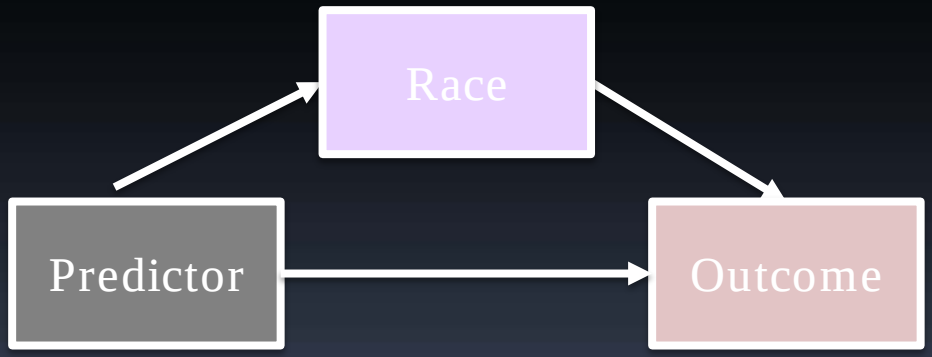
Race as a Confounder





- Race is associated with both the predictor and the outcome but is not in the primary hypothesis
- While it is extraneous it should not be omitted due to model bias that distorts the magnitude of the relationship between the predictor and the outcome
- Not an intermediate step in the causal path
- Not a surrogate for the exposure
- In a regression, race should be included as a covariate
- Assumes race has an additive effect

Race as a Mediator



- Rather than hypothesizing a direct causal relationship between the independent variable and the dependent variable, a mediational model hypothesizes that the independent variable influences the mediator variable (race), which in turn influences the dependent variable.
- Association between dependent variable and independent variable
- Independent variable is a significant predictor of race
- Race is a predictor of the outcome
- Race is significant predictor of the dependent variable controlling for the independent variable
- Previously significant path between the independent and dependent variable is now greatly reduced (partial mediation) or not non-significant (full mediation).

Race as an Effect Modifier

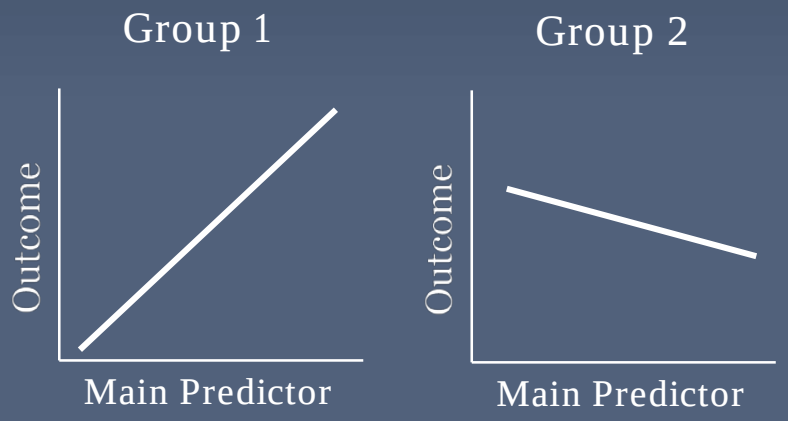
Effect modification/interaction hypothesis: There is a difference in the association between the predictor and outcome depending on race.

Interaction Term

- Same predictors
- Different intercepts
- Different slopes

Stratified Analysis

- Different/same predictors
- Different intercepts
- Different slopes



DESCRIPTIVE ANALYSIS OF 2014 RACE-BASED HEALTH DISPARITIES MEASUREMENT LITERATURE

Approach

Using the Pubmed, JSTOR, and Ovid databases, we examined racial health disparities literature from 2014

Key words “racial healthcare disparities,” limited to articles in English, and year = 2014

