Institute for
Health Metrics
and Evaluation

Health Disparities in Cardiovascular Diseases in the United States

6 October 2009

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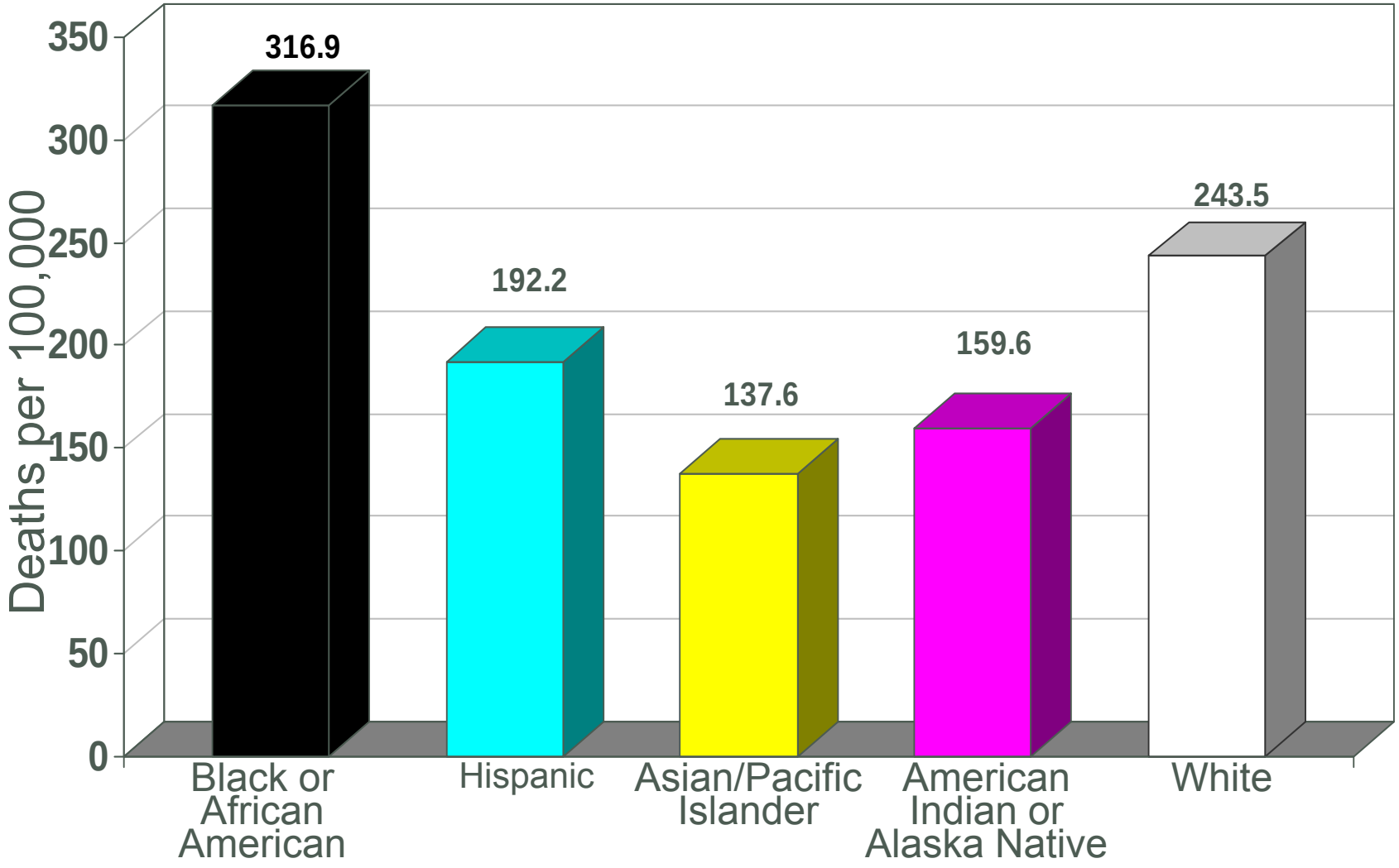
Presentation outline

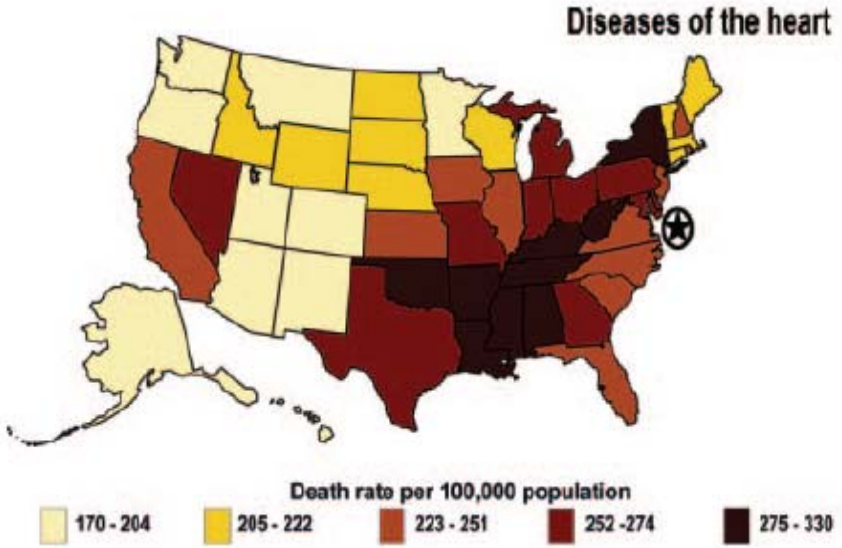
- US County mortality analysis
  - Analysis of life expectancy
  - Analysis of causes of death
- US national and state risk factor analysis
- Future research directions

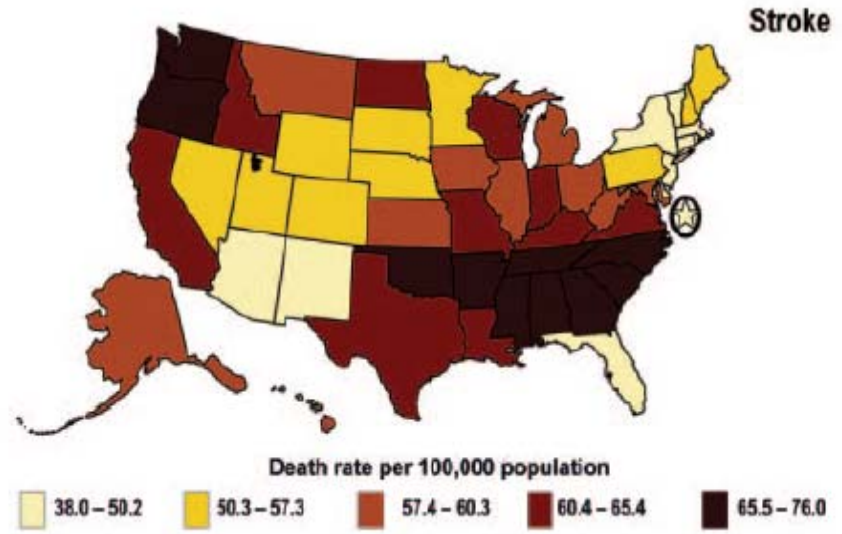
Disparities in Mortality from Diseases of the Heart, United States, 2001



Mensah, Mokdad, Ford, et al. Circulation 2005;111:1233-1241

CVD Mortality Rate by State, 2001





IHME Mensah et al. Circulation 2005;111:1233-1241

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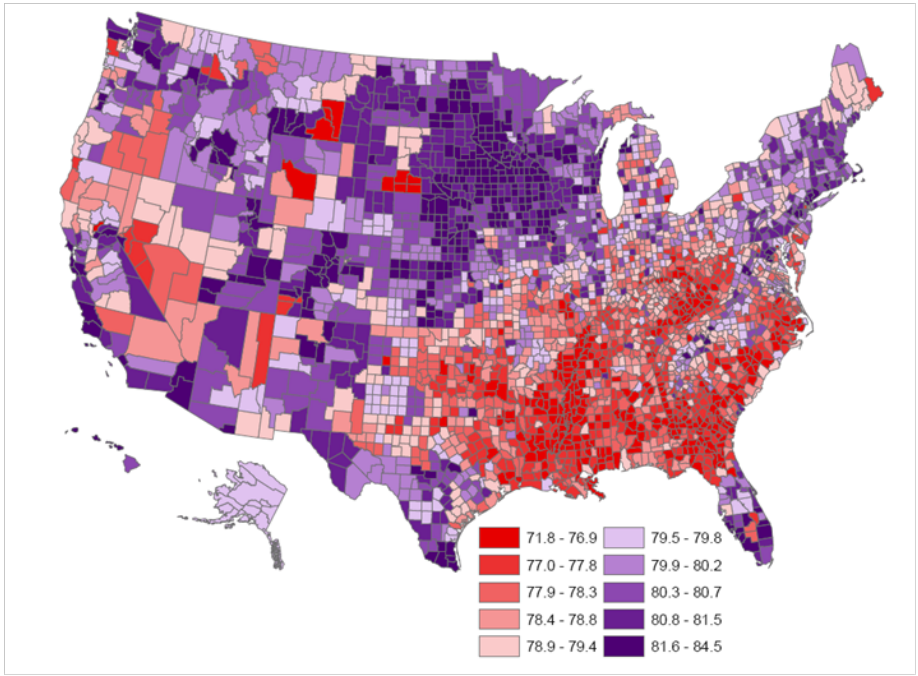
US county life expectancy methods

- 3,141 county and county equivalents merged into 2,068 county units to ensure
  - 10,000 males and females in 1990 in each county
  - consistency of county definition between 1959 and 2001
- Census data: 1960, 1970, 1980, 1990, 2000
- Death files: 1959-2001
- 5-year pooled death rates
- Estimate uncertainty in death rates and life expectancy using a binomial/Poisson simulation

Female life expectancy in US counties, 1997-2001



Highest life expectancy

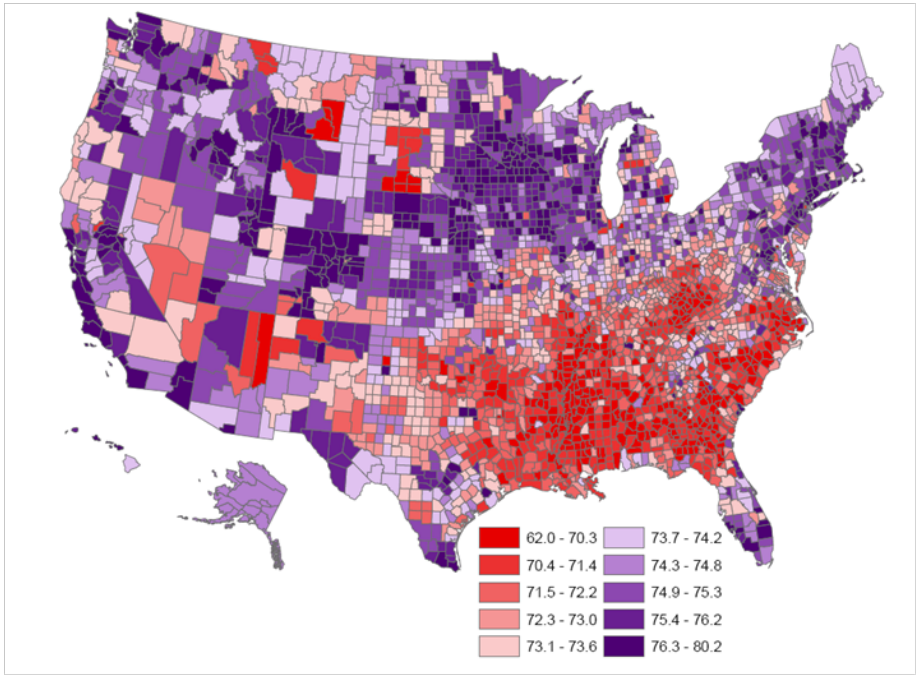
County	State	e(0)
Stearns	MN	84.5
Winneshiek	IA	84.0
Yuma & La Paz	AZ	83.9

Lowest life expectancy

County	State	e(0)
Phillips	AR	73.1
Petersburg	VA	72.9
Jackson,	SD	71.8
Washabaugh, Mellette,		
Bennett, Todd, & Shannon		

Ezzati et al *PLoS Medicine* 2008

Male life expectancy in US counties,1997-2001



Highest life expectancy

County	State	e(0)
Grand, Clear Creek	CO	80.2
Summit, Park, Jackson, Eagle, and Gilpin		
Summit & Morgan	UT	79.4
Montgomery	MD	79.3

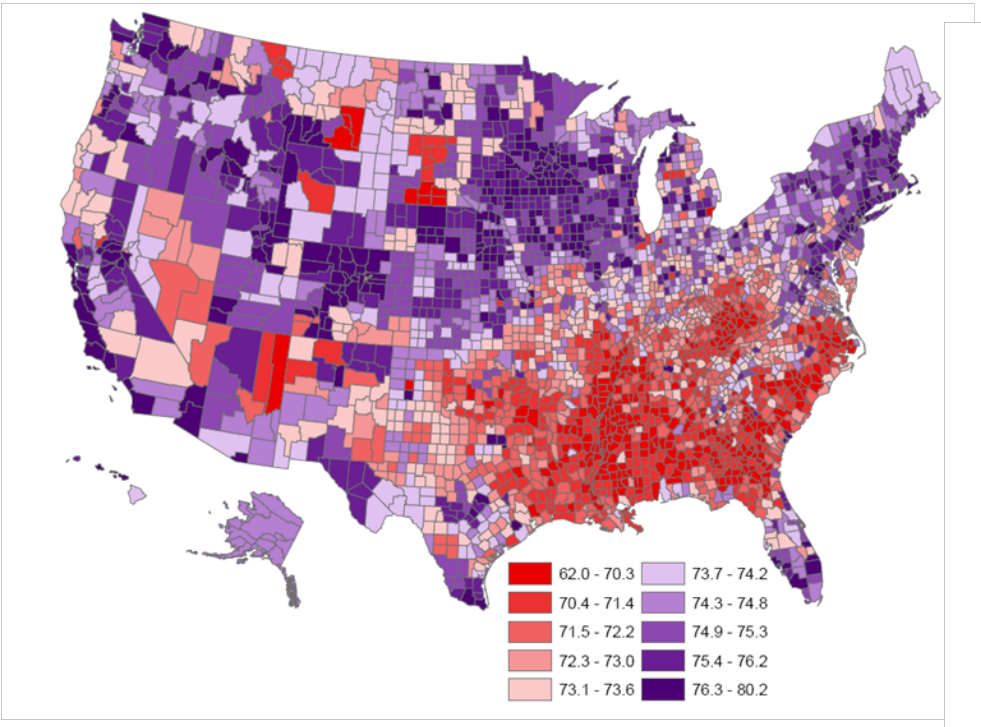
Lowest life expectancy

County	State	e(0)
Marlboro	SC	65.1
Baltimore City	MD	63.8
Jackson, Washabaugh, Mellette, Bennett, Todd, Shannon	SD	62.0

