# Measurement of Social Inequality

S Harper
PhD course: Advanced Social Epidemiology, 19th Aug – 23rd Aug, 2019
University of Copenhagen

museum of danish america

museum of danish america

MONDAY - FRIDAY
9am - 5pm

SATURDAY
10am - 5pm

SUNDAY
Noon - 5pm

22 h 40 min
1.613 miles

26 h
1.723 miles

Museum of Danish America

23 Jul 12:15

# Part 1:
# Measuring the "Social" in Social Inequality

# Outline

1. Why do we care?

2. Measures of individual socioeconomic position

   - Occupation
   - Income/wealth
   - Education
   - Housing/environment
   - Ethnic background

3. Measures of socioeconomic context / area

4. Life course exposures

5. Residual confounding

# Why should we care about measuring social position?

- Because we are epidemiologists, and exposure measurement matters!

- Ethical importance of social inequalities in health.

- As with other exposures, we need to think about:

  ‣ specific links between the elements of exposure and outcome of interest
  ‣ intensity
  ‣ duration
  ‣ cumulative vs. transient effects
  ‣ thresholds or dose-response
  ‣ *direct or indirect effects of exposure

# Why do we need to measure social position *accurately*?

1. Interest in social position as an EXPOSURE:

   Modifiable exposures and counterfactual causation

   Individual causal effect of social position (X), for disease/outcome Y=1:

$$Pr[Y = 1 \mid Set(X = x1)] \text{ vs. } Pr[Y = 1 \mid Set(X = x2)]$$

   Difference (or ratio) of between average risks of Y if assigned to differing levels of X (e.g., x1 vs. x2)
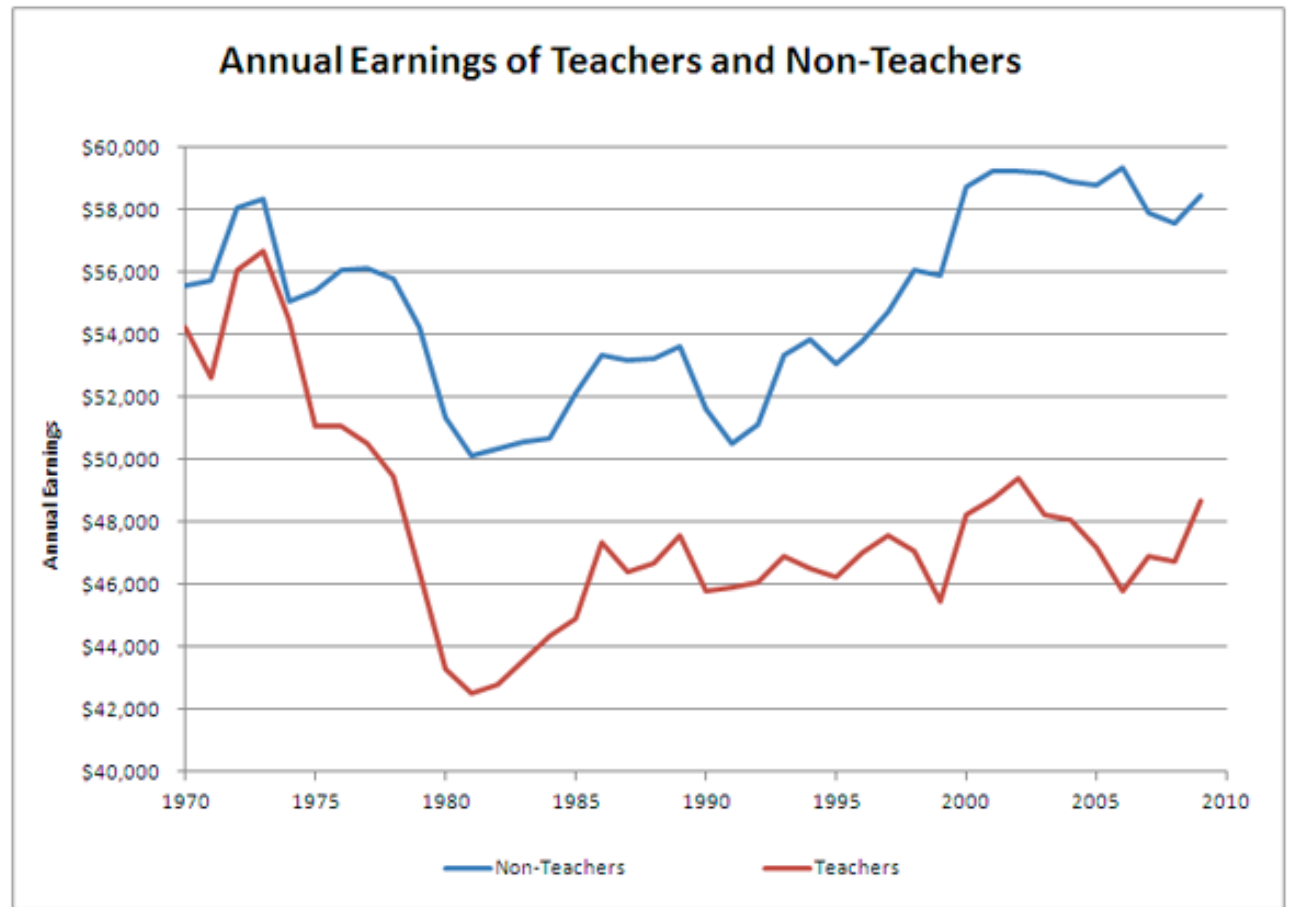
2. Need to control for CONFOUNDING by social position:
   - Social position correlated with many disease risks and exposures
   - Poor measurement of confounders=misclassification
   - Potential to bias your effect measure of interest

# Position vs. Status

- We usually think of socioeconomic indicators as "fixed" characteristics of individuals (i.e., status), at least analytically, but…

- Theoretically more useful to consider them as markers of location (i.e., position) in the social structure that may vary over time and with local context.

- "Position" implies that a given status takes place in the context of an overarching structure.

**Annual Earnings of Teachers and Non-Teachers**



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# Key Ideas: SEP Measures are Context-Dependent

"There is no single best indicator of SEP suitable for all study aims and applicable at all time points in all settings. Each indicator measures different, often related aspects of socioeconomic stratification and may be more or less relevant to different health outcomes and at different stages in the life course. The choice of SEP measure(s) should ideally be informed by consideration of the specific research question and the proposed mechanisms linking SEP to the outcome."
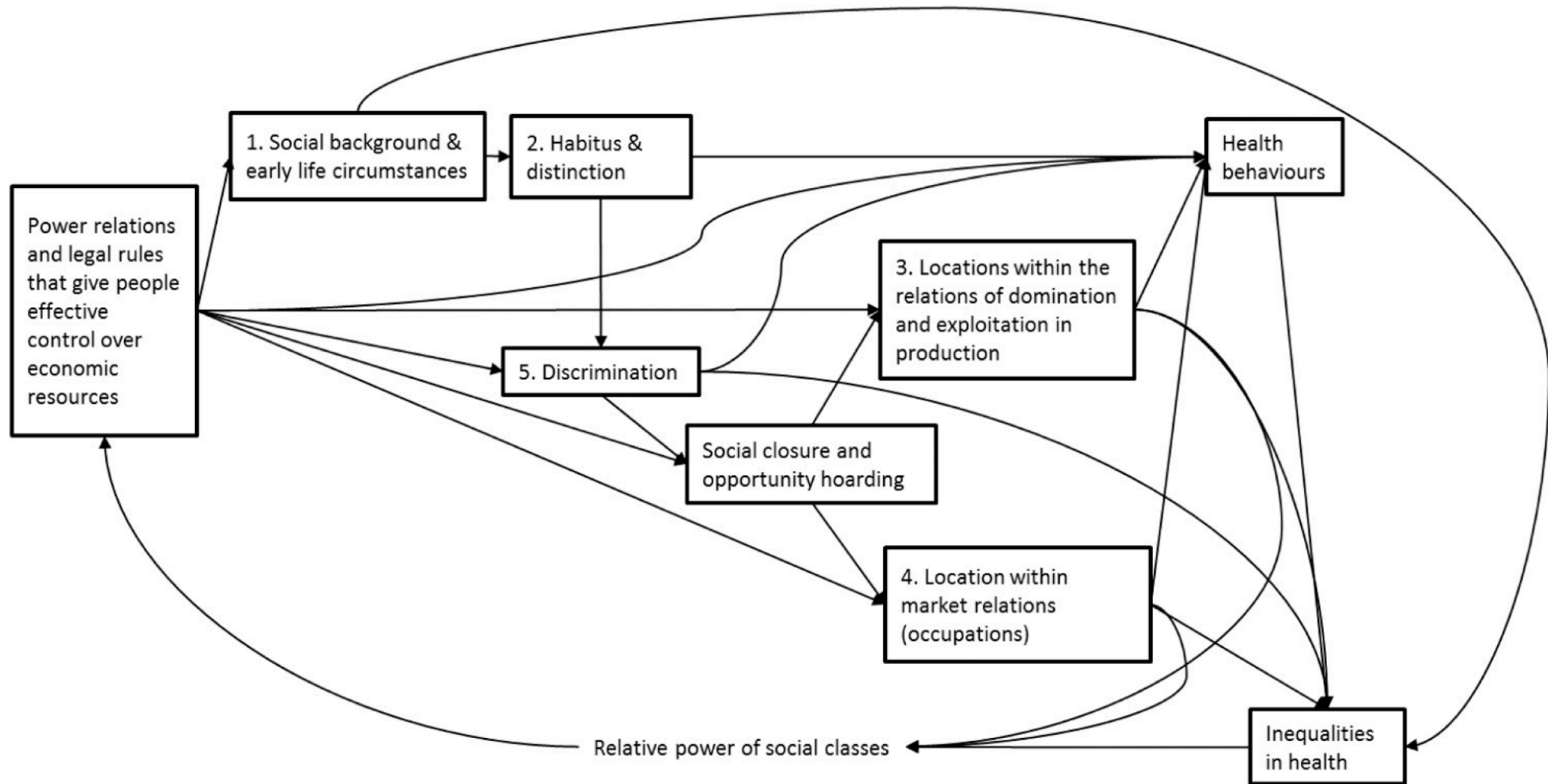
-Galobardes (2004)

Question for Discussion:

Suppose it's your job to measure and track health inequalities in Copenhagen.