A database of studies that measured a racial disparity was compiled

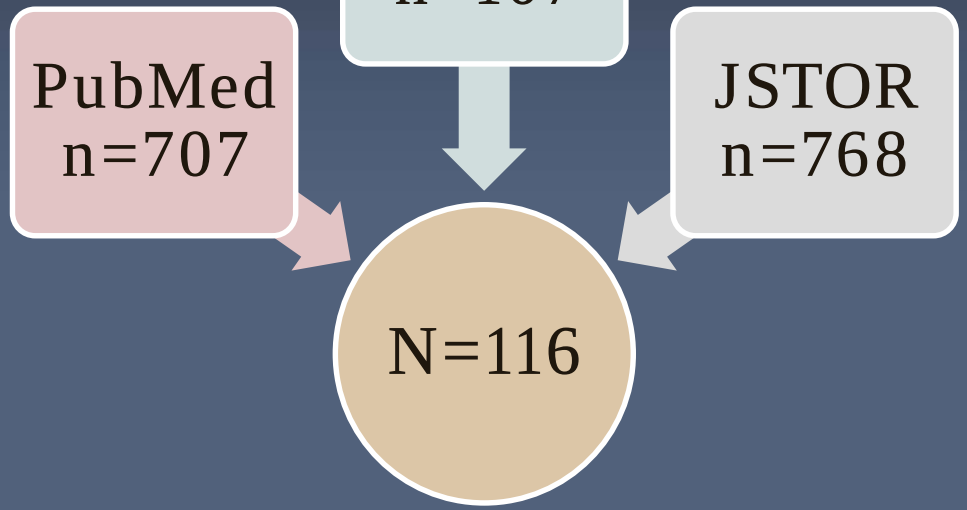
Studies that did not compare at least two groups were excluded

We analyze data by:

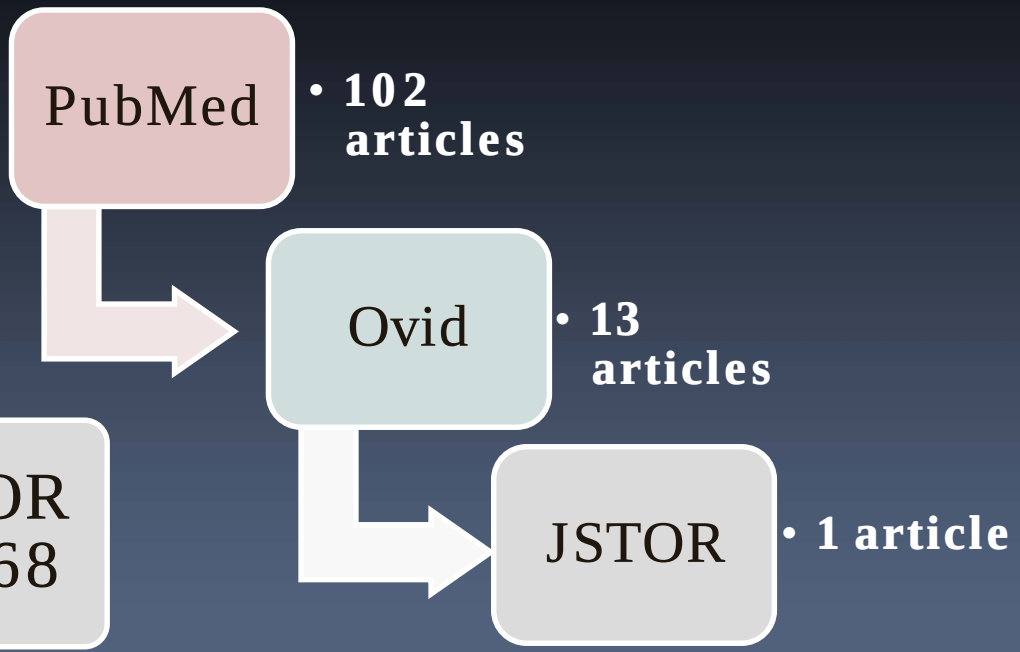
Journal category, populations compared, disease examined, study design, and generation of health disparities research