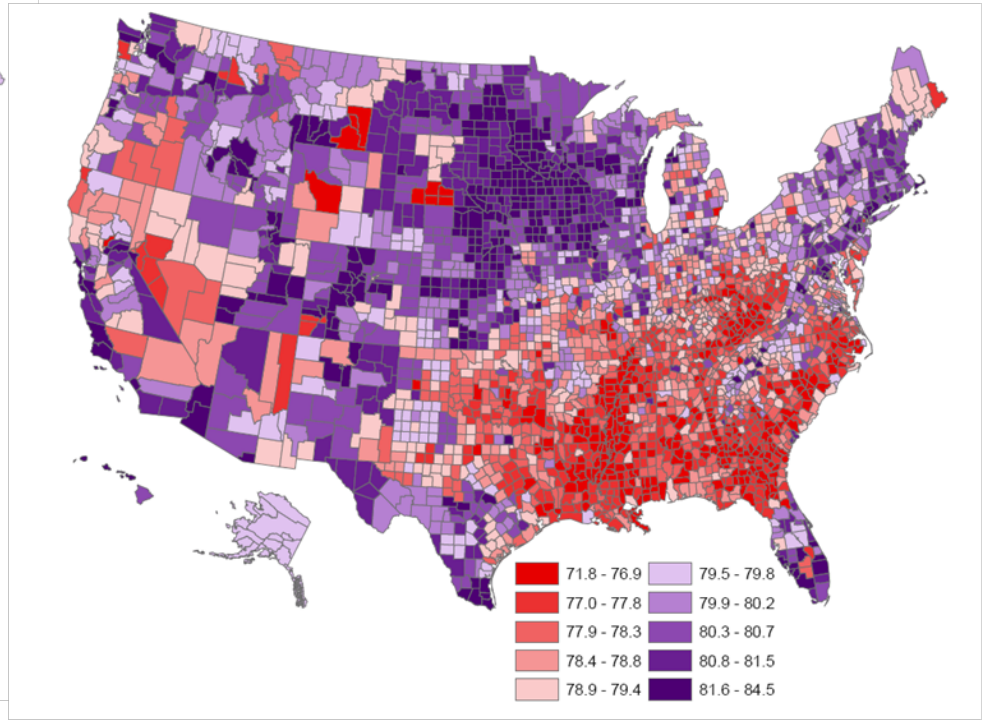
Ezzati et al *PLoS Medicine* 2008

County life expectancy 1997-2001

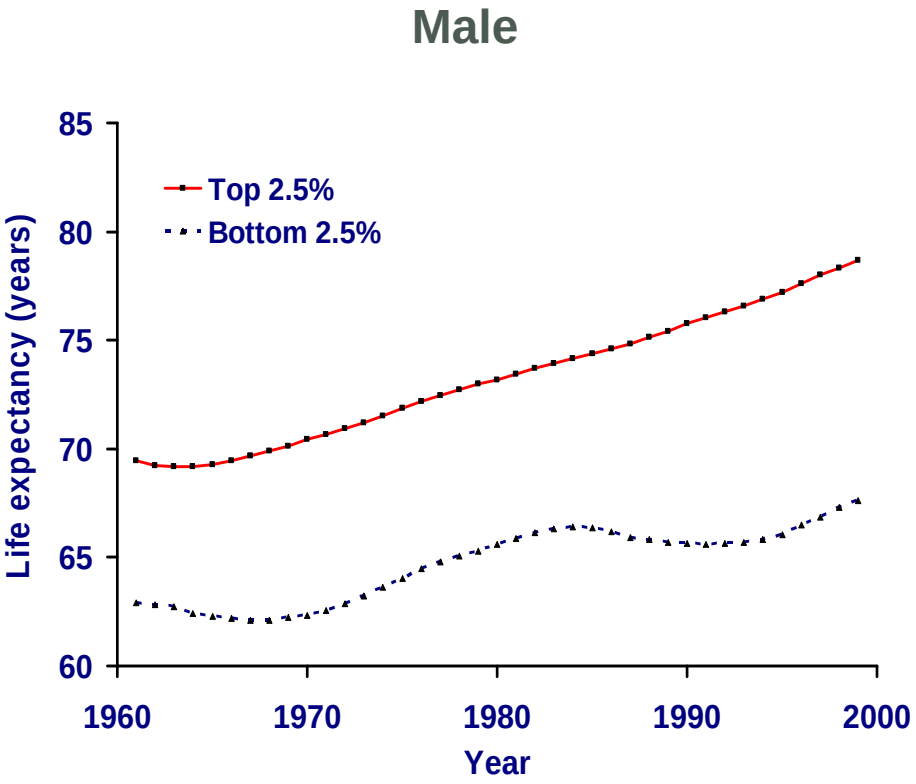
Males

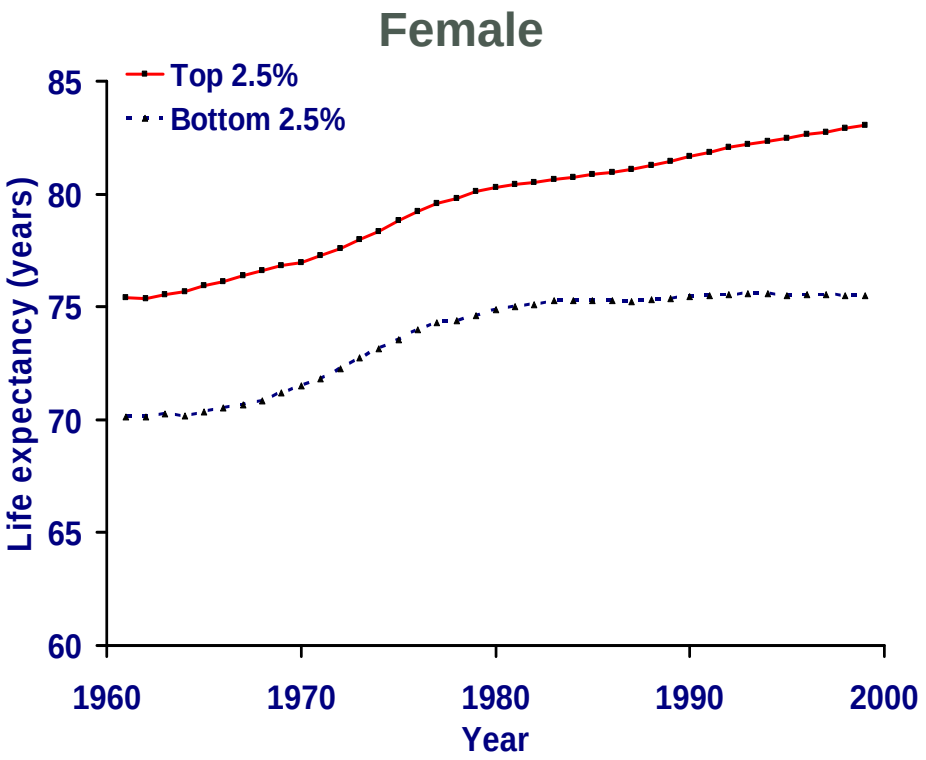


Females



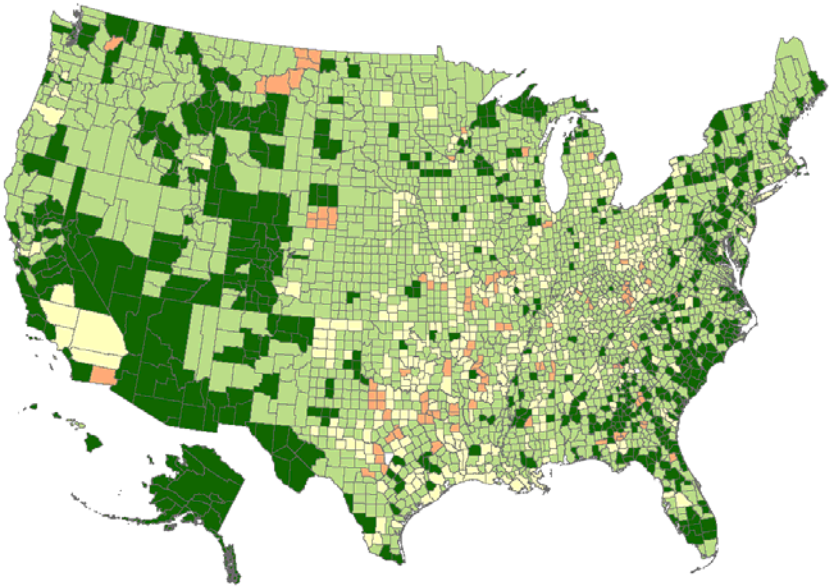
Life Expectancy for Top and Bottom 2.5% of Counties



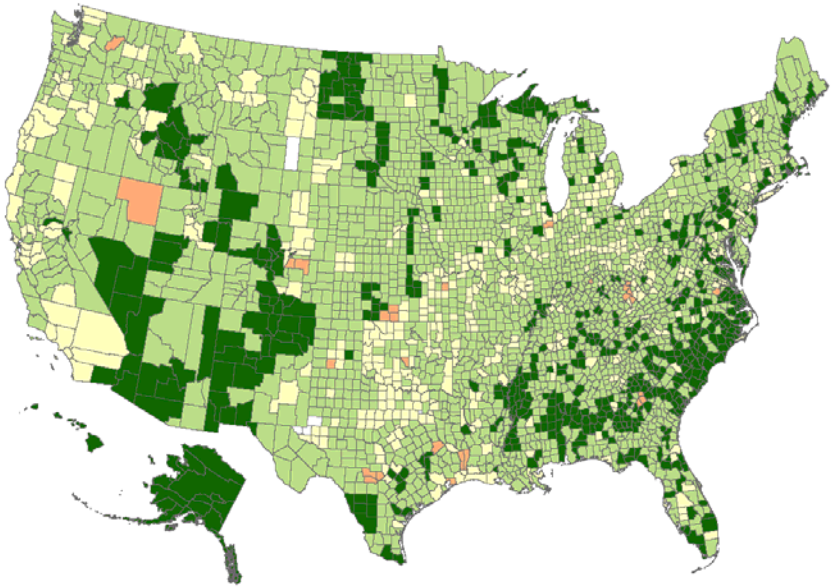


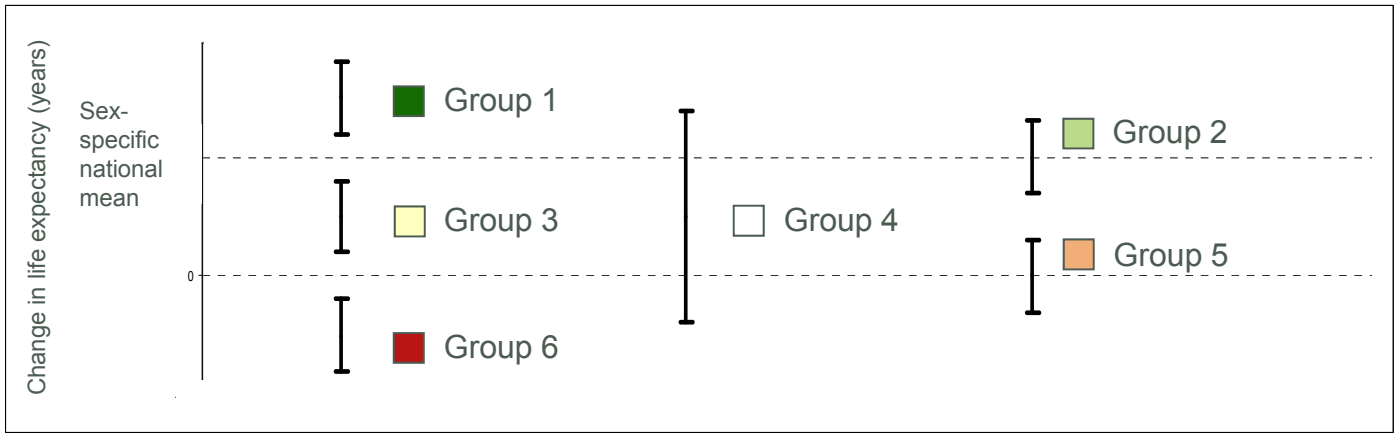
Change in county life expectancy (1961-83)

Male



Female





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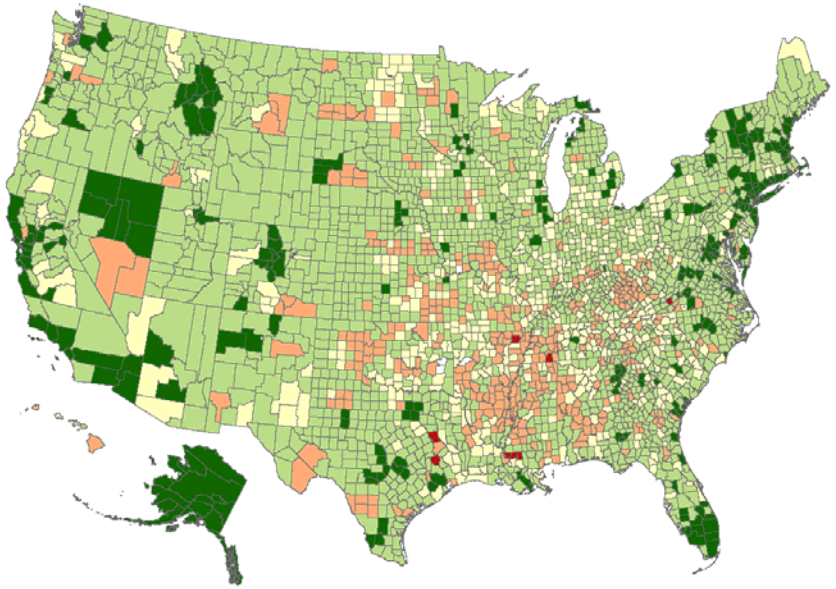
Change in county life expectancy (1983-99)

Male



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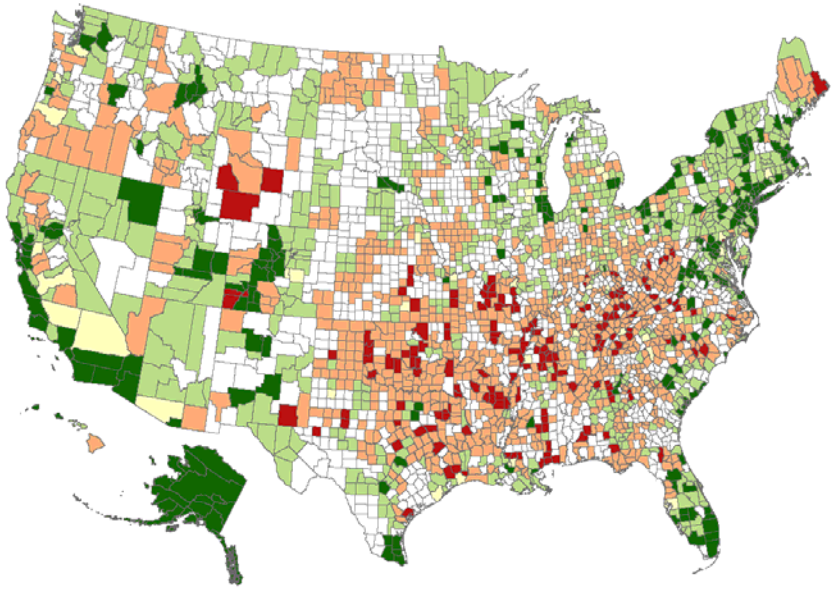
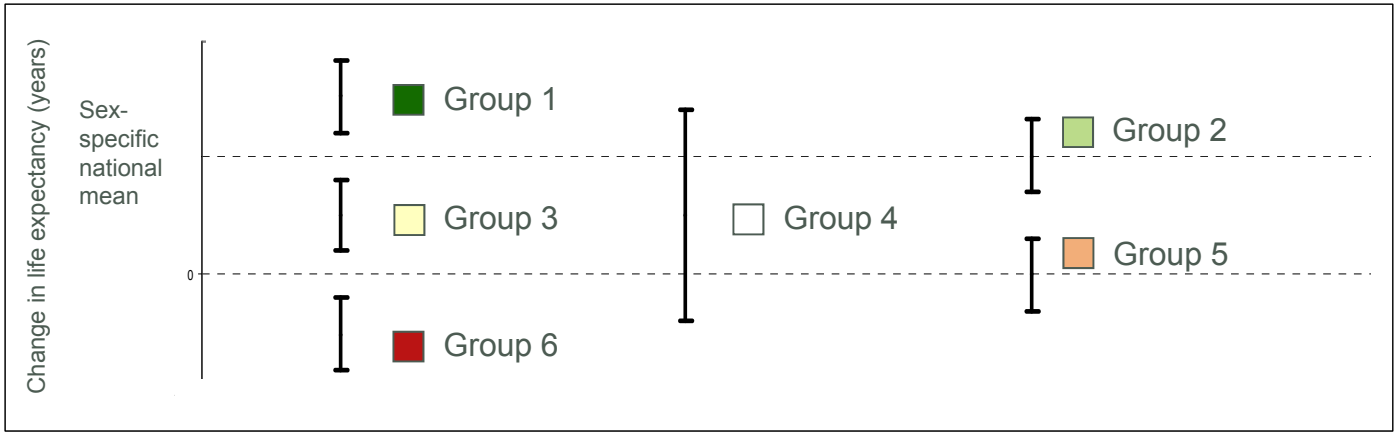