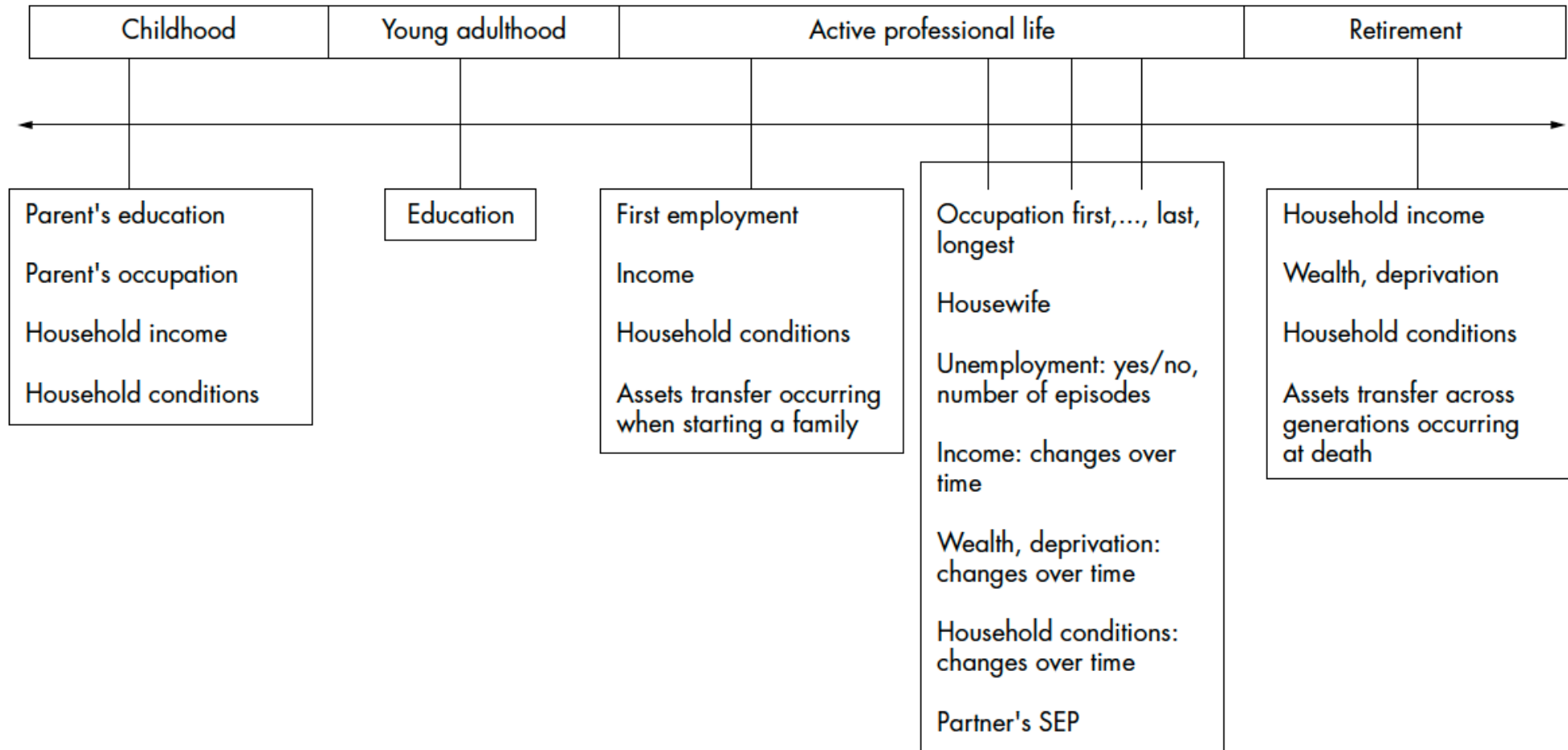What social indicator(s) would you choose?
Why?

# Theoretical basis for measuring the "social"



McCartney et al. (2019)

# Potential "stratifiers"

- Also called "dimensions of inequality"

- PROGRESS scheme used by WHO:
  ‣ **P**lace of residence (rural, urban, etc.)
  ‣ **R**ace or ethnicity
  ‣ **O**ccupation
  ‣ **G**ender
  ‣ **R**eligion
  ‣ **E**ducation
  ‣ **S**ocioeconomic status
  ‣ **S**ocial capital or resources

WHO (2013)

# Which indicator to use?



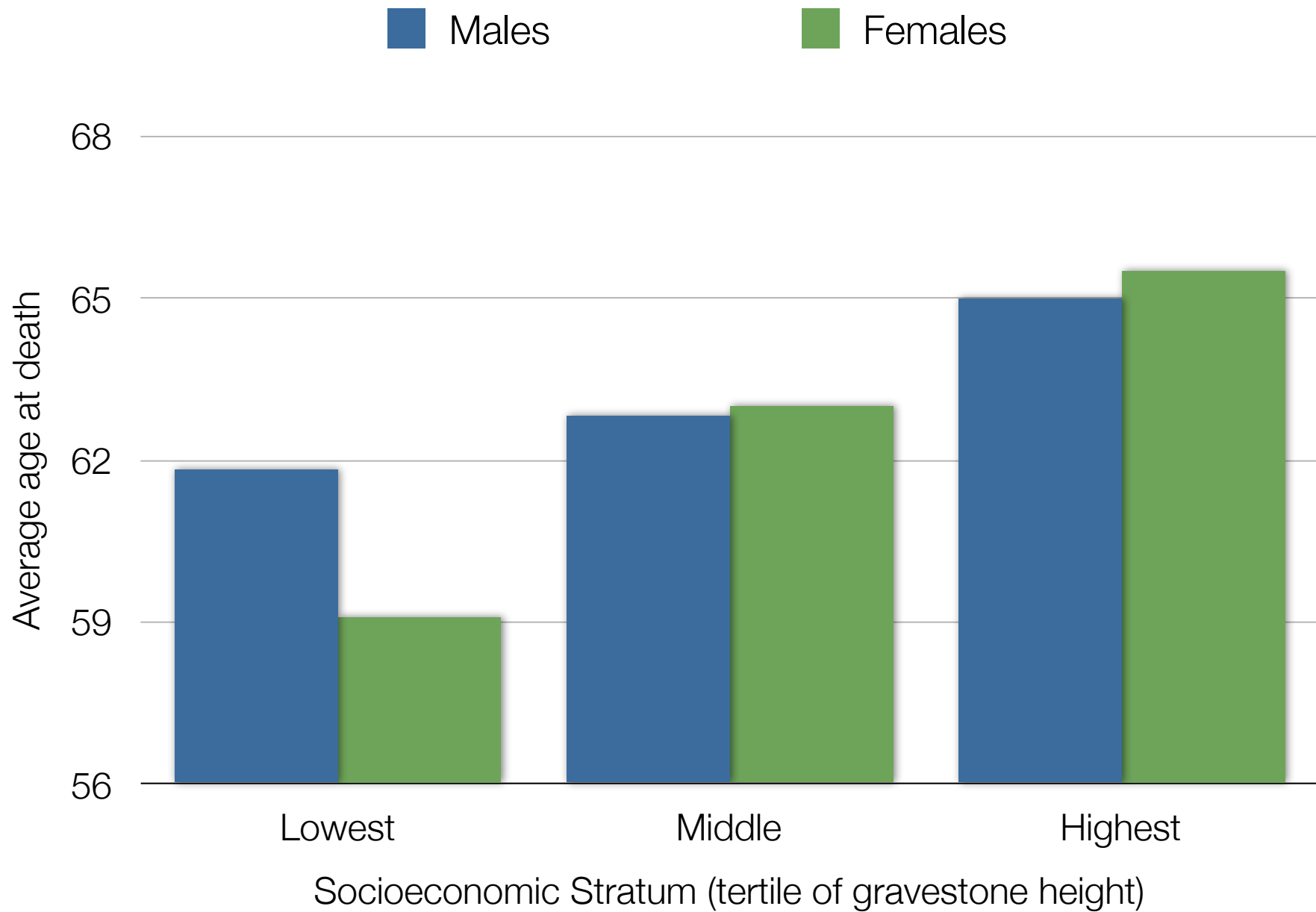| Childhood | Young adulthood | Active professional life | | Retirement |
|---|---|---|---|---|
| Parent's education<br><br>Parent's occupation<br><br>Household income<br><br>Household conditions | Education | First employment<br><br>Income<br><br>Household conditions<br><br>Assets transfer occurring when starting a family | Occupation first,..., last, longest<br><br>Housewife<br><br>Unemployment: yes/no, number of episodes<br><br>Income: changes over time<br><br>Wealth, deprivation: changes over time<br><br>Household conditions: changes over time<br><br>Partner's SEP | Household income<br><br>Wealth, deprivation<br><br>Household conditions<br><br>Assets transfer across generations occurring at death |

Galobardes (2007)

# Sometimes you have to be creative...



Source: Davey Smith (1992)

# Age at Death by Gravestone Height In Glasgow Graveyards

■ Males    ■ Females

Average age at death (y-axis): 56, 59, 62, 65, 68

Socioeconomic Stratum (tertile of gravestone height): Lowest, Middle, Highest

Source: Davey Smith (1992)

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# Individual measures: Occupation

Measurement

- Relevant exposure period? (current vs. longest held job)
- Relations to workplace and means of production

Interpretation

- May reflect both material resources and a measure of prestige/social standing
- Influences living conditions and represents a link between education and income.

Challenges

- Individual vs. household exposure status
- Comparability over time with changing societal norms
- Often country-specific, so limited comparability.
- Need to make specific links to exposures encountered in occupational setting

# Example: Smoking and class

- How to locate Danish 15-year olds in social class?

- Holstein et al. (2019) used parents occupational social class.

- "…defined by the occupational skills and competencies necessary for the job as well as the power and control associated with the position"

- "The participants reported their father's and mother's occupation and the research group coded this information into OSC from I (highest) to V (lowest) [14]. We added OSC VI to include economically inactive parents who receive unemployment benefits, disability pension, or other kinds of transfer income."

- "Each schoolchild was categorised by the highest ranking parent into high (I–II), middle (III–IV) and low (V–VI) OSC."

Holstein et al., 2019

# (Some) Danish Occupational Class Definitions

| Code | Class Description |
|------|-------------------|
| I | (a) jobs w/at least 4 years of university or a similar training); (b) white-collar jobs that imply management control of big organizations (top manager in a big company, top level civil servant, government advisor, or other executives and professionals within government, management and administration; owners of large-scale companies in both rural and urban trades with more than 50 subordinates, and self-employed with more than 20 subordinates. |
| II | white-collar jobs that require approximately 3 years of theoretical training (e.g., nurse, primary school teacher, social worker, medium level civil servant, journalist); (b) white-collar jobs which imply management responsibilities for 11 to 50 subordinates; (c) owners of medium-scale companies (i.e., companies with 6+ employees). |
| III | (a) non-manual white-collar jobs which demand expertise, approximately 1.5y of theoretical training and practical skills (e.g., accountant, police detective); (b) white-collar jobs which demand expertise at basic level but with management responsibilities for 1 to 10 subordinates; (c) self-employed with small-scale business (e.g., small-scale farmer, selfemployed craftsmen, and tradesmen with 0-5 employees). |
| | …continued… |