Database Searches

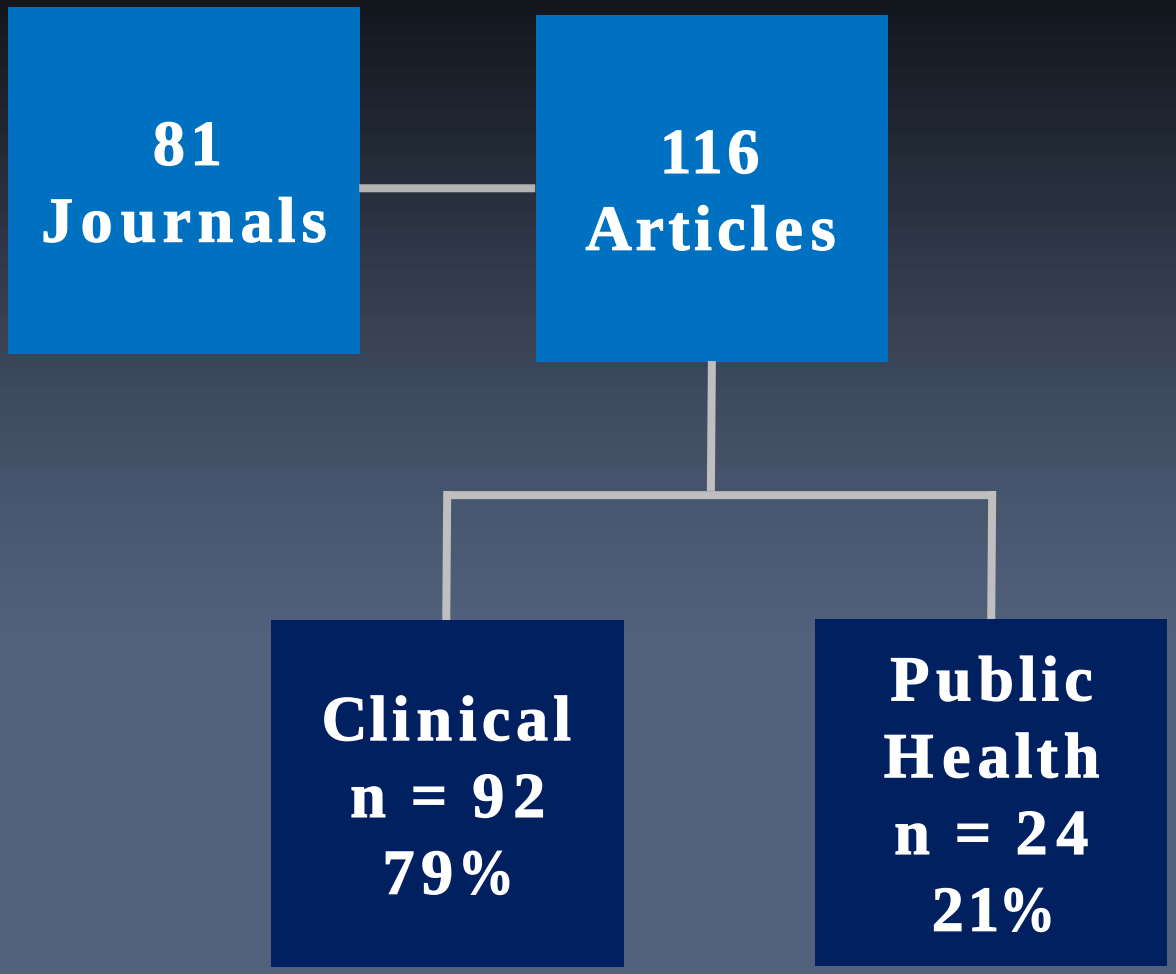
Search Results



Sample Development

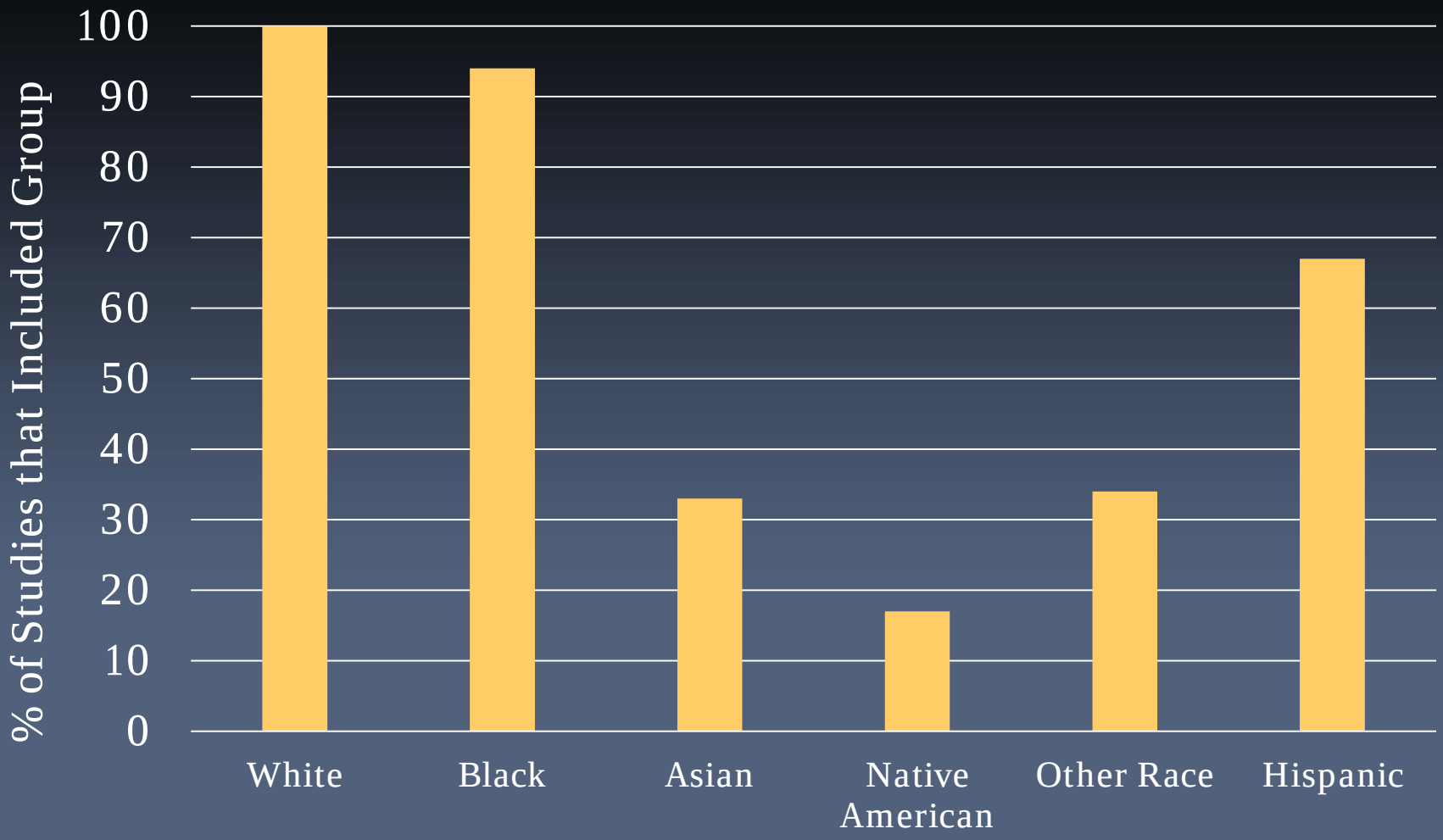


Articles by Journal Category



- 112 (97%) of the articles published in journals with a measured impact factor.
- The average journal impact factor was 4.80 (SD = 7.34).

