

# Measuring Social Inequality

Advanced Social Epidemiology PhD Course

Sam Harper

University of Copenhagen  
2021-10-11 to 2021-10-15

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

# 1. Measuring Social Position

1.1 Clarifying the Question

1.2 Individual Social Position

1.3 Aggregate Social Position

1.4 Residual Confounding

# 1. Measuring Social Position

1.1 Clarifying the Question

1.2 Individual Social Position

1.3 Aggregate Social Position

1.4 Residual Confounding

# Why should we care?

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

# The need for accuracy

## (1) Interest in social position as an EXPOSURE:

- Modifiable exposures and counterfactual causation Individual causal effect of social position ( $X$ ), for disease/outcome  $Y=1$ :

$$Pr[Y = 1 | Set(X = x1)] \quad vs. \quad Pr[Y = 1 | Set(X = x2)]$$

- 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/non-teachers



Source: [https://www.hamiltonproject.org/charts/annual\\_earnings\\_of\\_teachers\\_and\\_non-teachers](https://www.hamiltonproject.org/charts/annual_earnings_of_teachers_and_non-teachers)

# 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)

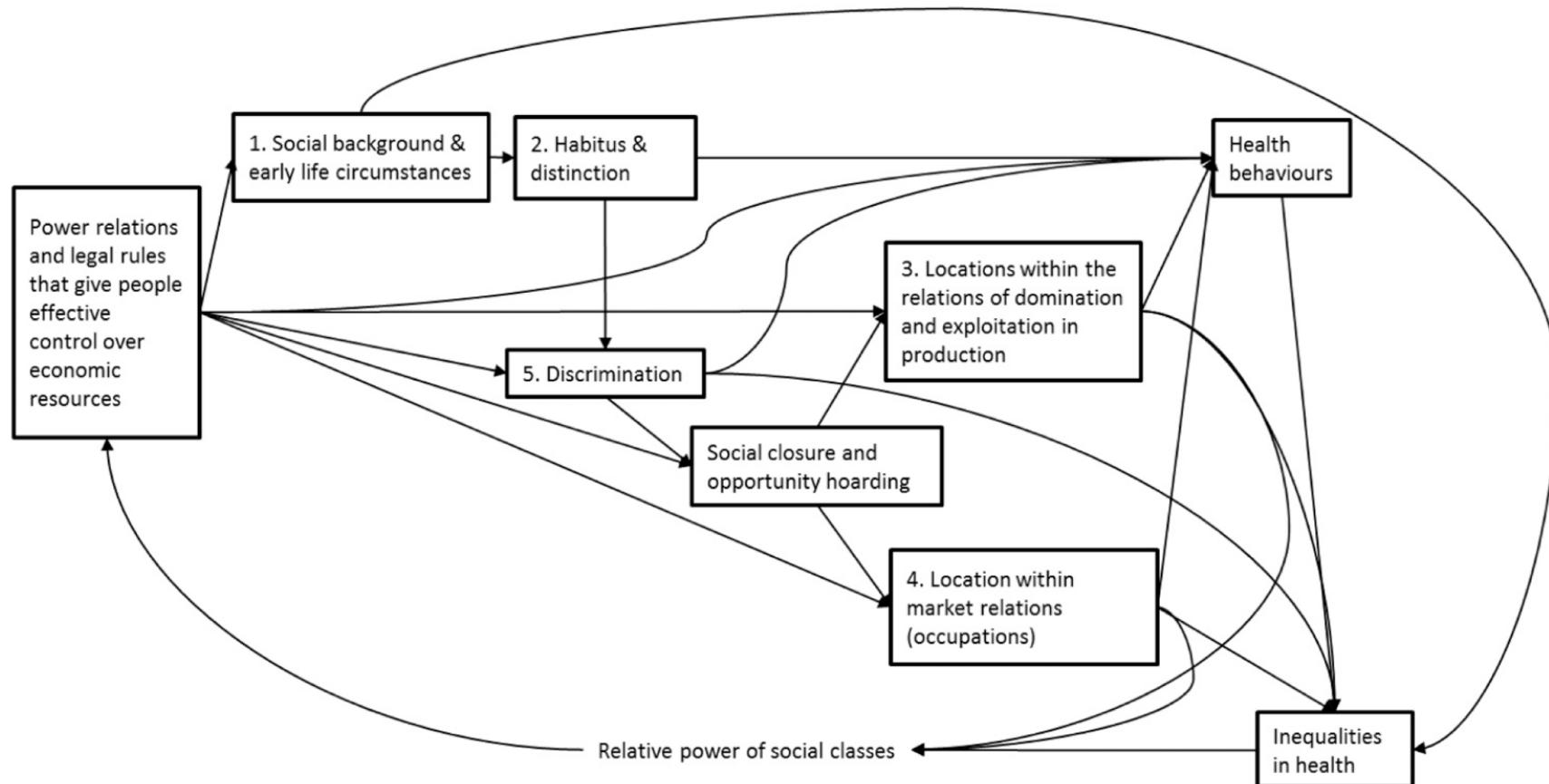
# Question for Discussion

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'



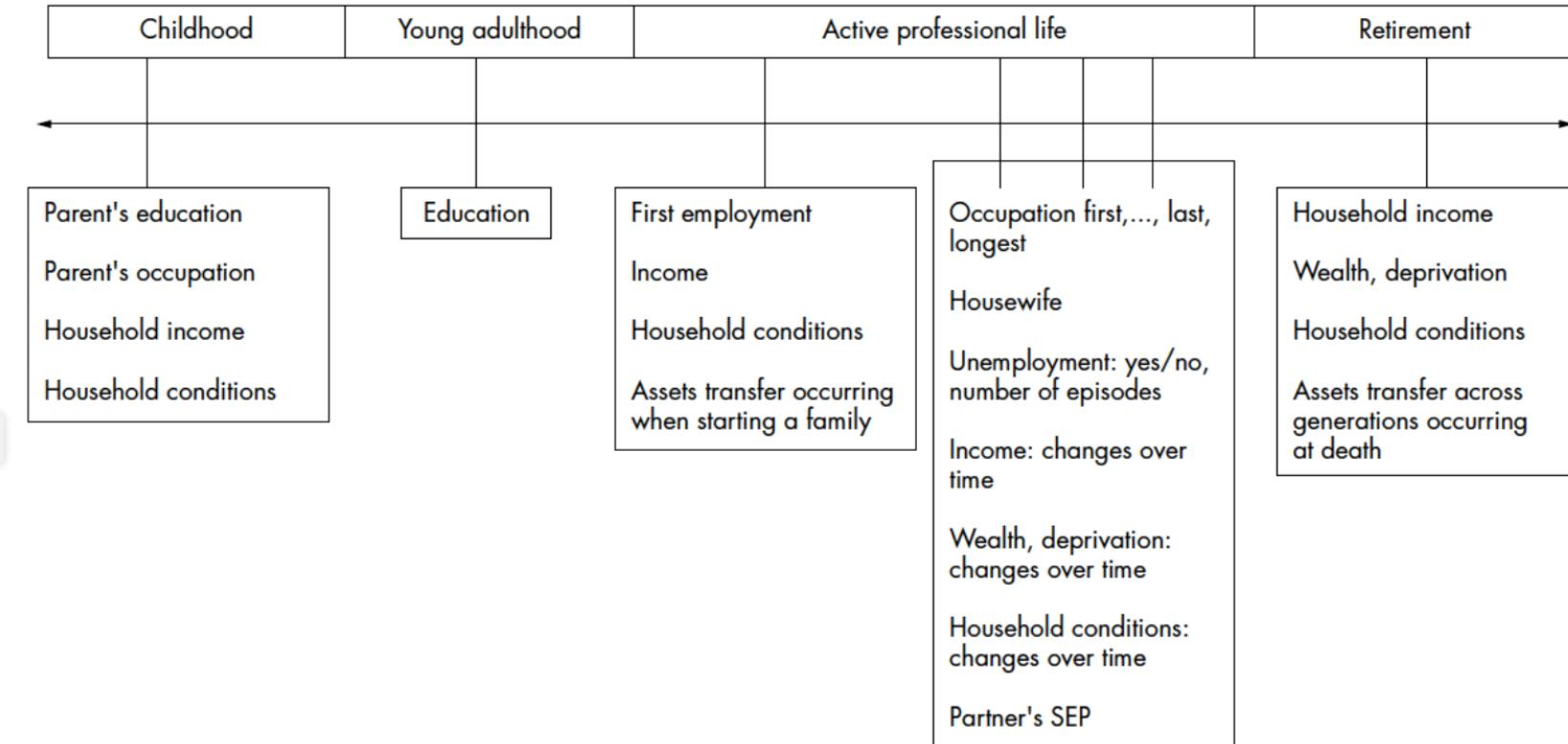
# Potential equity 'stratifiers'

Also called “dimensions of inequality”

PROGRESS scheme used by WHO:

- **Place of residence** (rural, urban, etc.)
- **Race or ethnicity**
- **Occupation**
- **Gender**
- **Religion**
- **Education**
- **Socioeconomic status**
- **Social capital or resources**

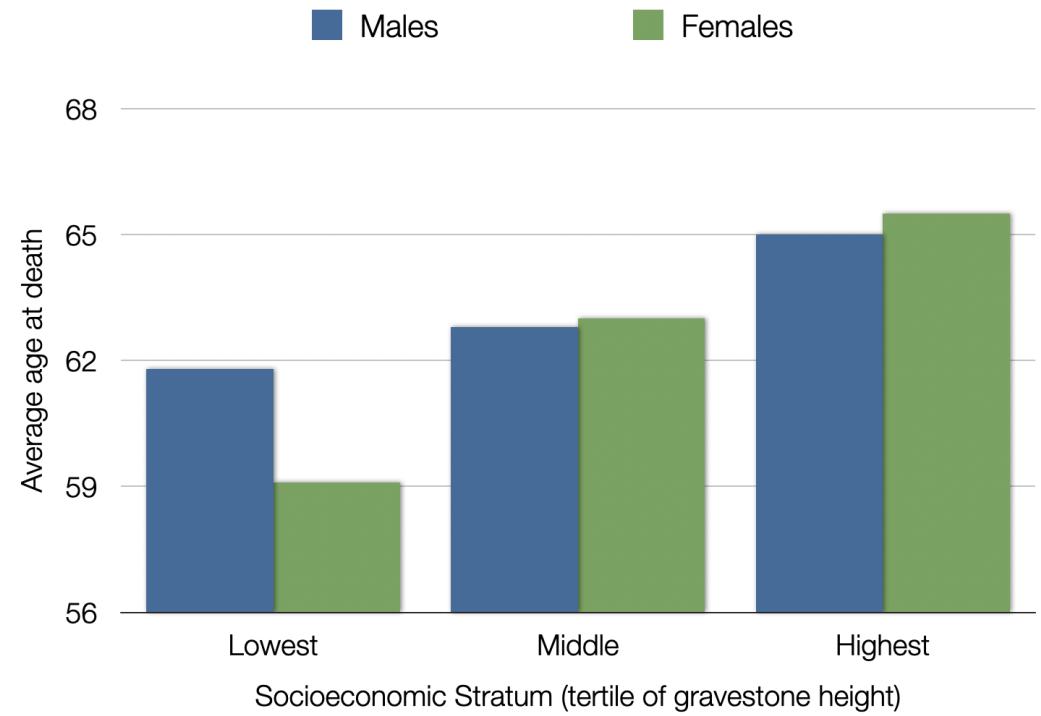
# Which indicator to use? When?



