

Genomics and Disparities in Health and Health Care: Challenges and Opportunities

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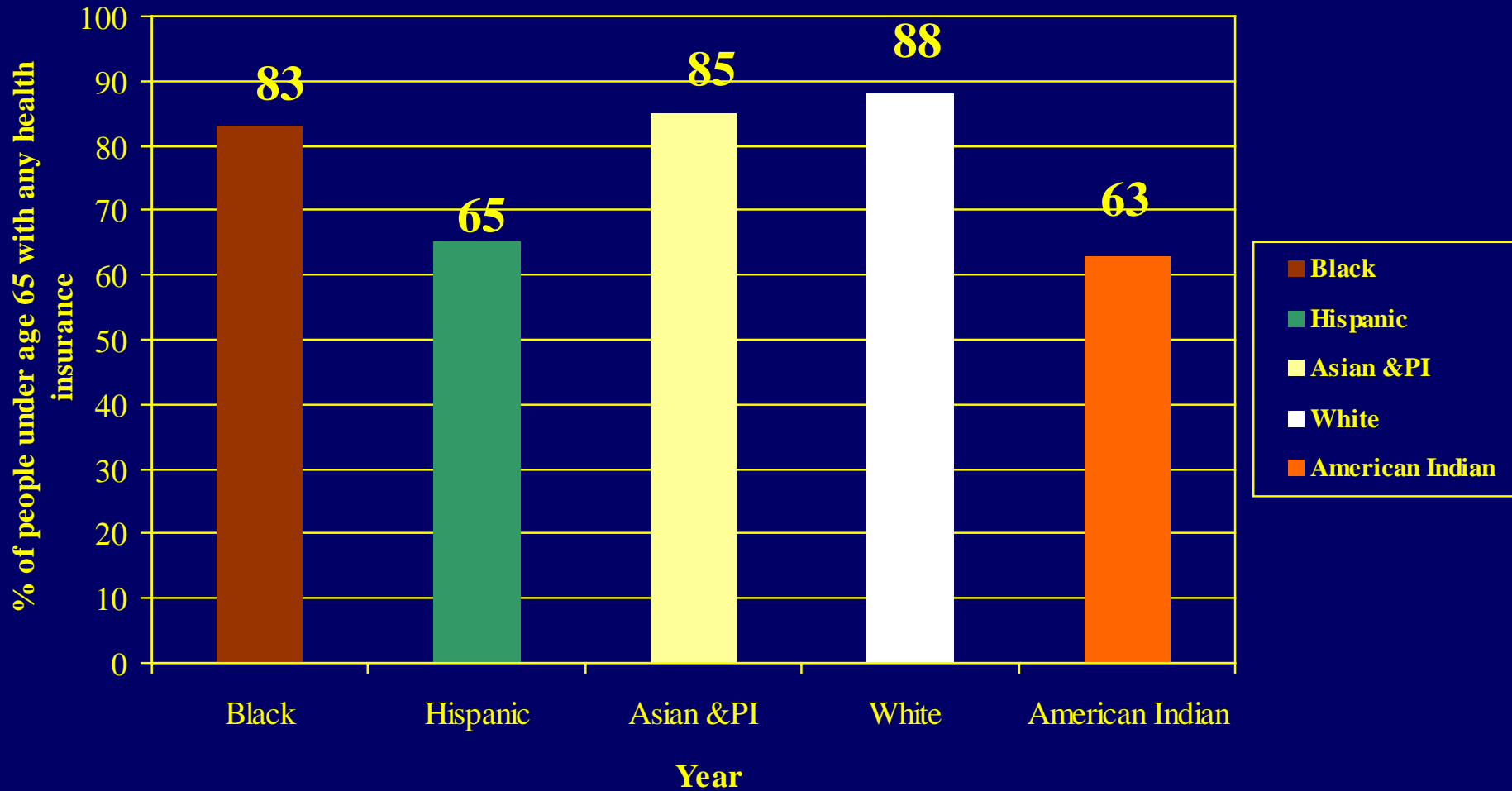
Florence & Laura Norman Professor of Public Health
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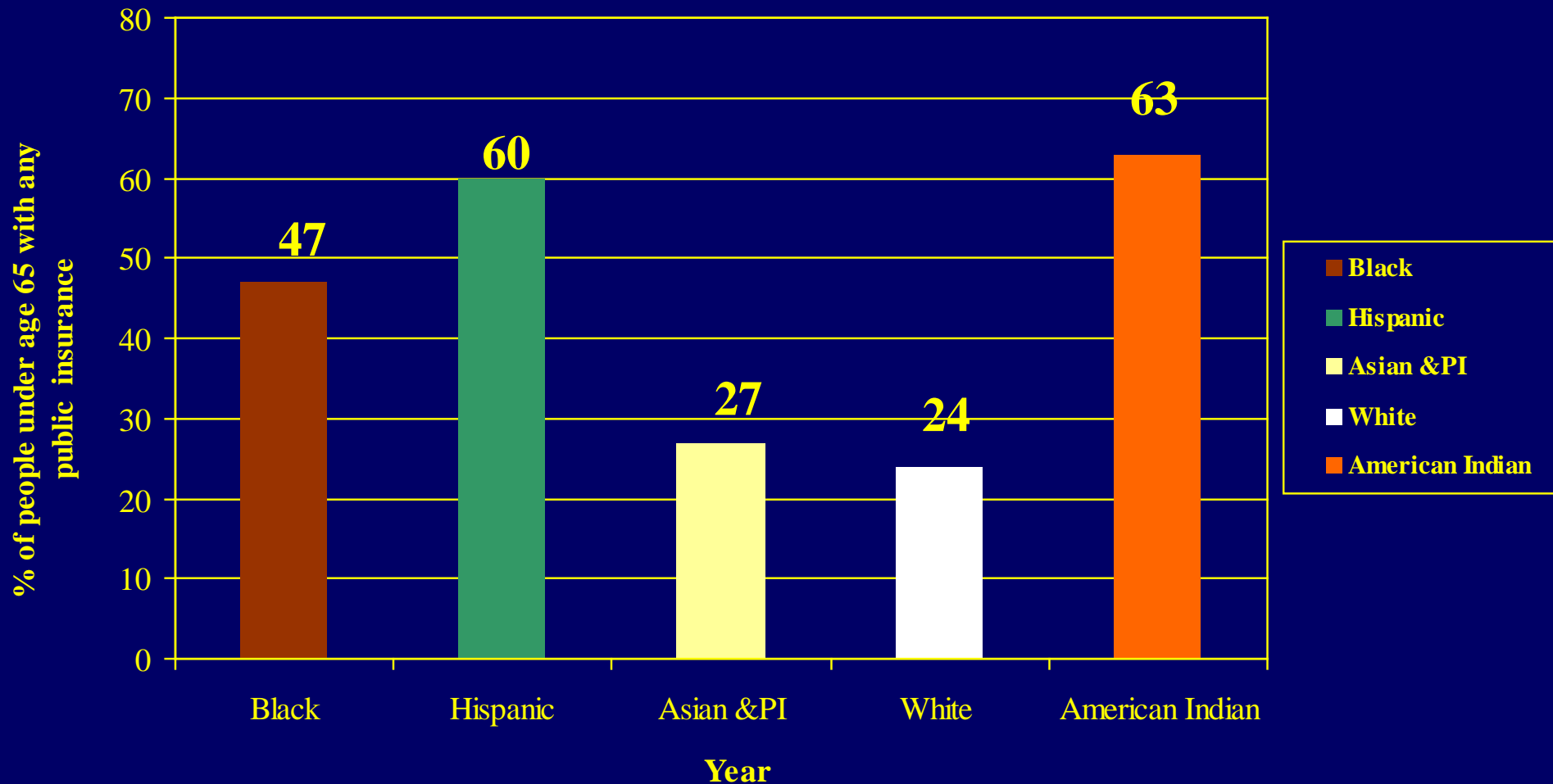
Pattern