Christensen et al., 2014

# (Some) Danish Occupational Class Definitions

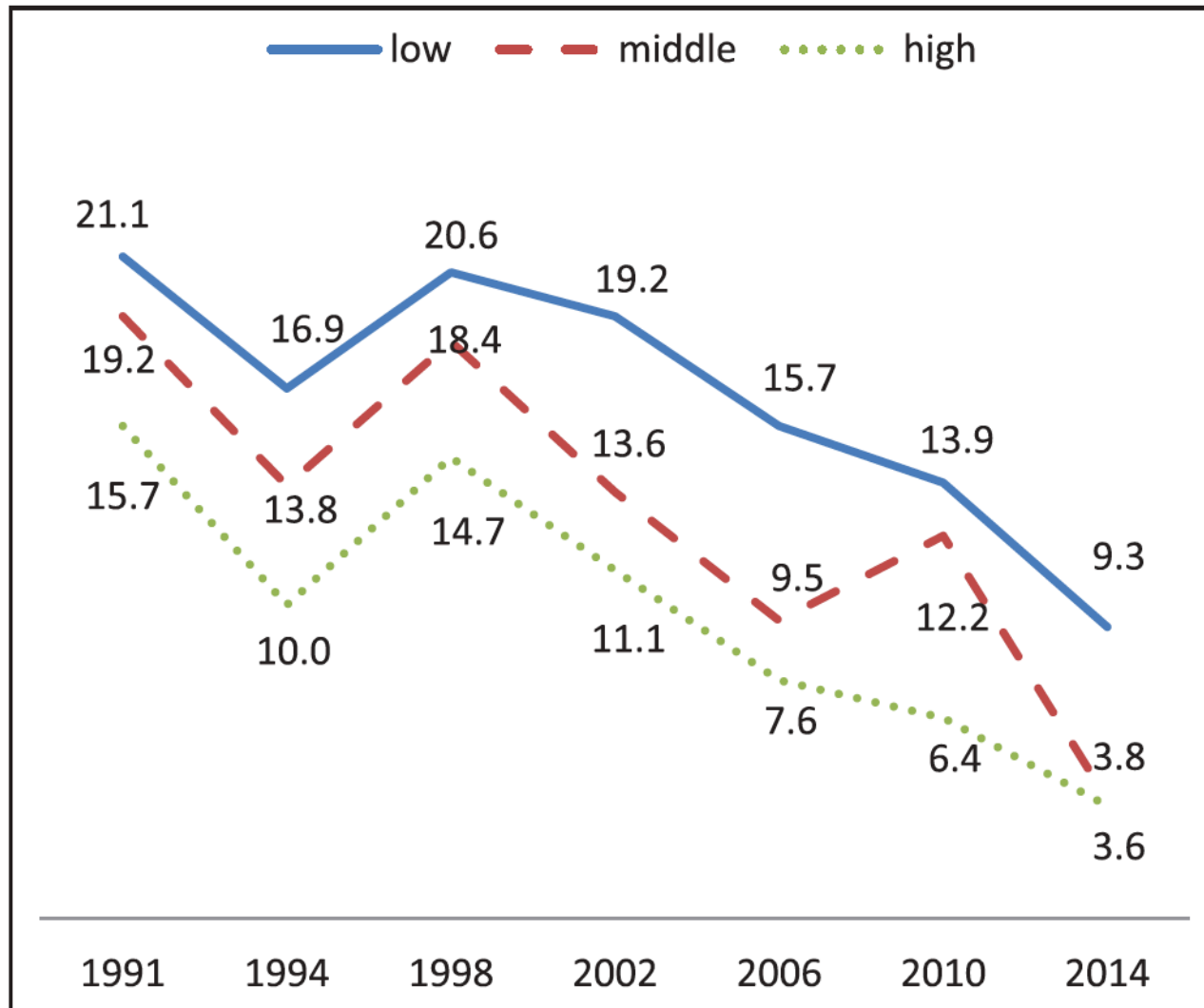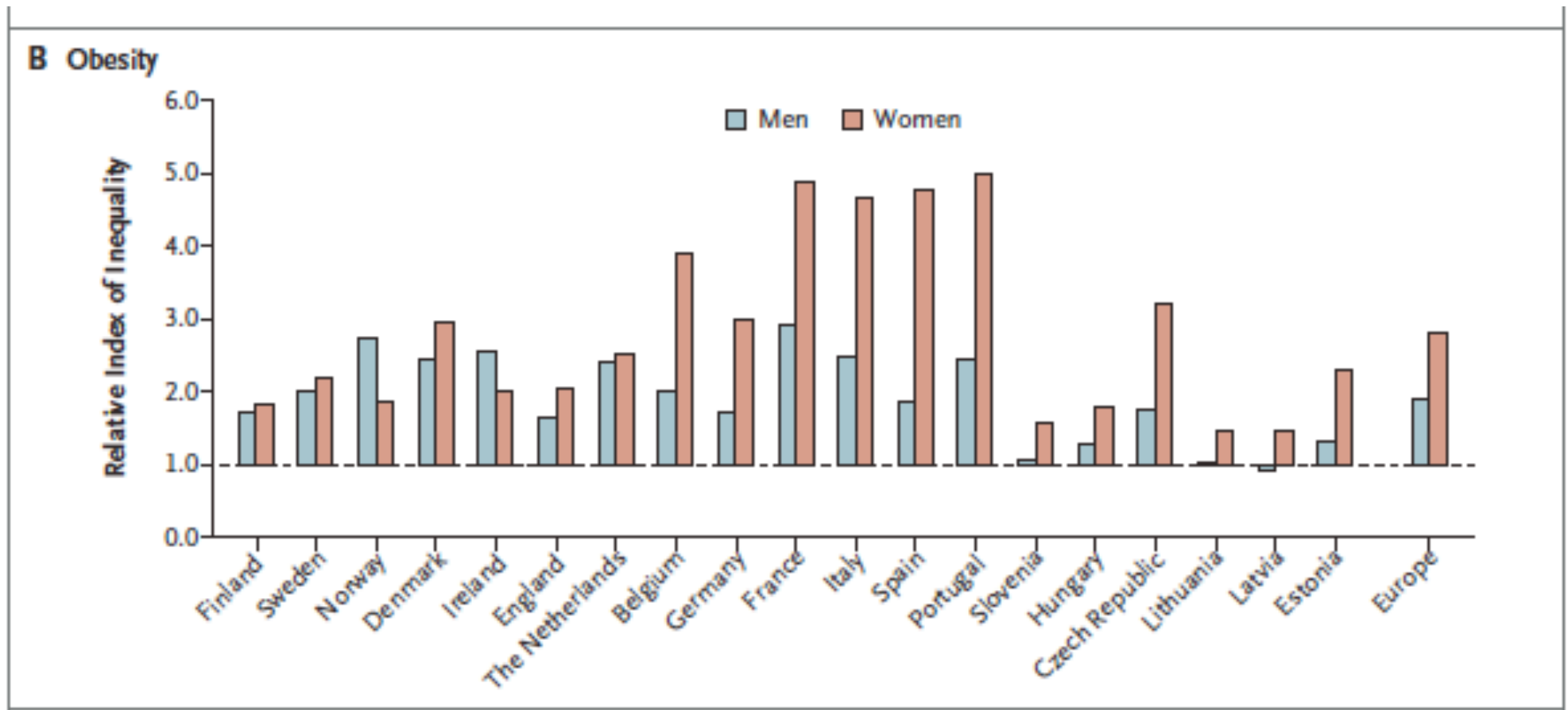| Code | Class Description |
|------|-------------------|
| IV | (a) manual white-collar jobs which require some theoretical training up to 1 year as well as practical training (e.g., technicians, nurse assistants, office worker, sales assistant); (b) craftsmen and tradesmen and other blue-collar workers with up to 1 year of theoretical training and practical training (e.g., carpenter, bricklayer, blacksmith, plumber). |
| V | manual jobs which require little theoretical and practical training including semi- or unskilled workers (e.g., lorry-driver, factory worker, construction worker, farm-worker). |
| VI | individuals who are economically inactive and rely primarily on transfer income (e.g., disability pensioner, unemployed, or long-term sick). |
| VII | This is a special category that includes individuals who are economically active (self-employed or have a job), but with insufficient information to categorize the job according to the Social Class Classification I to V. |
| VIII | special category includes students and housewives |

Christensen et al., 2014

# Example: Smoking and class



Figure 1. Percentage of 15-year-olds who smoke daily, by survey year and occupational social class.
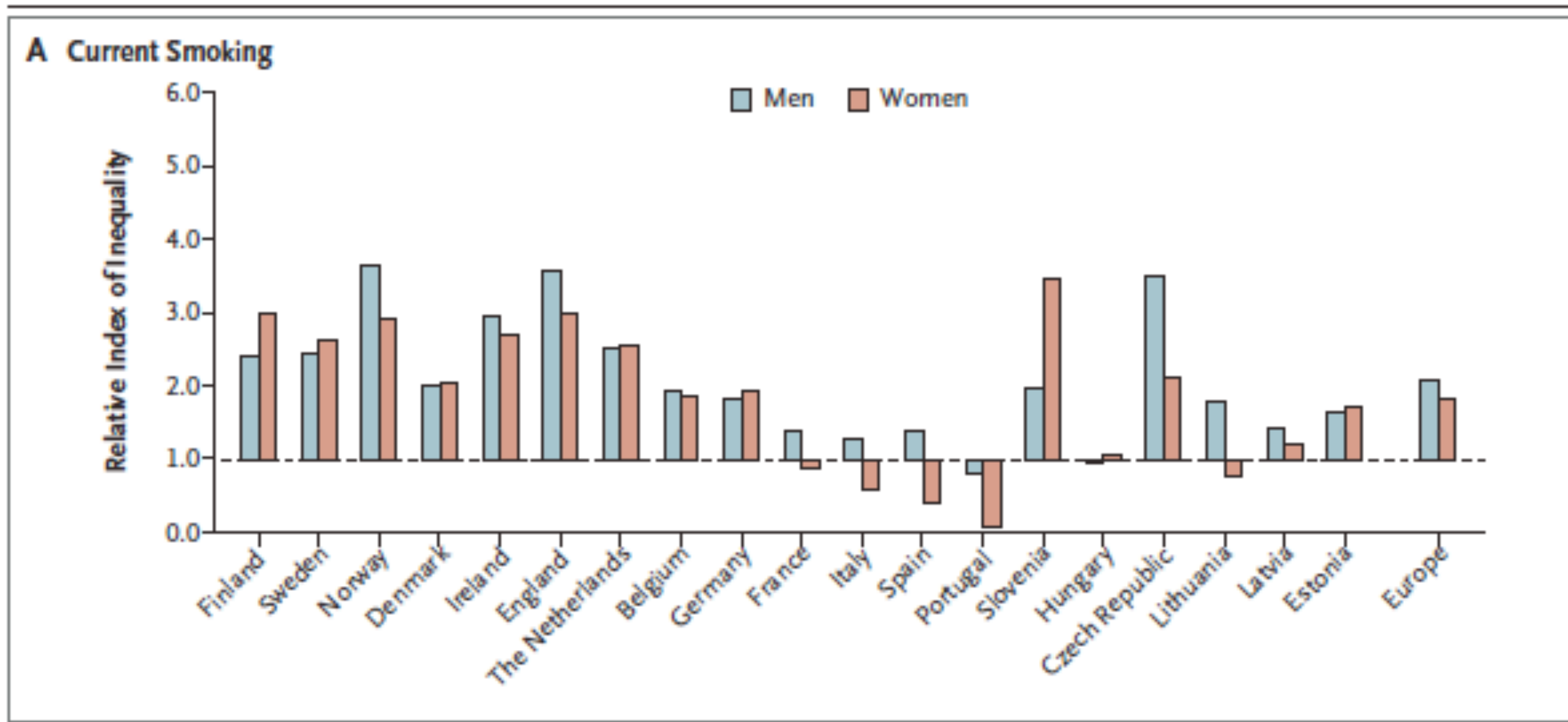
Holstein et al., 2019

# Individual measures: Education

- **Measurement**
  - Continuous (years of accumulated education)
  - Milestones/achievement categories (e.g., university degree)

- **Interpretation**
  - What is the relevant exposure?
  - Accumulated intellectual resources? Cognitive skills? Unmeasured non-cognitive skills (e.g., persistence, discipline)?

- **Challenges**
  - Potentially confounded by cohort effects
  - Does quality matter?

# Education and Risk Factors: Rich countries



**B Obesity**

Mackenbach et al. NEJM (2010)

# Education and Risk Factors: Rich countries



A **Current Smoking** — Relative Index of Inequality by country (Men and Women)

Mackenbach et al. NEJM (2010)