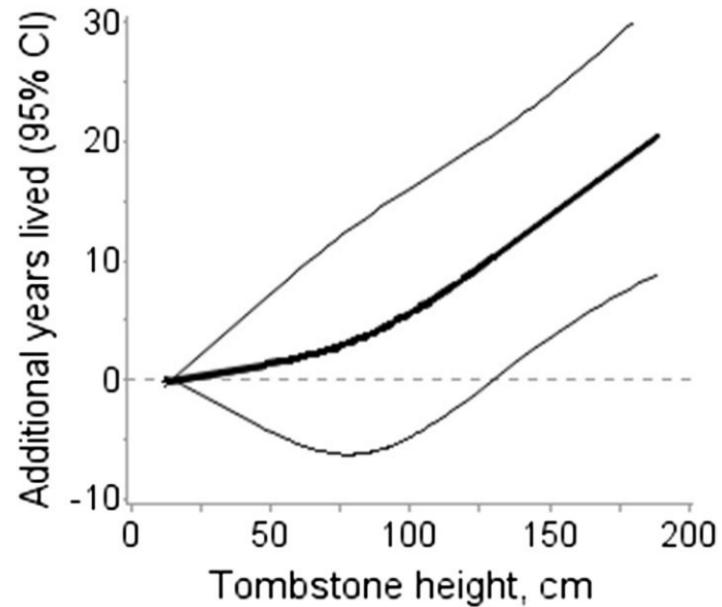
# Tombstone height and life expectancy in Glasgow (1801-1920)



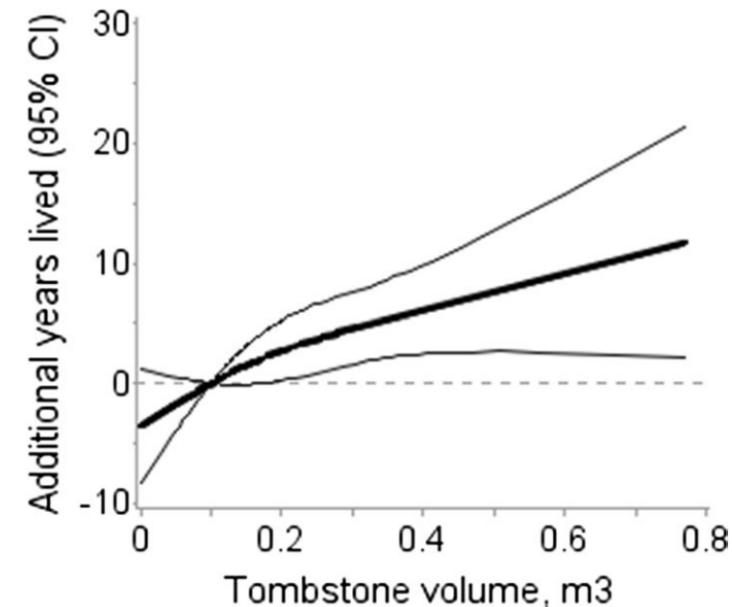
Sometimes you need to be creative...



# Tombstone height revisited in Canada (1820-1992)



**Fig. 1** Association of tombstone height with additional number of years lived (Additional number of years lived (central line) and 95% confidence interval (outer bands), adjusted for sex, marital status, and year of death as a continuous spline)



**Fig. 2** Association of tombstone volume with additional number of years lived (Additional number of years lived (central line) and 95% confidence interval (outer bands), adjusted for sex, marital status, and year of death as a continuous spline)

# 1. Measuring Social Position

1.1 Clarifying the Question

1.2 Individual Social Position

1.3 Aggregate Social Position

1.4 Residual Confounding

# Individual-level 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 in Denmark

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."

# (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...   |

# (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   |

# Smoking and occupational class

- Substantial reductions everywhere.
- Absolute inequality declined.
- Relative inequality increased.

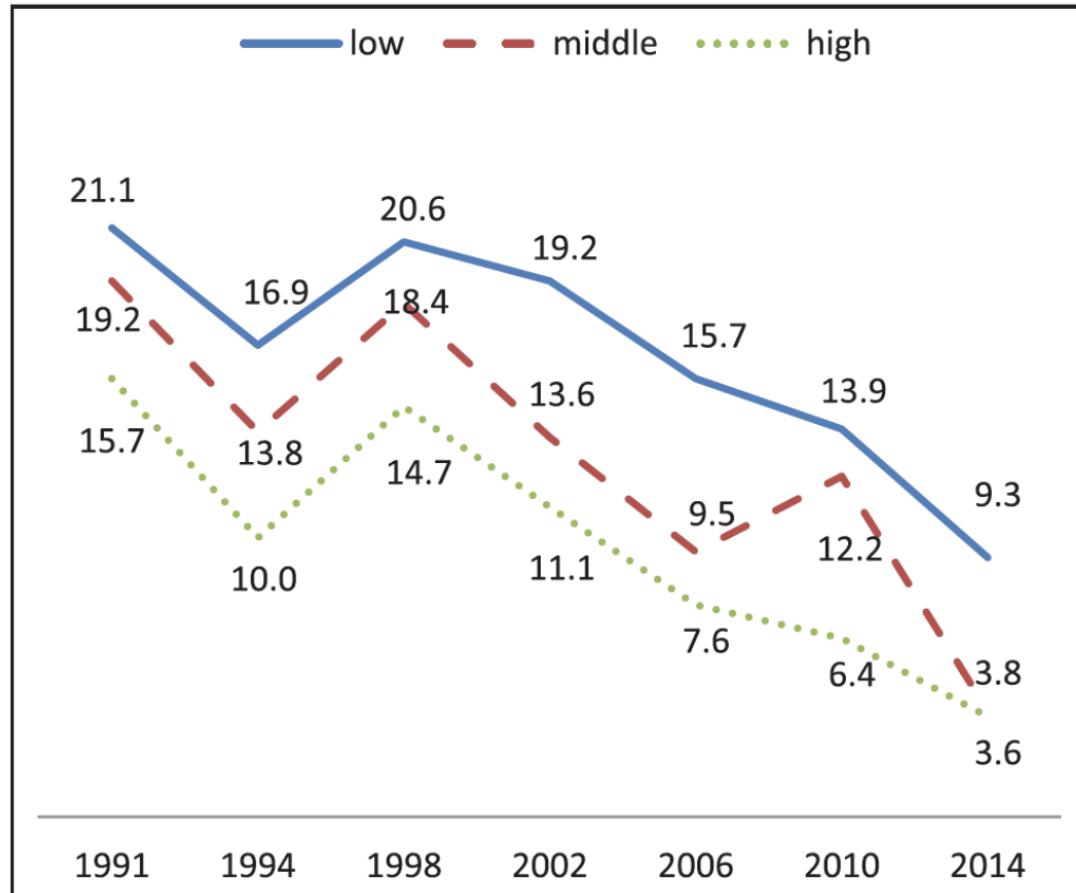


Figure 1. Percentage of 15-year-olds who smoke daily, by survey year and occupational social class.

# Individual measures: Education

## Measurement

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

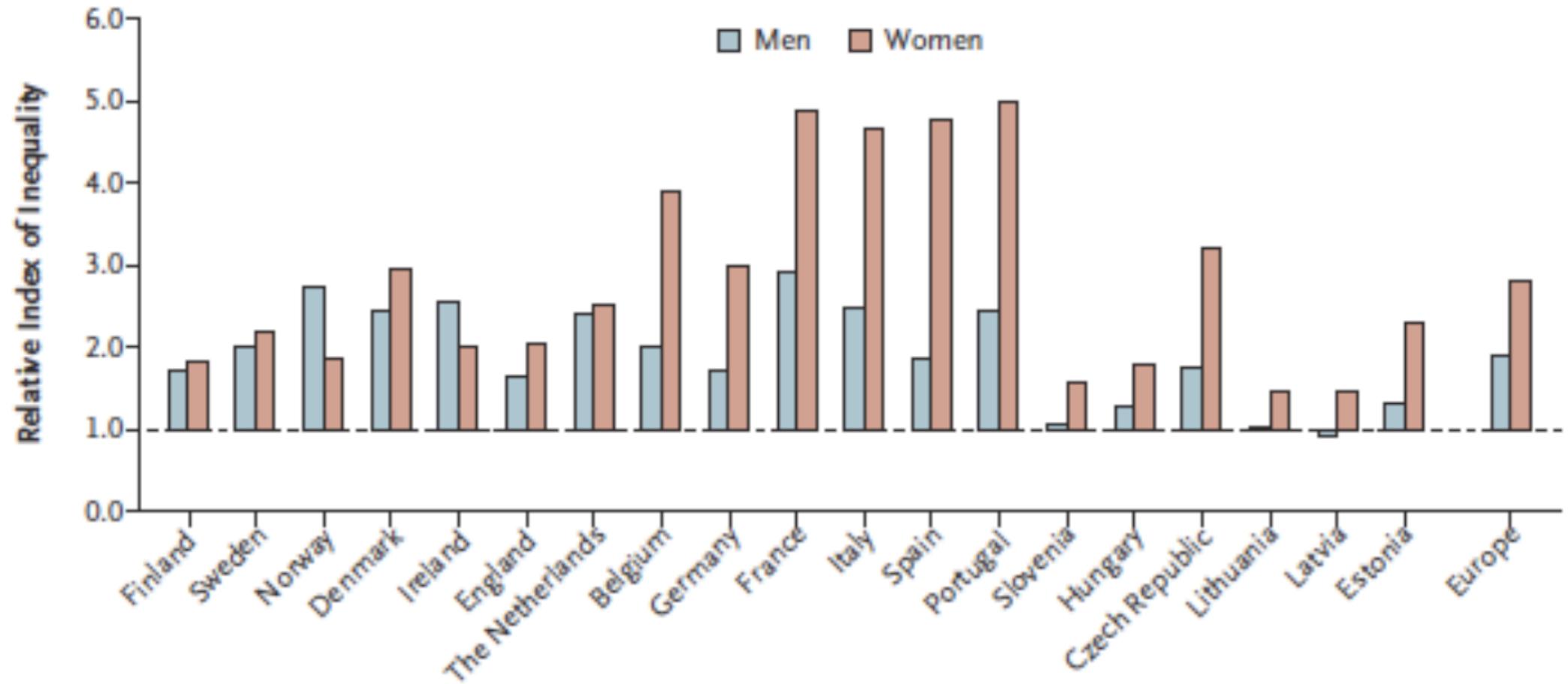
## Challenges

- Potentially confounded by cohort effects
- Does quality matter?
- Comparable between populations?

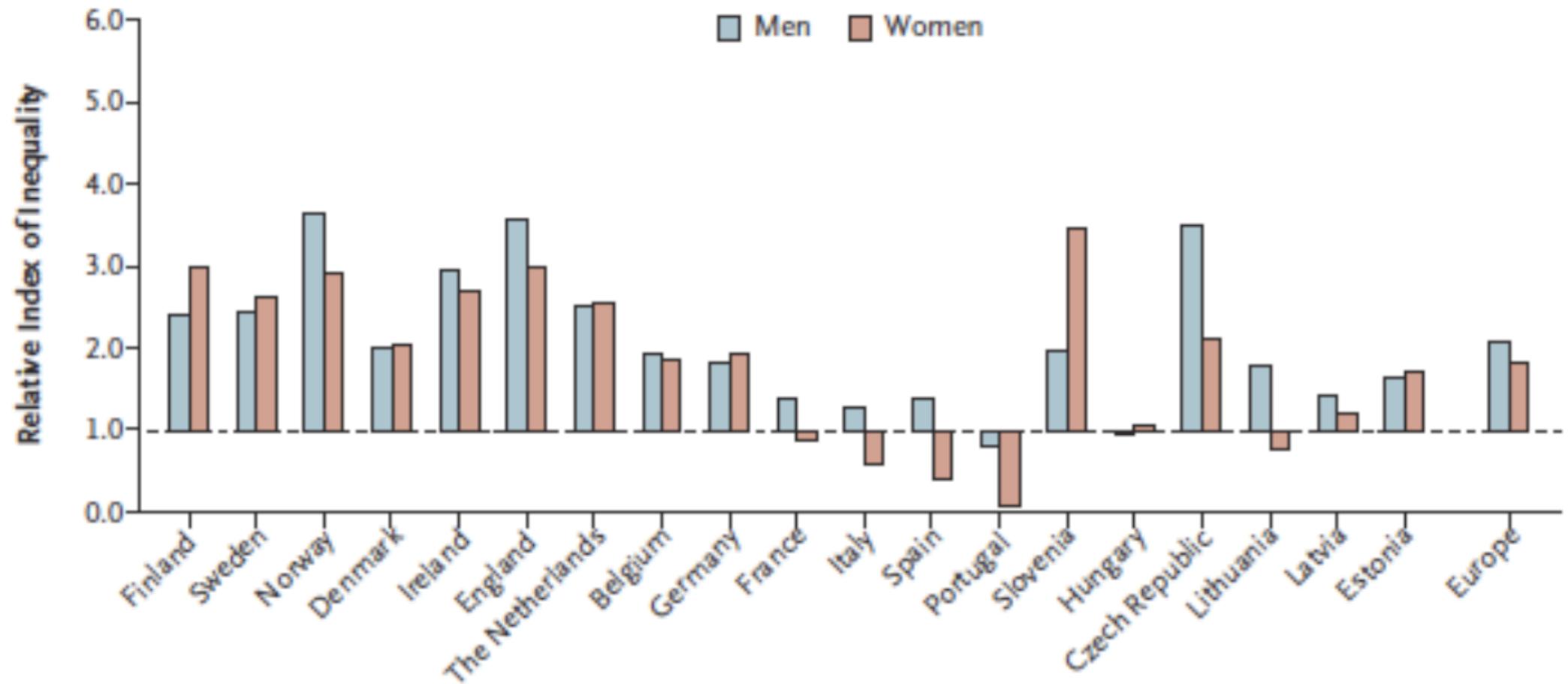
## Interpretation

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

## B Obesity



### A Current Smoking



# Exercise caution with education groups

- Bias/variance trade-offs in grouping.
- Careful with heterogeneous subpopulations.