There are Large Racial/Ethnic
Disparities in Access to Health Care

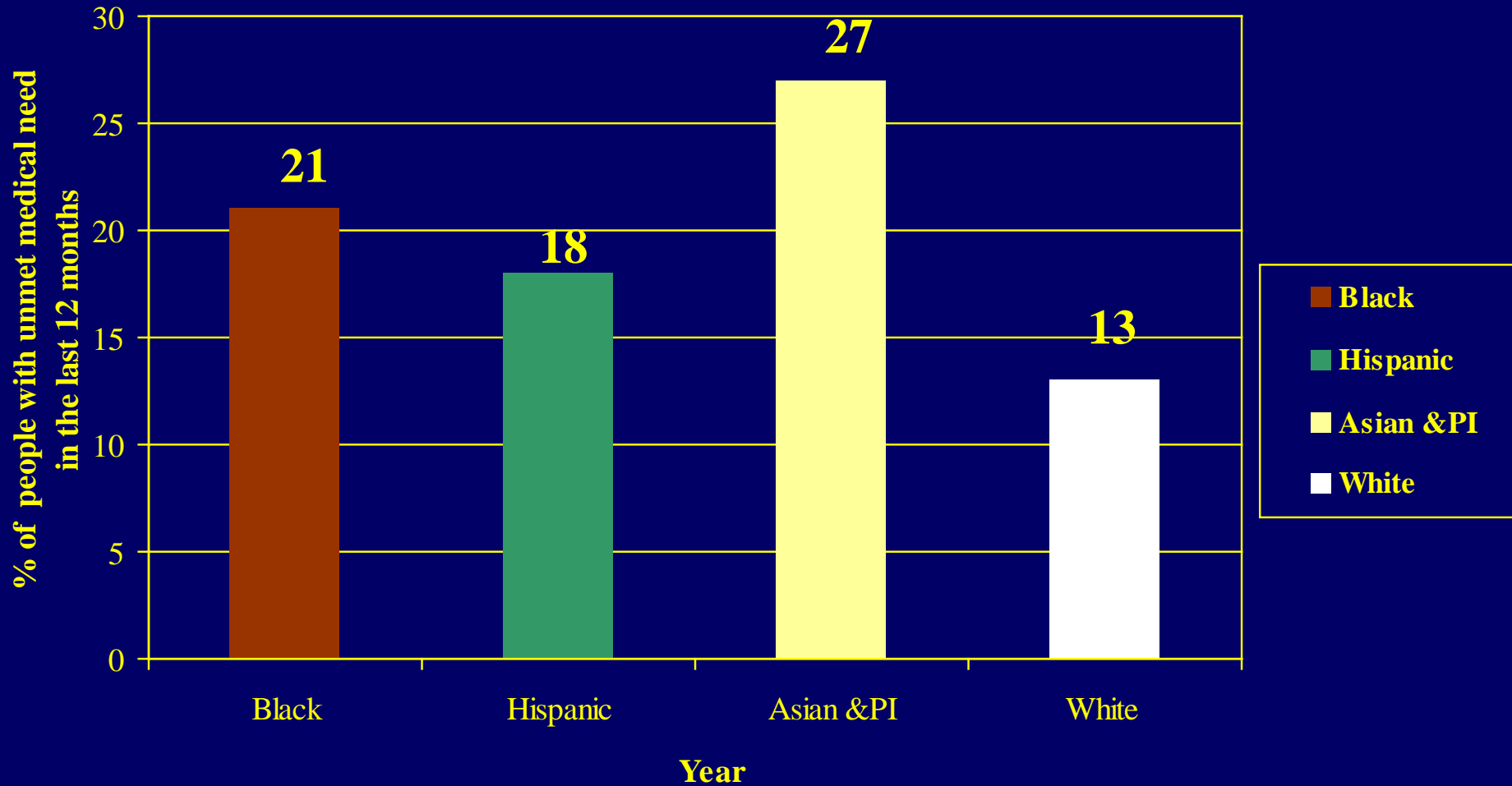
Percent of people under age 65 with any health insurance, 2006



Percent of people under age 65 with any public insurance, 2006



Percent of adults with unmet medical need in the last 12 months, 2005



Pattern

There are Large Racial/Ethnic
Disparities in the Quality and
Intensity of Health Care



UNEQUAL TREATMENT

CONFRONTING RACIAL AND ETHNIC
DISPARITIES IN HEALTH CARE

INSTITUTE OF MEDICINE

Race and Medical Care

- Across virtually every therapeutic intervention, ranging from high technology procedures to the most elementary forms of diagnostic and treatment interventions, minorities receive fewer procedures and poorer quality medical care than whites.
- These differences persist even after differences in health insurance, SES, stage and severity of disease, co-morbidity, and the type of medical facility are taken into account.
- They persist in contexts such as Medicare and the VA Health System, where differences in economic status and insurance coverage are minimized.

Ethnicity and Analgesia

A chart review of 139 patients with isolated long-bone fracture at UCLA Emergency Department (ED):

- All patients aged 15 to 55 years, had the injury within 6 hours of ER visit, had no alcohol intoxication.
- 55% of Hispanics received no analgesic compared to 26% of non-Hispanic whites.
- With simultaneous adjustment for sex, primary language, insurance status, occupational injury, time of presentation, total time in ED, fracture reduction and hospital admission, Hispanic ethnicity was the strongest predictor of no analgesia.
- After adjustment for all factors, Hispanics were 7.5 times more likely than NH whites to receive no analgesia.

Disparities in the Clinical Encounter: The Core Paradox

How could well-meaning and highly educated health professionals, working in their usual circumstances with diverse populations of patients, create a pattern of care that appears to be discriminatory?

Unconscious Discrimination

- When one holds a negative stereotype about a group and meets someone who fits the stereotype s/he will discriminate against that individual
 - Stereotype-linked bias is an
 - Automatic process
 - Unconscious process
 - It occurs even among persons who are not prejudiced
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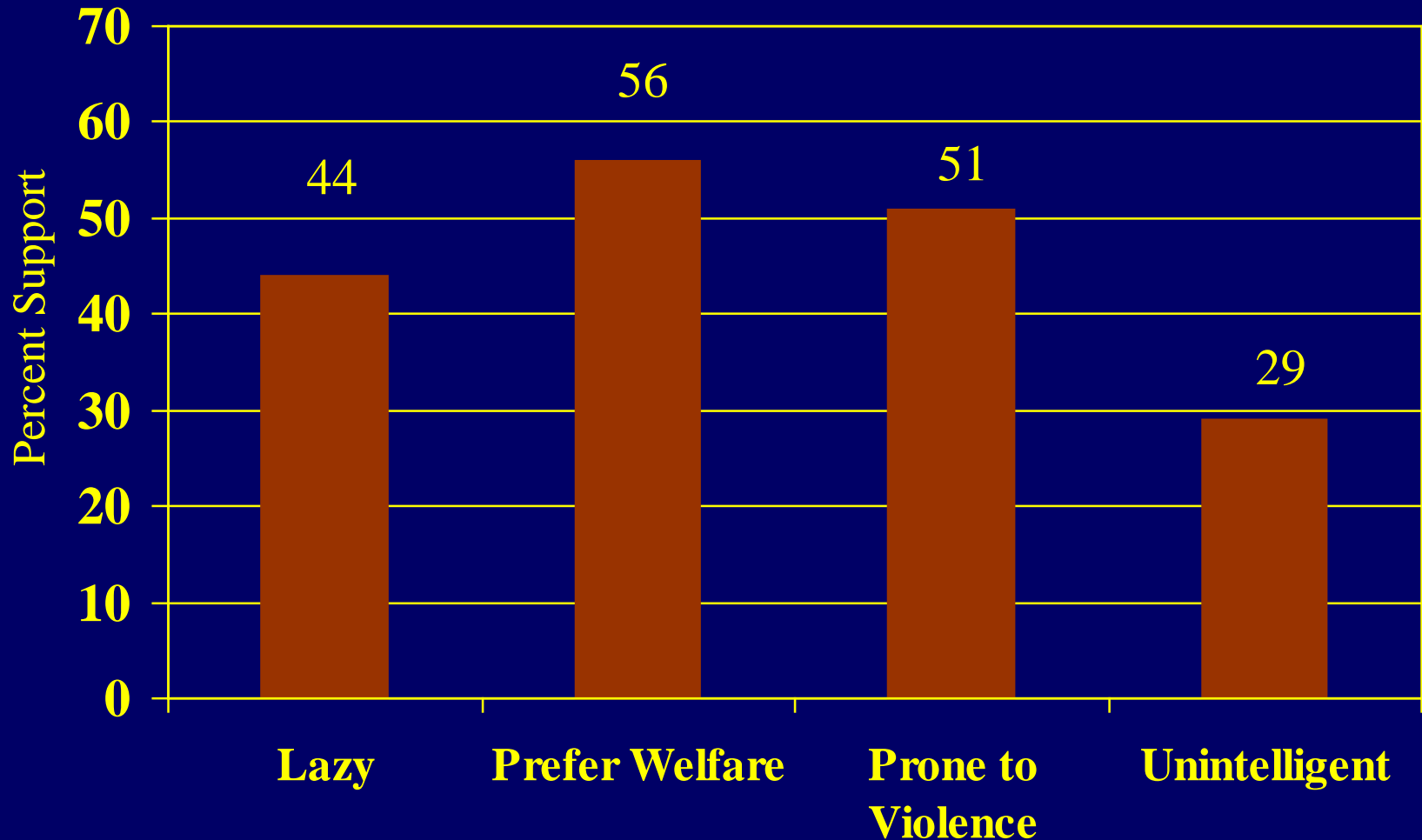
“I am not racist: I know I don’t stereotype”

