Use Slopes to Track the “Fundamental Cause” of Group Disparities in Health

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International Society for Intelligence Research
Madrid, December 19, 2009
“Fundamental cause”

• The relation between social class and health is so general (cannot be explained by income, access to care, etc.) that there must be a highly generalizable “fundamental cause”
g as the “fundamental cause”

• Hypothesis:
  – group differences in g are the fundamental cause of group differences in health

• Common “disproof:”
  – “If correct...one might have expected the relation between IQ and mortality to act through known risk factors. This does not appear to be the case. In fact, a recent analysis...shows that this relationship is abolished when education and income are in the same model” (Marmot & Kivimaki, 2009)
Example: Disparities in health behavior by education; all races & sexes: % who smoke, 2006 (age adjusted)
(CDC, Health in the United States, 2008, Table 64)
Lung cancer mortality, Men 25-64, 1950-1998 by social class of county, USA
(age adjusted)

Gradients sometimes flip over

From Singh et al. 2002 Journal of the National Cancer Institute
Typical health disparities by education; in all races & sexes:
% of non-ill 51-year-olds expected to have this chronic illness by age 63
(USA, ages 51-61 in 1992; Hayward et al, 2000)
Common policy goal: All gradients flat

Race difference —hypertension

Sex difference —diabetes

Men

Women

Hypertension
Diabetes
COPD
Cancer

white
black

Years

%
“Disparity” = group differences on health outcome X

“Explaining” between-group variation

Means, rates, etc.

8 yrs  12 yrs  16 yrs
“Disparity” = group differences on health outcome X

“Explaining” between-group variation

Means, rates, etc.

8 yrs 12 yrs 16 yrs
This is **not** about **individual** differences in health

**Not “explaining” within-group variation**

Within-group and between-group variance may arise from **different** mix of causes.
Many families of health disparities

- KNOWLEDGE
- CHRONIC ILLNESSES
- ADHERENCE
- HEALTH HABITS
- INJURIES
- MORTALITY
- INFECTIOUS DISEASES
Example 1
(Erikson & Torssander, 2008)

Among all individuals ages 30-59 in 1990
So—born 1930-1960; still alive 1990
    died ~ ages 31-73 (N ~ 130,000 deaths)
Social class = occupational level (1-6)

Universal health care
Ethnically homogeneous
Whole cohort (not sample)
Uniform classification of deaths

Removes 2 common sources of variance in disparities
Reduces error variance
Broad categories of death 1991-2003, Sweden
Social class disparities among individuals ages 30-59 in 1990
(Erikson & Torssander, 2008)

<table>
<thead>
<tr>
<th>Causes (selected)</th>
<th>Men (N=80,040)</th>
<th>Women (N=49,654)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Hazards ratios by social class</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Neoplasms</td>
<td>1.1</td>
<td>1.2</td>
</tr>
<tr>
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<td>1.3</td>
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<td>1.2</td>
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<td>TOTAL</td>
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1=Higher managerial/professional, 2=lower managerial/professional, 3=intermediate, 4=lower supervisory/skilled manual, 5=routine non-manual, 6=unskilled manual
Three major causes of death 1991-2003, Sweden

Social class gradients for individuals ages 30-59 in 1990
Three major causes of death 1991-2003, Sweden
Social class gradients for individuals ages 30-59 in 1990

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<tr>
<td>Hi</td>
<td>.18</td>
</tr>
<tr>
<td>Occupational class</td>
<td>.19</td>
</tr>
<tr>
<td>Lo</td>
<td>.17</td>
</tr>
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<td>.10</td>
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Distribution of all 101 class-mortality slopes (50 men, 51 women) NOT independent (includes broad categories plus high-volume sub-categories)

Mean = .16
SD = .09

But recall population—
- Universal health care
- Ethnically homogeneous
- Cohort born 1930-1960
- Died ~ ages 31-73

Need to explain this variation (in gradients)
Distribution of class-mortality slopes

Variability in size of gradients across causes

15 broad categories of death

<table>
<thead>
<tr>
<th></th>
<th>Men:</th>
<th>Women:</th>
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<tbody>
<tr>
<td></td>
<td>0.0</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>0.2</td>
<td>0.3</td>
</tr>
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slopes
Distribution of class-mortality slopes

More variability across specific causes

35 **specific causes of death**

Men:

Women:

15 **broad categories of death**

Men:

Women:

---
slopes 0.0 0.1 0.2 0.3 0.4
Distribution of class-mortality slopes

Sex differences in class gradients

35 specific causes of death

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<td>Women:</td>
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Plot of slopes for men vs. women, broad categories of death

Hazards ratios range from 1.3 to 5.3

$r = .38$

$\star = \text{all deaths}$
Plot of slopes for men vs. women, specific categories of death (where N > 100, each sex)