---

## Relative to Whom? Comment on “Relative Education and the Advantage of a College Degree”

American Sociological Review  
2021, Vol. 86(5) 1000–1010  
© American Sociological Association 2021  
DOI:10.1177/00031224211042326  
[journals.sagepub.com/home/asr](http://journals.sagepub.com/home/asr)  

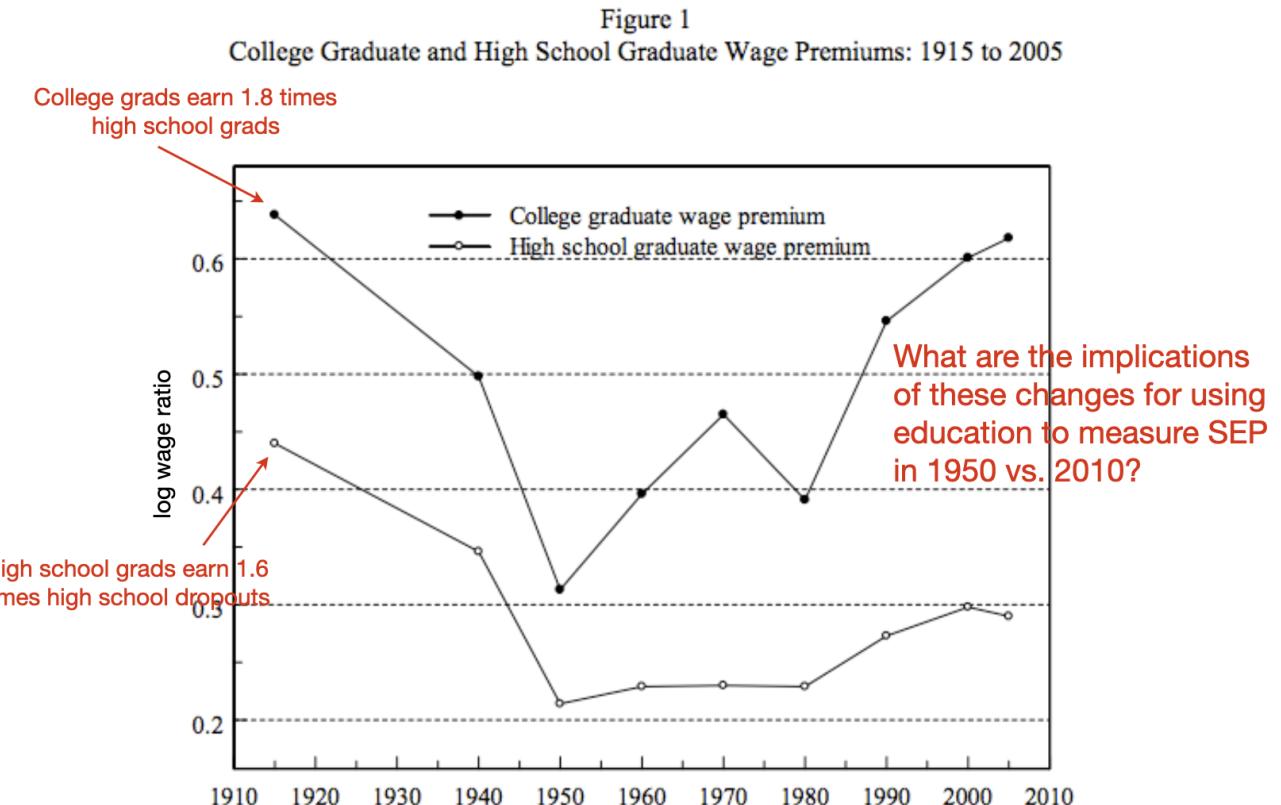

Jane Furey<sup>a</sup>

### Abstract

To understand the relative advantage of a bachelor's degree, we must consider the question: relative to whom? Using the Current Population Survey Annual Social and Economic Supplement, Horowitz (2018) argues that educational expansion between 1971 and 2010 decreased college graduates' skill usage and eroded their advantages relative to individuals without a postsecondary degree. However, the comparison group—individuals without a postsecondary degree—is inconsistently defined over time due to a change to the CPS in 1992; this group also includes individuals without a high school degree, high school graduates, and people with some college but no degree—three groups that have heterogeneous labor market experiences. I replicate Horowitz's analysis and repeat it using two alternative education categorization schemes that address these limitations. I show that college graduates' absolute and relative advantages in skill usage depend substantially on how we measure education. Notably, I find that college graduates maintain persistent relative advantages in skill usage when compared to high school graduates and individuals with some college, even as education expands. Although no classification system perfectly accounts for the full variation of the population, my findings demonstrate that researchers must carefully define key variables and comparison groups, especially when considering relative effects.

# Dynamic nature of SEP across place and time

- Do the health advantages of a college degree depend on when it is obtained?



## *Life Spans Shrink for Least-Educated Whites in the U.S.*

---



By Sabrina Tavernise

Sept. 20, 2012

“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)

# Questions about income

Household or individual income?

Absolute amount or categorical?

Threshold or gradient?

What about in-kind benefits?

Public assistance?

What about reverse causation?

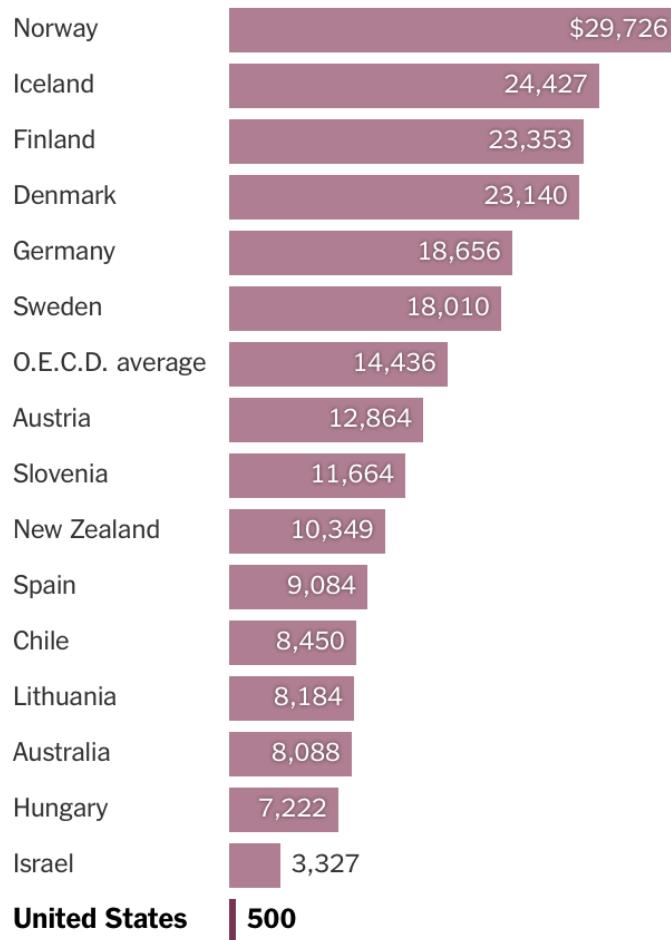
# What are you trying to measure?

- Is it 'just' income?
- Should we account for 'in-kind' support when trying to measure socioeconomic position?
- Would ignoring benefits lead to misclassification across countries?

Source: <https://www.nytimes.com/2021/10/06/upshot/child-care-biden.html>

## How Much Governments Spend on Child Care for Toddlers

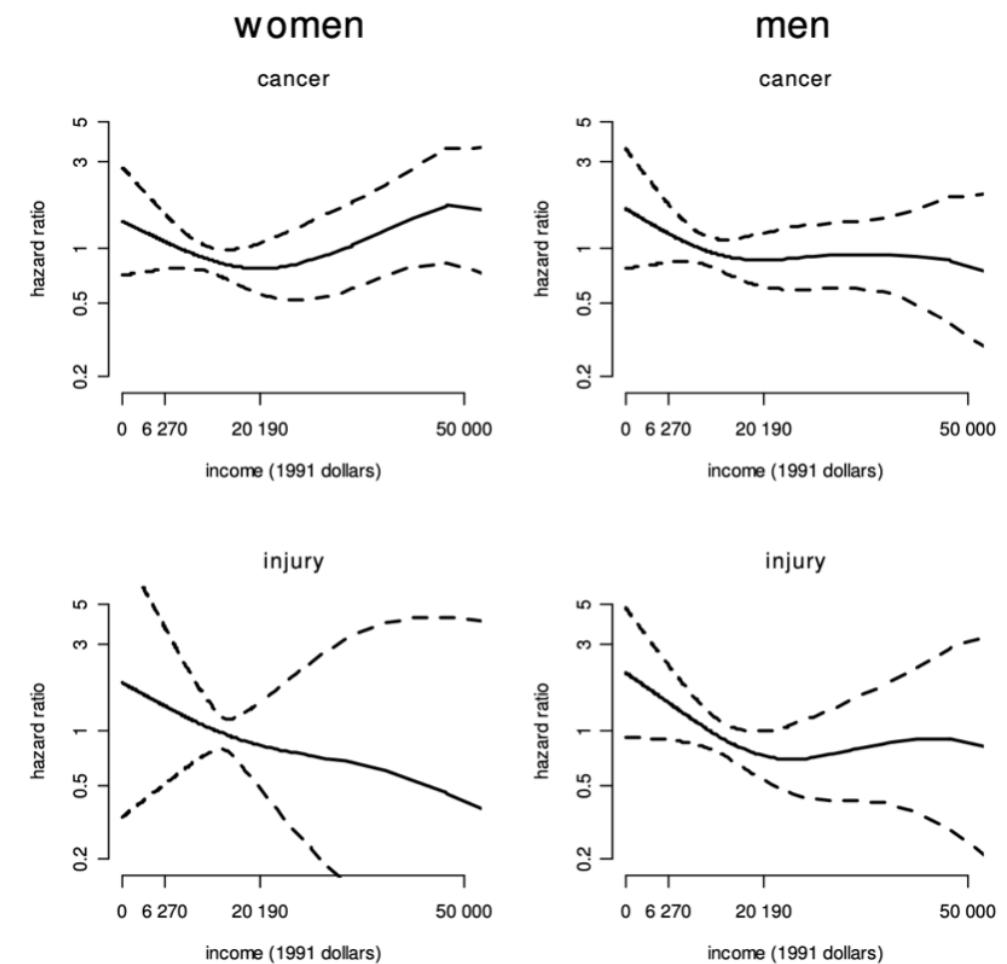
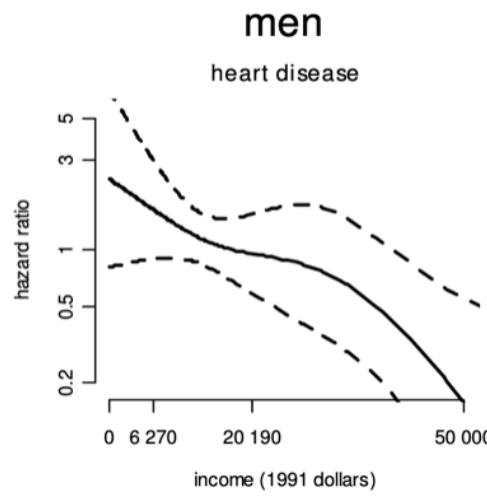
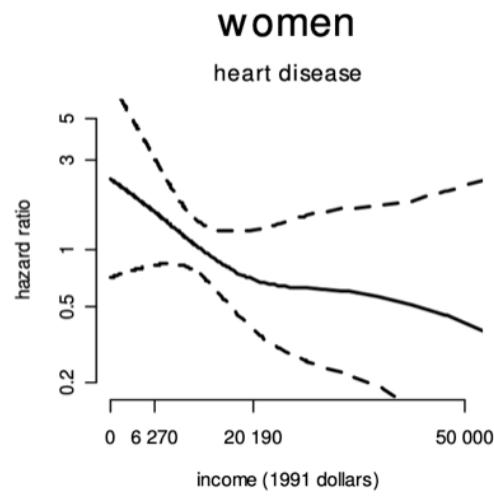
Annual public spending per child on early childhood care.