- Conclusive evidence that stereotypes are activated automatically (without intent).
 - Individuals frequently are not aware of activation nor impact on their perceptions, emotions and behavior.
 - They are activated more quickly and effortlessly than conscious cognition.
 - Many cognitive processes result in confirmation of expectancies (we process information in ways that support our beliefs).
-

Distinctive Social Exposures

Negatively Stereotyped

Percent of Whites Agreeing that Blacks are



General Social Survey (Davis and Smith), 1990

Stereotypes in Our Culture

- **BEAGLE** (Bound Encoding of the Aggregate Language Environment) Project contains about 10 million words from a sample of books, newspapers, magazine articles, etc.
- A good representation of American culture
- Equivalent to what the average college-level student has read in her lifetime
- Statistically analyzed the associative strength between pairs of words
- Provides estimate of how often Americans have seen or heard words paired over their lifetime

Stereotypes in Our Culture

BLACK	poor	.64	WHITE	wealthy	.48
BLACK	violent	.43	WHITE	progressive	.41
BLACK	religious	.42	WHITE	conventional	.37
BLACK	lazy	.40	WHITE	stubborn	.32
BLACK	cheerful	.40	WHITE	successful	.30
BLACK	dangerous	.33	WHITE	educated	.30
FEMALE	distant	.37	MALE	dominant	.46
FEMALE	warm	.35	MALE	leader	.31
FEMALE	gentle	.34	MALE	logical	.31
FEMALE	passive	.34	MALE	strong	.31

Unconscious Discrimination

Can be reduced under certain conditions

Reducing Racial Bias Among Health Care Providers: Lessons from Social-Cognitive Psychology

Diana Burgess, PhD^{1,2}, Michelle van Ryn, PhD, MPH^{1,3}, John Dovidio, PhD⁴, and Somnath Saha, MD, MPH⁵

Implications

- We need to ensure equitable access to genomic medicine
- The multiple barriers to accessing all of the benefits of genomics need to be effectively addressed
- Systematic efforts to build trust and partnerships with historically marginalized populations is important
- Public outreach programs can enhance understanding and awareness of genomics
- We need to strengthen the genomic education of healthcare providers
- We need to enhance science literacy at all education levels

Pattern

There are Large Racial Disparities In
Health

Race/Ethnicity and Health: Two Patterns

- Racial groups with a long history characterized by economic exploitation, social stigmatization, and geographic marginalization have markedly elevated levels of poor health outcomes:
 - Blacks or African Americans
 - American Indians and Alaskan Natives
 - Native Hawaiians and other Pacific Islanders
 - Immigrant groups tend to have better health than the U.S. average, but their health tends to worsen over time and across subsequent generations:
 - Asians
 - Hispanics
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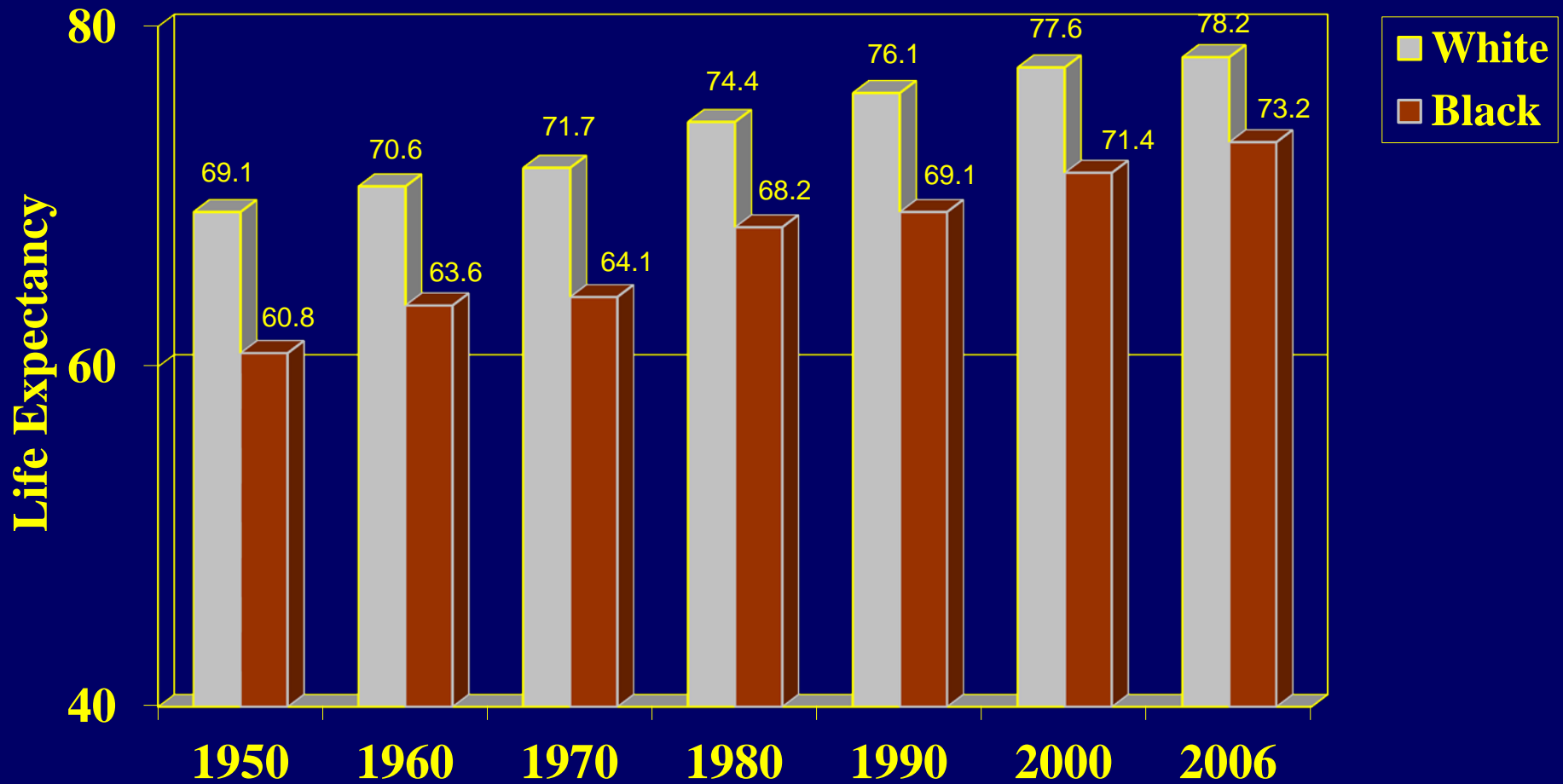
Racial Disparities in Health