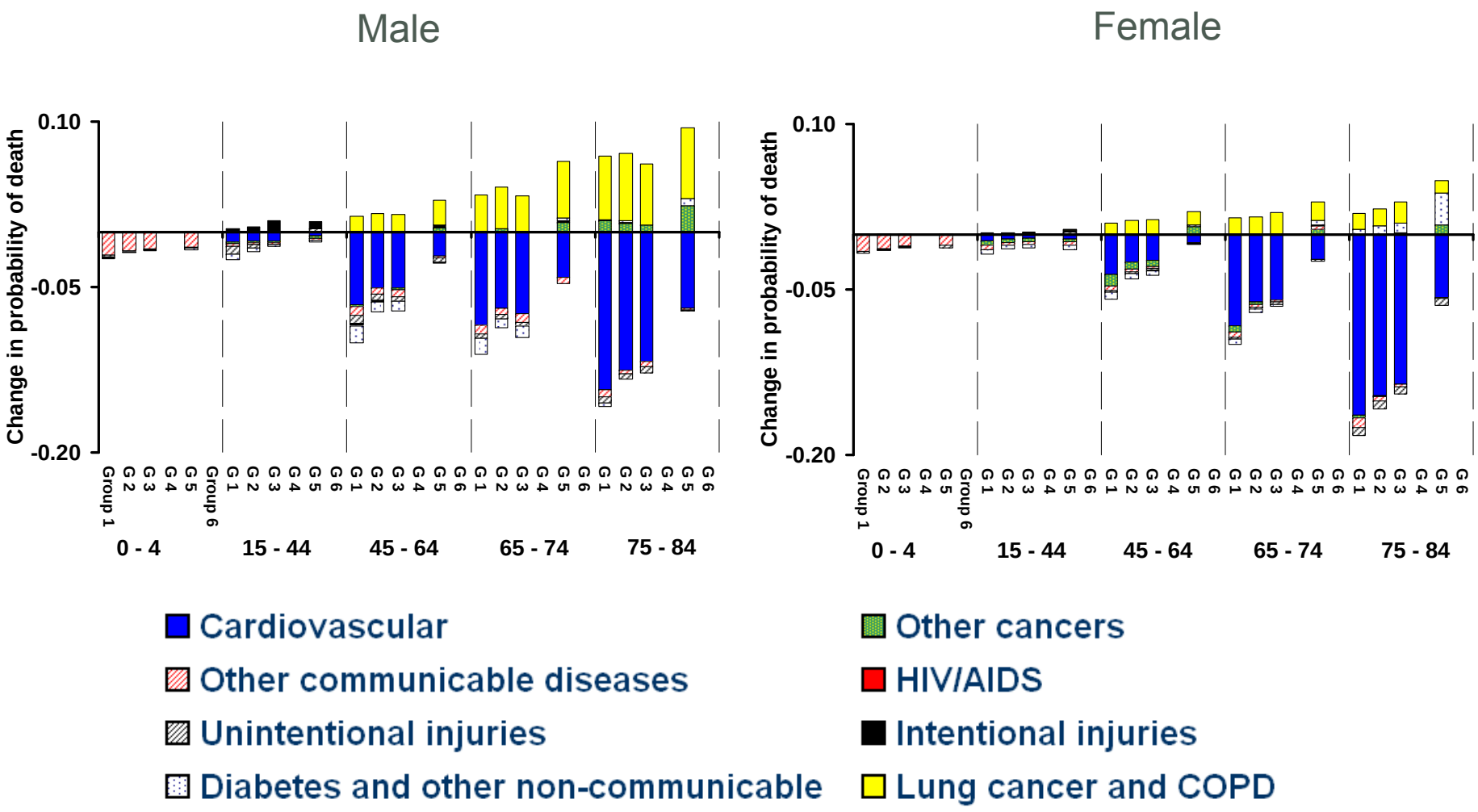


Ezzati et al *PLoS Medicine* 2008

Migration analysis

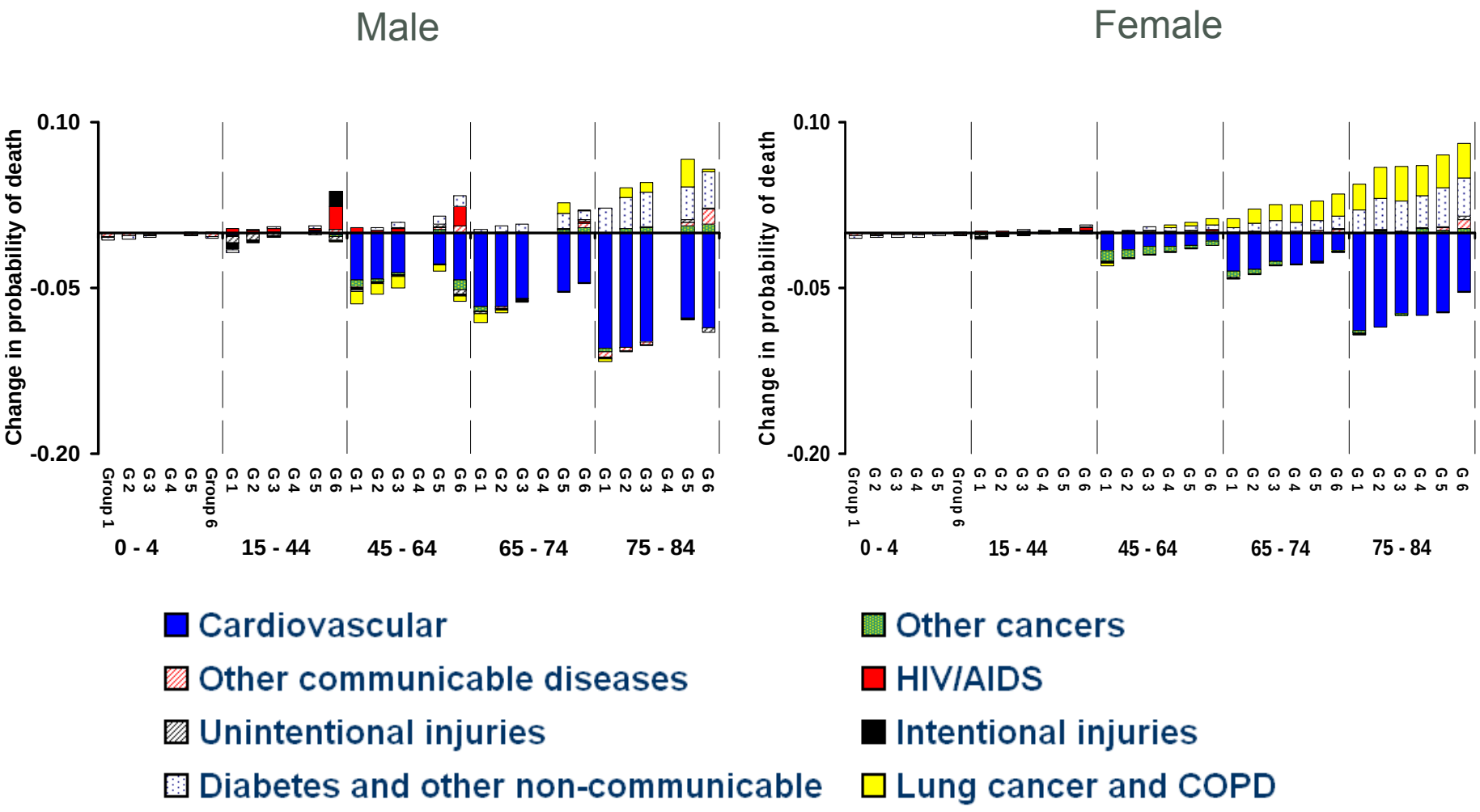
- Use IRS “County-to-County Migration Flows” for 1993-1999
  - Number of individuals moving from each county to every other county
  - Their mean and median incomes
  - No data on seasonal and illegal migration

Change in probabilities of death in county groups, by cause (1961-83)



Ezzati et al *PLoS Medicine*, in-press

Change in probabilities of death in county groups, by cause (1983-89)

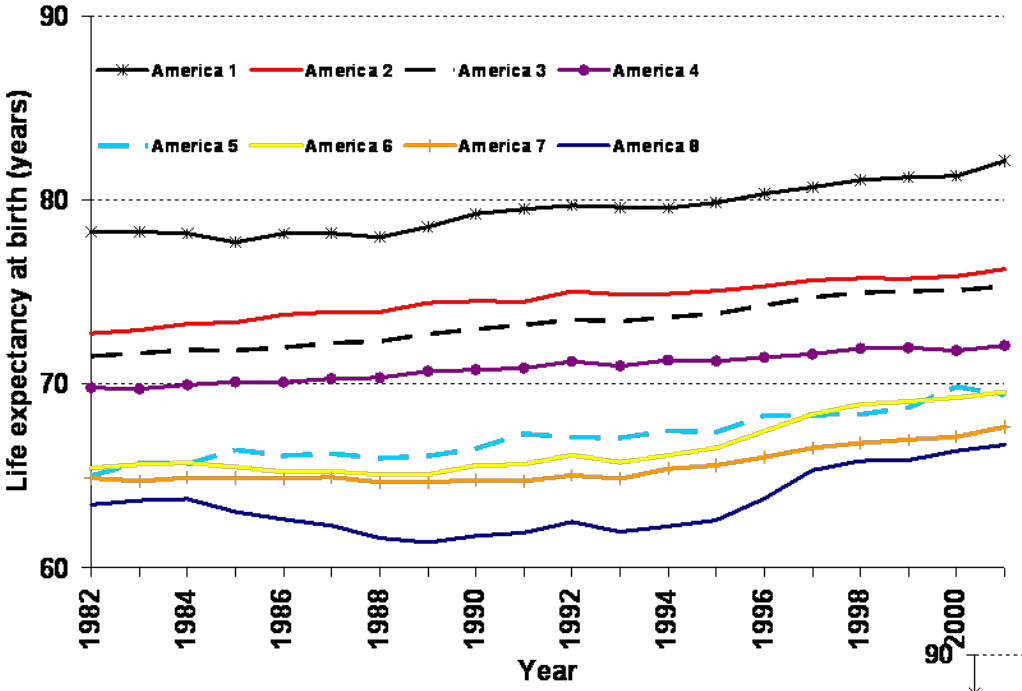


Ezzati et al *PLoS Medicine*, in-press

Definitions of the Eight Americas

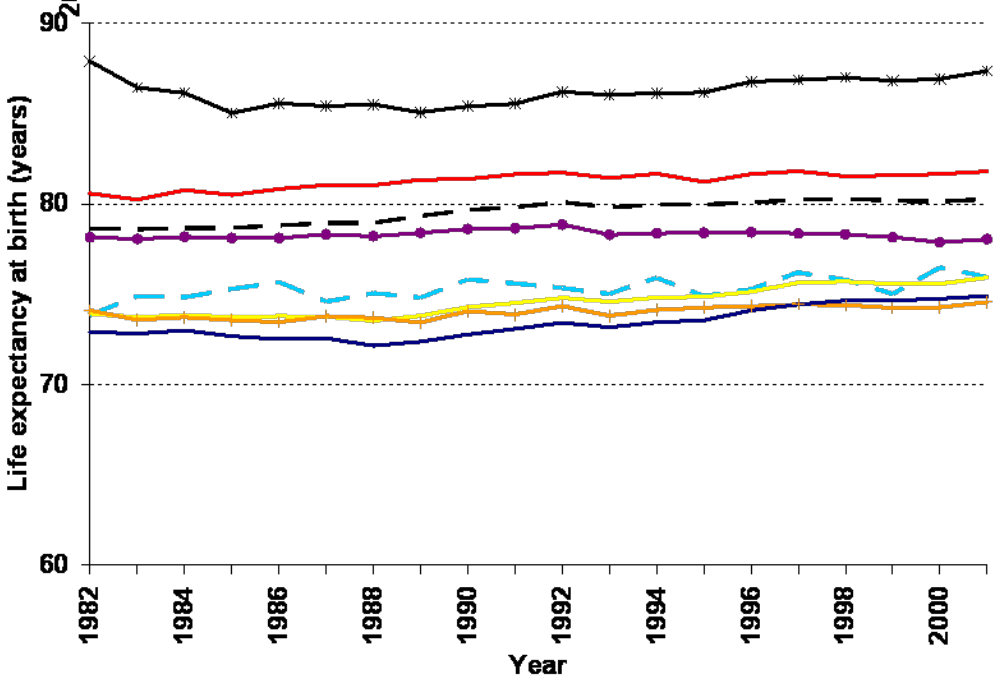
- America 1: Asians living in counties where Pacific Islanders < 40% of population
- America 2: White low-income rural Northland
- America 3: Middle America
- America 4: White poor Appalachia and Mississippi Valley
- America 5: Western Native Americans
- America 6: Black middle America
- America 7: Black poor rural south
- America 8: Black high-risk urban