- Broadly similar patterns for all countries
- Note stronger gradients for men than women

# Specificity of income effects: mechanisms matter

- Differ by gender
- Differ by cause



Rehkopf et al. (2008)

# Individual measures: Ethnic background

## Measurement

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

## Challenges

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

## Interpretation

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

# Why might ethnicity 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.

- Measuring 'exposure' by 'distance' relative to Western diet.

VOL. 104

SEPTEMBER, 1976

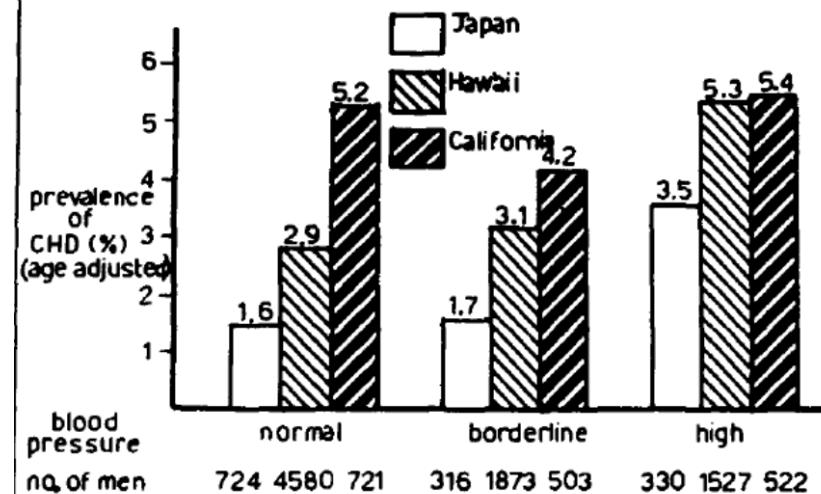
NO. 3

**Original Contributions**

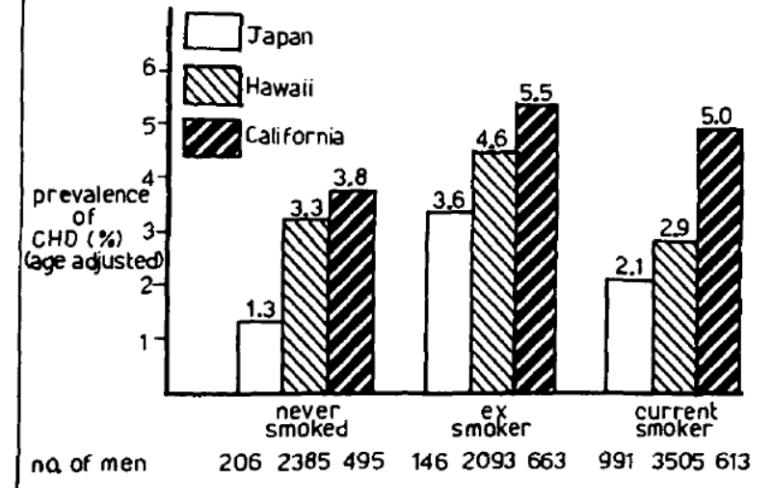
ACCULTURATION AND CORONARY HEART DISEASE IN  
JAPANESE-AMERICANS<sup>1</sup>

MICHAEL G. MARMOT, AND S. LEONARD SYME

**B. Controlling for blood pressure**



**C. Controlling for smoking**



- More 'direct' measures of diet according to following 'traditional' based on country of origin.

VOL. 104

SEPTEMBER, 1976

NO. 3

### Original Contributions

#### ACCULTURATION AND CORONARY HEART DISEASE IN JAPANESE-AMERICANS<sup>1</sup>

MICHAEL G. MARMOT, AND S. LEONARD SYME

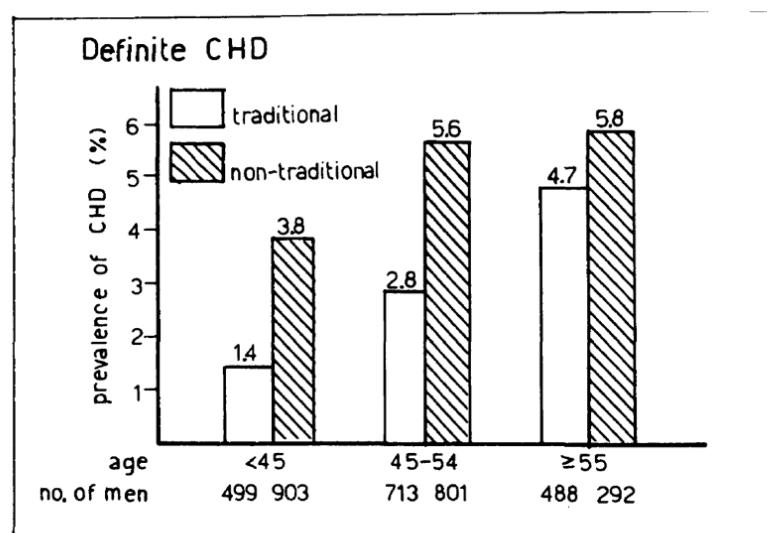


FIGURE 4. Prevalence of CHD by culture of upbringing.

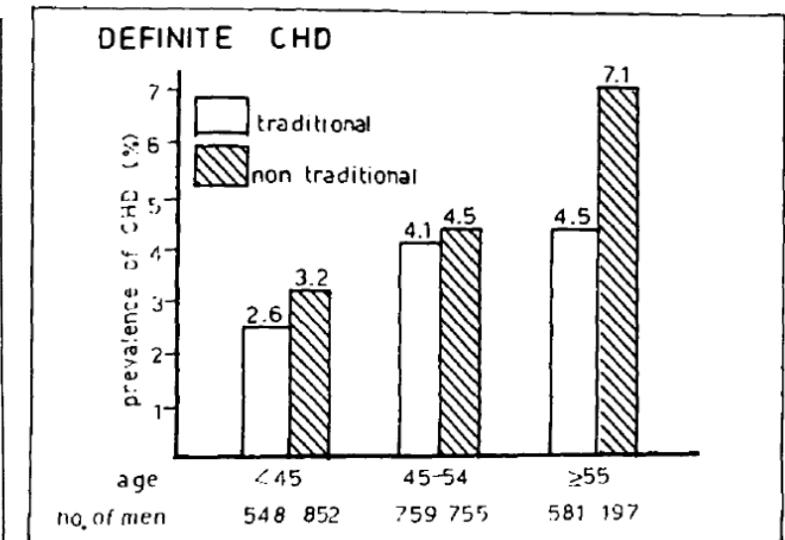
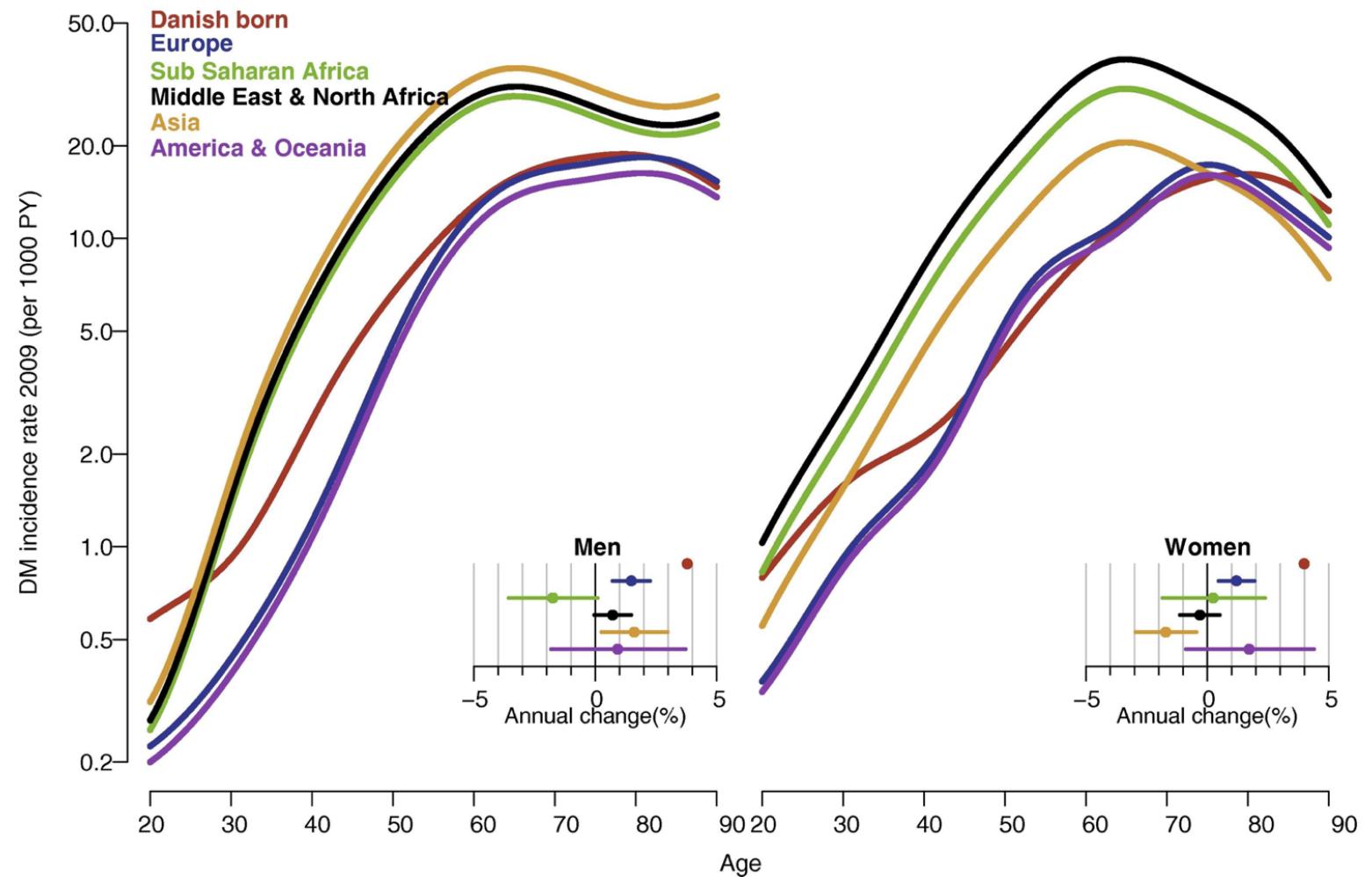


FIGURE 12. Prevalence of CHD by cultural assimilation.