- African Americans have higher death rates than Whites for 12 of the 15 leading causes of death.
 - Blacks and American Indians have higher age-specific death rates than Whites from birth through the retirement years.
 - Hispanics have higher death rates than whites for diabetes, hypertension, liver cirrhosis & homicide
 - Asians tend to have lower overall mortality rates than Whites
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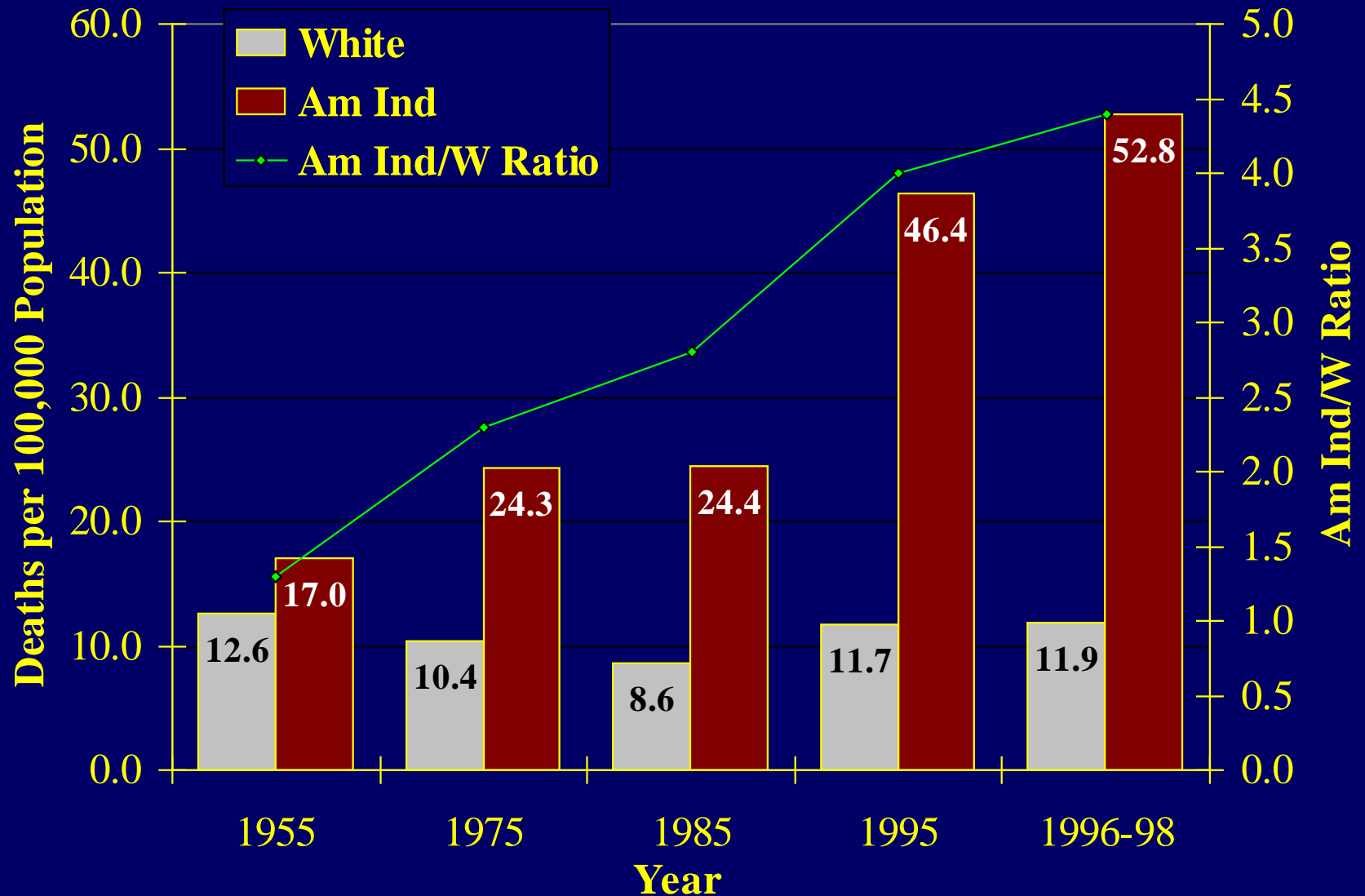
Pattern

Racial Disparities In Health Are
Persistent Over Time

Life Expectancy Lags, 1950-2006



Diabetes Death Rates 1955-1998



Pattern

Minorities get sick younger, have more severe illness and die sooner than Whites

Early Onset: Heart Failure

A 20-year follow-up of young adults in the CARDIA study found that incident heart failure before the age of 50 was 20 times more common in Blacks than Whites, with the average age of onset being 39 years old

Allostatic Load

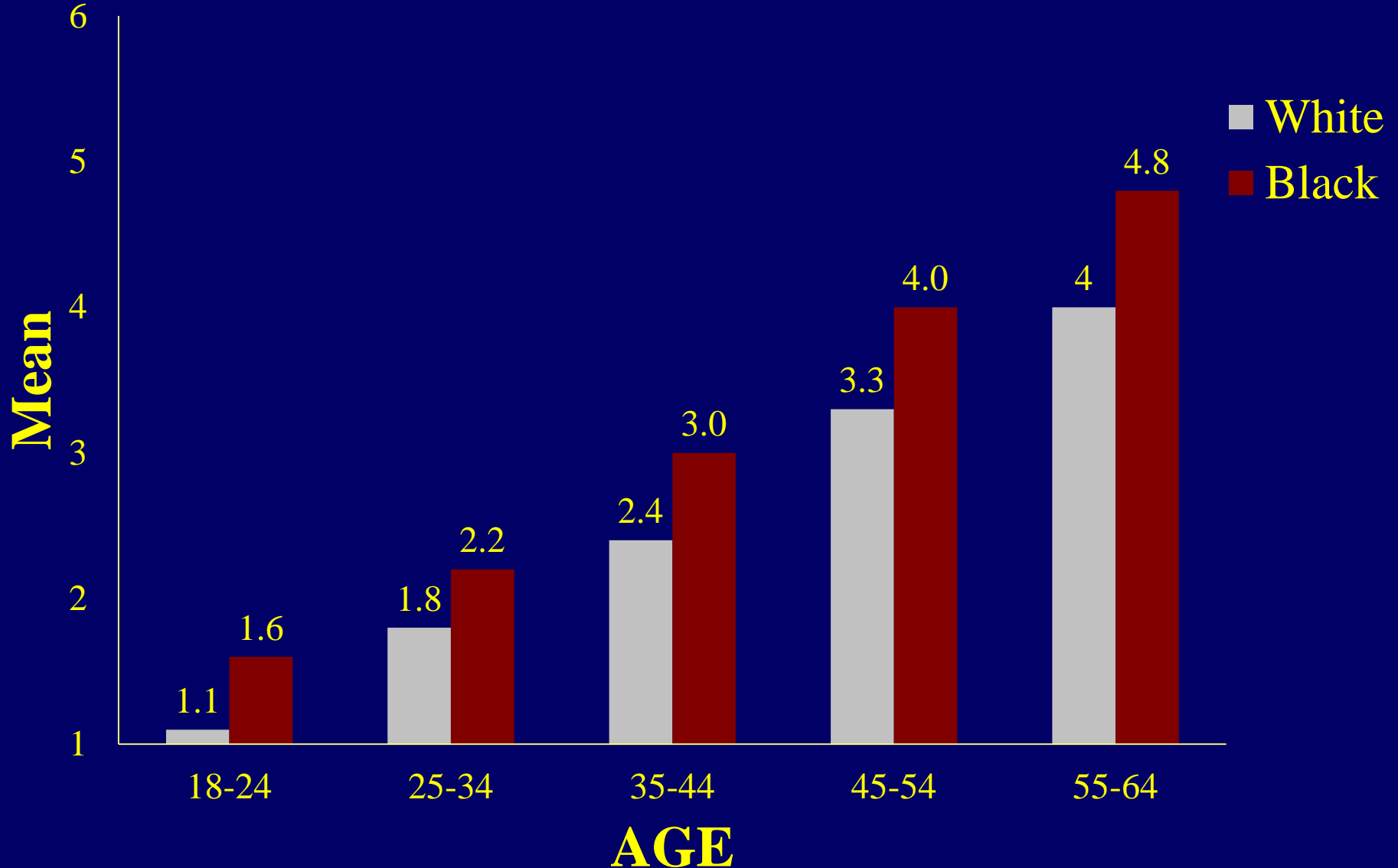
10 biomarkers

High-risk thresholds *

1. Systolic blood pressure	127 mm HG
2. Diastolic blood pressure	80 mm HG
3. Body Mass Index	30.9
4. Glycated hemoglobin	5.4%
5. Albumin	4.2 g/dL
6. Creatinine clearance	66 mg/dL
7. Triglycerides	168 mg/dL
8. C-reactive protein	0.41 mg/dL
9. Homocysteine	9 μ mol/L
10. Total cholesterol	225