Life Expectancy at Birth in the Eight Americas



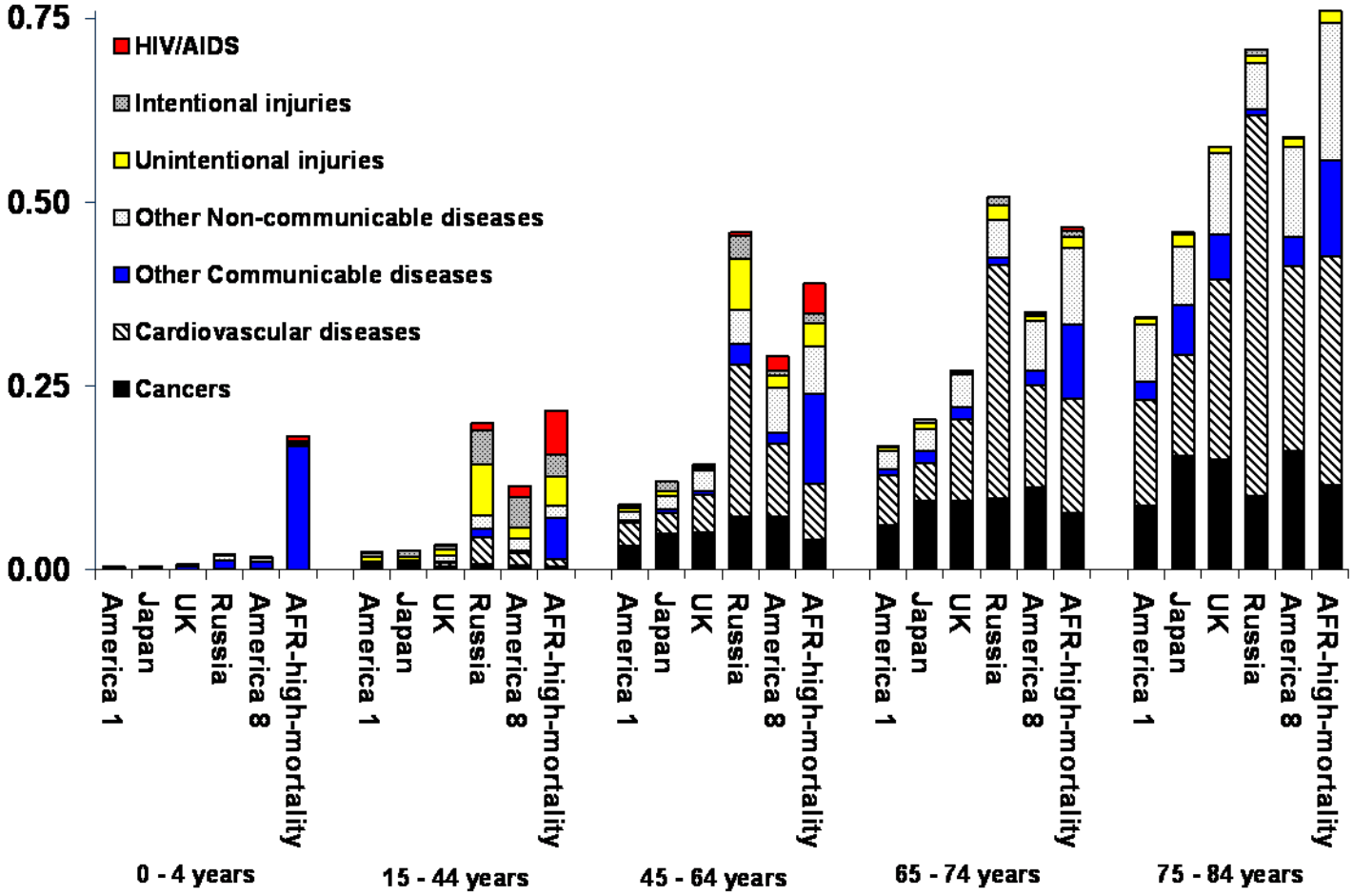
Males

Females



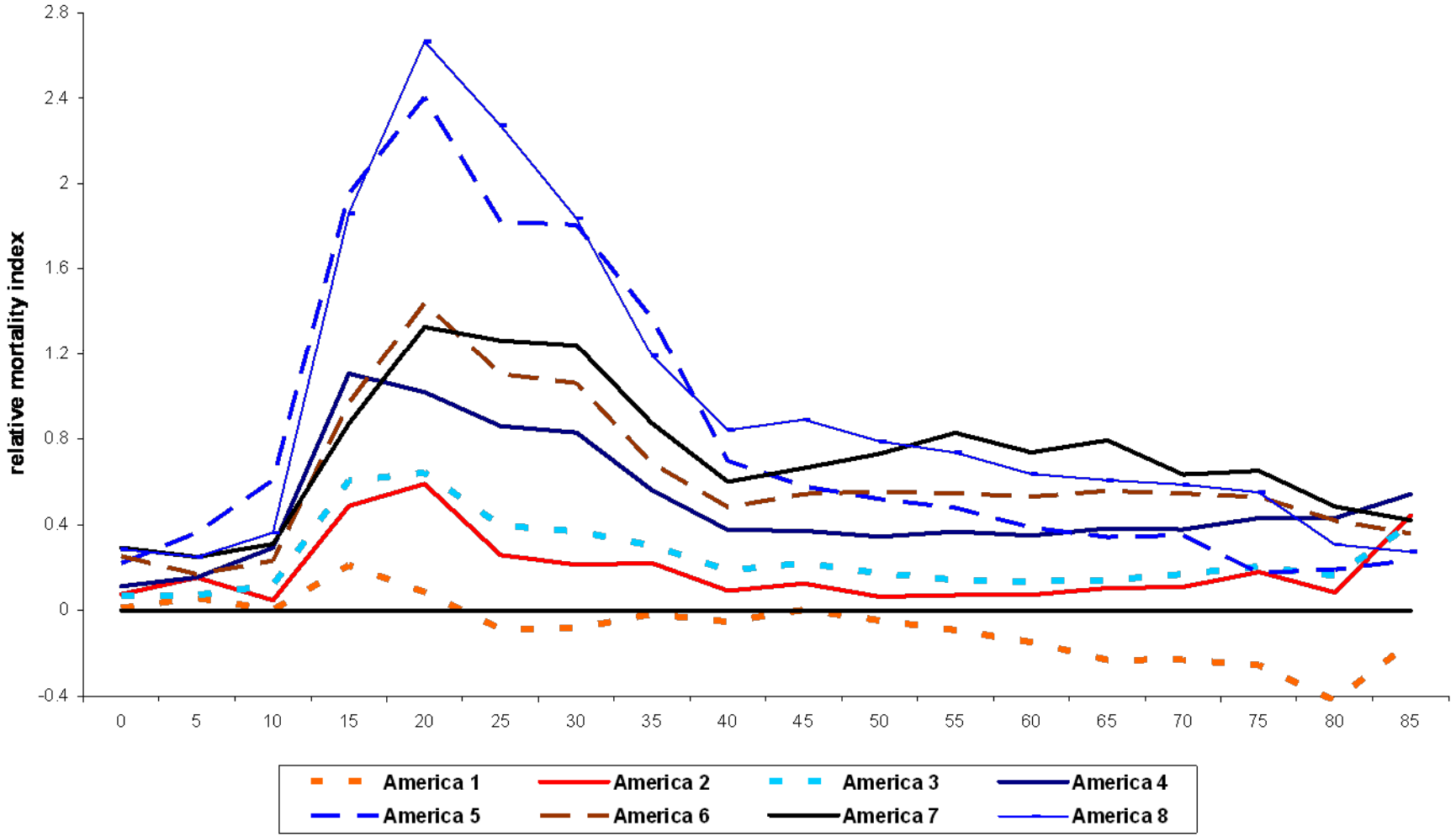
Murray et al. *PLoS Medicine* 2006

Male Causes of Death in the Eight Americas Compared to Japan, UK, Russia and West Africa



Murray et al. *PLoS Medicine* 2006

Mortality in the Eight Americas by Age Compared to Other High-Income Countries



Murray et al. *AJPM* 2005

US county life expectancy summary

- Rise in cross-county life expectancy disparity since the early 1980s
- Continued rise in life expectancy of better-off counties but stagnation or decline in some of the worse-off ones
- Similar conclusions, with even larger disparities, when analyzed by race-county combinations (“Eight Americas”)
- The patterns are unlikely to be due to migration

- Rise in mortality disparities driven primarily by differential change in chronic diseases like lung cancer, COPD, diabetes, and cardiovascular diseases (plus HIV/AIDS and homicide for men)
- Likely role of smoking, blood pressure, and obesity should be explored

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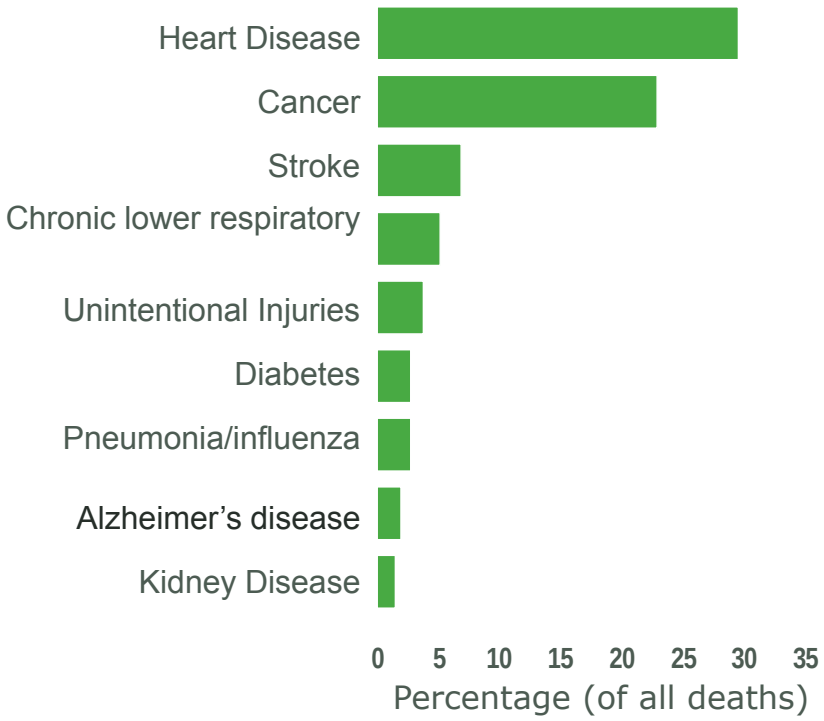
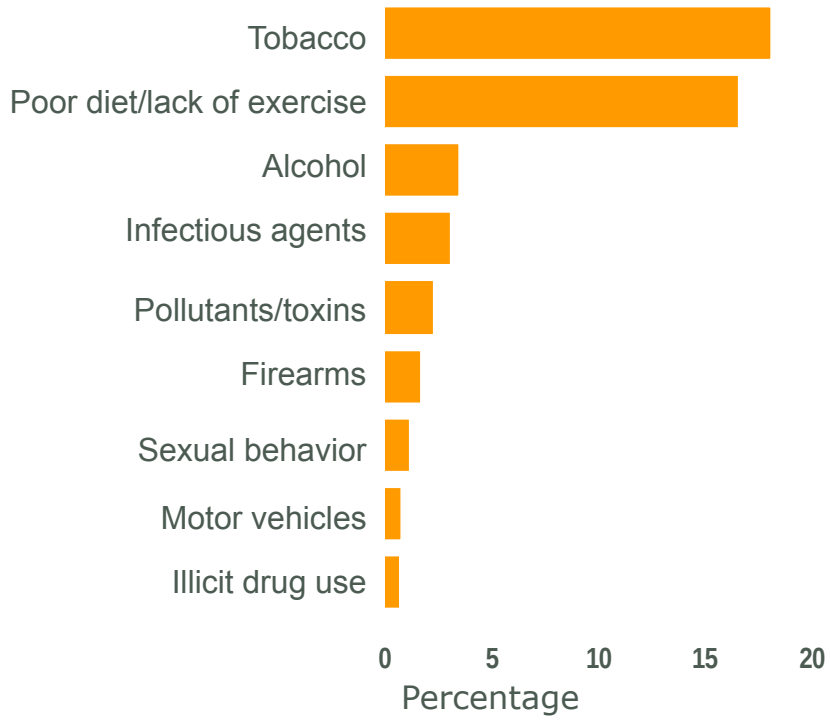
Causes of Death

United States, 2000

Leading Causes of Death*



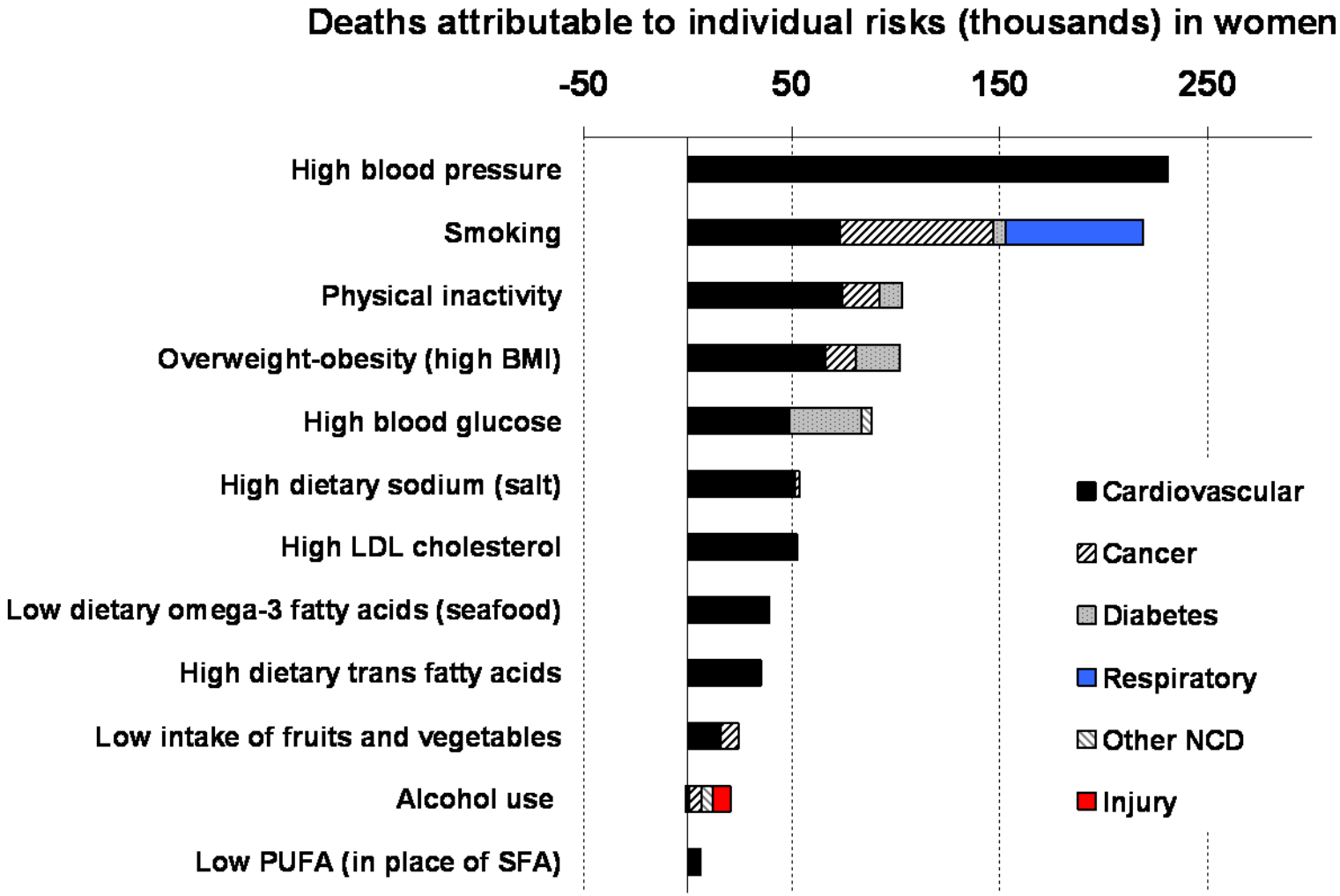
Actual Causes of Death†



* National Center for Health Statistics. Mortality Report. Hyattsville, MD: US Department of Health and Human Services; 2002

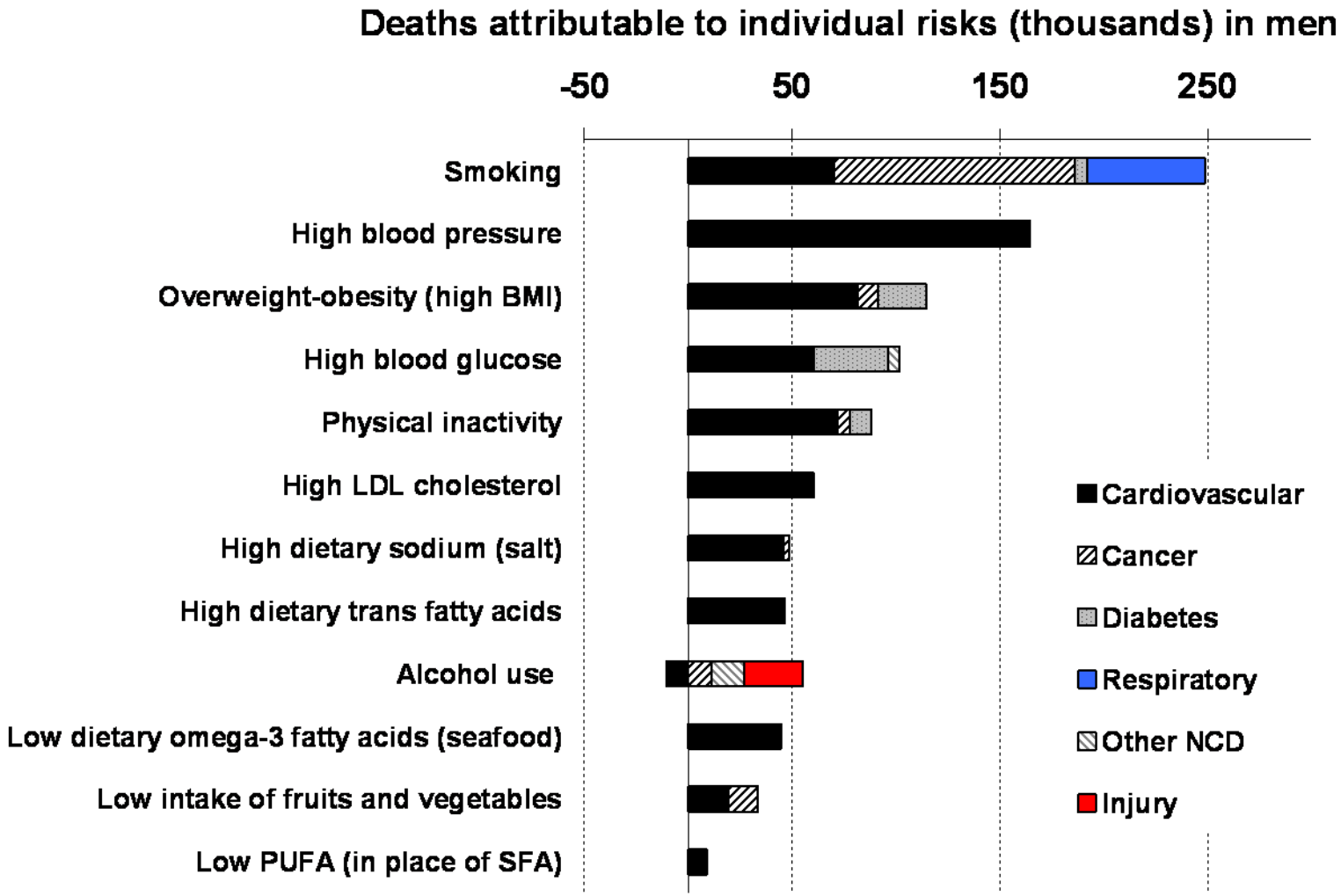
† Adapted from McGinnis Foege, updated by Mokdad et. al.