- 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)

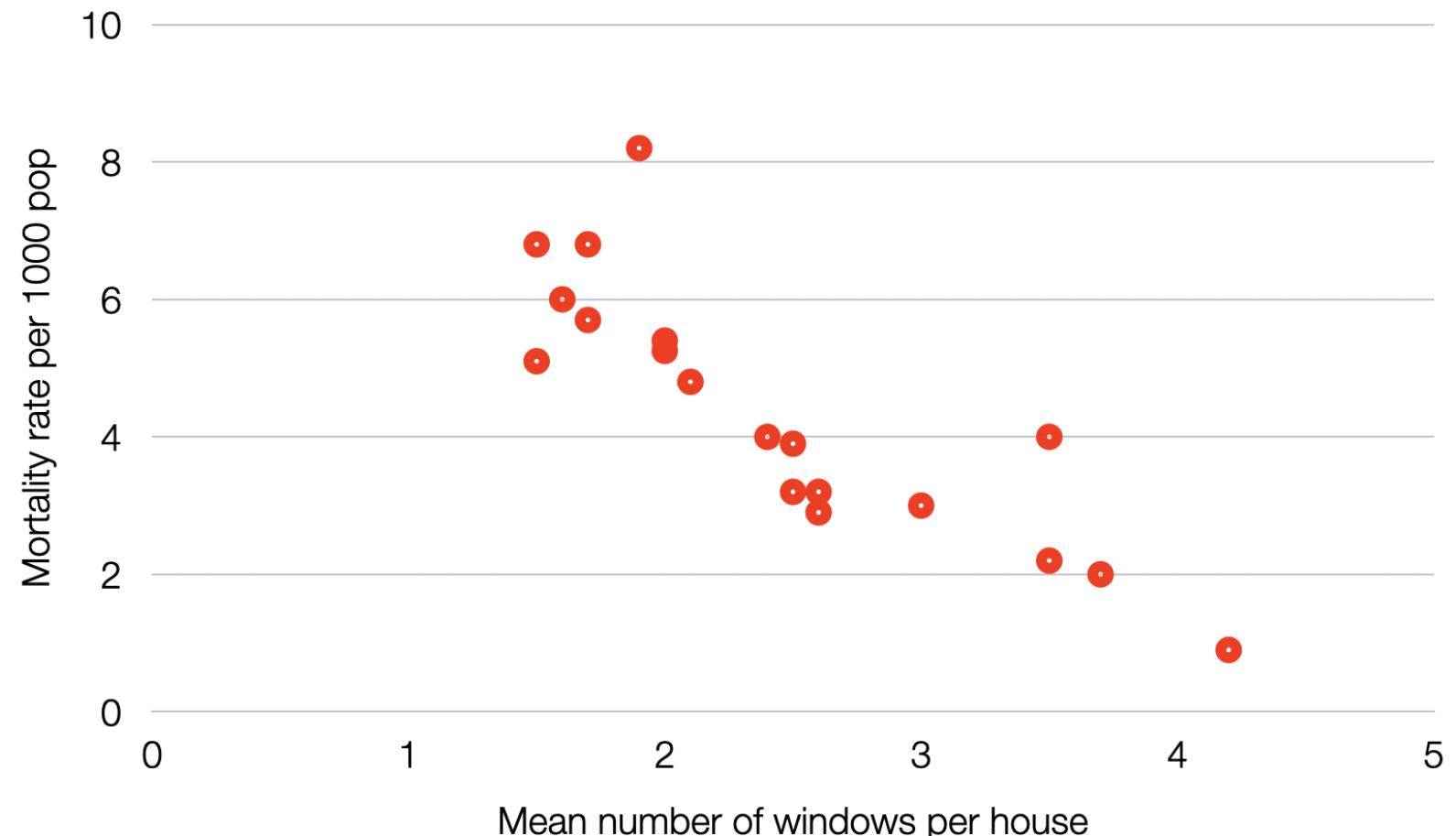
## Challenges

- Comparability, potential expense in data collection
- Good example of a modifiable social exposure

## Interpretation

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

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



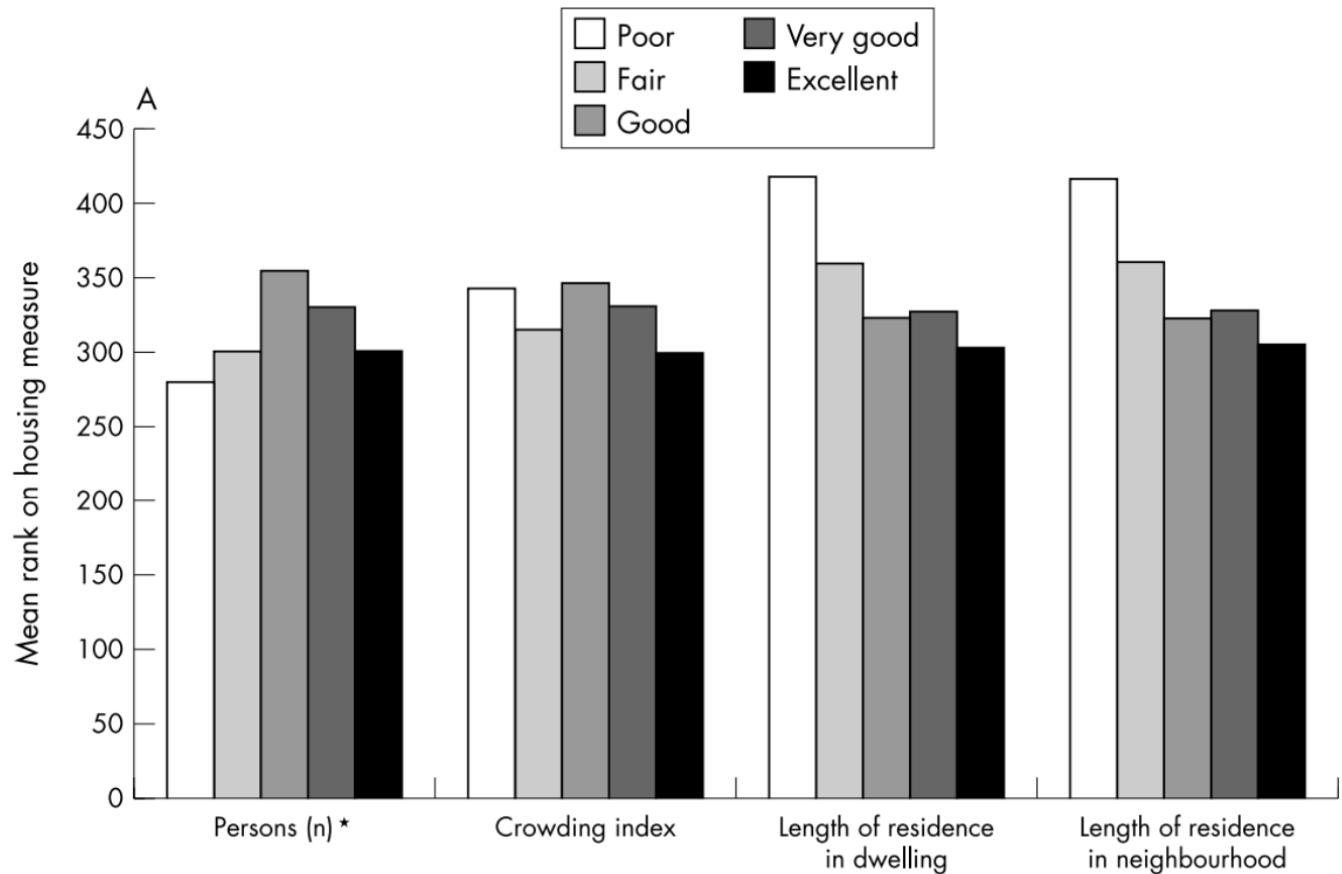
Murphy, S and Egger, M. International Journal of Epidemiology (2002), data from Marie-Davy, Revue d'hygiène (1911)

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

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

- Note variation with self-reported health across different dimensions of housing

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



# 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 with 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 position

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

<sup>a</sup> All p values less than 0.05 denote that the correlations are significantly different from each other.

<sup>b</sup> Indicates the correlation is significant at p < .001.

# What the Rich Won't Tell You

“There's nobody who knows how much we spend. You're the only person I ever said those numbers to out loud.”

[查看简体中文版](#) | [查看繁體中文版](#)

By RACHEL SHERMAN SEPT. 8, 2017



- As always, consider 'relative' to what when making comparisons between exposed and unexposed groups.
- Applies equally to subjective measures.

**SundayReview** | What the Rich Won't Tell You

---

My interviewees never talked about themselves as “rich” or “upper class,” often preferring terms like “comfortable” or “fortunate.” Some even identified as “middle class” or “in the middle,” typically comparing themselves with the super-wealthy, who are especially prominent in New York City, rather than to those with less.

When I used the word “affluent” in an email to a stay-at-home mom with a \$2.5 million household income, a house in the Hamptons and a child in private school, she almost canceled the interview, she told me later. Real affluence, she said, belonged to her friends who traveled on a private plane.

# 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

# 1. Measuring Social Position

1.1 Clarifying the Question

1.2 Individual Social Position

1.3 Aggregate Social Position

1.4 Residual Confounding

# Area-based measures of SEP

## 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 those 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.

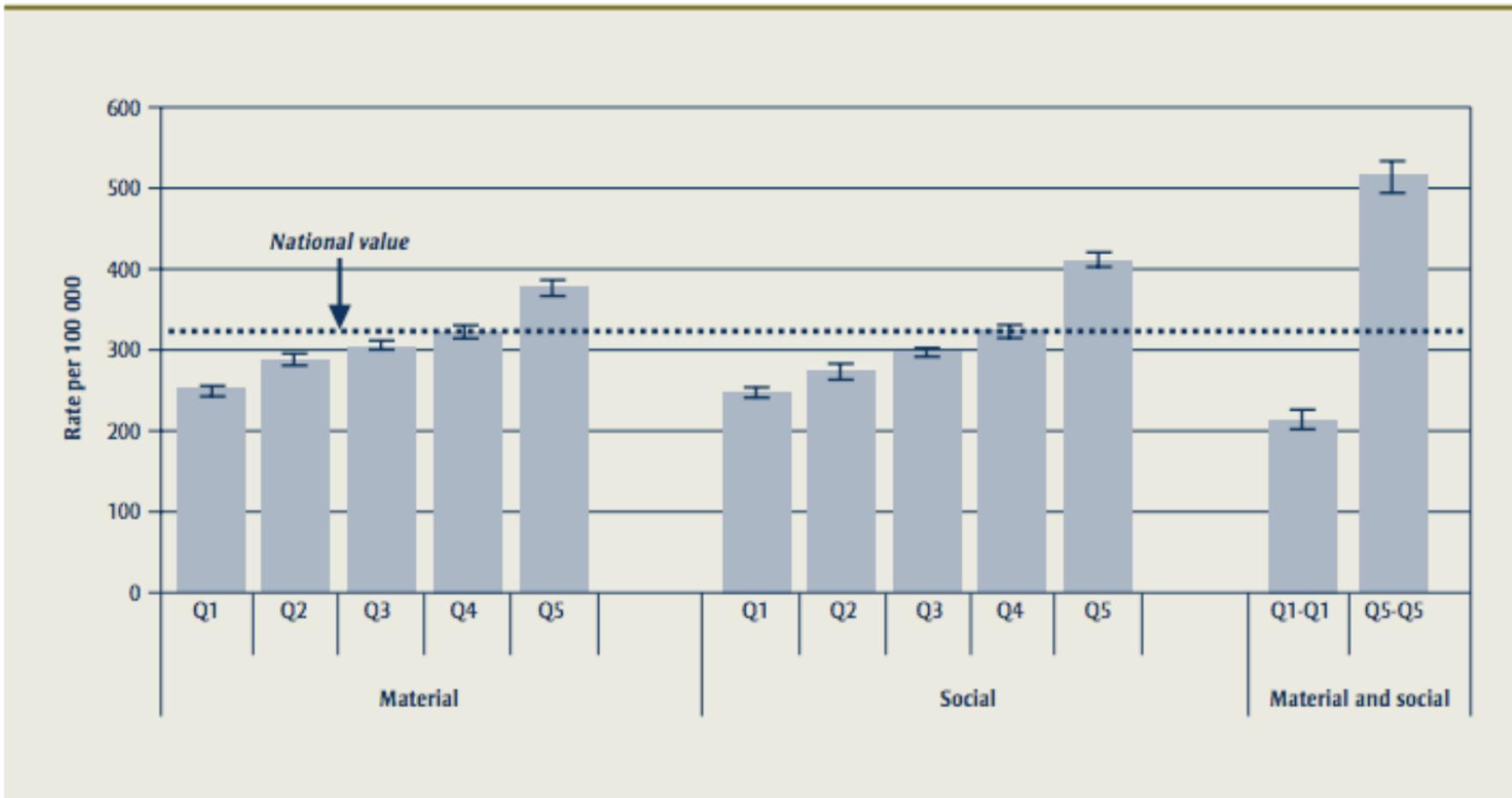
Some data manipulation (smoothing, age-sex standardization)