Racial/Ethnic Groups Compared



Study Design

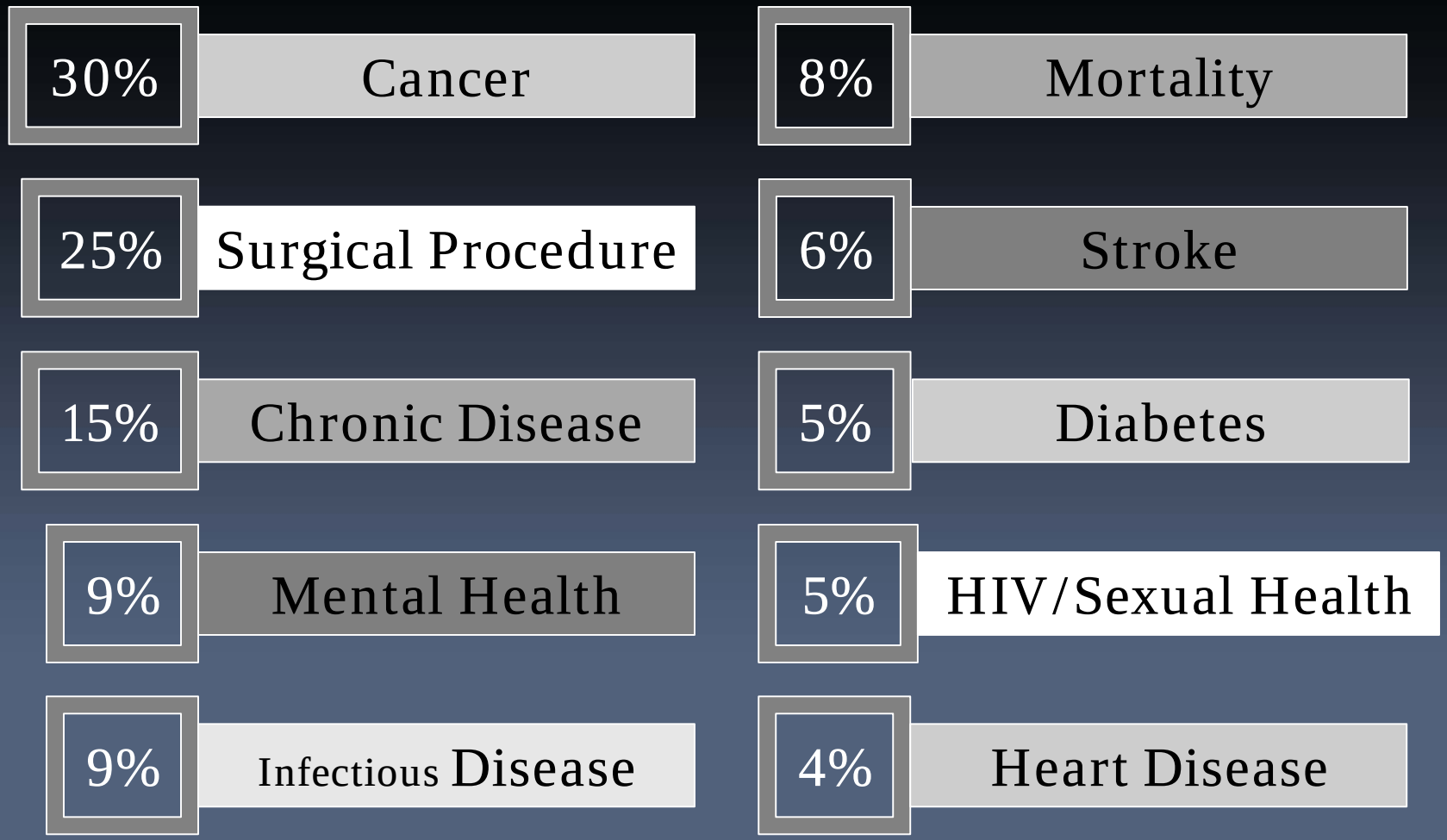
100%
Observational Studies

91%
Secondary Data Analysis

44%
Examined Neighborhood Factors

22%
Multilevel

Outcomes Examined



More articles examined cancer as an outcome that any other condition (35 of the 116 papers).

Generations of Disparities Research

1st Generation – 70% of articles
Do disparities exist?

2nd Generation – 24% of articles
Why do disparities exist?

3rd Generation – 6% of articles
Do interventions work?

Measures of Health Disparities

Type of Measure Used	n	%
Absolute	7	6.0
Relative	62	53.5
Absolute and Relative	24	20.7
Significance Test Only	23	19.8

Are publications meeting the 11 guidelines?

Number and percentage of articles meeting each guideline											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
n	101	77	7	43	96	2	115	7	34	NA	80
%	87.1	66.3	6.0	37.1	82.8	1.7	99.1	6.0	29.3	NA	69.0

Number and percent of Guidelines Met by article								
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**
n	13	3	4	12	38	33	9	4
%	11.2	2.6	3.5	10.3	32.8	28.5	7.8	3.5

Meeting the Guidelines

- The average number of guidelines met for the articles was 5.8 out of 11 (SD = 1.8).
- The minimum number of guidelines met was 2 and the maximum was 9.
- 69% of the articles presented confidence intervals around the absolute or relative measures.
- Of articles that presented an absolute or relative measure, 77% used the more favorable rate as the reference point
- 98% had an explicit reference point.
- 42% with calculated disparity measures presented the measures in terms of adverse events.

Type of Measure and Generation of disparities research

Statistically significant associations were found between generation and:

- **Type of measure used** ($p = 0.0410$). The majority of 1st and 2nd generation articles used relative measures only, while absolute measures only were most common in 3rd generation articles.

- **Use of an relative measure** ($p = 0.0231$). Relative measures were least common in 3rd generation research and most common in 1st.

Are we going the right way?

Standardize Reporting

Each study should document:

- The 11 guidelines are followed
- Study characteristics
  - Individual or multi-level
  - Intervention, observational study, RCT
  - Primary data collection or secondary data analysis
  - State neighborhood or contextual factors examined
  - Populations compared
- Disease or risk factor examined
- Generation of health disparities research
- Data source
- Use both an absolute and relative measure of disparity
  - Type of disparity measures used

Conclusions

- We still lack an evidence-based approach to disparities reduction
- There is a need for statistical infrastructure to monitor progress and evaluate change in the reduction of health disparities
- Given the theoretical and measurement differences within the literature a clear direction on how best to define disparities by disease and population is needed
- In order to be able to systematically examine the racial disparities literature there is a need for standardized reporting and use consistent methods for quantifying change

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