Risk factors for mortality in the US, women



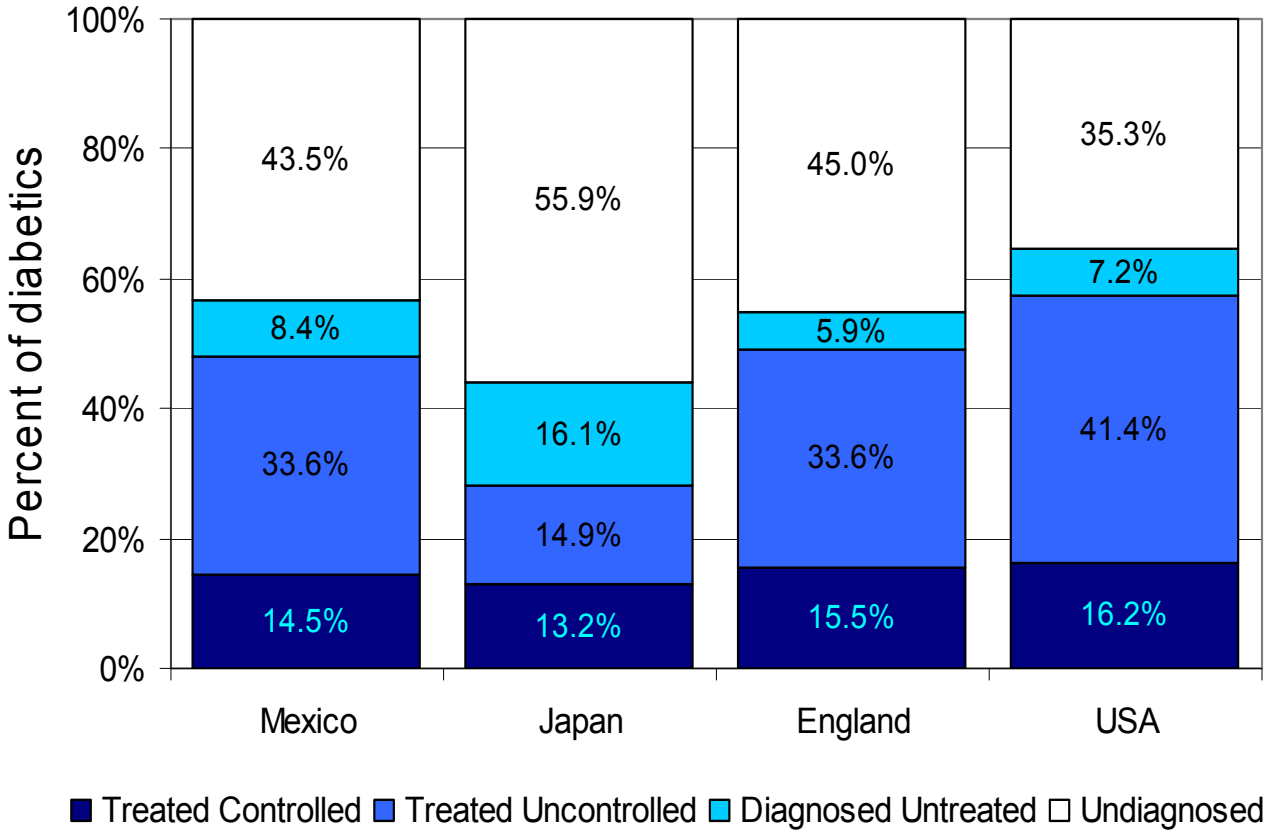
Danaei et al *PLoS Medicine* 2009

Risk factors for mortality in the US, men



Danaei et al *PLoS Medicine* 2009

Glycemic Control in Diabetics in Mexico, England, USA and Japan



Key Messages on Disparities

Large disparities across sub-groups in the US defined by race/ethnicity and place.

Disparities are constant or worsening.

Some populations in the US have declining levels of life expectancy.

Most disparities are due to non-communicable diseases in young and middle-aged adults.

Classic risk factors are likely to account for a large component of disparities.

Effective coverage of key primary care and preventive interventions for these risk factors is low

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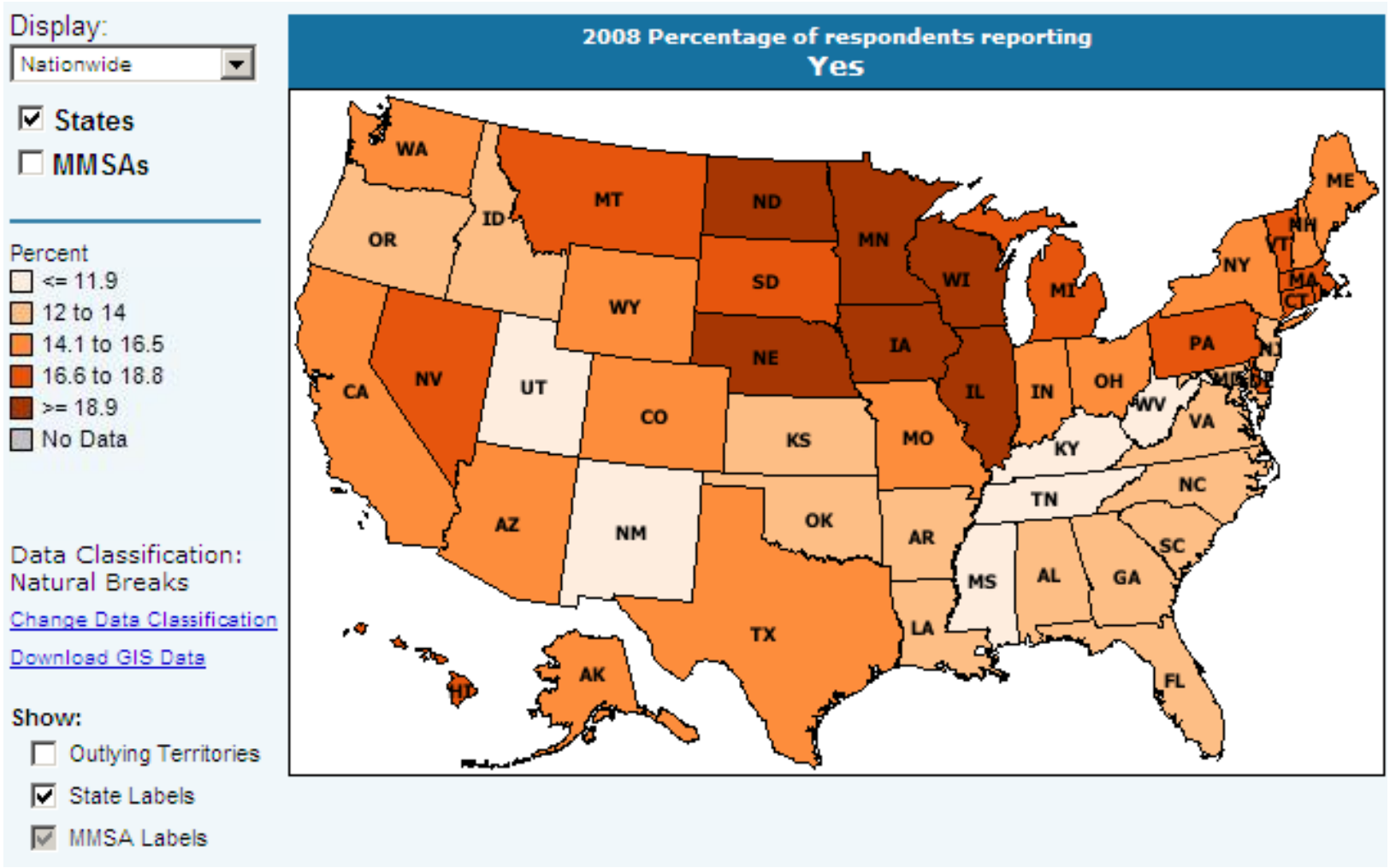
Major risk factor data sources in the US

- National Health and Nutrition Examination Survey (NHANES)
  - In-person interview and measured tests
  - Only nationally representative
  - Traditionally not annual
- Behavioral Risk Factor Surveillance System (BRFSS)
  - Telephone survey
  - State-representative (+ county-representative in some large counties)
  - Annual