* = < 25th percentile for creatinine clearance; >75th percentile for others

Mean Score on Allostatic Load by Age



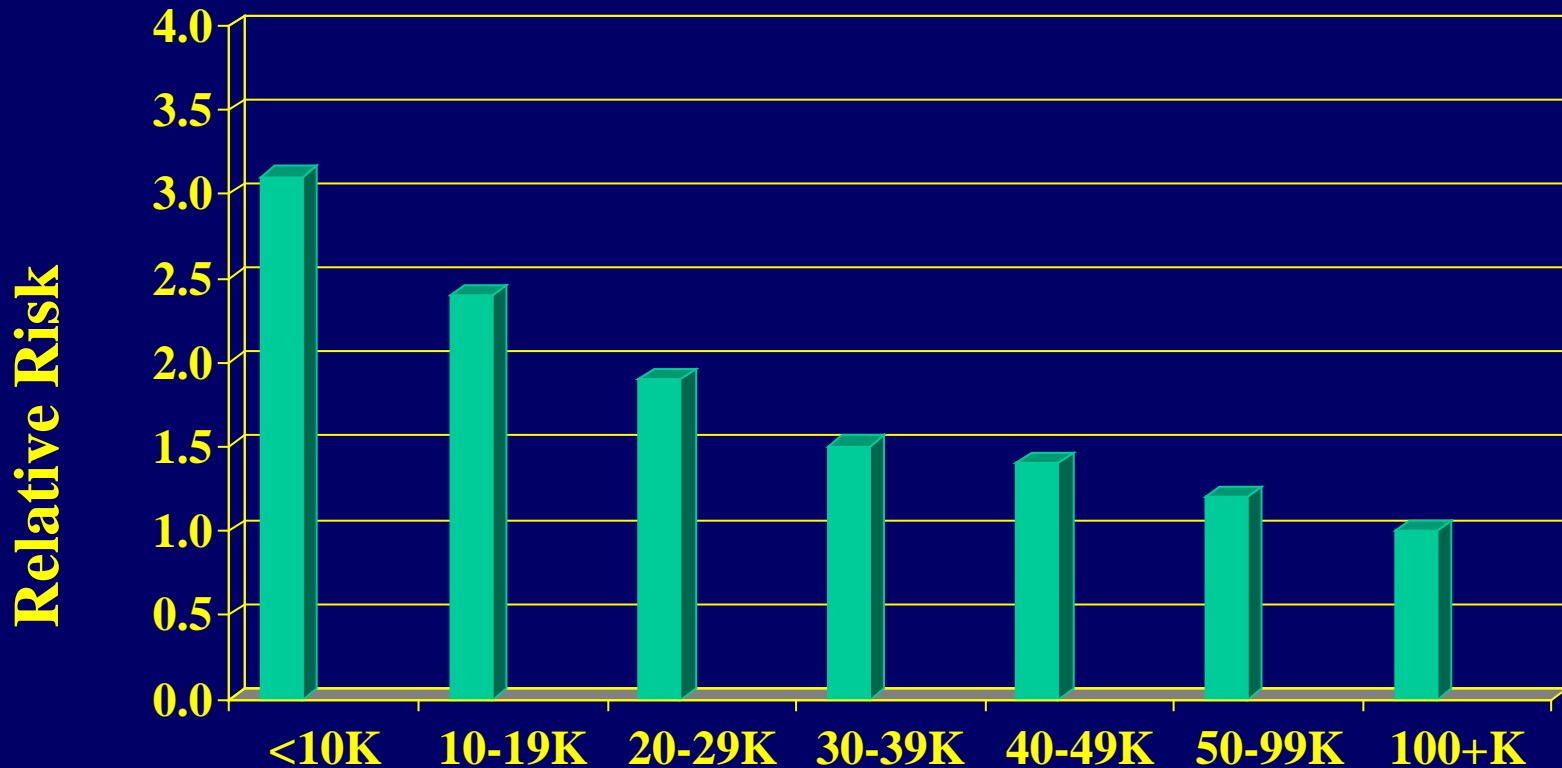
Making Sense of “Racial” Differences

- Race reflects simultaneous unmeasured confounding for genetic (ancestral history and geographic origins) factors and environmental exposures
- Race reflects unmeasured confounding due to the current social environment
- Race reflects unmeasured confounding due to exposures over the life course (and generations) and biological adaptation to these environmental exposures. This includes changes in gene expression

Central Role of Socioeconomic Status (SES)

**Typically measured by income, education, or
occupation, SES is one of the most robust
determinants of variations in health
in virtually every society**

Relative Risk of Premature Death by Family Income (U.S.)



Family Income in 1980 (adjusted to 1999 dollars)

Pattern

Racial/Ethnic Disparities in Health
reflect more than just SES

*Minorities have elevated levels of illness
even at comparable levels of SES*

Life Expectancy At Age 25

Group	White	Black	Difference
All	53.4	48.4	5.0

Life Expectancy At Age 25

Group	White	Black	Difference
All	53.4	48.4	5.0
Education			
a. 0-12 Years	50.1		
b. 12 Years	54.1		
c. Some College	55.2		
d. College Grad	56.5		
Difference	6.4		

Murphy, NVSS 2000; Braveman et al. AJPH, 2010; NLMS 1988-1998

Life Expectancy At Age 25

Group	White	Black	Difference
All	53.4	48.4	5.0
Education			
a. 0-12 Years	50.1	47.0	
b. 12 Years	54.1	49.9	
c. Some College	55.2	50.9	
d. College Grad	56.5	52.3	
Difference	6.4	5.3	

Murphy, NVSS 2000; Braveman et al. AJPH, 2010; NLMS 1988-1998

Life Expectancy At Age 25

Group	White	Black	Difference
All	53.4	48.4	5.0
Education			
a. 0-12 Years	50.1	47.0	3.1
b. 12 Years	54.1	49.9	4.2
c. Some College	55.2	50.9	4.3
d. College Grad	56.5	52.3	4.2
Difference	6.4	5.3	

Murphy, NVSS 2000; Braveman et al. AJPH, 2010; NLMS 1988-1998

Meharry vs Johns Hopkins

A 1958 – 65, all Black, cohort of Meharry Medical College MDs was compared with a 1957- 64, all White, cohort of Johns Hopkins MDs. 23-25 years later, the Black MDs were more likely to have:

- higher risk of CVD (RR=1.65)
- earlier onset of disease
- incidence rates of diabetes & hypertension that were twice as high
- higher incidence of coronary artery disease (1.4 times)
- higher case fatality (52% vs 9%)

Why Race Still Matters

1. Health is affected not only by current SES but by exposure to social and economic adversity over the life course.
 2. All indicators of SES are non-equivalent across race. Compared to whites, blacks & Hispanics receive less income at the same levels of education, have less wealth at the equivalent income levels, and have less purchasing power (at a given income level) because of higher costs of goods and services.
 3. Personal experiences of discrimination and institutional racism are added pathogenic factors that can affect the health in multiple ways.
-

Non Equivalence of SES across Race

Compared to whites, blacks and Hispanics:

- Receive less income at the same levels of education,
- have less wealth at the equivalent income levels, and
- have less purchasing power (at a given level of income) because of higher costs of goods and services.