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

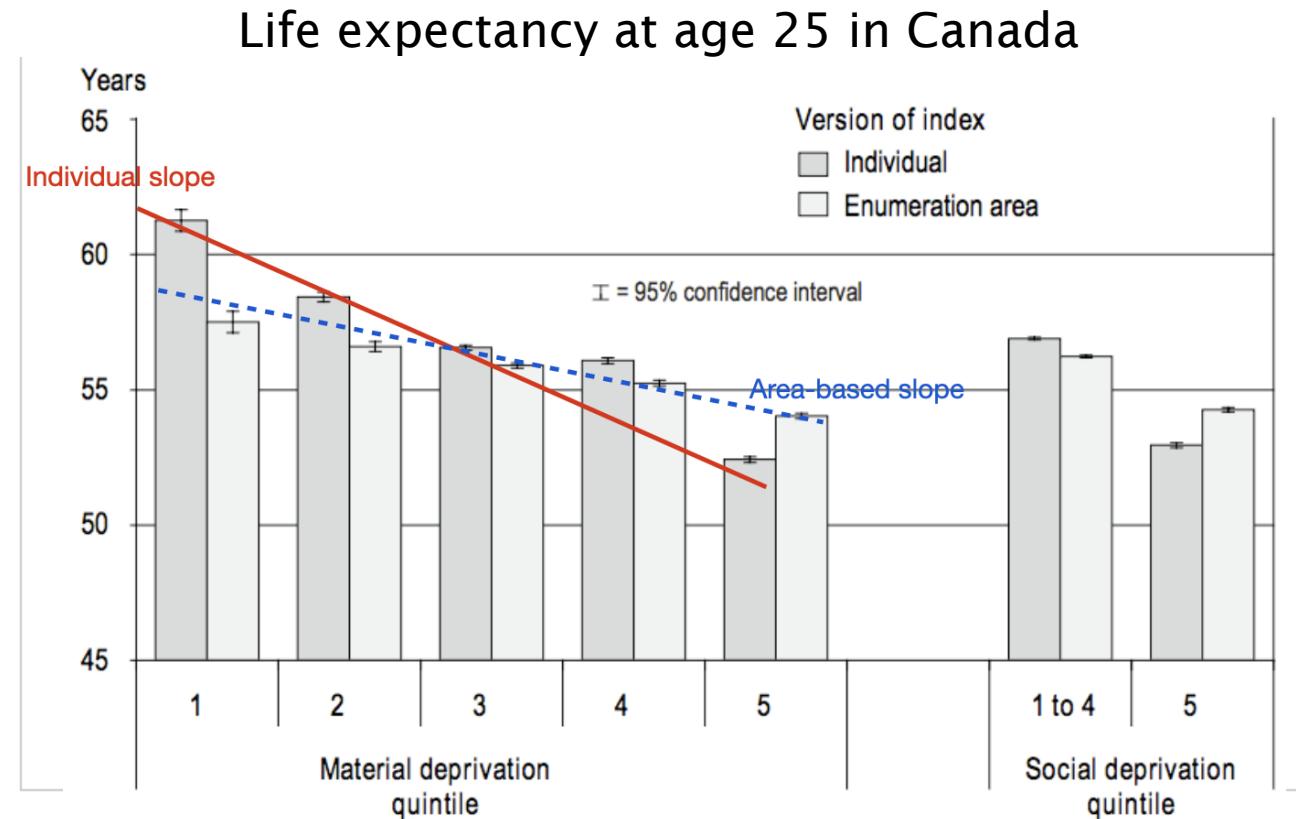


NOTE: Death rates are adjusted for age, sex, geographic area and the other forms of deprivation.

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

# Use of Area-Based Measures Typically ‘Flattens’ Gradients

- Area-level EP as a proxy for individual-level indicators generate misclassification.
- In general, the larger the area, the greater the underestimate is likely to be.



# A socioeconomic deprivation index for small areas in Denmark

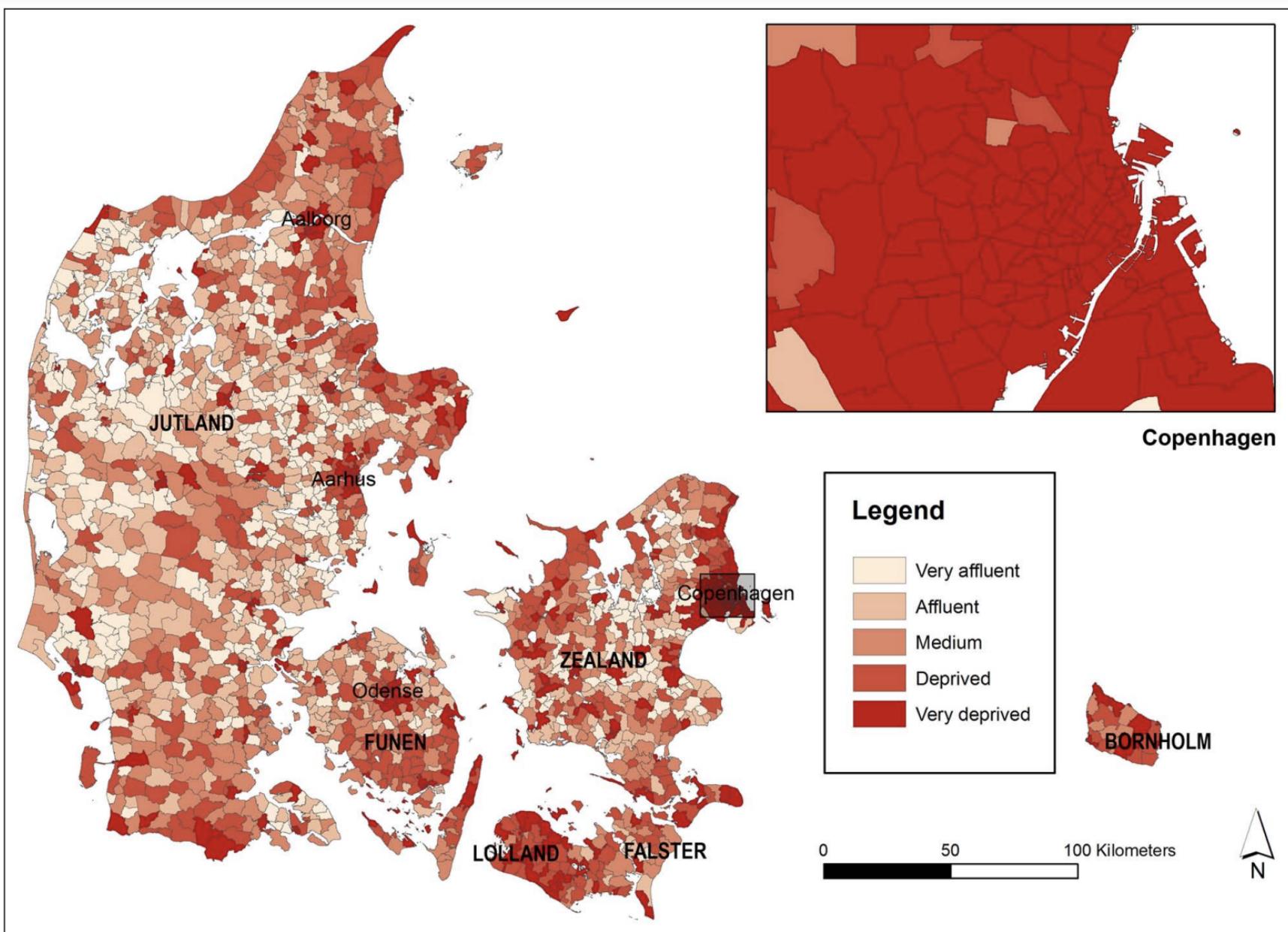
MATHIAS MEIJER<sup>1,2,3</sup>, GERDA ENGHOLM<sup>2</sup>, ULRIKE GRITTER<sup>4</sup> & KIM BLOOMFIELD<sup>3,4,5</sup>

<sup>1</sup>National Institute of Public Health, Institute of Public Health, University of Southern Denmark, Denmark, <sup>2</sup>Department of Cancer Prevention and Documentation, Danish Cancer Society, Denmark, <sup>3</sup>Unit For Health Promotion Research, Institute of Public Health, University of Southern Denmark, Denmark, <sup>4</sup>Department for Biostatistics and Clinical Epidemiology, Charité – University Medicine Berlin, Germany, and <sup>5</sup>Centre for Alcohol and Drug Research, School of Business and Social Science, Aarhus University, Denmark