# Exercise caution with 'equivalent' education

- Both GED and HS graduate = 12 years of education in USA, but should we consider them 'exchangeable'?
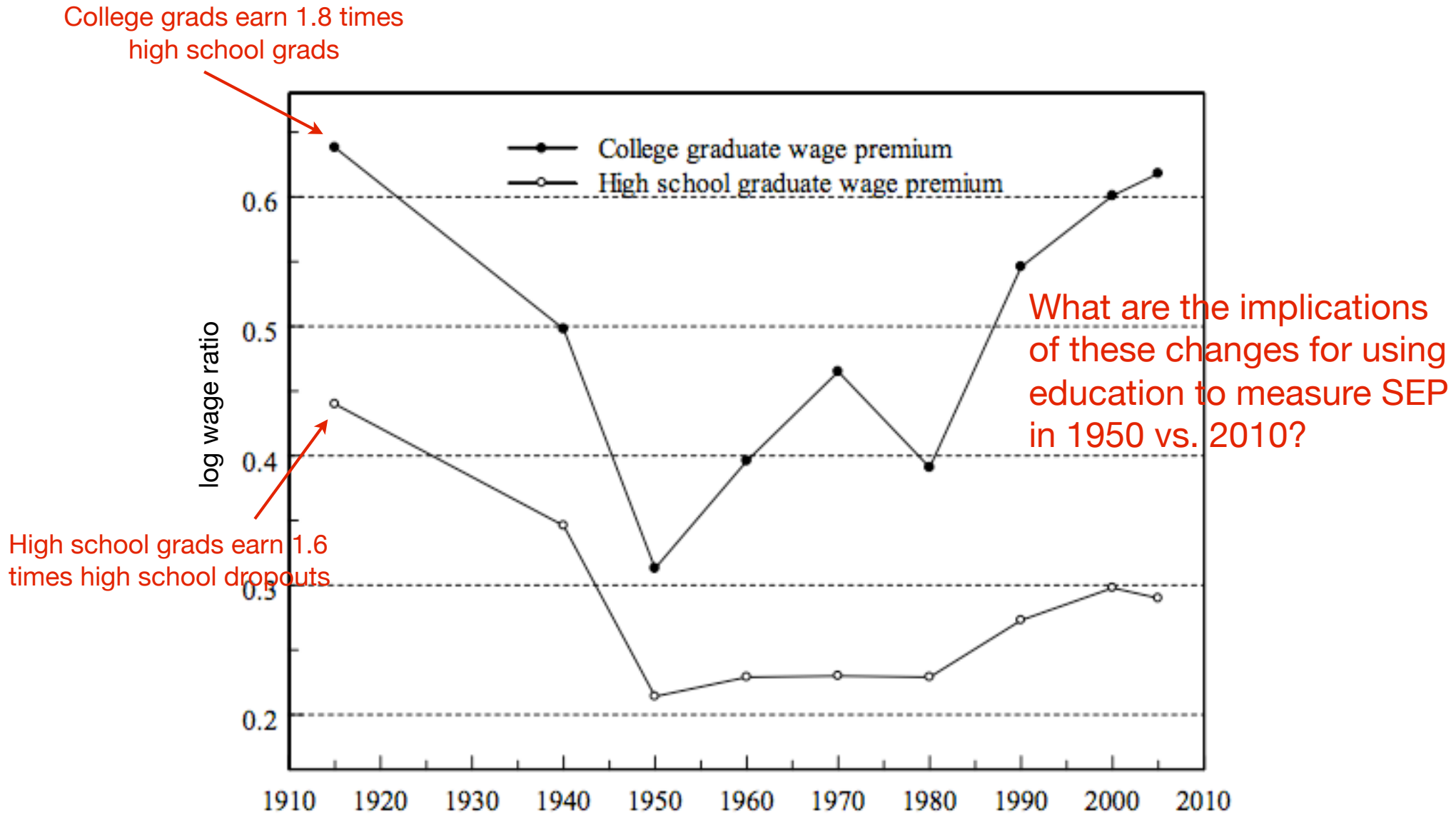- Need to consider links to specific risk factors

## Table 1
### Smoking and Overweight Status by Schooling Level

| Schooling | Current Smoker | | Overweight (BMI > 25) | |
|---|---|---|---|---|
| | Men (%) | Women (%) | Men (%) | Women (%) |
| < High school graduate | 38 | 30 | 62 | 59 |
| GED diploma | 48 | 40 | 64 | 56 |
| High school graduate | 31 | 26 | 65 | 50 |
| Some college, no degree | 26 | 22 | 66 | 46 |
| Associate degree | 23 | 22 | 66 | 46 |
| Bachelor's degree | 14 | 11 | 59 | 36 |
| Graduate degree | 9 | 8 | 54 | 29 |

Sources.—Schoenborn, Adams, and Barnes (2002); Schoenborn, Vickerie, and Barnes (2003).

# Dynamic nature of SEP across time/place

### Figure 1
### College Graduate and High School Graduate Wage Premiums: 1915 to 2005



College grads earn 1.8 times high school grads

High school grads earn 1.6 times high school dropouts

What are the implications of these changes for using education to measure SEP in 1950 vs. 2010?

Source: Goldin and Katz (2007)

The changing context of social exposures has implications for evaluating descriptive trends as well.

Editorial

**Is life expectancy really falling for groups of low socio-economic status? Lagged selection bias and artefactual trends in mortality**

"In terms of mortality risk, those excluded from high school in the early part of the 20th century are not comparable with those excluded from high school a generation later, because those left behind by the high school expansions in mid century likely had childhoods that were more disadvantaged along many dimensions, and so were at higher mortality risk all along. Describing differences between these two subgroups as a 'decline' in the life expectancy of high school non-completers simply because they were born at different times almost certainly reflects [lagged selection bias]."

-Dowd and Hamoudi, *Int J Epid* 2014

# Individual measures: household income

- Do you think that income *per se* is causally related to health?

- If not, why do we measure it?

- How would you test it?

- Potential pathways involving income
  ‣ Material conditions (Housing quality, food, clothing, medical care, opportunities for recreation, etc.)
  ‣ Psychosocial factors (financial insecurity, etc.)
  ‣ Health behaviors
  ‣ These factors often travel together (residual confounding).

# Individual measures: household income

- Measurement
  - Continuous is ideal, but often much missing data
  - Categories may be some improvement, but how to adjust for inflation?
  - Some novel study designs to get more data (links to tax records, reporting above or below thresholds)

- Interpretation
  - Difficult, since it is unlikely that income itself is the causal exposure

- Challenges
  - Consumption may be better linked to resources that affect health, but very expensive (both time and $) to measure (e.g. World Bank's LSMS)

# Measuring income: Issues

- Household or individual income?

- Absolute amount or categorical?

- Threshold or gradient?

- What about in-kind benefits? Public assistance?
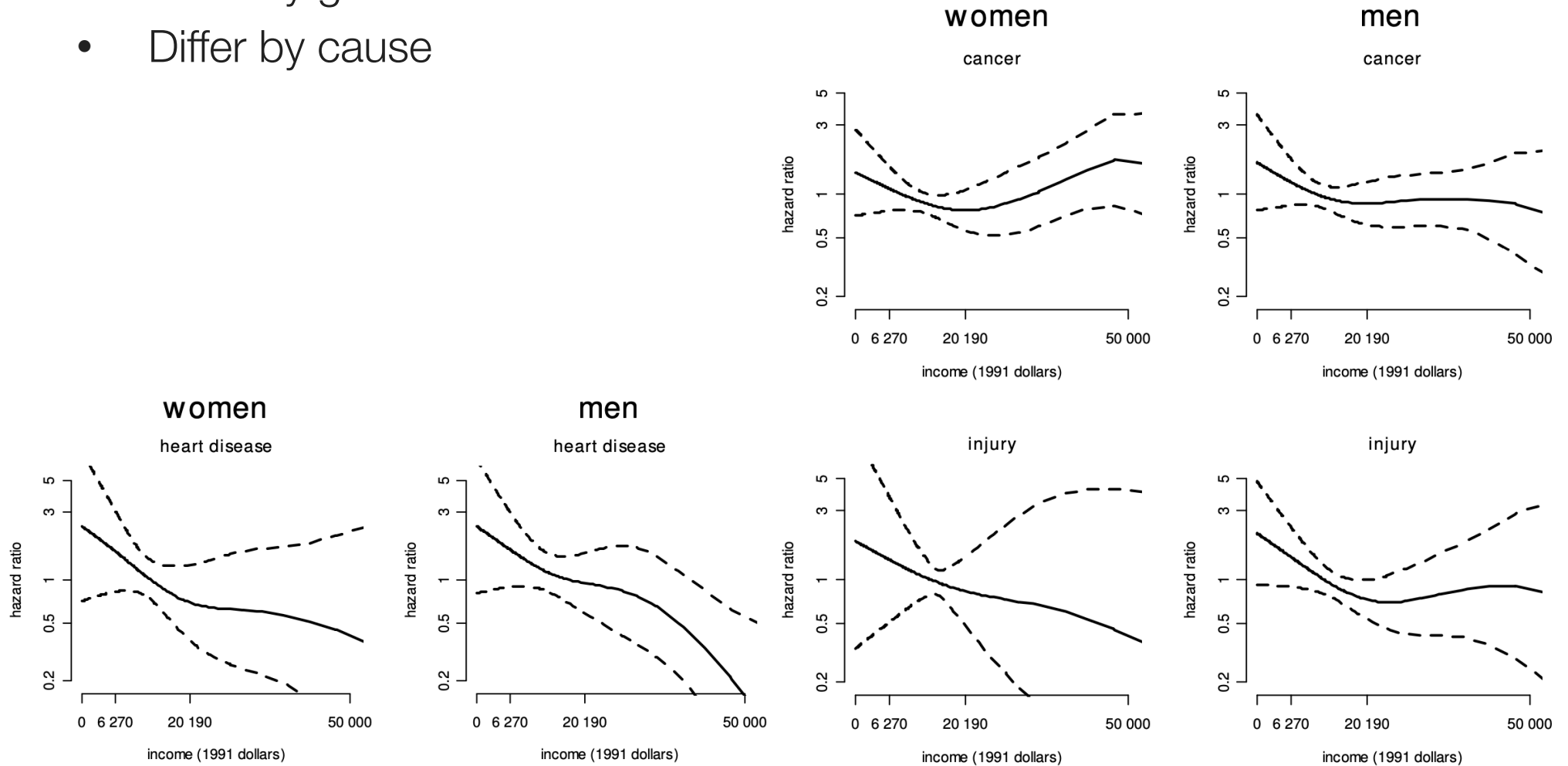
- What about reverse causation?

**Figure 3** Age-standardised mortality for individuals aged 25–64 at baseline plotted against the relative group median. Full-drawn lines are 2003, dotted lines are 1995. The upper set of lines in each plot is for men, the lower set is for women.

- Broadly similar patterns for all countries

- Note stronger gradients for men than women

Mortensen et al. (2015)

# Specificity of income effects: mechanisms matter

- Differ by gender
- Differ by cause

# Specificity of income effects: mechanisms matter

- 

Finland (Martikainen 2001)



(b)

RR — Women aged 30-64, all diseases
Income decile

RR — Women aged 65+, all diseases
Income decile

RR — Women aged 30-64, accidents and violence
Income decile

RR — Women aged 65+, accidents and violence
Income decile

# Individual measures: ethnic background

- Measurement
  ‣ No gold standard
  ‣ Self-reported typical
  ‣ Genetic markers of geographic ancestry exist, but limited.

- Interpretation
  ‣ Potentially measured with less error, but encompasses wide range of possible historical factors

- Challenges
  ‣ Changes in arbitrary categories over time (e.g., North American countries are bad at this)

# Why might ethnic background affect health?

- May be associated with living conditions such as safe housing, freedom from violence, and access to health enhancing resources.

- In some countries, ethnic background shows strong associations with important behavioural and biological risk factors, but there is wide variation.

- Certain ethnic groups may be victims of overt and covert discrimination that can affect their health through multiple channels.