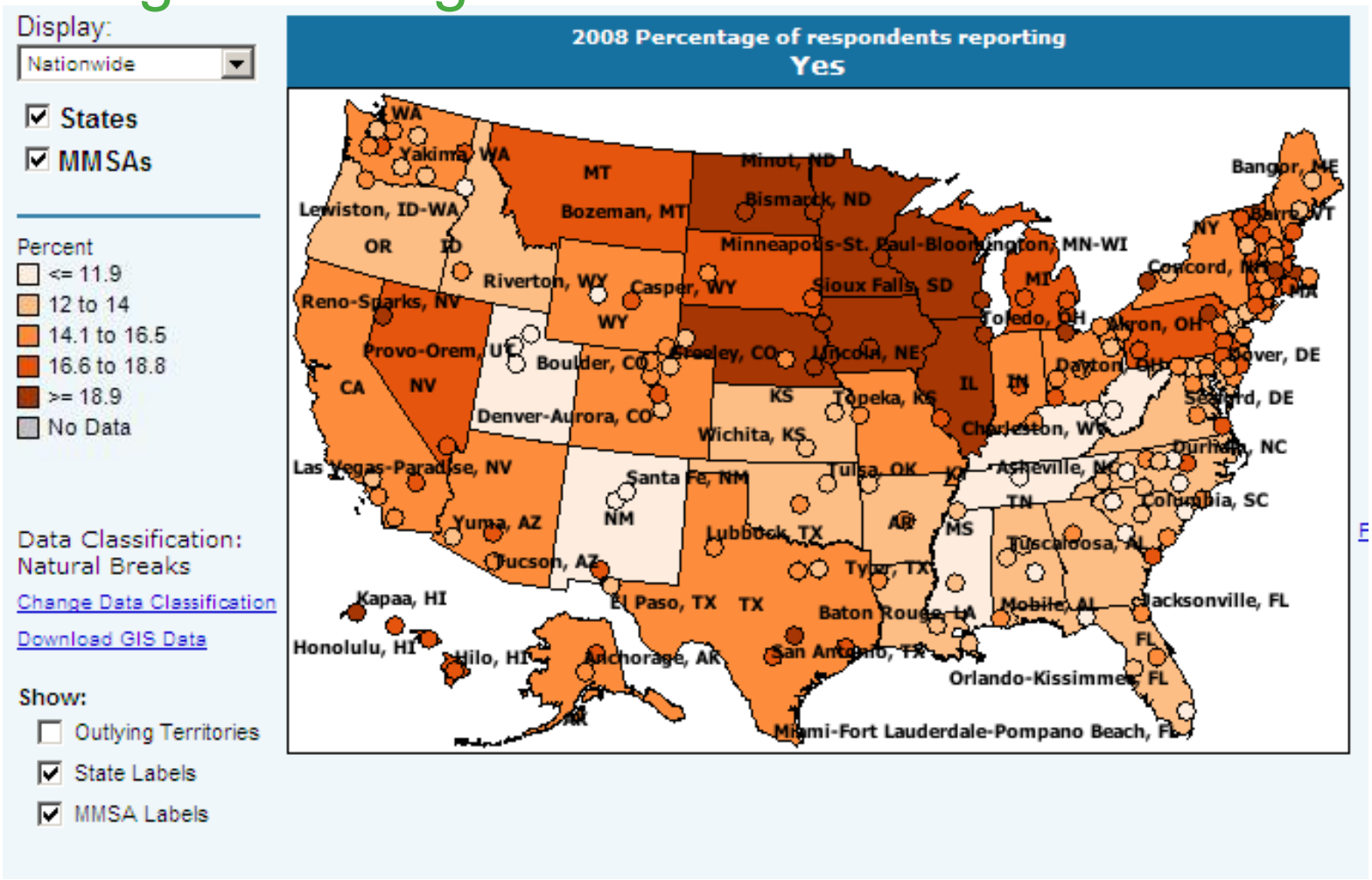
Binge Drinking

- Average 15.6%

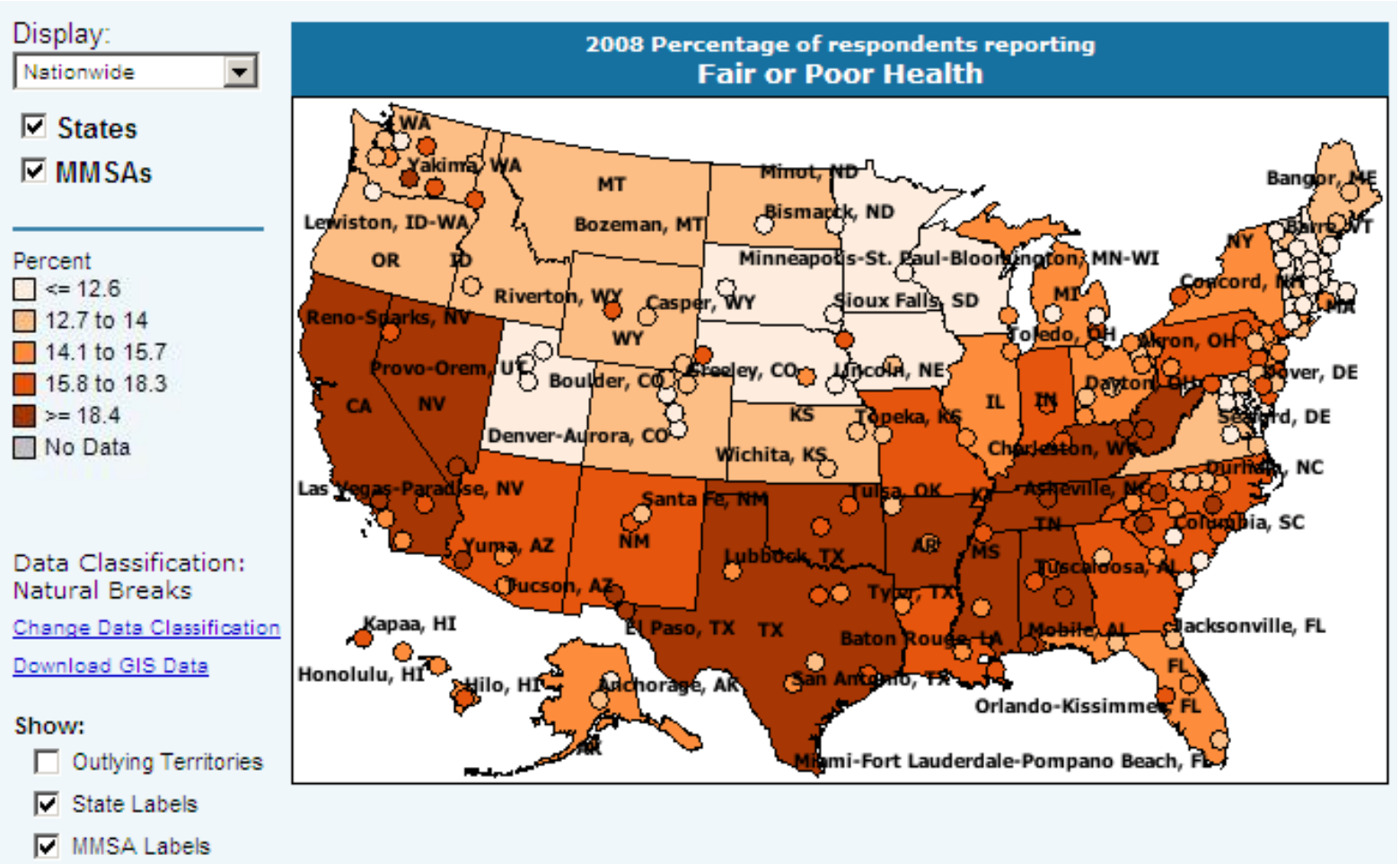
Binge Drinking



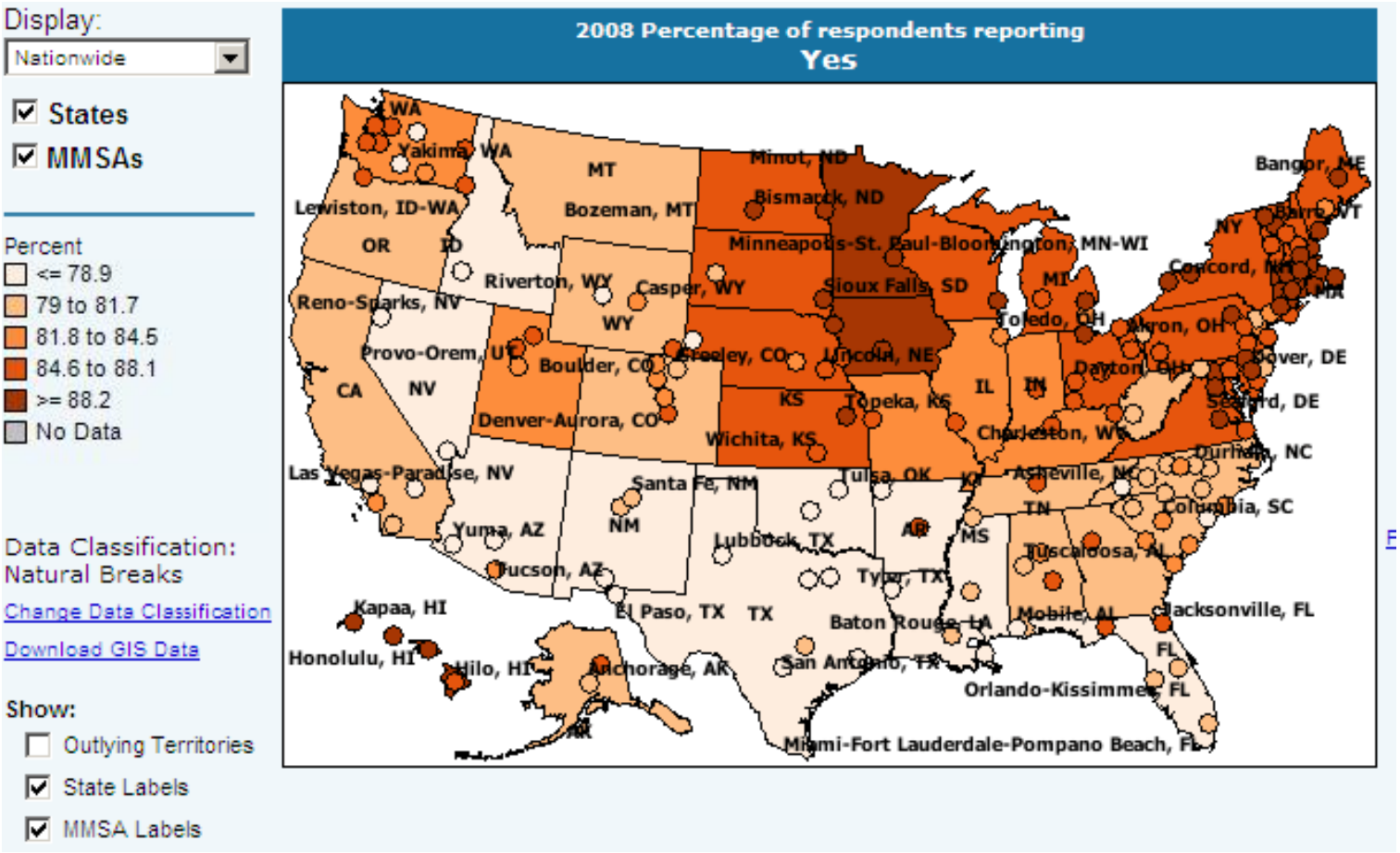
Binge Drinking



Health Status



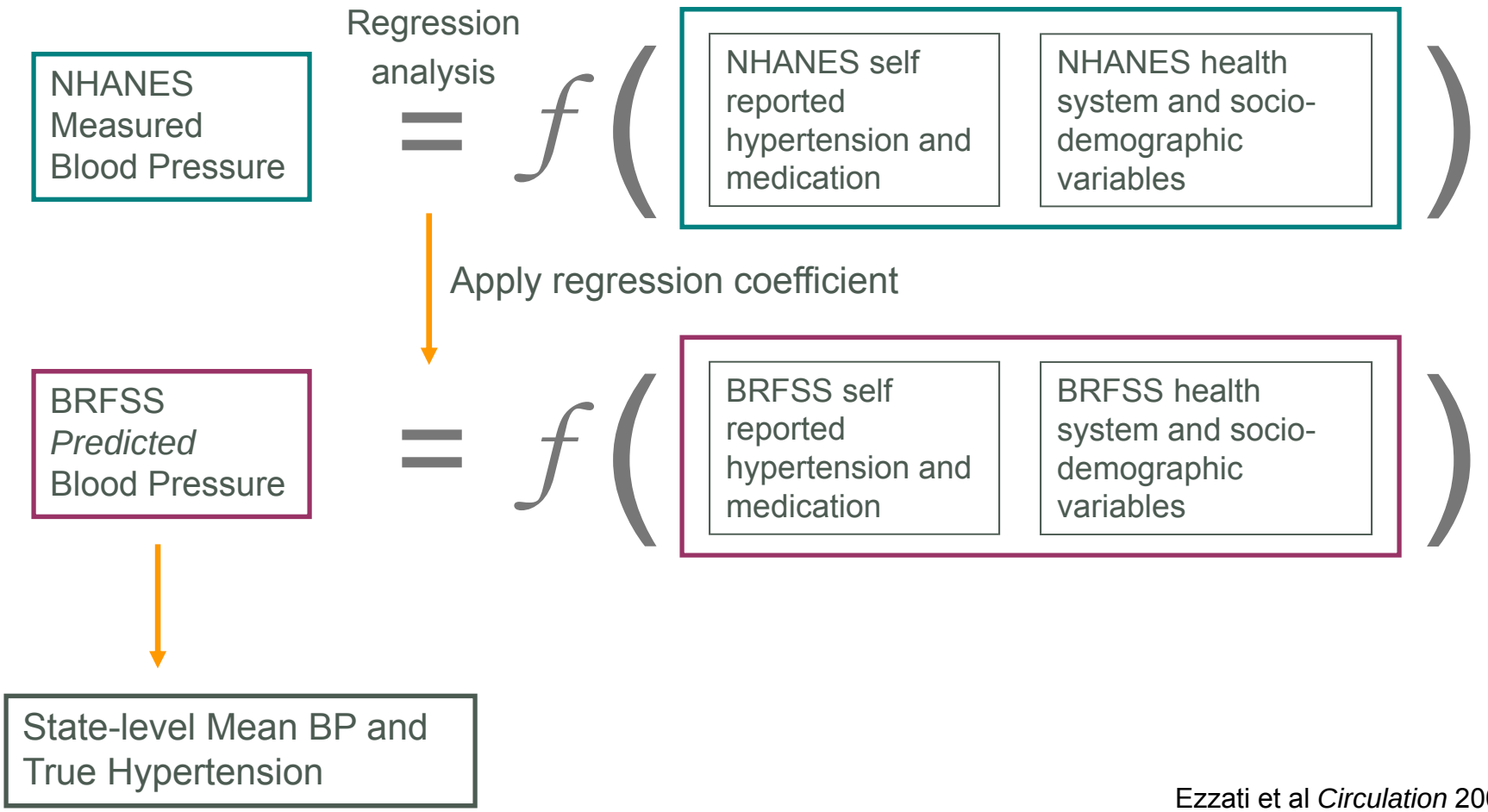
Health Insurance, Ages 18-64



Sub-national estimates for blood pressure

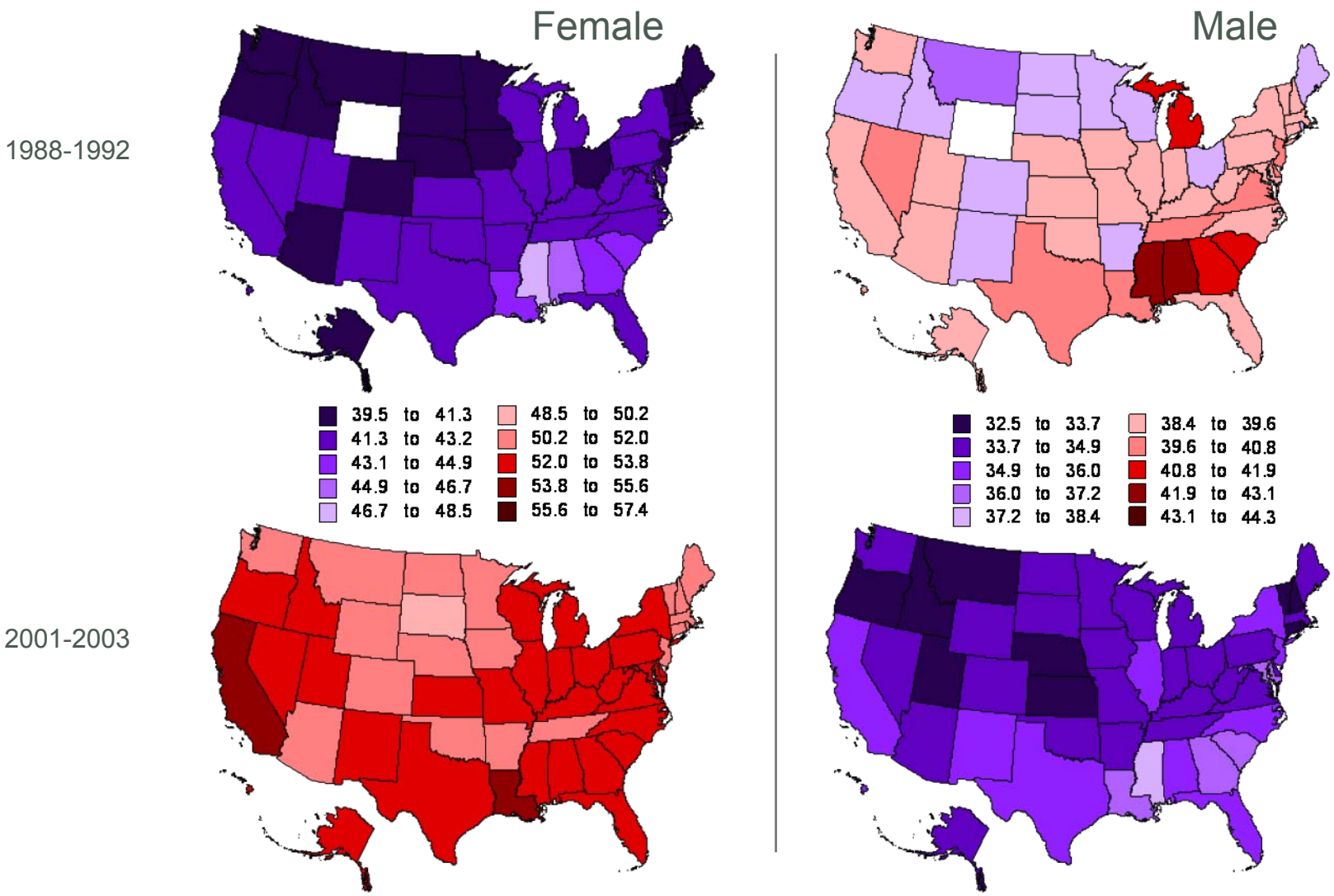
- NHANES includes measured blood pressure but is only nationally representative
- BRFSS, representative for states and large counties, includes some questions on self-reported diagnosis with high blood pressure and on medication
- Problems with self-reported hypertension
  - Some who self-report as hypertensive are controlling BP with lifestyle/medicine and have reduced level below threshold
  - Some people do not know they are hypertensive

Blood pressure estimation steps



Ezzati et al *Circulation* 2008

Prevalence of uncontrolled hypertension, age ≥ 60 years



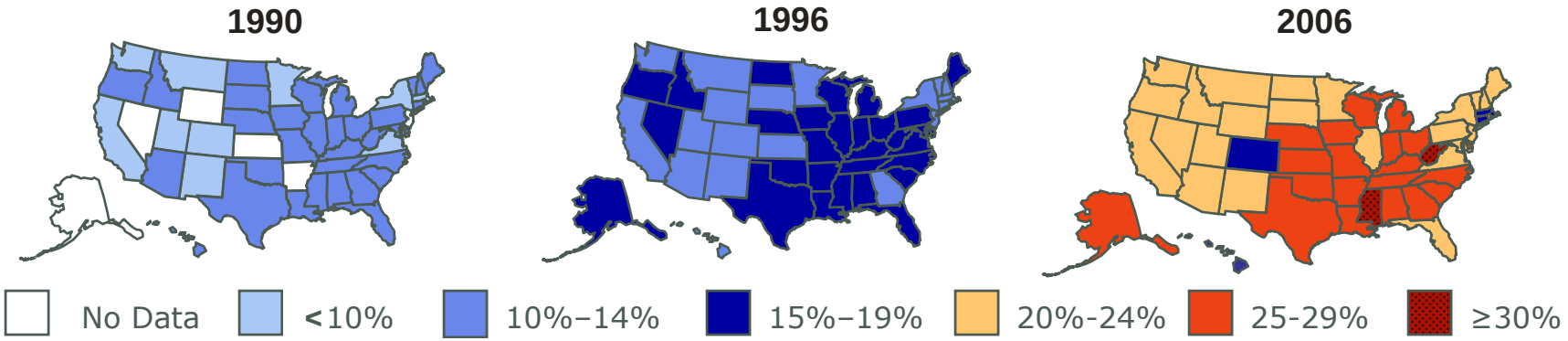
Ezzati et al *Circulation* 2008

US state blood pressure summary

- Age-standardized uncontrolled hypertension prevalence
  - highest in the District of Columbia, Mississippi, Louisiana, Alabama, Texas, Georgia, and South Carolina (18-21% for men and 24-26% for women)
  - lowest in Vermont, Minnesota, Connecticut, New Hampshire, Iowa, and Colorado (15-16% for men and around 21% for women)
- Women had a higher prevalence of uncontrolled hypertension than men in every state by 4 to 7 percentage points
- In the 1990s, uncontrolled hypertension increased among women in all states and decreased among men in all states (by very small amounts in some)
- Stroke and CHD among women of different age groups would be 2-4% lower if blood pressure had stayed at its 1990 levels

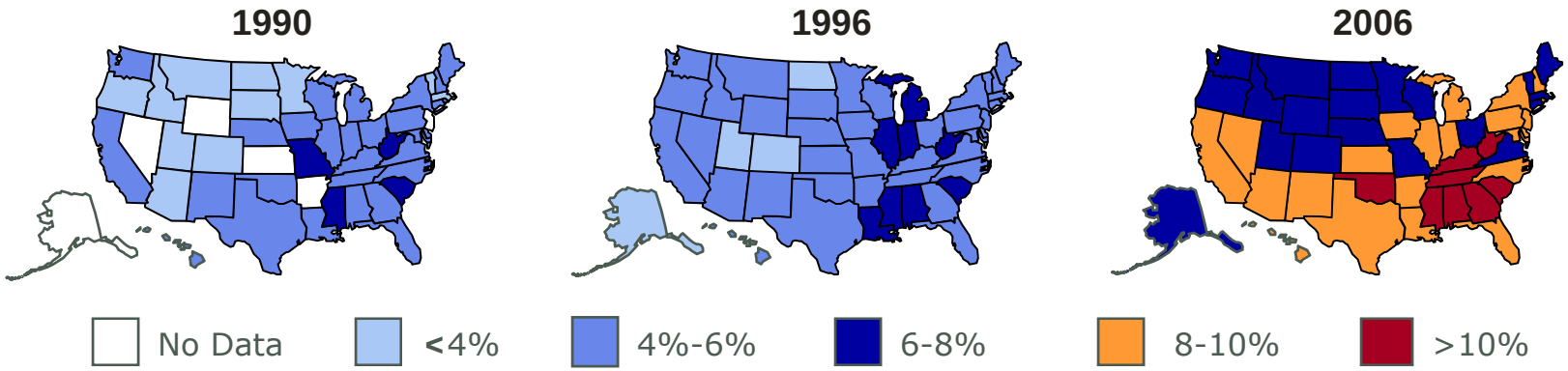
Prevalence of Obesity* Among U.S. Adults