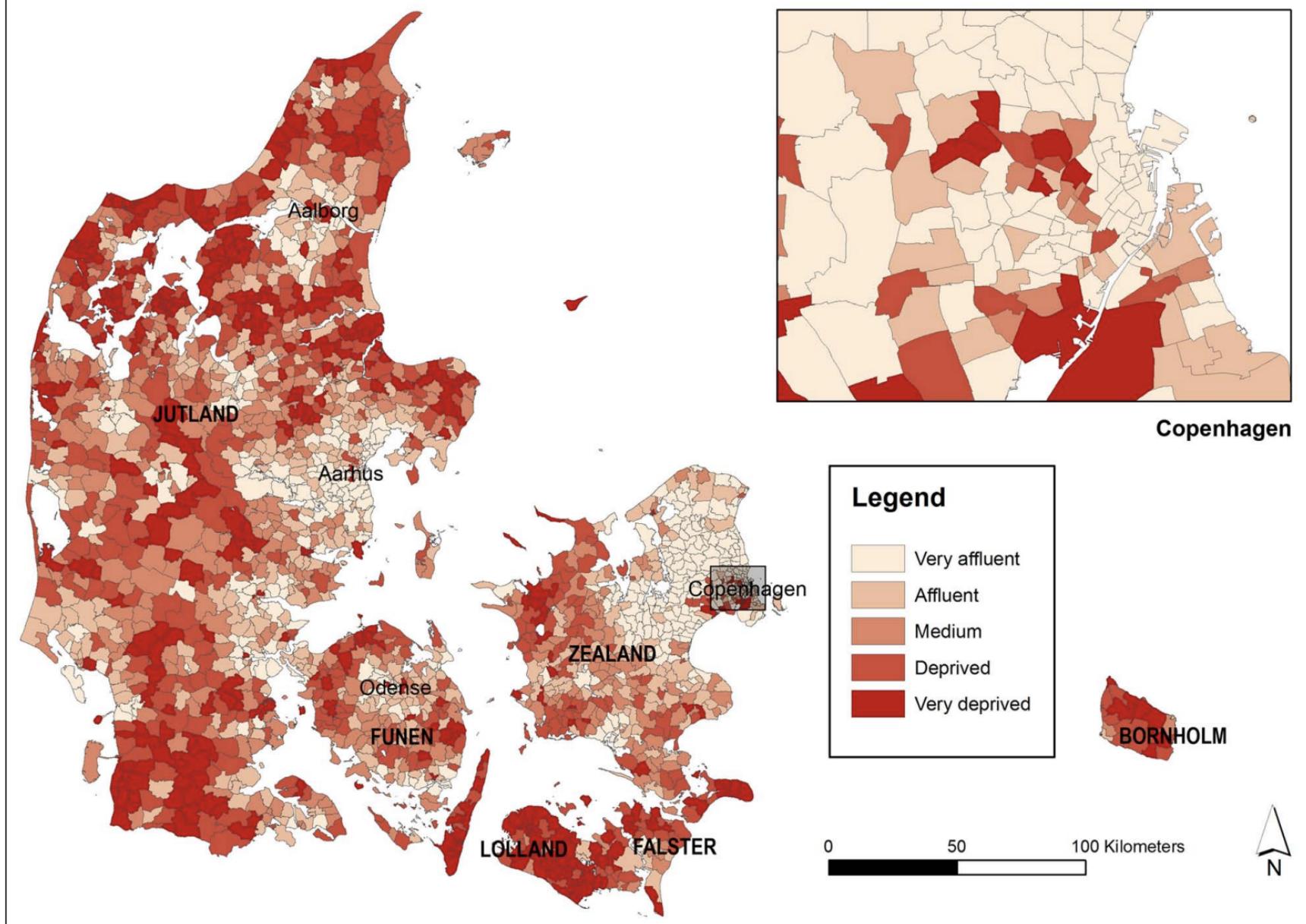
## Abstract

*Aims:* To describe the development of a deprivation index for Danish parishes and to investigate its association with all-cause mortality compared with the Townsend index and individual-level factors. *Methods:* Nine socioeconomic factors were aggregated to the parish level from individual-level register data comprising the entire Danish population in 2005. A principal component analysis was conducted to reduce the number of factors and to apply weights. An ecological analysis investigated the association between the Danish Deprivation Index (DANDEX) and standardised mortality ratios in Danish parishes. Results were compared with the Townsend index and a possible modifying effect of population density was investigated. Sensitivity of the index was investigated with multilevel survival analyses evaluating the association between all-cause mortality and DANDEX, the Townsend Index, individual-level socioeconomic factors, and population density.

*Results:* DANDEX consists of two components measuring socioeconomic properties of all 2119 Danish parishes. The first component measures deprivation related to housing (house and car ownership) while the second component is related to classical measures of socioeconomic status (education, income, occupation). A clear gradient in standardised mortality ratios was seen across quintiles of both index components. Modifying effects were seen when stratifying the index components by population density. In a frailty model, DANDEX accounted for 76% of the between-parish variation in all-cause mortality, while the Townsend index and individual socioeconomic factors accounted for 71 and 76%, respectively. *Conclusions:* The index can be used to identify Danish parishes by their levels of deprivation and it provides municipalities with a tool to allocate resources to the geographic areas where they are most needed.



**Figure 1.** Relative deprivation related to component 1(the housing component) of DANDEX in 2005, with enlargement of the Copenhagen area.



**Figure 2.** Relative deprivation related to component 2 (the socioeconomic component) of DANDEX in 2005, with enlargement of the Copenhagen area.

# Context matters

- Aggregate measures also need to be put into context
- Measuring 'structural' racism requires a different approach than aggregate SEP.
- Start with epidemiologic question!

ACCEPTED MANUSCRIPT

## Measuring Structural Racism: A guide for epidemiologists and other health researchers

Paris B Adkins-Jackson ✉, Tongtan Chantarat, Zinzi D Bailey, Ninez A Ponce

*American Journal of Epidemiology*, kwab239, <https://doi.org/10.1093/aje/kwab239>

Published: 25 September 2021 Article history ▾

“ Cite Permissions Share ▾

### Abstract

There have been over one hundred years of literature discussing the deleterious influence of racism on health. Much of the literature describes racism as a driver of social determinants of health such as housing, employment, income, and education. More recently, increased attention has been given to measuring the structural nature of a system that advantages one racialized group over others rather than solely relying on individual acknowledgement of racism. Despite these advances, there is still a need for methodological and analytical approaches to complement the aforementioned. This commentary calls on epidemiologists and other health researchers at-large to engage the discourse on measuring structural racism. First, we address the conflation between race and racism in epidemiological research. Next, we offer methodological recommendations (linking of interdisciplinary variables and datasets and leveraging mixed-method and life course approaches) and analytical recommendations (integration of mixed data, use of multidimensional models) that epidemiologists and other health researchers may consider in health equity research. The goal of this

# 1. Measuring Social Position

1.1 Clarifying the Question

1.2 Individual Social Position

1.3 Aggregate Social Position

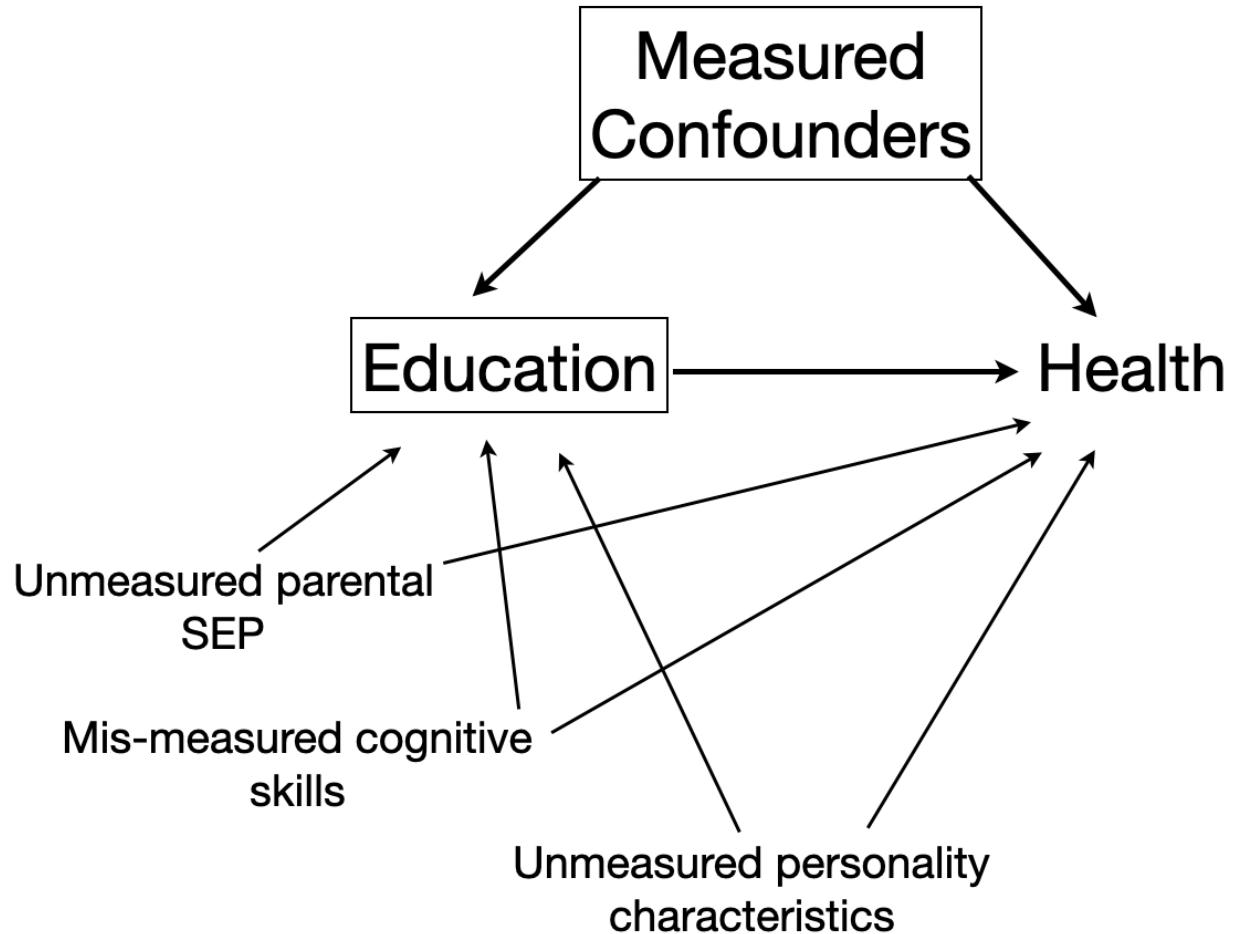
1.4 Residual Confounding

# 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?

- What are the consequences of unmeasured confounders for SEP?
- Likely effect is an over-estimate of the effect of SEP on health.



# Residual confounding is plausible...if you look for it

We are not aware of any instance of a robust positive association between stress and objective physical disease being reported from a population where either stress was associated with social advantage (but disease was not) or disease was associated with social advantage (but stress was not).

-Macloed and Davey Smith, *Am J Epid* 2005

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, **without the strong potential influence of residual confounding by socioeconomic status.**

-Kroenke, Kawachi et al. *Am J Epid* 2005

## Among Nurses:

- Strong gradient in neighborhood SEP
- Strong gradient in postsecondary education
- Strong gradient in husband's education

**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),<br>n = 9820<br>neighborhoods                 | Q2,<br>n = 9820                                   | Q3,<br>n = 9821                                   | Q4,<br>n = 9820                                     | Q5 (highest SES),<br>n = 9821                       |
| <b>Neighborhood characteristics</b>                         |   |   |   |   |   |
| 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  |
| <b>Individual characteristics</b>                           |   |   |   |   |   |
| Median age, y   | n = 17,119 women, <sup>a</sup><br>n = 6667 women <sup>b</sup> | n = 20,486, <sup>a</sup><br>n = 8521 <sup>b</sup> | n = 22,031, <sup>a</sup><br>n = 9141 <sup>b</sup> | n = 25,128, <sup>a</sup><br>n = 10,460 <sup>b</sup> | n = 26,365, <sup>a</sup><br>n = 11,339 <sup>b</sup> |
| % 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  |

# Key idea: we need 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)

- Multiple measures also applies to 'intersecting' positions:
- Ethnicity AND gender
- Gender AND race
- Etc...

**Table 4.** Odds Ratios for Racial/Ethnic Disparities in Fair or Poor Health Among Adults Aged 18-64 Years—National Health Interview Survey, 1989-1994 (n = 380 552)

| SES Measure in Model*               | Black Non-Hispanic | Mexican American |
|-------------------------------------|--------------------|------------------|
| None (baseline)                     | 2.47 (2.30-2.64)   | 2.16 (2.01-2.32) |
| Poverty level‡                      | 1.65 (1.56-1.76)   | 1.30 (1.22-1.39) |
| Income, per \$1000§                 | 1.67 (1.57-1.78)   | 1.44 (1.32-1.56) |
| Educational level                   | 1.96 (1.85-2.08)   | 1.06 (0.99-1.14) |
| Education, per 1 y                  | 2.02 (1.91-2.14)   | 0.89 (0.82-0.97) |
| Poverty level and educational level | 1.53 (1.45-1.61)   | 0.86 (0.81-0.93) |

Abbreviations: CI, confidence interval; OR, odds ratio; SES, socioeconomic status.

\*All models included race/ethnicity, age, and sex.

†White non-Hispanic is the reference group.

‡Annual income estimated in categories defined by 100% increments of the federal poverty level according to family or household size (0%-100%, 101%-200%, 201%-300%, 301%-400%, >400%, unknown).

§Annual income in continuous dollars estimated as the midpoints of a given income range.

||Completed education in levels according to earned credentials (<9 years, some high school, high school graduate/ General Equivalency Diploma, some college, college graduate or more).

# 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

- Example of potential influences on cardiovascular disease
- Note links to mechanisms.