# Original Contributions

## ACCULTURATION AND CORONARY HEART DISEASE IN JAPANESE-AMERICANS[1]
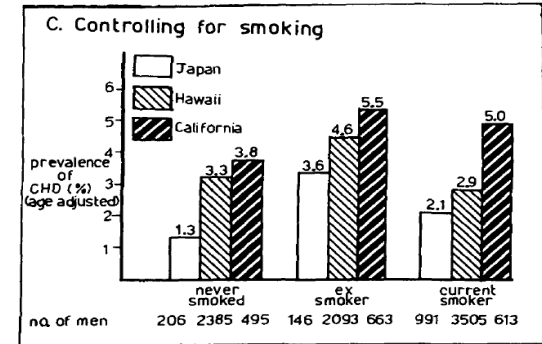
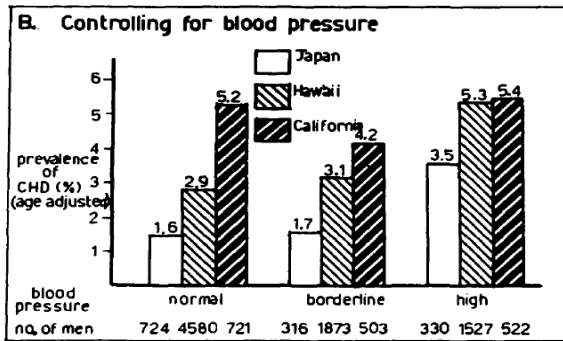### MICHAEL G. MARMOT, AND S. LEONARD SYME
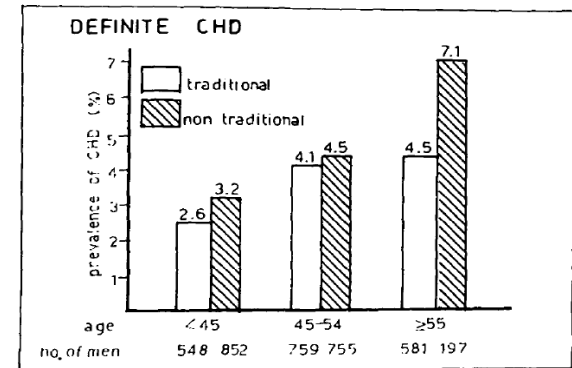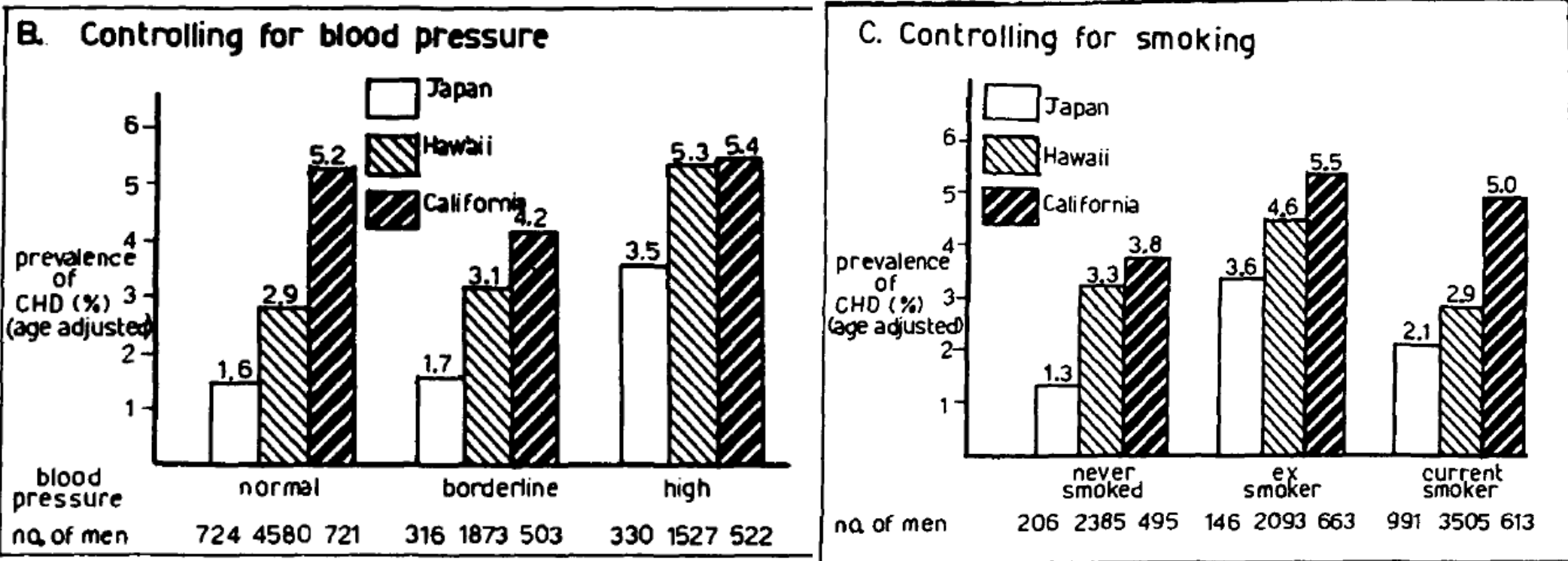




FIGURE 4. Prevalence of CHD by culture of upbringing.

FIGURE 12. Prevalence of CHD by cultural assimilation.

## Original Contributions

### ACCULTURATION AND CORONARY HEART DISEASE IN JAPANESE-AMERICANS[1]

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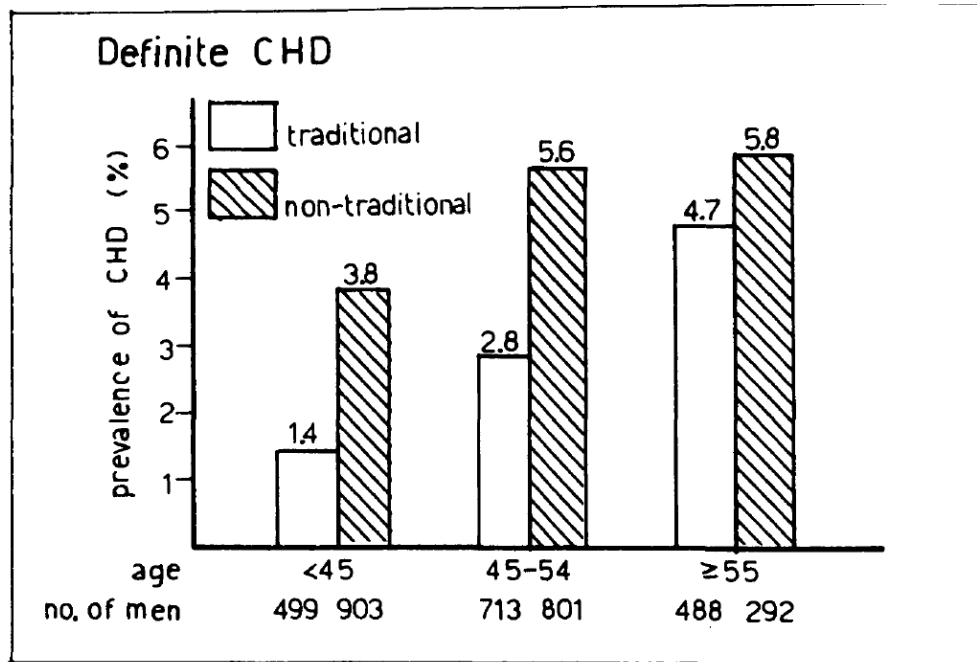MICHAEL G. MARMOT, AND S. LEONARD SYME



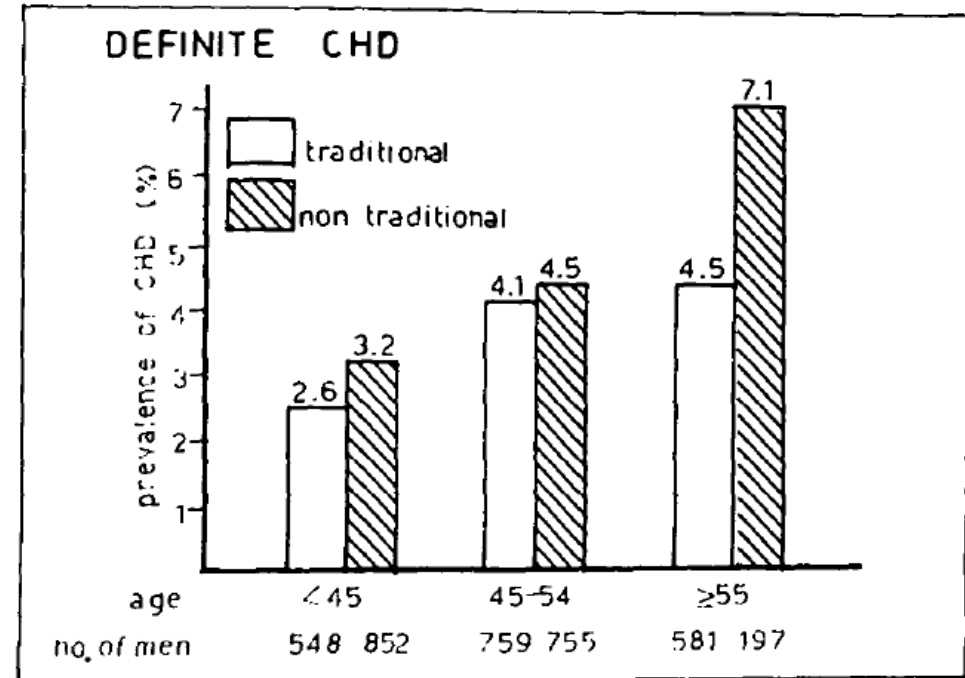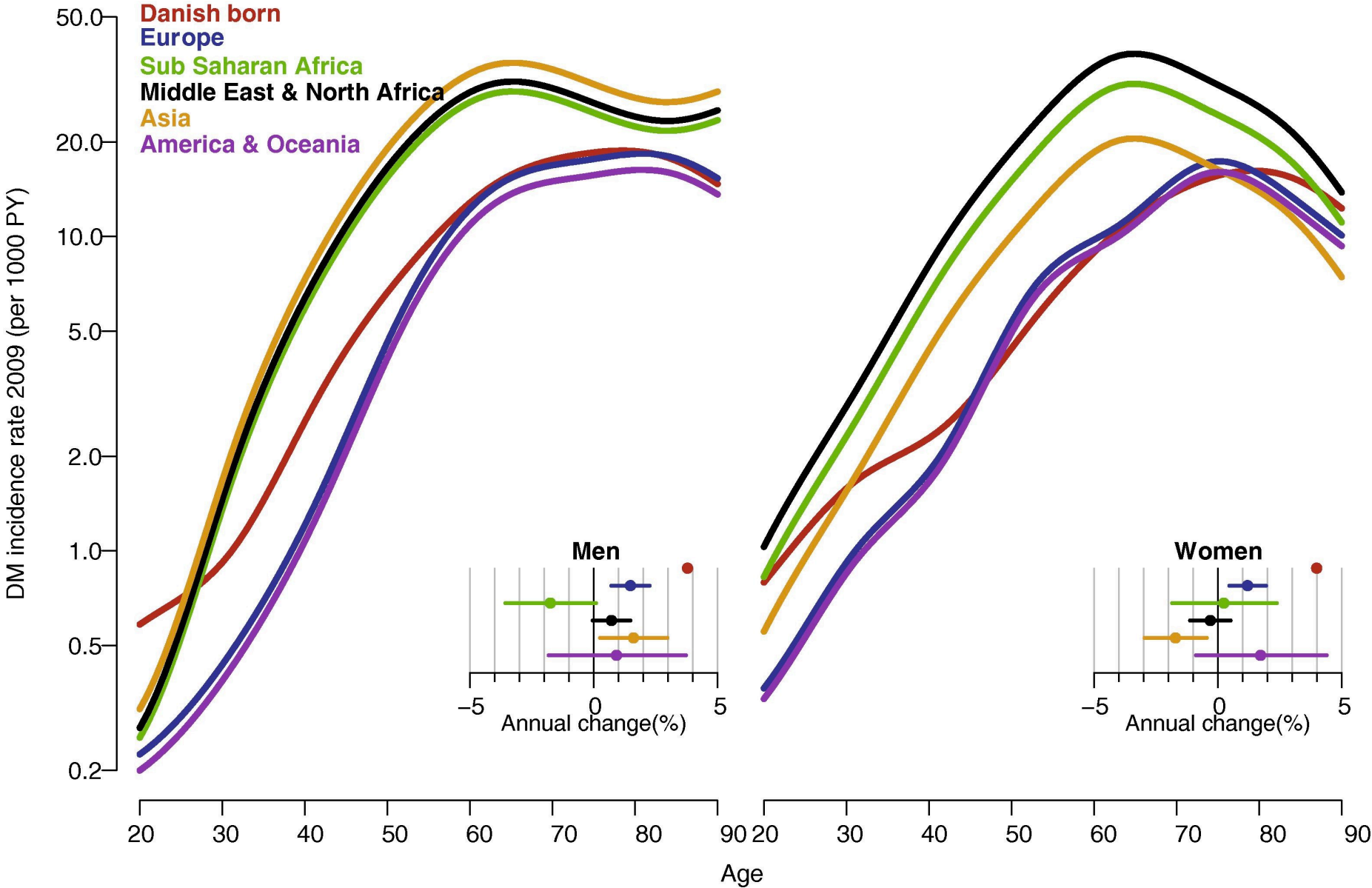FIGURE 4. Prevalence of CHD by culture of upbringing.



FIGURE 12. Prevalence of CHD by cultural assimilation.