(*BMI ≥30, or about 30 lbs overweight for 5'4" person)



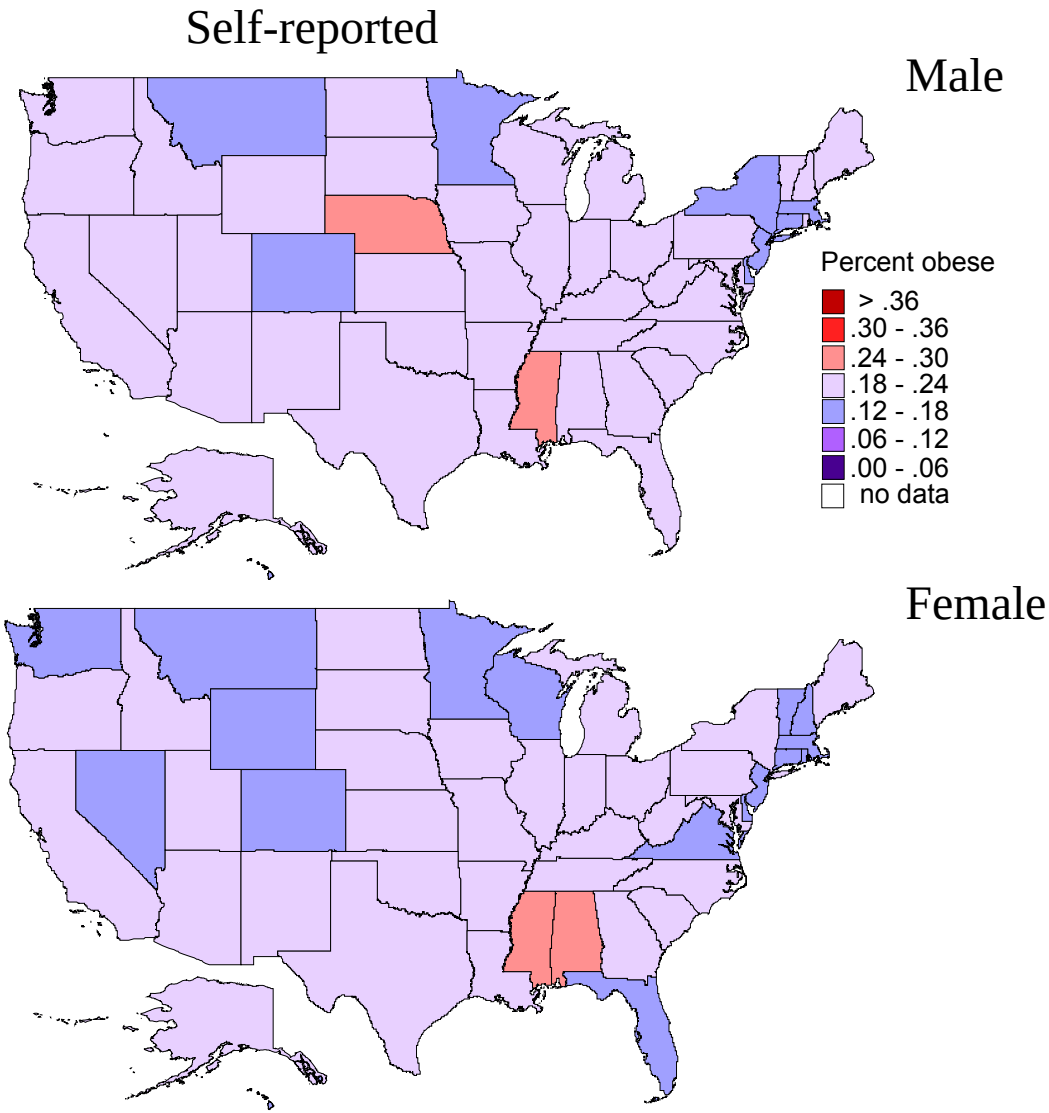
Prevalence of Diabetes* Among U.S. Adults

(*Includes gestational diabetes)



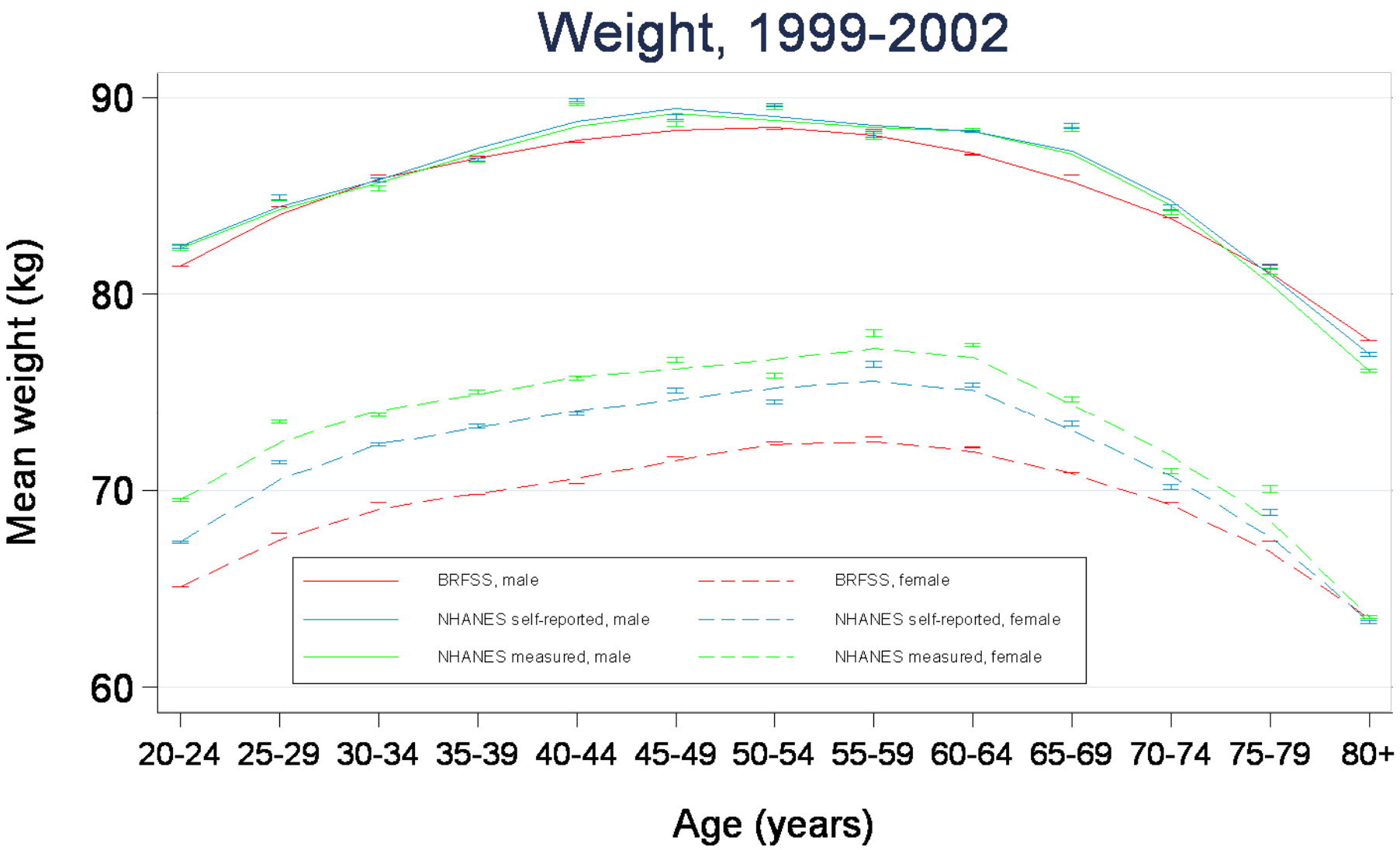
Source: Behavioral Risk Factor Surveillance System, CDC.

State obesity prevalence in BRFSS, 2000



Ezzati et al *JRSM* 2006

Self-reported and measured weight, 1999-2002



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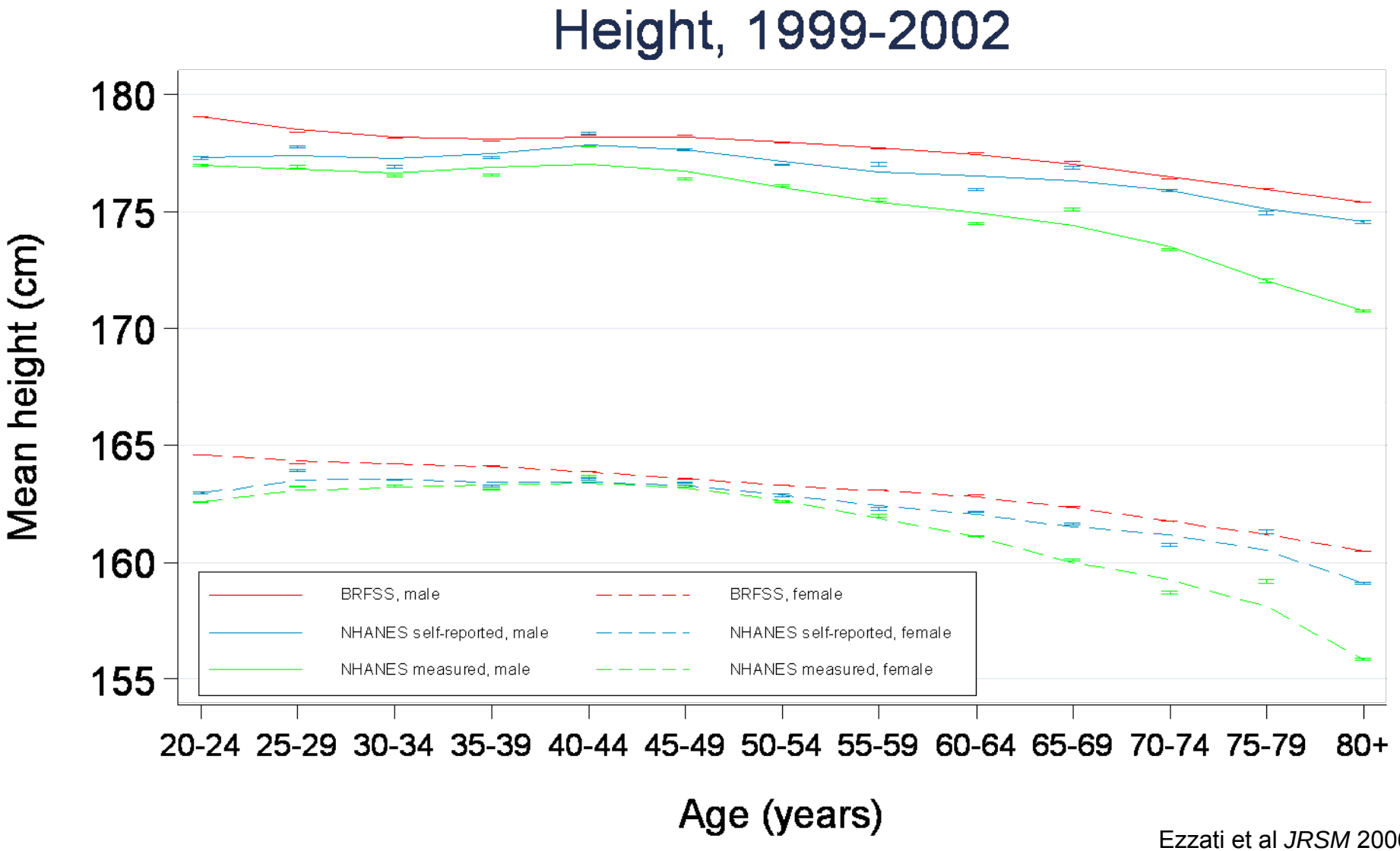
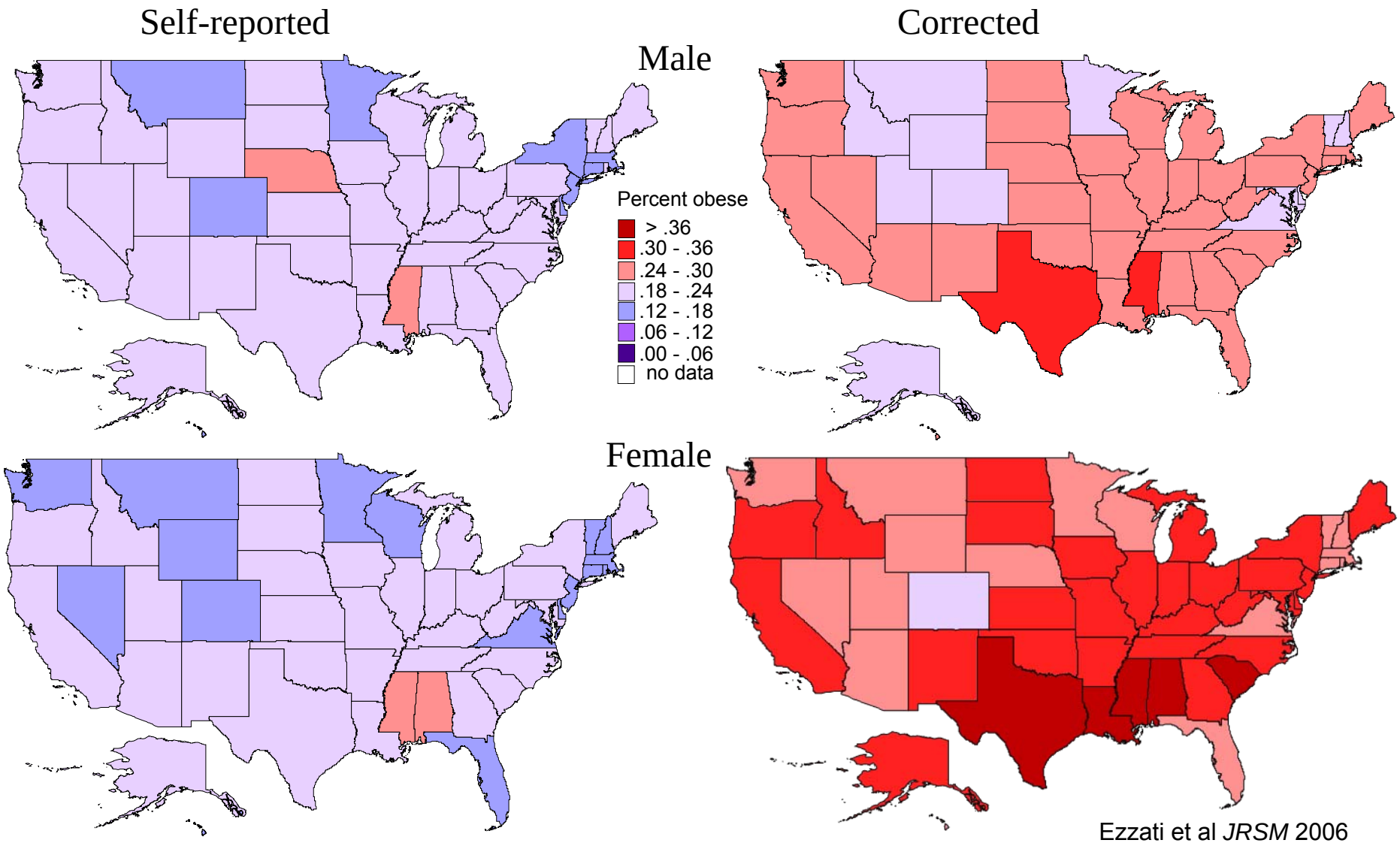
Self-reported and measured height, 1999-2002



Ezzati et al *JRSM* 2006

State obesity prevalence in BRFSS and after correction for self-report bias, 2000



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A National Disparity Monitoring System for Non-Communicable Diseases

Bringing Medical and Public Health Perspectives on Disparities Together

Merging tools and methods to provide detailed clinical and biomedical understanding of key determinants of population health and disparities in population and health.