Distinctive Social Exposures

Measurement Issue:

The minority poor are poorer than the white poor

Wealth of Whites and of Minorities per \$1 of Whites, 2000

Household Income	White	B/W Ratio	Hisp/W Ratio
Total	\$ 79,400	9¢	12¢
Poorest 20%	\$ 24,000	1¢	2¢
2nd Quintile	\$ 48,500	11¢	12¢
3rd Quintile	\$ 59,500	19¢	19¢
4th Quintile	\$ 92,842	35¢	39¢
Richest 20%	\$ 208,023	31¢	35¢

Source: Orzechowski & Sepielli 2003, U.S. Census

Distinctive Social Exposures

The added burden of racism

Racism and Health: Mechanisms

- Institutional discrimination can restrict socioeconomic attainment and group differences in SES and health.
 - Segregation can create pathogenic residential conditions.
 - Discrimination can lead to reduced access to desirable goods and services.
 - Internalized racism (acceptance of society's negative characterization) can adversely affect health.
 - Racism can create conditions that increase exposure to traditional stressors (e.g. unemployment).
 - Experiences of discrimination may be a neglected psychosocial stressor.
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Perceived Discrimination:

*Experiences of discrimination are a
neglected psychosocial stressor*

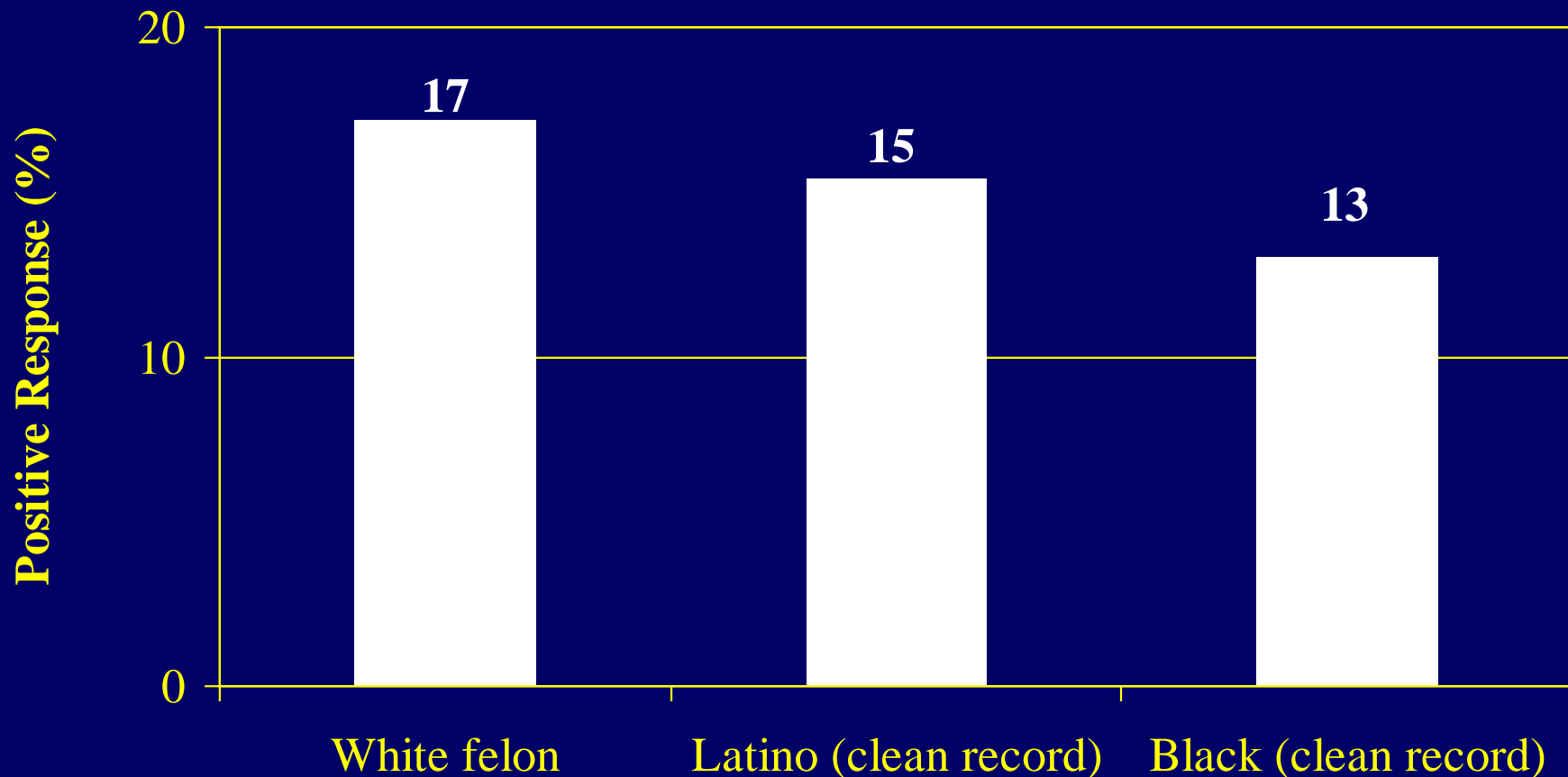
Discrimination Persists

- Pairs of young, well-groomed, well-spoken college men with identical resumes apply for 350 advertised entry-level jobs in Milwaukee, Wisconsin. Two teams were black and two were white. In each team, one said that he had served an 18-month prison sentence for cocaine possession.
- The study found that it was easier for a white male with a felony conviction to get a job than a black male whose record was clean.

Percent of Job Applicants Receiving a Callback

Criminal Record	White	Black
No	34%	14%
Yes	17%	5%

Race, Criminal Record, and Entry-level Jobs in NY, 2004



Devah Pager et al Am Soc Review, 2009; 169 employers

Perceived Discrimination and Health

- Discrimination is associated with elevated risk of
 - diabetes risk (Hemoglobin A1c)
 - substance use (smoking, alcohol, other drugs)
 - breast cancer incidence
 - uterine myomas (fibroids)
 - subclinical carotid artery disease (IMT; intima-media thickness)
 - Delays in seeking treatment, lower adherence to treatment regimes, lower rates of follow-up
- Discrimination accounts, in part, for racial/ethnic disparities in health, in U.S., and elsewhere

Every Day Discrimination

In your day-to-day life how often have any of the following things happened to you?

- You are treated with less courtesy than other people.
- You are treated with less respect than other people.
- You receive poorer service than other people at restaurants or stores.
- People act as if they think you are not smart.
- People act as if they are afraid of you.
- People act as if they think you are dishonest.
- People act as if they're better than you are.
- You are called names or insulted.
- You are threatened or harassed.

What do you think was the main reason for these experiences?

Discrimination & Health: Tene Lewis et al

- **Everyday Discrimination: positively associated with:**
 - coronary artery calcification (Lewis et al., Psy Med, 2006)
 - C-reactive protein (Lewis et al., Brain Beh Immunity, 2010)
 - blood pressure (Lewis et al., J Gerontology: Bio Sci & Med Sci 2009)
 - **lower** birth weight (Earnshaw et al., Ann Beh Med, 2013)
 - cognitive impairment (Barnes et al., 2012)
 - poor sleep [**object. & subject.**] (Lewis et al, Hlth Psy, 2012)
 - mortality (Barnes et al., J Gerontology: Bio Sci & Med Sci, 2008).
 - visceral fat (Lewis et al., Am J Epidemiology, 2011)
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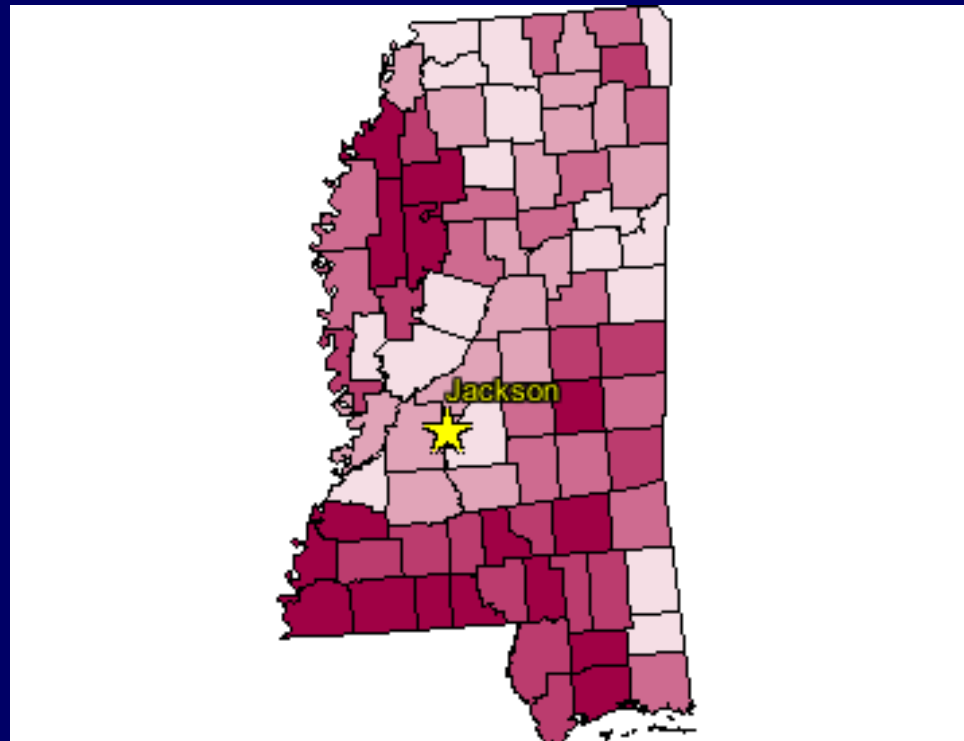
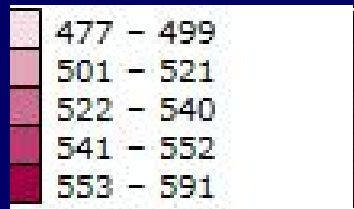
Distinctive Social Exposures