# Diabetes among migrants in Denmark: Incidence, mortality, and prevalence based on a longitudinal register study of the entire Danish population



Andersen et al. (2016)

# Individual measures: housing

- Measurement

  ‣ Conditions (specific exposures, e.g., lead, pathogens)

  ‣ Ownership (i.e., prestige or status indicator)

  ‣ Specific household assets (e.g., computers, heating)

- Interpretation

  ‣ More direct measures of material circumstances, but need to consider why those circumstances may be linked to specific health outcomes

- Challenges

  ‣ Comparability, potential expense in data collection

  ‣ Good example of a modifiable social exposure

# Indicators of wealth and tuberculosis mortality in arrondissements of Paris, 1858-1902



Murphy, S and Egger, M.  International Journal of Epidemiology (2002), data from Marie-Davy, Revue d'hygiene (1911)
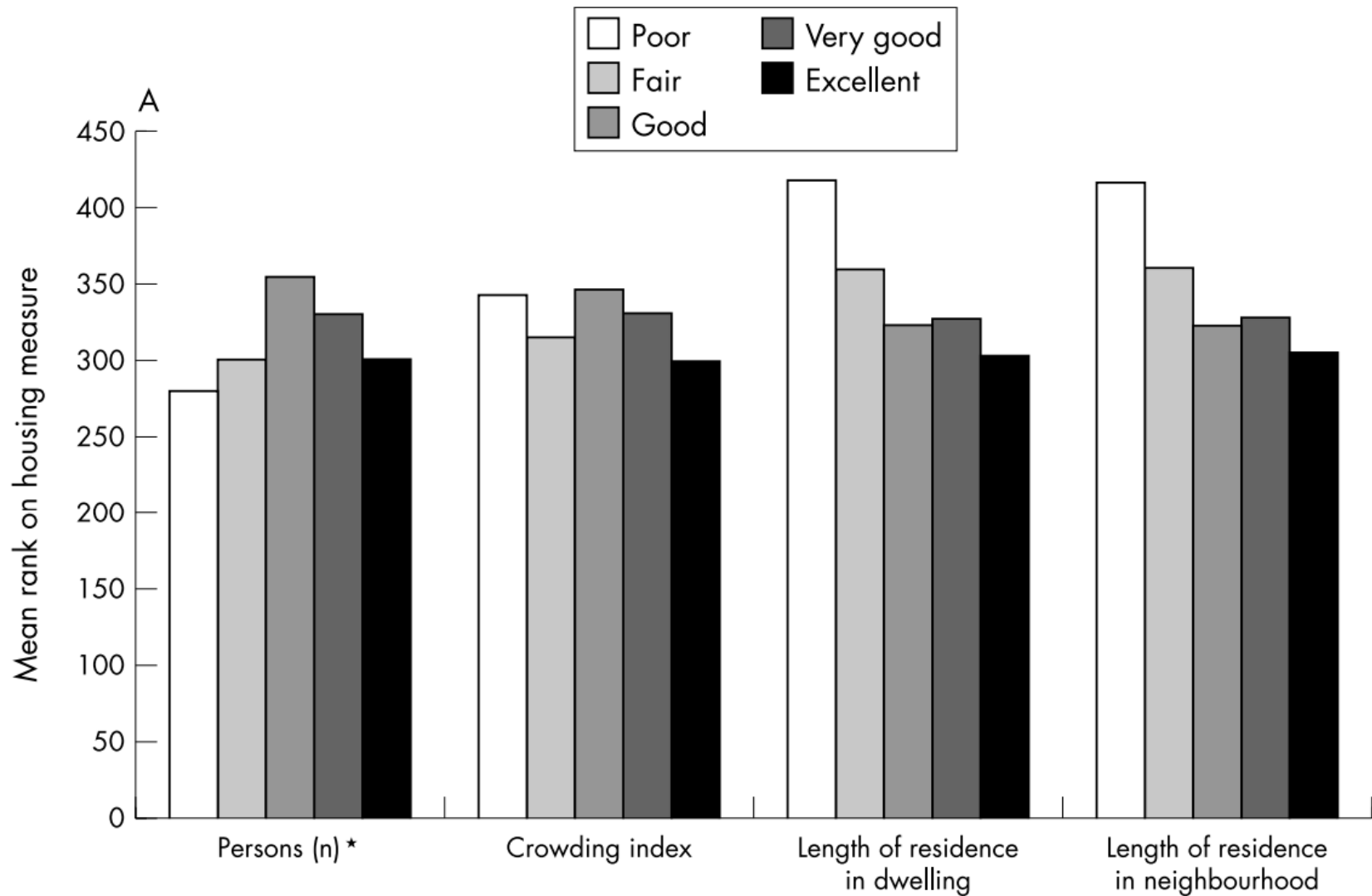
# Housing and inequalities in health: a study of socioeconomic dimensions of housing and self reported health from a survey of Vancouver residents

**Table 1** Descriptive statistics. Housing and quality of life in Vancouver

| | | | |
|---|---|---|---|
| *Gender* | | *Household characteristics* | |
| % female | 54.3 | Mean number of people per household | 2.53 |
| | | Median number of people per household | 2.0 |
| *Age distribution of sample respondents* | | | |
| 18–34 | 39.3 | Mean crowding index (bedrooms per person) | 1.04 |
| 35–54 | 42.0 | | |
| 55–64 | 7.2 | Mean length of residence in current dwelling (years) | 7.18 |
| 65 or older | 10.5 | Median length of residence in current dwelling (years) | 3.04 |
| | | | |
| *Marital status* | | Mean length of residence in current neighbourhood (years) | 10.1 |
| % married or common law | 50.3 | Median length of residence in current neighbourhood (years) | 5.0 |
| % single | 34.2 | | |
| | | % of respondents spending >30% of income on housing† | 41.9 |
| *Education* | | % of respondents who find it somewhat or extremely difficult to meet monthly housing costs | 42.0 |
| % with less than high school education | 6.0 | | |
| % completed high school | 18.5 | *Housing demand / control / meaning* | |
| % completed university | 35.2 | *% agree or strongly agree* | |
| | | I feel like I belong in neighbourhood | 85.2 |
| *Income** | | I feel proud to live in my neighbourhood | 84.5 |
| % with income less than $25000 | 19.1 | I am proud to show my home to visitors | 81.1 |
| % with income between $25000 and $59999 | 30.6 | I can't stand to be at home sometimes | 22.2 |
| % with income greater than $60000 | 26.8 | My home provides a good place to live my life | 90.3 |
| | | I often worry about being forced to move | 12.6 |
| *Dwelling characteristics* | | My home is a good reflection of who I am | 80.6 |
| % living in single house | 38.5 | | |
| % living in semi-detached house | 10.2 | *Respondents' health status* | |
| % living in self contained apartment in a house | 8.8 | % reporting fair / poor health | 10.5 |
| % living in low rise apartment | 26.5 | % reporting feeling downhearted and blue 'a good bit of the time' or more in past 2 weeks | 11.2 |
| % living in high rise apartment | 15.8 | % reporting feeling constantly under stress 'fairly often' or more in past 2 weeks | 26.3 |
| *Housing tenure* | | % of households with resident with a physical disability | 7.8 |
| % who own their home | 45.4 | | |

Dunn (2002)

# Housing and inequalities in health: a study of socioeconomic dimensions of housing and self reported health from a survey of Vancouver residents



**Figure 2** (A) Household attributes and health status. (B) Household attributes and mental health.
*p<0.05, **p<0.01, ***p<0.001.

Dunn (2002)

# Is Objective Social Position the Gold Standard?

- Increased emphasis in recent years on measuring and estimating the effects of subjective social status (SSS)

- Idea is that perceived social status may be associated with stress responses, negative emotions, psycho-neuroendocrine pathways that may lead to poorer health

- Across several large samples, SSS was found to be correlated both both income (r = 0.39–0.58) and education (r = 0.30–0.40) (Dunn et al., 2005; Operario et al., 2004; Singh-Manoux et al., 2003)

# Measuring Subjective Social Status

- MacArthur Scale of Subjective Social Status (ladder measurement scale)

- May be applied to specific dimensions of SEP (education, income) or defined by users as the ladder at right

- Thought to capture residual variation in social position and perceptions of status

- "Insofar as social standing has beneficial effects on biological processes related to health, standing on the community ladder may be as important as standing on the SES ladder." (Adler, Stewart, 2007)

**Think of this ladder as representing where people stand in their communities.**

People define community in different ways; please define it in whatever way is most meaningful to you. At the **top** of the ladder are the people who have the highest standing in their community. At the **bottom** are the people who have the lowest standing in their community.

**Where would you place yourself on this ladder?**

Please place a large "**X**" on the rung where you think you stand at this time in your life, relative to other people in your community.

"Standing" with respect to what?

Would this mean the same thing to all respondents?

# Does Subjective Social Status Predict Health and Change in Health Status Better Than Objective Status?

Archana Singh-Manoux, PhD, Michael G. Marmot, FRCP, and Nancy E. Adler, PhD

*Subjective status more "normally" distributed*

*Subjective status more strongly related to subjective SES indicators*

TABLE 1. Frequency Distribution of the SES Categories, Assessed at Phase 5 (1997 to 1999)

| SES | Subjective SES Ladder (10 Categories) | | Objective SES Grade (6 Categories) | |
|---|---|---|---|---|
| | Men $n = 3924$ | Women $n = 1562$ | Men $n = 3924$ | Women $n = 1562$ |
| 1 (High status) | 1.4% | 0.8% | 26.9% | 9.5% |
| 2 | 6.0% | 3.9% | 27.2% | 12.4% |
| 3 | 20.3% | 10.7% | 16.5% | 7.9% |
| 4 | 28.8% | 18.4% | 16.4% | 18.1% |
| 5 | 19.2% | 21.3% | 8.6% | 23.4% |
| 6 | 13.5% | 26.2% | 4.4% | 28.7% |
| 7 | 7.2% | 11.7% | | |
| 8 | 2.8% | 5.2% | | |
| 9 | 0.7% | 1.5% | | |
| 10 (Low status) | 0.2% | 0.3% | | |

TABLE 2. Objective SES, Subjective SES: Relationship With Other Measures of SES, Assessed at Phase 5 (1997 to 1999)

| Indicators of SES | Men $n = 3924$ | | | Women $n = 1562$ | | |
|---|---|---|---|---|---|---|
| | Objective SES (Grade) | Subjective SES (Ladder) | Test for Difference[a] | Objective SES (Grade) | Subjective SES (Ladder) | Test for Difference[a] |
| Childhood SES | 0.14[b] | 0.18[b] | $p = .05$ | 0.38[b] | 0.33[b] | $p = .08$ |
| Education | 0.42[b] | 0.36[b] | $p = .0005$ | 0.64[b] | 0.45[b] | $p < .0001$ |
| Income | 0.58[b] | 0.44[b] | $p < .0001$ | 0.69[b] | 0.45[b] | $p < .0001$ |
| Household income | 0.53[b] | 0.45[b] | $p < .0001$ | 0.59[b] | 0.53[b] | $p = .009$ |
| Household wealth | 0.40[b] | 0.40[b] | $p = 1$ | 0.40[b] | 0.46[b] | $p = .02$ |
| Feeling of financial security | 0.27[b] | 0.39[b] | $p < .0001$ | 0.20[b] | 0.36[b] | $p < .0001$ |

[a] All $p$ values less than 0.05 denote that the correlations are significantly different from each other.
[b] Indicates the correlation is significant at $p < .001$.