Demonstrate the linkage between interventions to modify risk factors and manage disease and population health.

Foster implementation research on how to deliver known effective public health and medical interventions.

Three Types of Population Health Data Collection

Cohort studies to help identify new causal relationships and quantify heterogeneity in known relationships across groups or over time.

Surveillance of levels, trends and patterns in NCDs, risk factors and other determinants, and the delivery of public health and medical interventions.

Population laboratories for testing the impact of innovative methods for public health and medical care intervention delivery.

Status of Population Health Data Collection in the US

Cohort studies – Framingham, Jackson, etc provide strong basis for causal relationships. Some challenges for genetic linkages and components of diet.

Surveillance – NHANES at the national level, sub-national surveillance only on mortality by cause and self-reported behaviors and diagnoses through BRFSS. For selected cardiology interventions NCDR provides some data on service delivery. CMS data on hospital admissions

Population laboratories – developed ad hoc for the limited number of implementation studies.

Americas Surveillance System: Goals

Surveillance of disease incidence and prevalence, functional health outcomes, measured risks and public health and clinical response for the different Americas.

Quantify the contribution of the major NCD risk factors to patterns and trends in disparities across Americas

Demonstrate an innovative model for surveillance that empowers local decision-makers with information in a decentralized health system that could be subsequently implemented on a wider basis

Create an environment for conducting rigorous implementation research and evaluating the effectiveness of new health intervention programs

Basic Design

Implement in 9 county clusters selected to represent each of the 8 Americas and Hispanic populations a integrated multi-mode surveillance system.

Each county would collect self-reported data, examination data, vital events, and provider data.

Record linkage and repeat surveying of the same individuals would maximize the information content of the data collected.

Surveillance data would with appropriate safeguards for privacy be available for researchers in the public domain

County Selection: Criteria

Total population of at least 150,000 for a particular America of interest

Collectively, the county-clusters are selected to give wide geographic coverage

Preference given to states and counties with successful local collaborations on surveillance in the past with other surveys such as BRFSS, NHANES, NHIS, etc…

8 Americas Surveillance System: Components

- Health and health care survey data
  - Mixed-mode (telephone, cell phone, mail, in-person) interview survey
  - Physical examination survey
  - Repeat selective physical measurements after 1 and 2 years for those with key risk factors and or treatments
- Administrative data
  - Mortality data by cause from the vital registration system
  - Health service provider data from hospitals, emergency rooms, and clinics

Health Interview Survey Instrument Modules

- *Socio-demographics:* age, sex, ethnicity, marital status, employment, income, household and personal assets, and education.
- *Functional health status:* self-rated health across multiple domains such as mobility, self-care, pain and discomfort, cognition, vision, hearing, and affect.
- *Risk factors:* physical activity, tobacco and alcohol use, diet, seat-belt use, sexual behavior.
- *Self-reported symptoms and diagnoses:* diabetes, cardiovascular disease, chronic respiratory disease, asthma, cancer, and injuries.
- *Health service access, coverage, and expenditure:* health insurance coverage, health care seeking behavior, general health care utilization, cancer screening, medication, physical aids, and out-of-pocket payments for health.

Examination Survey Modules

- *Functional health status*: timed walk, chair sit, visual acuity, audiometry.
- *Risk factors*: blood pressure, blood glucose, lipids, anthropometry, serum cotinine.
- *Disease status*: echocardiography, spirometry.
- *Intervention coverage*: plasma measurement of medication levels.

Health Interview Survey Instrument Modules

- *Socio-demographics:* age, sex, ethnicity, marital status, employment, income, household and personal assets, and education.
- *Functional health status:* self-rated health across multiple domains such as mobility, self-care, pain and discomfort, cognition, vision, hearing, and affect.
- *Risk factors:* physical activity, tobacco and alcohol use, diet, seat-belt use, sexual behavior.
- *Self-reported symptoms and diagnoses:* diabetes, cardiovascular disease, chronic respiratory disease, asthma, cancer, and injuries.
- *Health service access, coverage, and expenditure:* health insurance coverage, health care seeking behavior, general health care utilization, cancer screening, medication, physical aids, and out-of-pocket payments for health.

Physical Examination Survey Measurements

Leading Cause of DALYs	Risk Factors	Disease Status	Intervention Coverage
Ischemic Heart Disease	•Weight •Standing Height •Waist Circumference •Hip Circumference •Heart rate •Blood pressure •Ambulatory Blood Pressure Monitor •Etc.	•ECG •Echocardiography	•Plasma/urine marker for ACEI •Direct plasma measurement of medication levels •Urine Sodium
COPD	•Serum Cotinine •Home Air Sampling •Home Dust Sampling	•Spirometry	
Diabetes Mellitus	•Waist Circumference •Hip Circumference •Fasting Glucose	•HgbA1C	
Asthma		•Spirometry	•Urine albuterol
Cancer Colon or Rectum	•Plasma markers of food intake (e.g. beta-carotene, whole grains)		
Chronic Kidney Disease		•Creatinine •Urine •Albumin/creatinine ratio	
Lead Toxicity		•Serum Lead	

Physical Examination Survey Measurements of Functional Health Status and Follow-up Exam Survey Measurements

Physical Examination Survey Measurements of Functional Health Status

Mobility
6-minute walk test (6MWT)
Chair rise test (CRT)
Standing balance
One-legged stance task

Cognition
Mini-Mental State
Cognitive Abilities Screening Instrument
Wechsler Abbreviated Scale of Intelligence

Vision
Early Treatment Diabetic Retinopathy Study log of minimum angle of resolution chart (ETDR logMAR)

Hearing
Standard pure tone audiometry

Self-care Performance
eating/feeding (use of suitable utensils to bring food to mouth, chewing and swallowing, chopping vegetables with knife, cleaning up after eating)
dressing (dressing above waist)
washing face and hands
hair grooming
The scoring will be based on observations of trained interviewers, who must first instruct participants how to perform the test in a standardized way.

Follow-up Exam Survey Measurements

Exam
Weight
Standing Height
Waist Circumference
Hip Circumference
Heart Rate
Blood Pressure

Blood
Lipid Panel
Apoliprotein B/A1
CRP
Lp(a)
Fasting Glucose
HgbA1C
Direct plasma measurement of medication levels

Data Collection Schedule in Each Site

Each year a random sample of 2000 for health interview survey

For each sample of 2000, sub-sampling used to collect examination data and follow-up data:

800 in year 1 for examination survey

1000 in year 2 for repeat health interview survey

250 in year 2 for repeat examination survey, selected based on responses in year 1 examination survey

Multimode Design

Population of interest

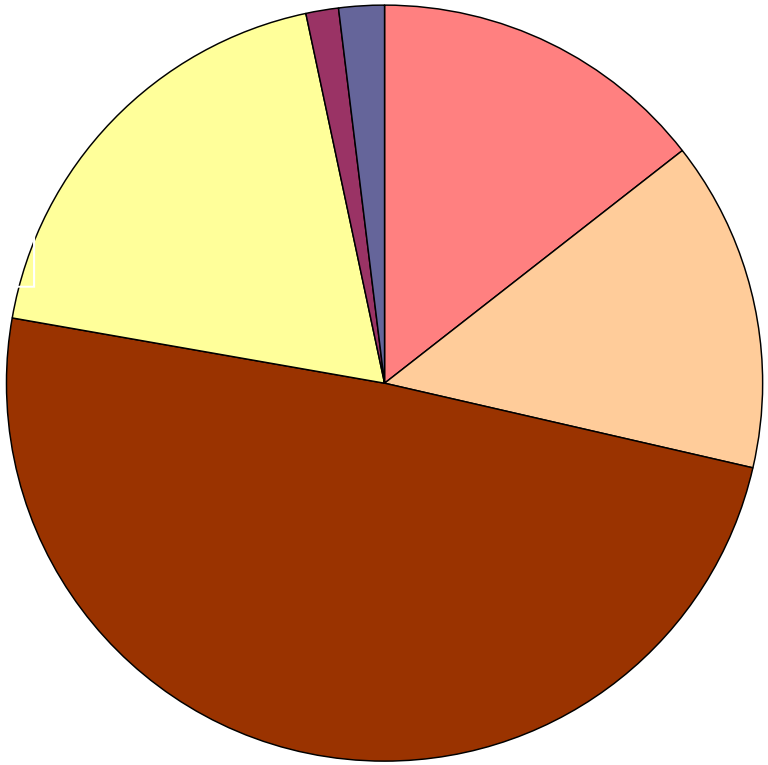
Landline, cellular, mail, or/and in person

Comparability

- Within study
- Across studies

Questionnaire design and reducing measurement error

Percent Distribution of Household Telephone Status for Adults, July-December 2007



Many Challenges for Comparability

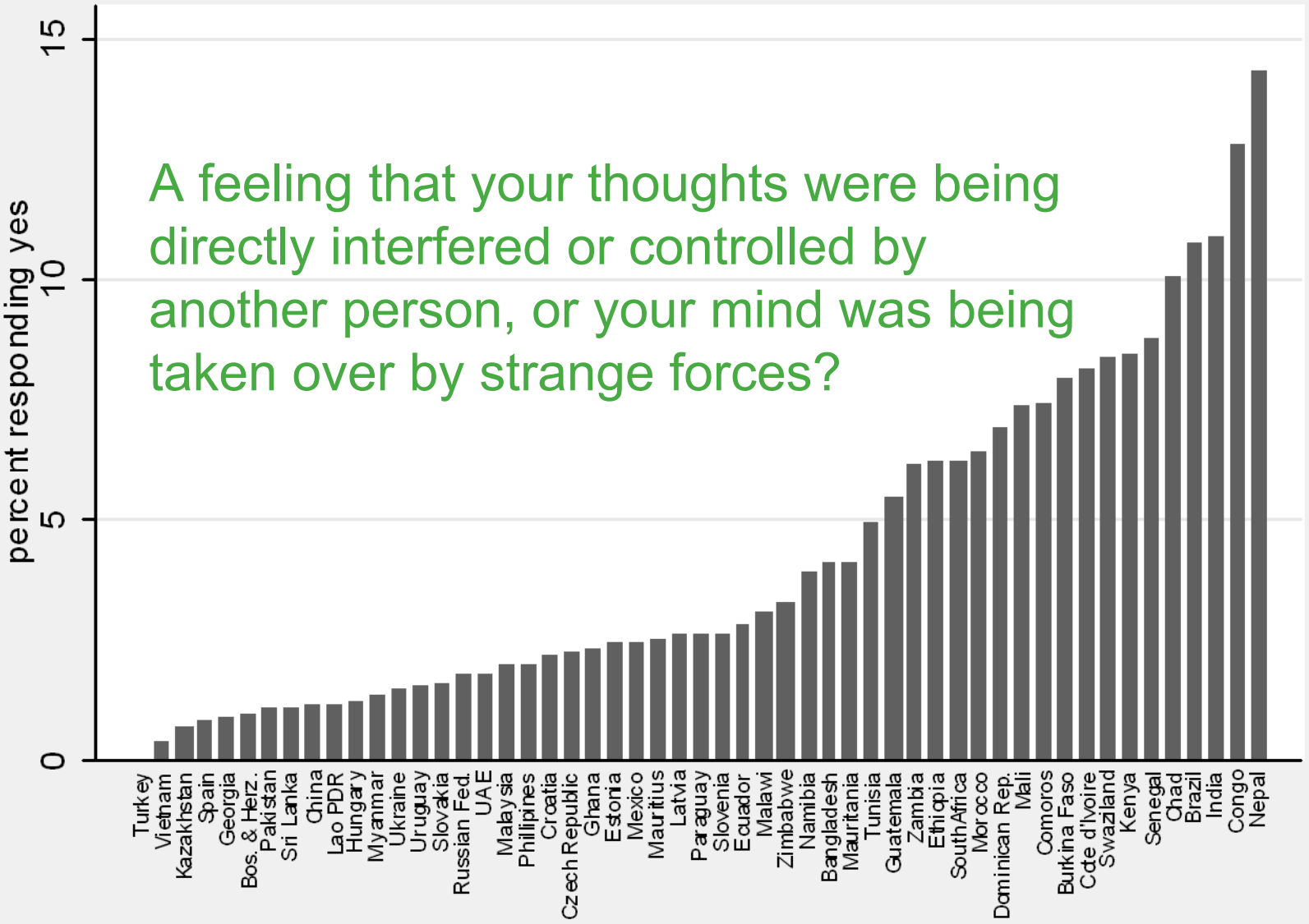
Content of key items can vary e.g. diet, certain risks

Differential item functioning (DIF) – the same item and response categories may be used differently by different cultural groups.

Comparability: Content

Fruits and Vegetables

- 2 weeks dietary records for fruits and vegetables
- Identify top 75% to 80% FV items for each America
- Based on America a different questionnaire is administered


A feeling that your thoughts were being directly interfered or controlled by another person, or your mind was being taken over by strange forces?
percent responding yes
0
5
10
15
Turkey
Vietnam
Kazakhstan
Spain
Georgia
Bos. & Herz.
Pakistan
Sri Lanka
China
Lao PDR
Hungary
Myanmar
Ukraine
Uruguay
Slovakia
Russian Fed.
UAE
Malaysia
Phillipines
Croatia
Czech Republic
Ghana
Estonia
Mexico
Mauritius
Latvia
Paraguay
Slovenia
Ecuador
Malawi
Zimbabwe
Namibia
Bangladesh
Mauritania
Tunisia
Guatemala
Zambia
Ethiopia
SouthAfrica
Morocco
Dominican Rep.
Mali
Comoros
Burkina Faso
Cote d'Ivoire
Swaziland
Kenya
Senegal
Chad
Brazil
India
Congo
Nepal

8 Americas Surveillance System: Survey Data Quality

Interviewer monitoring and feedback: To make sure interviewers do the interviews consistently and do not inadvertently introduce bias.

Verification callbacks or interviews: To make sure the survey is capturing consistent responses.

Interviewer performance statistics: To monitor and improve data collection techniques.

Data collection statistics: To make sure a consistent number of interviews take place across all sites and across years.

Data editing, correction, and submission: To check for and correct errors in the data.

Data weighting: To make sure data accurately reflects the population

Administrative Data Capture

Critical component of the proposed surveillance system will be to enroll service providers in these communities to provide detailed service provision data.

Build on hospital record linkage systems in Washington and Michigan, NCDR, CMS data files and other initiatives.

Methods and approaches need to be extended beyond hospitals and beyond cardiology services for capturing more detailed clinical data.

Record Linkage

Value of each component of the surveillance data (surveys, service provider data and death data) will be enhanced through record linkage.

Linkage experience highlights the importance of capturing effective variables for direct match and probabilistic linkage routines.

Record linkage for health service providers will require working with providers to modify data captured through routine systems.

Innovations

- Data sources linkage (surveillance, morbidity, mortality, etc…)
- Advanced surveillance methodology
- Comparability across the Americas
- Ensure high data quality
- Sharing and releasing data

Institute for
Health Metrics
and Evaluation

Thank you!

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Excess Deaths Associated with Underweight, Overweight, and Obesity

- Flegal et al., JAMA 2005;293:1861-1867

- NHANES I (1971/75-1992)
  - Underweight (41,930), 25-<30 (-14,354), 30-<35 (112,310), 35+ (186,498)
- NHANES II (1976/80-1992)
  - Underweight (19,618), 25-<30 (-171,945), 30-<35 (5,140), 35+ (21,777)
- NHANES III (1988/94-2000)
  - Underweight (38,456), 25-<30 (-99,979), 30-<35 (-13,865), 35+ (57,515)