Place Matters!

Geographic location determines
exposure to risk factors and resources
that affect health

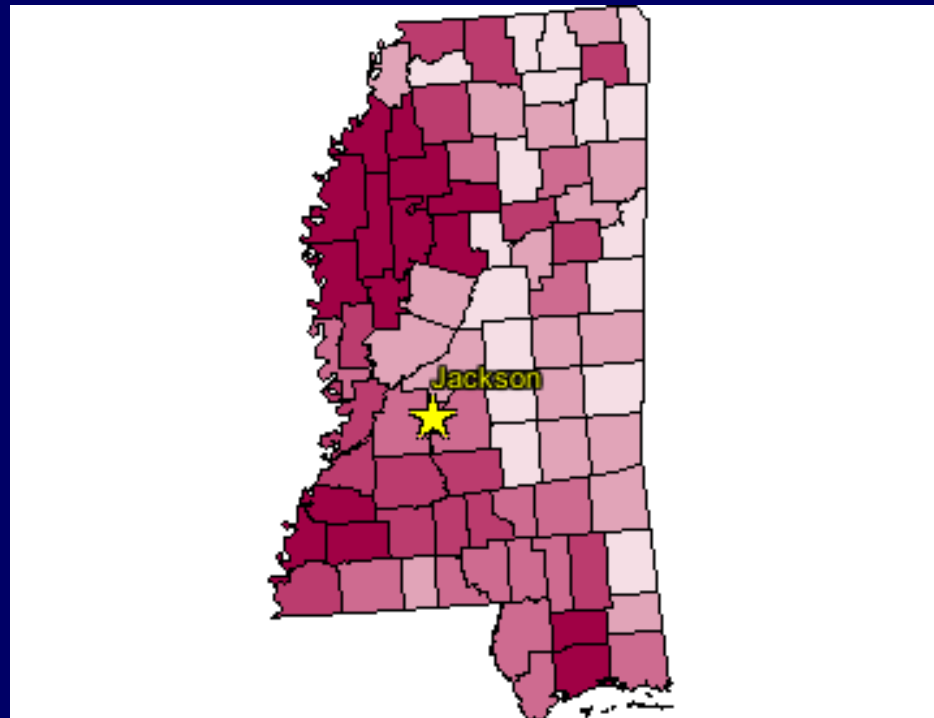
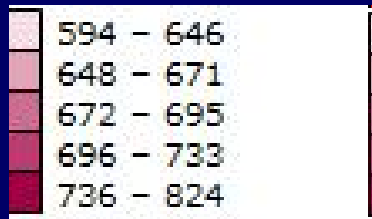
Heart Disease Rates Mississippi 1996-2000

White Women



Heart Disease Rates Mississippi 1996-2000

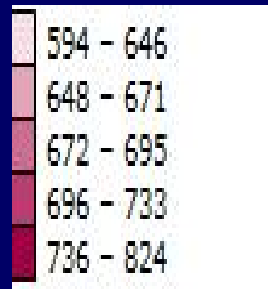
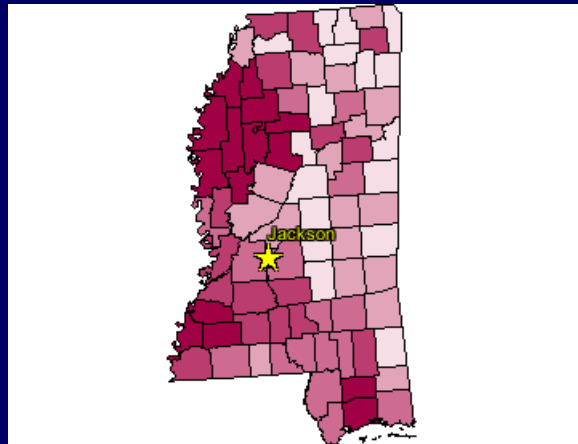
Black Women



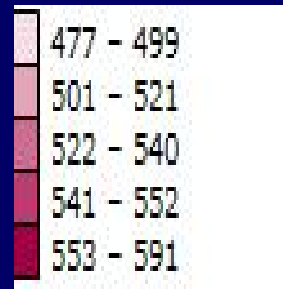
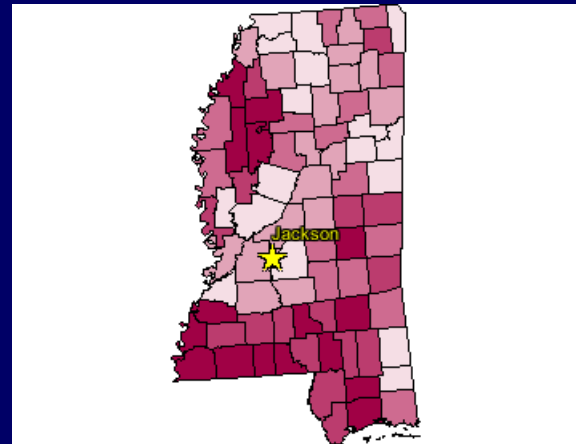
Heart Disease Rates Mississippi 1996-2000

Women

Black



White



*Residential Segregation is a
place-based example of
Institutional Discrimination that
has pervasive adverse effects on
health*

Racial Segregation Is ...

1. Myrdal (1944): ... "basic" to understanding racial inequality in America.
 2. Kenneth Clark (1965): ...key to understanding racial inequality.
 3. Kerner Commission (1968): ...the "linchpin" of U.S. race relations and the source of the large and growing racial inequality in SES.
 4. John Cell (1982): ... "one of the most successful political ideologies" of the last century and "the dominant system of racial regulation and control" in the U.S.
 5. Massey and Denton (1993): ... "the key structural factor for the perpetuation of Black poverty in the U.S." and the "missing link" in efforts to understand urban poverty.
-

How Segregation Can Affect Health

1. Segregation determines SES by affecting quality of education and employment opportunities.
2. Segregation can create pathogenic neighborhood and housing conditions.
3. Conditions linked to segregation can constrain the practice of health behaviors and encourage unhealthy ones.
4. Segregation can adversely affect access to medical care and to high-quality care.