# Area-based measures of socioeconomic position

- Measurement
  - Often aggregates of individual attributes (e.g., neighbourhood income or education)
  - Importance of defining the "area" of exposure
  - Typically composite indicators or derived indices (e.g. Townsend, Carstairs in the UK, Pampalon in Canada)

- Interpretation
  - Especially challenging for a composite index of SEP (how to define the causal effect?)
  - "Independent" effects are of enormous interest

- Challenges
  - Often used as imperfect proxies for "missing" individual-level data
  - How to deal with selection into and out of areas by individuals of different SEP
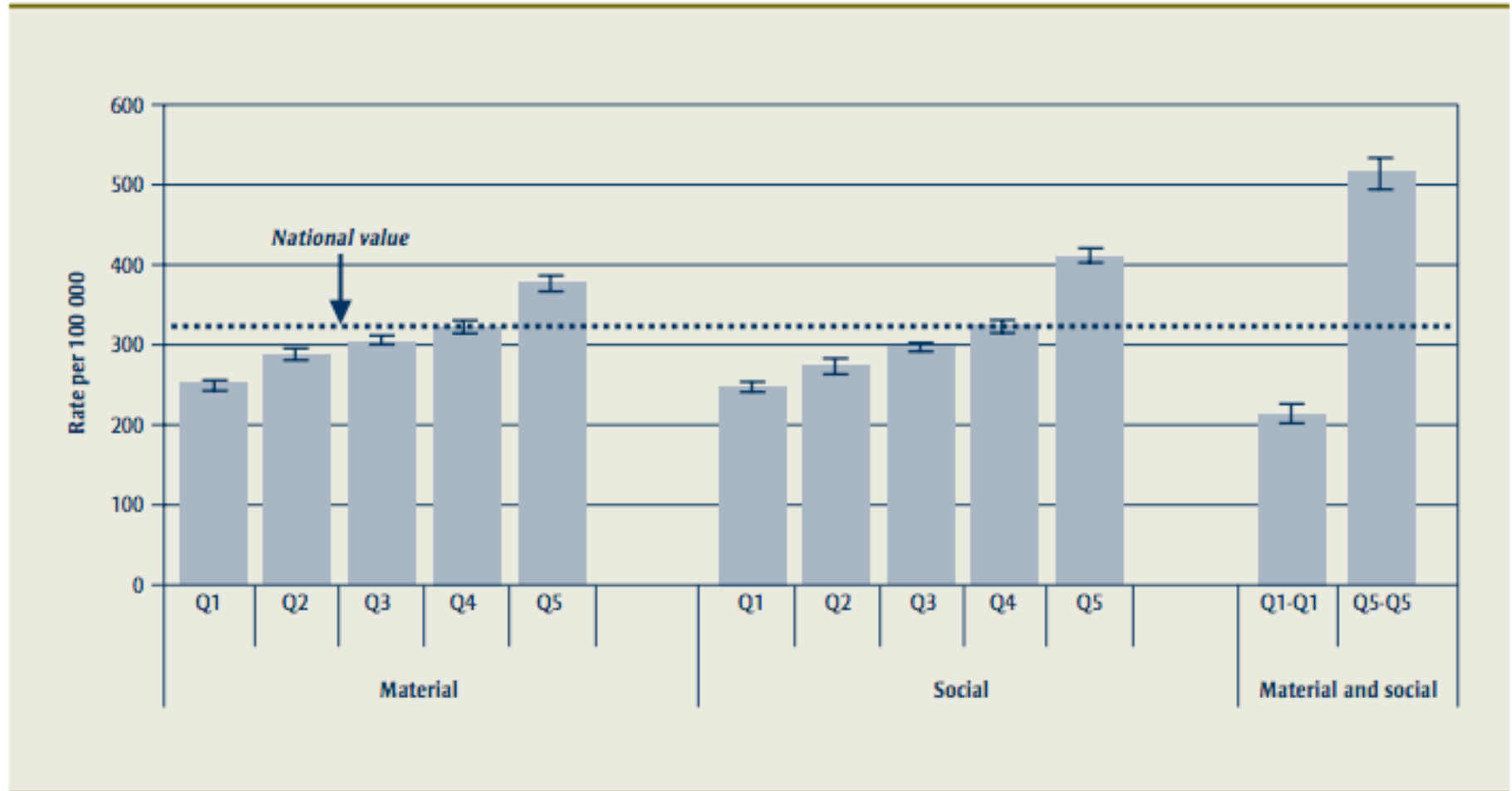
# Area-based measures in Canada

Pampalon Index

- Census dissemination areas (DAs), approx. 400-700 persons. Why?

- Components
  ‣ the proportion of people aged 15 years and older with no high school diploma;
  ‣ the employment/population ratio of people aged 15 years and older;
  ‣ the average income of people aged 15 years and older;
  ‣ the proportion of individuals aged 15 years and older living alone;
  ‣ the proportion of individuals aged 15 years and older who are separated, divorced or widowed;
  ‣ and the proportion of single-parent families.

- Some data manipulation (smoothing, age-sex standardization)

- Principal components analysis (PCA) with varimax rotation

# A deprivation index for health planning in Canada

*R. Pampalon, PhD (1); D. Hamel, MSc (1); P. Gamache, BSc (1); G. Raymond, BSc (2)*

**FIGURE 1**
**Premature mortality rate by quintile of material and social deprivation Canada, 2001**
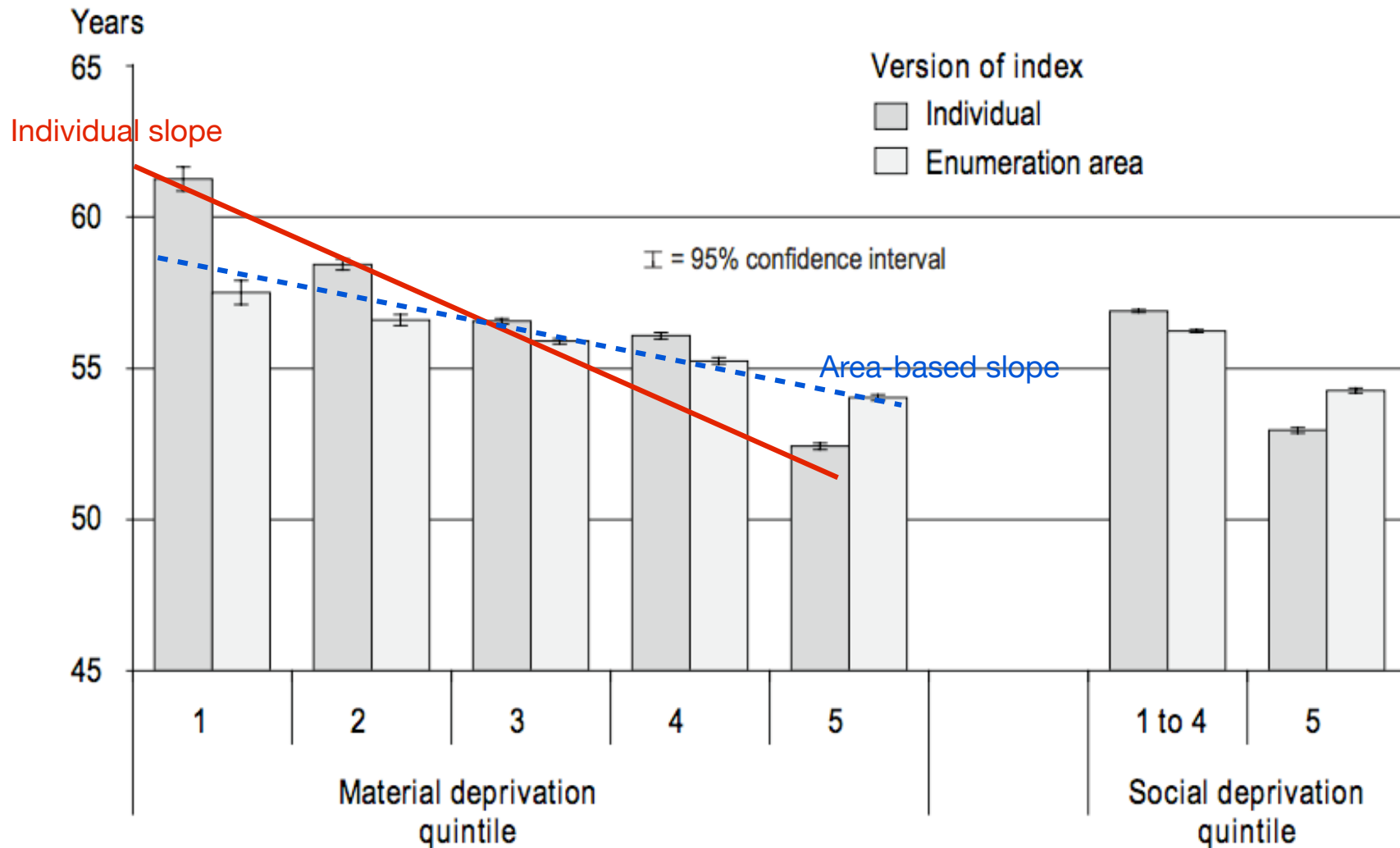


NOTE: Death rates are adjusted for age, sex, geographic area and the other forms of deprivation.

Source: 2001 Census of Canada; Statistics Canada, 2001 Canadian Mortality Database.

Life expectancy at age 25 according to individual and enumeration area versions of deprivation index, by material and social deprivation quintile, Canada, 1991 to 2001

Source: Census mortality follow-up study, 1991 to 2001.

Pampalon (2009)

# Area-based measures: methodological implications

- "When area-level measures of SEP are used as proxies for individual-level indicators, the estimate of the association with SEP and the health outcomes is likely to be an underestimate"
  - ‣ Why?

- "In general, the larger the area, the greater the underestimate is likely to be"
  - ‣ Why?

# What about SEP in poorer countries?

- Potential difficulties:
  ‣ Large peasant classes
  ‣ Informal economic sector
  ‣ Remittances from family members working abroad
  ‣ Geographic differences

- Ideally, measure consumption expenditures (the purchase of goods and services), but questionnaires are lengthy (World Bank's *Living Standards Measurement Survey* takes about 1 hr to complete)

- Current approaches attempt to measure household assets
  ‣ What people own
  ‣ Not a proxy for current consumption
  ‣ Idea is to try and capture a household's long run economic status

# Importance of Residual Confounding

Do measures of socioeconomic position have the same "meaning" for all groups in the population?

Would you expect those with similar education to have *identical* distributions of other measures of SEP?

# Likely effect will be to overestimate the effect of education



Measured Confounders

Education → Health

Unmeasured parental SEP

Mis-measured cognitive skills

Unmeasured personality characteristics

# Key idea: The need for multiple measures

"Furthermore, while a single measure of SEP may show an association with a health outcome, it will not encompass the entirety of the effect of SEP on health. This issue is of particular importance when SEP is a potential confounding factor.

Multiple SEP indicators, preferably measured across the life course, will be needed to avoid residual confounding by unmeasured socioeconomic circumstances."

-Galobardes (2004)

# Confounding by socioeconomic position remains after adjusting for neighbourhood deprivation: an example using smoking and mortality

**Tony Blakely, Darren Hunt, Alistair Woodward**

**Table 1** Rate ratios of 25–77 year old all cause mortality for current smokers compared with never smokers, adjusted for: (1) baseline of age and ethnicity; (2) baseline plus one socioeconomic factor (deprivation, income, or education); (3) baseline plus deprivation, income, and education simultaneously; and (4) model 3 plus car access, housing tenure, and labour force status

| Poisson regression model | Rate ratios for current compared to never smokers (95% confidence intervals) | | Percentage reduction of excess rate ratio (that is, rate ratio−1) compared with baseline model | |
|---|---|---|---|---|
| | Men | Women | Men | Women |
| Tobacco smoking: current compared with never | | | | |
| (1) Baseline model—adjusting for just age and ethnicity | 2.10 (2.01 to 2.20) | 2.06 (1.95 to 2.17) | – | – |
| (2) Adjusting additionally for just one socioeconomic factor: | | | | |
| (2a) Model 1, plus neighbourhood socioeconomic deprivation | 1.97 (1.88 to 2.06) | 1.95 (1.85 to 2.06) | 12 | 10 |
| (2b) Model 1, plus equivalised household income | 1.98 (1.89 to 2.07) | 1.98 (1.87 to 2.09) | 11 | 8 |
| (2c) Model 1, plus highest educational qualification | 2.05 (1.96 to 2.15) | 2.01 (1.90 to 2.12) | 5 | 5 |
| (3) Adjusting simultaneously for deprivation, income, and education | 1.88 (1.80 to 1.97) | 1.89 (1.79 to 2.00) | 20 | 16 |
| (4) Adjusting fully for all socioeconomic factors* | 1.81 (1.72 to 1.89) | 1.86 (1.76 to 1.97) | 26 | 19 |

The New Zealand index of small area socioeconomic deprivation (NZDep96) was used to measure neighbourhood deprivation (see Methods). Equivalised household income (five level categorical variable) was calculated by summing the incomes of all people in the household, and equivalising for economies of scale (number of adults and children in household) using the New Zealand specific Jensen index. Highest educational qualification was obtained directly from census data (nil, school, post-school). *In addition to the variables listed in the table, the fully adjusted model also includes census data on: household car access (nil, 1, ≥2), housing tenure (freehold, rental and other), and labour force status (employed, unemployed, non-active).