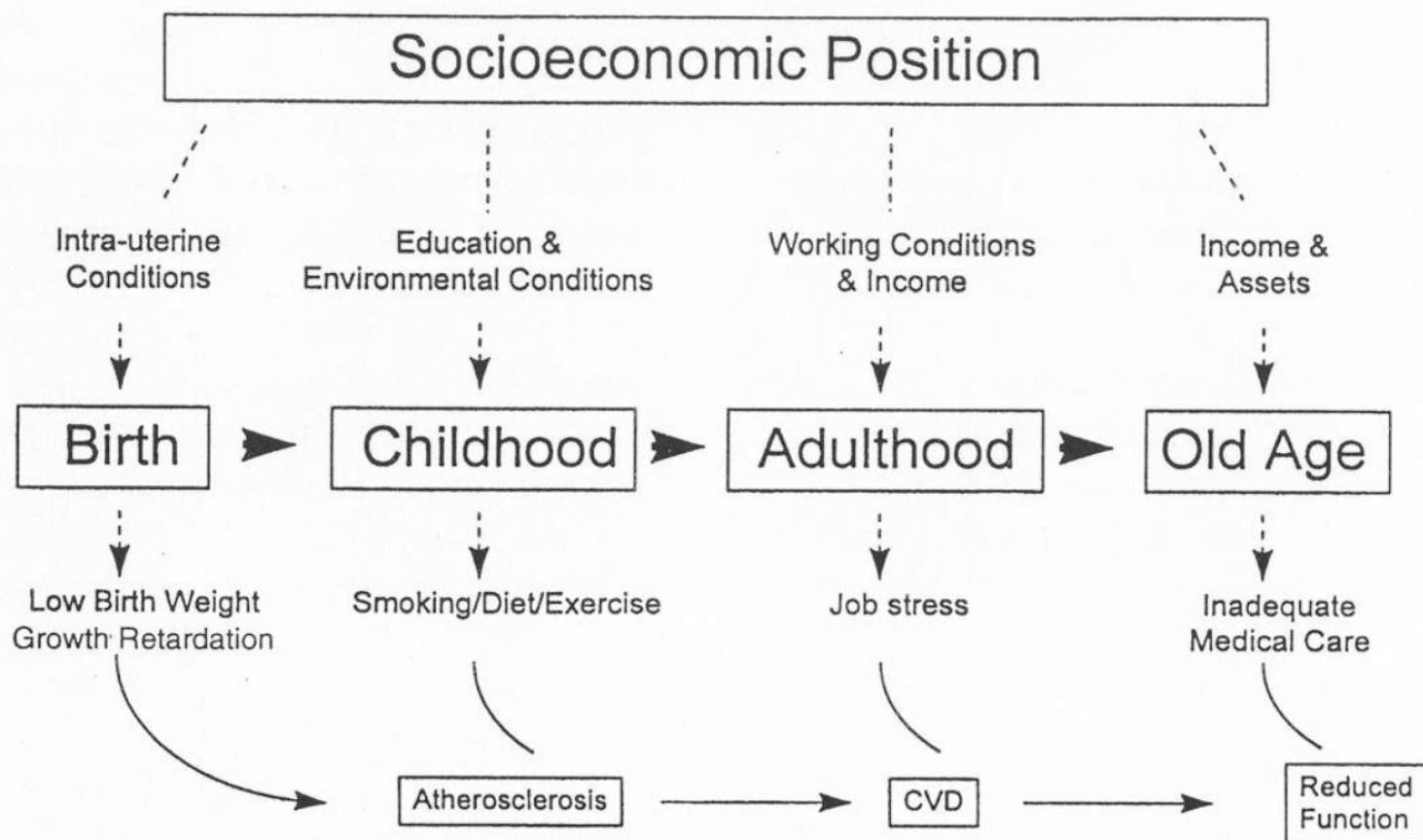


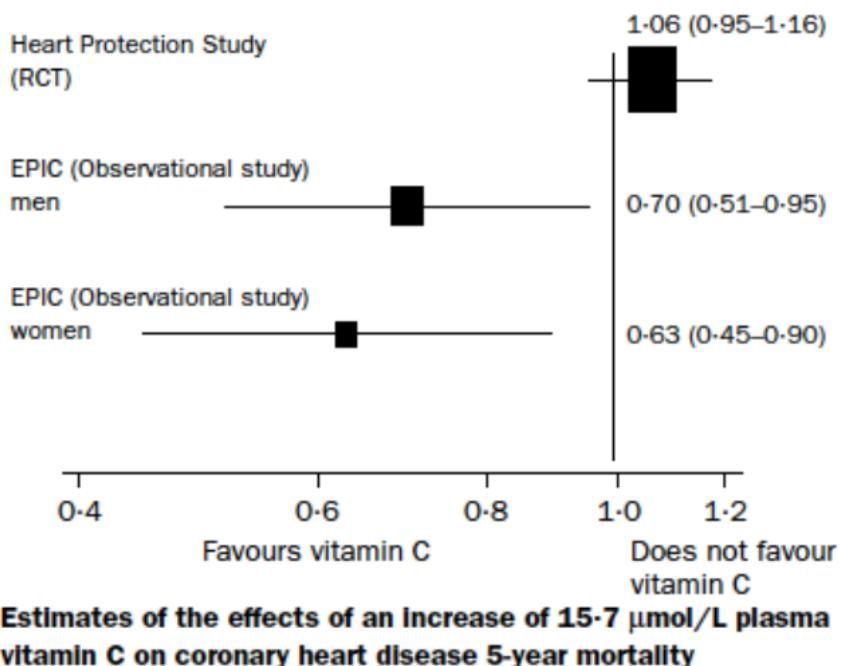
Figure 2–1. Socioeconomic influences on cardiovascular disease from a lifecourse perspective.

- Differences between RCT and observational studies
- Could residual confounding by SEP play a role?

## 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

---



- Systematic relationships between health behaviors and measures of SEP

- Across the life course
- How well can you 'adjust' for it?

|   | Vitamin C quartile (range $\mu\text{mol/L}$ ) |                           |                           |                           | Odds ratio<br>(95% CI)* | p       |  |  |
|---|---|---------------------------|---------------------------|---------------------------|-------------------------|---------|--|--|
|   | 1 (0.00–20.46)                                | 2 (20.47–39.27)           | 3 (39.28–59.64)           | 4 (59.65–190.47)          |                         |         |  |  |
| <b>Socioeconomic indicators</b>                   |   |                           |                           |                           |                         |         |  |  |
| Childhood   |   |                           |                           |                           |                         |         |  |  |
| Manual social class (%)                           | 91.6 (89.3–93.4)                              | 88.5 (86.0–90.7)          | 83.9 (81.0–86.5)          | 82.1 (79.2–84.7)          | 0.88 (0.84–0.92)        | <0.0001 |  |  |
| No bathroom in house (%)                          | 45.1 (41.7–48.4)                              | 40.7 (37.5–44.0)          | 33.7 (30.6–36.9)          | 33.4 (30.3–36.6)          | 0.92 (0.90–0.95)        | <0.0001 |  |  |
| No hot water in house (%)                         | 39.5 (36.2–42.8)                              | 37.5 (34.3–40.8)          | 31.7 (28.6–34.8)          | 29.9 (26.9–33.0)          | 0.93 (0.91–0.97)        | <0.0001 |  |  |
| Shared bedroom (%)                                | 57.6 (54.2–60.9)                              | 56.0 (52.6–59.3)          | 49.9 (46.6–53.2)          | 47.9 (44.6–51.3)          | 0.93 (0.90–0.97)        | <0.0001 |  |  |
| No car access (%)                                 | 86.5 (84.0–88.7)                              | 84.7 (82.1–87.0)          | 79.9 (77.1–82.5)          | 78.9 (76.0–81.6)          | 0.91 (0.87–0.94)        | <0.0001 |  |  |
| Completed full-time education by age 18 years (%) | 94.7 (93.0–96.0)                              | 90.2 (88.0–92.1)          | 84.1 (81.5–86.4)          | 83.4 (80.8–85.7)          | 0.82 (0.78–0.86)        | <0.0001 |  |  |
| Adult   |   |                           |                           |                           |                         |         |  |  |
| Manual social class (%)                           | 61.7 (58.2–65.0)                              | 56.1 (52.6–59.4)          | 46.0 (42.6–49.3)          | 44.7 (41.4–48.0)          | 0.88 (0.85–0.91)        | <0.0001 |  |  |
| Local authority housing (%)                       | 19.1 (16.7–21.8)                              | 11.2 (9.3–13.4)           | 10.3 (8.5–12.5)           | 8.5 (6.9–10.5)            | 0.85 (0.81–0.88)        | <0.0001 |  |  |
| No car access (%)                                 | 35.8 (32.5–39.2)                              | 27.3 (24.4–30.5)          | 22.6 (19.9–25.5)          | 22.6 (19.9–25.5)          | 0.90 (0.87–0.93)        | <0.0001 |  |  |
| State pension only (%)                            | 36.7 (33.5–40.1)                              | 28.7 (25.7–31.9)          | 22.3 (19.6–25.3)          | 24.4 (21.6–27.4)          | 0.89 (0.86–0.92)        | <0.0001 |  |  |
| <b>Behavioural and lifestyle risk factors</b>     |   |                           |                           |                           |                         |         |  |  |
| Current smoker (%)                                | 17.6 (15.3–20.2)                              | 11.5 (9.6–13.7)           | 7.5 (6.0–9.4)             | 6.4 (5.0–8.1)             | 0.81 (0.78–0.85)        | <0.0001 |  |  |
| Ex smoker (%)†                                    | 38.5 (35.1–42.0)                              | 38.5 (35.2–41.9)          | 37.0 (33.9–40.4)          | 34.9 (31.8–38.2)          | 0.97 (0.94–1.00)        | 0.05    |  |  |
| ≥1 h leisure exercise per week (%)                | 11.1 (9.3–13.3)                               | 18.0 (15.6–20.7)          | 20.5 (18.0–23.3)          | 22.9 (20.2–25.8)          | 1.14 (1.10–1.19)        | <0.0001 |  |  |
| Low-fat diet (%)                                  | 13.5 (11.4–15.8)                              | 13.9 (11.8–16.3)          | 15.9 (13.6–18.4)          | 19.7 (17.2–22.4)          | 1.08 (1.04–1.12)        | <0.0001 |  |  |
| High-fibre diet (%)                               | 2.6 (1.7–3.8)                                 | 3.9 (2.8–5.3)             | 5.5 (4.2–7.1)             | 4.8 (3.6–6.4)             | 1.10 (1.02–1.18)        | 0.01    |  |  |
| Obese: BMI >30 kg/m <sup>2</sup> (%)              | 31.5 (28.6–34.6)                              | 28.0 (25.3–31.1)          | 24.6 (21.9–27.5)          | 21.1 (18.6–23.9)          | 0.92 (0.89–0.95)        | <0.0001 |  |  |
| Daily alcohol consumption (%)                     | 10.9 (9.0–13.1)                               | 16.1 (13.8–18.6)          | 18.7 (16.3–21.3)          | 22.0 (19.5–24.9)          | 1.15 (1.10–1.19)        | <0.0001 |  |  |
| <b>Biomarkers childhood environment</b>           |   |                           |                           |                           |                         |         |  |  |
| Adult height (mm)                                 | 1581.0<br>(1577.1–1584.9)                     | 1583.3<br>(1581.4–1589.2) | 1591.4<br>(1587.5–1595.3) | 1594.3<br>(1590.4–1598.3) | 2.20<br>(1.37–3.04)‡    | <0.0001 |  |  |
| Adult leg length (mm)                             | 753.1<br>(750.4–755.8)                        | 755.4<br>(752.7–758.0)    | 758.3<br>(752.7–758.0)    | 762.6<br>(759.9–765.3)    | 1.47<br>(0.90–2.05)‡    | <0.0001 |  |  |
| Adult leg to trunk ratio %                        | 91.1 (90.7–91.4)                              | 91.1 (90.8–91.5)          | 91.2 (90.9–91.6)          | 91.8 (91.5–92.2)          | 0.10 (0.02–0.17)‡       | 0.01    |  |  |

# 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).

# Broad challenges for measuring the 'social'

## Measuring

- Importance of considering the life course.
- Social position is always contextual.
- Multiple measures almost certainly necessary.

## Interpreting effects

- Reverse causation
  - Impact of health 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...

Next Up:

Measuring the 'Inequality' in Social Inequality