Our Neighborhood Affects Our Health

Unhealthy Community

vs

Healthy Community

Unsafe even in daylight



Safe neighborhoods, safe schools, safe walking routes

Exposure to toxic air, hazardous waste



Clean air and environment

No parks/areas for physical activity



Well-equipped parks and open/spaces/organized community recreation

Limited affordable housing is run-down; linked to crime ridden neighborhoods



High-quality mixed income housing, both owned and rental

Convenience/liquor stores, cigarettes and liquor billboards, no grocery store



Well-stocked grocery stores offering nutritious foods



Our Neighborhood Affects Our Health

Unhealthy Community

vs

Healthy Community

Streets and sidewalks in disrepair



Clean streets that are easy to navigate

Burned-out homes, littered streets



Well-kept homes and tree-lined streets

No culturally sensitive community centers, social services or opportunities to engage with neighbors in community life



Organized multicultural community programs, social services, neighborhood councils or other opportunities for participation in community life

No local health care services



Primary care through physicians' offices or health center; school-based health

Lack of public transportation, walking or biking paths



Accessible, safe public transportation, walking and bike paths

Residential Segregation and SES

A study of the effects of segregation on young African American adults found that the elimination of segregation would erase black-white differences in

- Earnings
- High School Graduation Rate
- Unemployment

And reduce racial differences in single motherhood by two-thirds

Segregation and Medical Care -I

- Pharmacies in segregated neighborhoods are less likely to have adequate medication supplies (Morrison et al. 2000)
 - Hospitals in black neighborhoods are more likely to close (Buchmueller et al 2004; McLafferty, 1982; Whiteis, 1992).
 - MDs are less likely to participate in Medicaid in racially segregated areas. Poverty concentration is unrelated to MD Medicaid participation (Greene et al. 2006)
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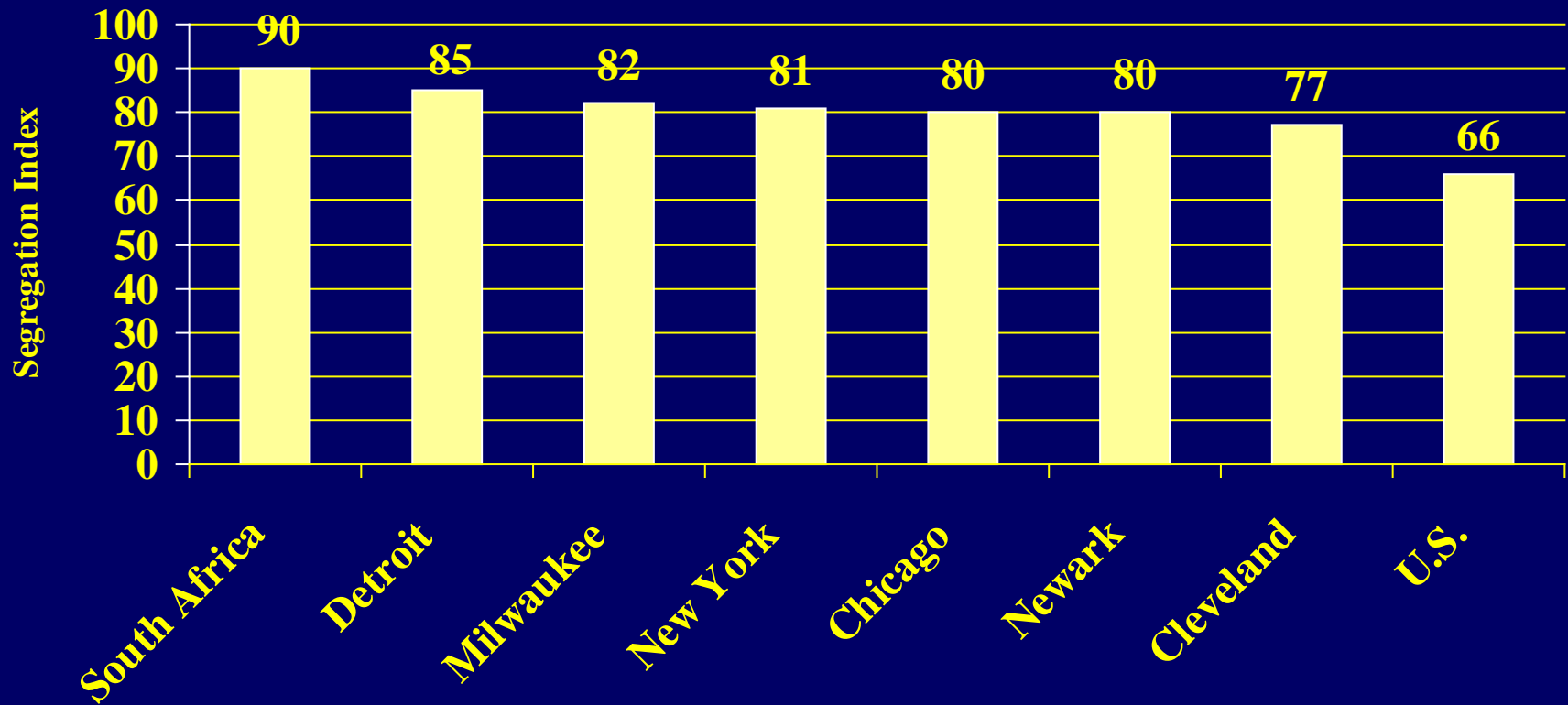
Segregation and Medical Care -II

- Blacks are more likely than whites to reside in areas (segregated) where the quality of care is low (Baicker, et al 2004).
 - African Americans receive most of their care from a small group of physicians who are less likely than other doctors to be board certified and are less able to provide high quality care and referral to specialty care (Bach, et al. 2004).
-

Racial Differences in Residential Environment

- In the 171 largest cities in the U.S., there is not even one city where whites live in ecological equality to blacks in terms of poverty rates or rates of single-parent households.
- “The worst urban context in which whites reside is considerably better than the average context of black communities.”
p.41

American Apartheid: South Africa (de jure) in 1991 & U.S. (de facto) in 2000



Massey 2004; Iceland et al. 2002; Glaeser & Vigdor 2001

Research Implications: Distinctive Patterns?

- What effects do these distinctive residential environments have on normal physiological processes?
 - How are normal adaptive and regulatory systems affected by the harsh residential environment of blacks and other minorities?
 - To what extent does African Americans' biological adaptation to their residential environments lead to some biological profiles that are different from other groups and some distinctive patterns of interactions (between biological and psychosocial factors)?
-

Understanding the Social Environment

“Any successful attempt to constructively leverage the remarkable advances of the genomic era will depend upon our ability to understand genetic influences and their interactions with the environmental context within which they operate.”

Michael J. Meaney

Gene-Environment Interactions

- Future Genomic research needs to give increased attention to the comprehensive, detailed, and rigorous characterization of the risk factors/resources in the psychological, social, chemical and physical environment that may interact with genetic to affect health risk
 - Much of the research to date on race and genetics has, emphasized gene frequency differences over gene expression differences. Given racial and SES differences in residential and occupational environments, more systematic attention should be given to understanding the contribution of epigenetics to disease risk.
-

Social Environment and Epigenetic Changes

- By analyzing the brain tissue from adults who had committed suicide, one study found genetic changes in those who had been abused as a child. That is, hippocampal gene expression was decreased in victims of child abuse compared to controls with no abuse.
- Another study found changes in prostate gene expression among men with low-risk prostate cancer in response to lifestyle changes in diet, exercise, stress management and social support.
- Several studies have linked adverse social conditions in early life with adult differences in gene expression in the cells of the immune system. Confirmed in randomized experiment with rhesus macaques

Research Challenge

We need a more integrated science to better elucidate:

- how individuals zip code interacts with their genetic code to affect health risks?
 - how do multiple dimensions of the social and physical environment,
 - combine, additively and/or interactively with each other,
 - and with innate and acquired biological factors,
 - and accumulate over the life course,
 - to affect the onset of illness
 - and the progression of disease processes
-

Concluding Thoughts

- First, many non-genetic factors contribute to health disparities. Racial groups differ on a broad range of environmental risks and exposures
- Second, we need trans-NIH initiatives to develop improved definitions and measurement of the social environment in all of its complexity
- Third, gene-environmental interactions are central to understanding the role of genomics in disease. We need better integration of social environmental exposures with innate and acquired biological factors
- Fourth, conclusions about the contribution of genetics should be based on direct tests of genetic traits

Concluding Thoughts -II

- Fifth, research on race and genetics should exercise caution in making generalizations and inferences to entire “racial” populations when coverage of the diverse ancestral groupings is limited
- Sixth, given the distinctive environments of racial minorities in the U.S., more systematic attention should be given to identifying and understanding potential epigenetic effects.
- Finally, more attention needs to be given now to ensure that the full potential of genomics becomes accessible to all. This will require reforming current infrastructures and developing best practices