# Residual confounding is usually plausible…if you look for it

"Because of the narrow range of socioeconomic status in the Nurses' Health Study, we have a unique data set in which to examine associations of stress with health outcomes, <u>without the strong potential influence of residual confounding by socioeconomic status</u>. "

-Kroenke, Kawachi et al., AJE (2005)

# …5 years later…Kim, Kawachi et al. Cancer (2010)

**Table 1.** Characteristics by Quintile of Neighborhood Socioeconomic Score Among 111,129 Women in the Nurses' Health Study in 1986

| Characteristics | Neighborhood Socioeconomic Score | | | | |
|---|---|---|---|---|---|
| | Q1 (lowest SES), n = 9820 neighborhoods | Q2, n = 9820 | Q3, n = 9821 | Q4, n = 9820 | Q5 (highest SES), n = 9821 |
| **Neighborhood characteristics** | | | | | |
| Median household income, US$1000 | 22.7 | 30.8 | 37.8 | 45.2 | 65.3 |
| Median house value, US$1000 | 56.4 | 86.8 | 118.6 | 156.5 | 254.0 |
| % households receiving interest, dividend, or rental income | 30.4 | 42.6 | 49.4 | 56.8 | 67.9 |
| % adults high school+ | 64.5 | 76.0 | 82.0 | 87.5 | 93.4 |
| % adults college+ | 13.0 | 20.8 | 28.7 | 39.4 | 57.6 |
| % in executive, managerial, or professional occupations | 15.6 | 22.0 | 28.5 | 36.4 | 50.3 |
| **Individual characteristics** | n = 17,119 women,[a] n = 6667 women[b] | n = 20,486,[a] n = 8521[b] | n = 22,031,[a] n = 9141[b] | n = 25,128,[a] n = 10,460[b] | n = 26,365,[a] n = 11,339[b] |
| Median age, y | 52.6 | 52.4 | 52.0 | 51.8 | 51.6 |
| % white | 90.0 | 93.4 | 94.1 | 94.7 | 94.8 |
| Educational attainment, % college+ | 16.7 | 18.6 | 21.8 | 26.0 | 33.5 |
| Husband's educational attainment, % college+ | 33.9 | 40.6 | 48.9 | 58.0 | 75.3 |

# Life course socioeconomic position

- We do not magically become 'exposed' to a particular social position as adults.

- Thinking about social exposures over the entire life course is useful for understanding how social conditions at different times in life may lead to health inequalities in adulthood.

- Important methodological challenges
  ‣ subjective vs. objective measures of early life social conditions
  ‣ how well can you recall your parents' education? occupation? income?
  ‣ how to combine measures to model socioeconomic trajectories over time

# Thinking about socioeconomic position over the life course

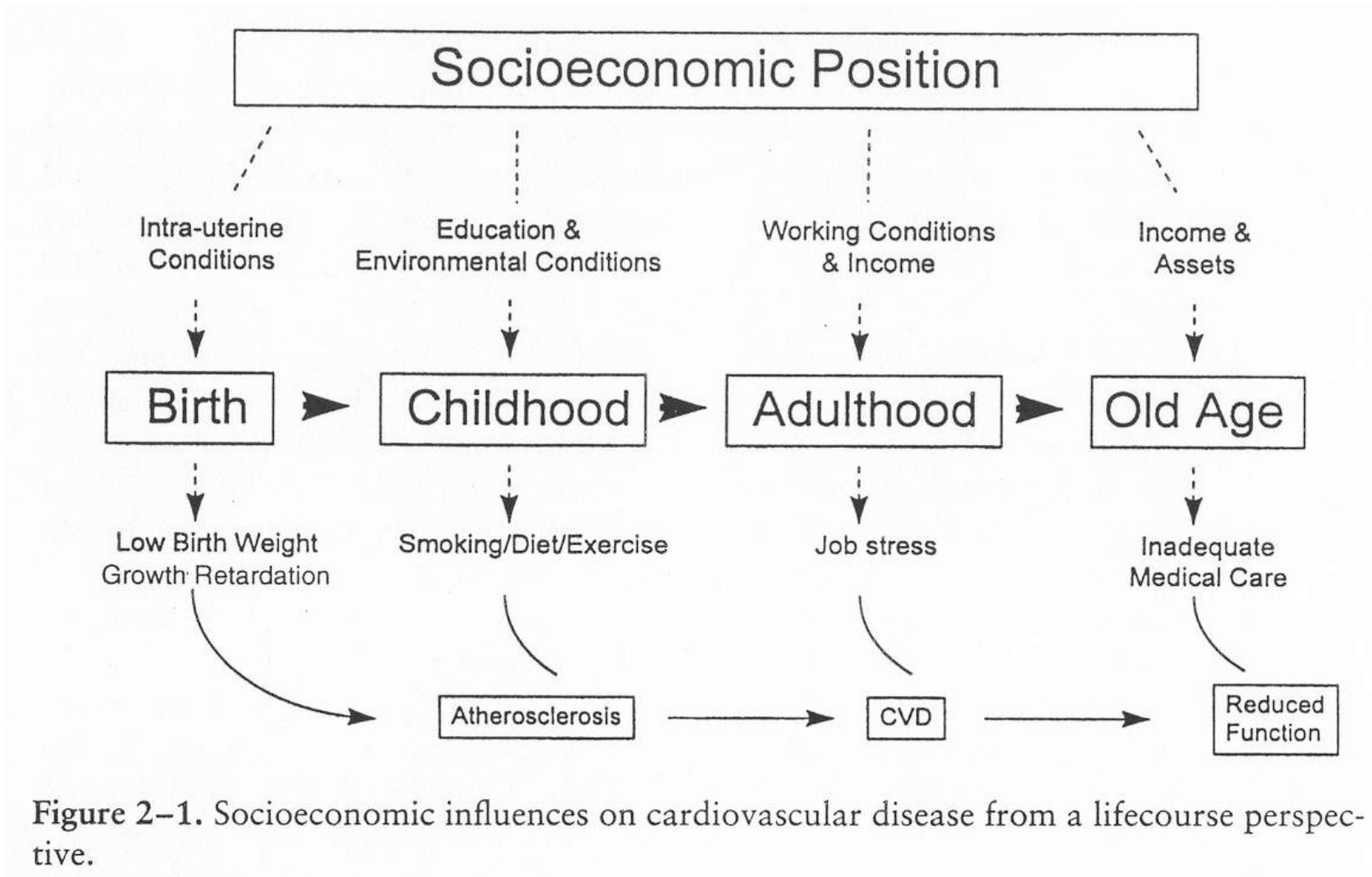- Example of potential influences on cardiovascular disease:



Figure 2–1. Socioeconomic influences on cardiovascular disease from a lifecourse perspective.

Lynch and Kaplan (2000)

**Those confounded vitamins: what can we learn from the differences between observational versus randomised trial evidence?**

*Debbie A Lawlor, George Davey Smith, K Richard Bruckdorfer, Devi Kundu, Shah Ebrahim*



Estimates of the effects of an increase of 15·7 μmol/L plasma vitamin C on coronary heart disease 5-year mortality

Heart Protection Study (RCT): 1·06 (0·95–1·16)
EPIC (Observational study) men: 0·70 (0·51–0·95)
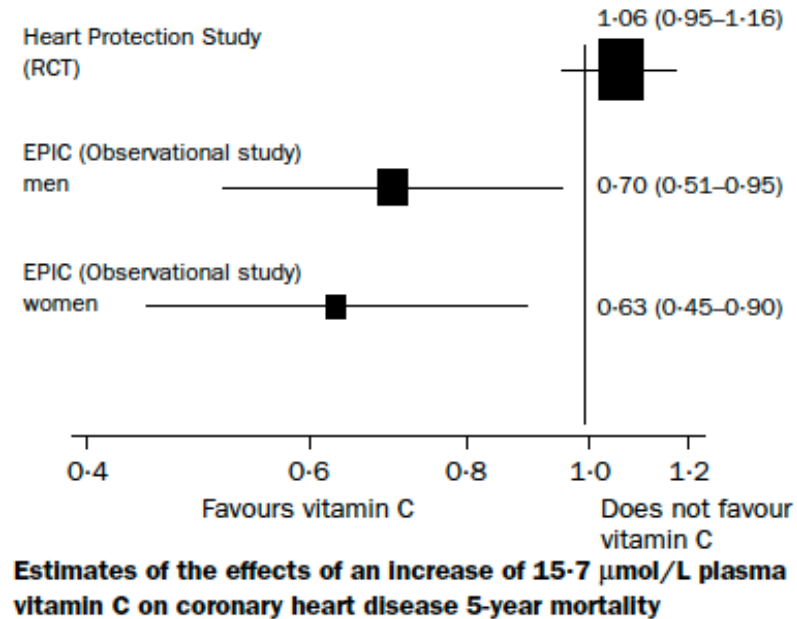EPIC (Observational study) women: 0·63 (0·45–0·90)

**TABLE 4—Association of Ever and Current Use of Hormone Replacement Therapy with Coronary Heart Disease, Adjustment for Life-Course SEP, and Other Adult Risk Factors and Adjustment Just for Adult Indicators of SEP and Other Adult Risk Factors: British Women's and Heart and Health Study (n = 3496), 1999–2001**

| | OR (95% CI) of CHD | | |
| --- | --- | --- | --- |
| | Crude | Adjusted for Life-Course Cumulative SEP Score and Adult Behavioral and Physiological Risk Factors[a] | Adjusted for Adult Indicators of SEP and Adult Behavioral and Physiological Risk Factors[b] |
| Ever vs never use of HRT | 0.66 (0.53, 0.83) | 1.09 (0.81, 1.45) | 0.87 (0.67, 1.13) |
| Current vs past or never use of HRT | 0.74 (0.54, 1.02) | 1.15 (0.78, 1.70) | 0.84 (0.59, 1.15) |

Note. OR = odds ratio; CI = confidence interval; HRT = hormone replacement therapy; SEP = socioeconomic position; CHD = coronary heart disease.

[a]Adjusted for life-course cumulative SEP score, systolic blood pressure, high-density lipoprotein cholesterol, triglyceride levels, type 1 diabetes, body mass index, waist-to-hip ratio, age at menopause, hysterectomy/oophorectomy, physical activity, smoking, and low-fat diet.

[b]Adjusted for adult social class, car access as an adult, housing tenure as an adult, pension arrangements, systolic blood pressure, high-density lipoprotein cholesterol, triglyceride levels, type 1 diabetes, body mass index, waist-to-hip ratio, age at menopause, hysterectomy/oophorectomy, physical activity, and smoking.

# Recommendations

1. Have a hypothesis about SEP and disease mechanisms.

2. Tailor your indicator to capture presumed etiologic effects.

3. Use several indicators.

4. Consider your specific population, birth-cohort, time period.

5. Consider area-based as well as individual-based measures.

6. Think about specificity in interpreting your findings.

7. Comparability between subgroups (e.g., gender, ethnicity).

Galobardes et al. (2004)

# Broad Challenges for Measuring Social Position

- Importance of considering the life course.

- Social position is always contextual.

- Multiple measures almost certainly necessary.


- Interpreting effects of measures of social position
  - ‣ Reverse causation
    - Impact of heath shocks on income and labour force status in adulthood (downward selection)
    - Impact of health in childhood/adolescence on future socioeconomic trajectories, including education

  - ‣ Residual confounding, residual confounding, residual confounding…