Hazard ratios range from 0.9 to 6.3

$r = .86$
Class gradients: Specific neoplasms

- Neoplasms

- Women

- Men

= All neoplasms
Class gradients: Specific neoplasms

Women
- skin
- colon
- lymph
- pancreas
- rectum
- kidney
- bladder

Men
- lung, larynx
- stomach
- esophagus
- liver
- lip/oral

= All neoplasms
Women

- cervix
- breast, ovary
- skin

Men

- prostate
- lip/oral
- esophagus
- stomach
- pancreas
- lymph
- colon
- bladder
- kidney
- uterine cervix
- uterus
- other uterine

= All neoplasms
Class gradients: Specific circulatory causes

![Graph showing class gradients for specific circulatory causes](image)

- **Circulatory**
- **Women**
- **Men**

- Red star indicates all circulatory causes.
Class gradients: Specific circulatory causes

- Women
- Men

0.3
0.2
0.1
0.0
0.1
0.2
0.3
0.4

Circulatory

= All circulatory
Class gradients: Specific external causes

-0.1 0 0.1 0.2 0.3 0.4

Women

Men

= All external injuries & accidental poisoning
Class gradients: Specific external causes

- Women:
  - suicide
  - accidental poisoning
  - homicide
  - falls
  - undetermined intent
  - traffic accidents

- Men:
  - suicide
  - accidental poisoning
  - homicide
  - falls
  - undetermined intent
  - traffic accidents
Age of sample matters
Causes of death differ by age: males in USA
(CDC, Health data interactive)

Incubating cause ("internal")

Sudden cause ("external")

<table>
<thead>
<tr>
<th>Age Group</th>
<th>2003-2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-17</td>
<td></td>
<td></td>
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<tr>
<td>18-24</td>
<td></td>
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<tr>
<td>25-44</td>
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<tr>
<td>45-54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55-64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65+</td>
<td></td>
<td></td>
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</table>

Swedish sample

Illness  
Suicide  
Homicide  
"Accidents"
Specific causes in other broad categories
(digestive, endocrine, mental, respiratory)
Most frequent specific internal causes of death:
All are “entirely preventable” by patient (Eurostat report)
Example 2
(Gottfredson, 2004)

Mortality in US, 1980-1986
All ages
External causes only
Social class = neighborhood income level (1-6)

Differential access to health care
Ethnically diverse
Class-mortality gradients, for 55 specific external causes, US population, 1980-1986

classes = 6 levels of neighborhood income

Mean = .12
SD = .20

classes = 6 levels of neighborhood income

<table>
<thead>
<tr>
<th>Category</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suicide</td>
<td>-.15</td>
</tr>
<tr>
<td>Drugs, alcohol, poisons</td>
<td>-.04</td>
</tr>
<tr>
<td>Falls</td>
<td>.02</td>
</tr>
<tr>
<td>Elderly</td>
<td>.12</td>
</tr>
<tr>
<td>Homicide</td>
<td>.10</td>
</tr>
<tr>
<td>Undetermined intent: firearm, poison</td>
<td>.15</td>
</tr>
<tr>
<td>Vehicles/pedestrian, drowning</td>
<td>.30</td>
</tr>
<tr>
<td>Burns, cold, choke, neglect, firearm</td>
<td>.29</td>
</tr>
<tr>
<td>Cut, crushed, machines, electric</td>
<td></td>
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</table>
classes = 6 levels of neighborhood income

<table>
<thead>
<tr>
<th>External Cause</th>
<th>F, M = Swedish mean slopes</th>
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<tbody>
<tr>
<td>Suicide</td>
<td>-0.15</td>
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Changes in:

Options & information:
- preventability (don’t smoke)
- detection (pap smear)
- controllability (diet, insulin)

Population composition:
- age
- cohort
- ethnicity

Source of hypotheses I:
Migration of slopes over time and cohorts

Meta-analysis of slopes
Source of hypotheses II: 
*g* theory + epidemiological perspective

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Distribution of:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host exposure</td>
<td>Passive</td>
</tr>
<tr>
<td>(hazards)</td>
<td>Active</td>
</tr>
<tr>
<td>Host susceptibility</td>
<td>Biological</td>
</tr>
<tr>
<td></td>
<td>Cognitive</td>
</tr>
<tr>
<td>Vector burden</td>
<td>Biological</td>
</tr>
<tr>
<td>(virulence)</td>
<td>Cognitive</td>
</tr>
<tr>
<td>Statistical artifacts</td>
<td>Sampling error</td>
</tr>
<tr>
<td></td>
<td>Measurement error</td>
</tr>
<tr>
<td></td>
<td>Restriction in range</td>
</tr>
</tbody>
</table>

*Note: The table highlights active and passive components in the context of host exposure and susceptibility, along with biological and cognitive factors influencing the distribution of host susceptibility and vector burden.*
Thank you