The Functional Form of the Relationship between Educational Attainment and Adult All-Cause Mortality Risk

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Why is the question important?

- Adults with more education live longer and healthier lives than those with less[1]

- The gap in mortality risk between education levels grew over the 20th century[2]

- Explaining WHY the association exists requires that we can empirically describe it

Data

Theory

[1]Kitagawa & Hauser; Elo & Preston 1996; Rogers et al 2000; Crimmins, et al1996; Backlund et al 1999
[2]Preston & Elo 1995; Feldman et al 1989; Lauderdale 2001; Pappas et al 1993; Crimmins & Saito 2001

Two main theoretical explanations

Human Capital (e.g., Mirowsky and Ross 2003; Becker 1993)

• Each and every year of education lowers mortality risk by enhancing cognitive function, problem solving skills, labor market skills, health behaviors, a sense of control, social ties, et cetera

• Supporting data: linear decline in mortality risk

Credentialism (e.g., Collins 1979)

•Education has no inherent value. It is associated with mortality risk simply because educational credentials are symbolic tokens that open access to social opportunities

• Supporting data: step-change reductions in mortality risk

Neither theory has unequivocal support

Could the association be a hybrid of the two theories?

Does the association vary by gender, race, and/or age?

Most extensive study to date: Backlund et al 1999
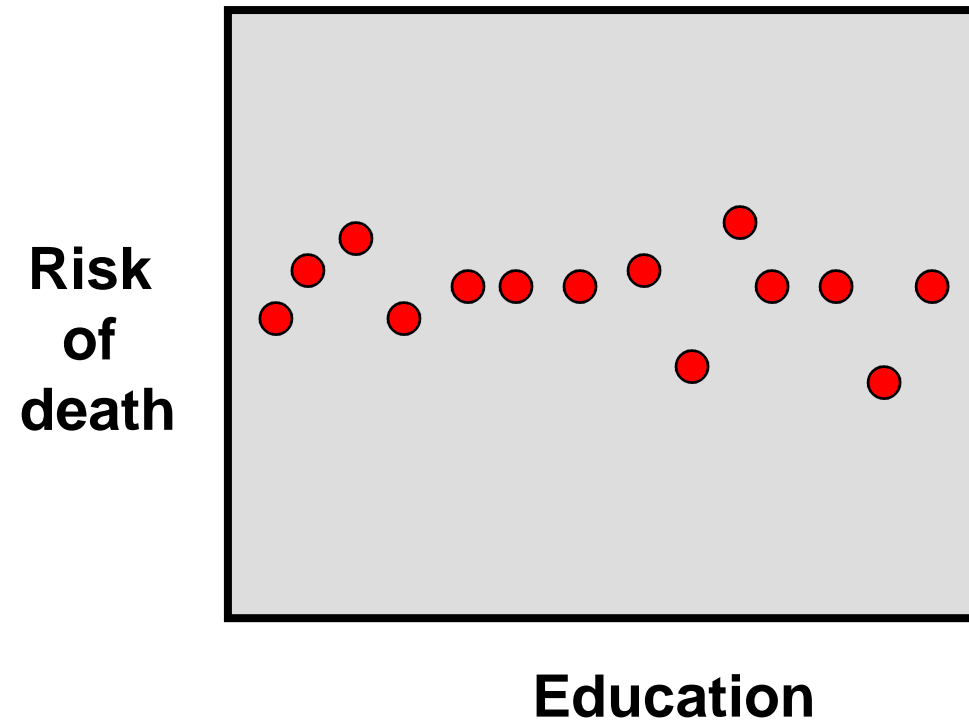
→ tested 4 forms among working age adults

Research Questions

Among a broad set of 13 functional forms…

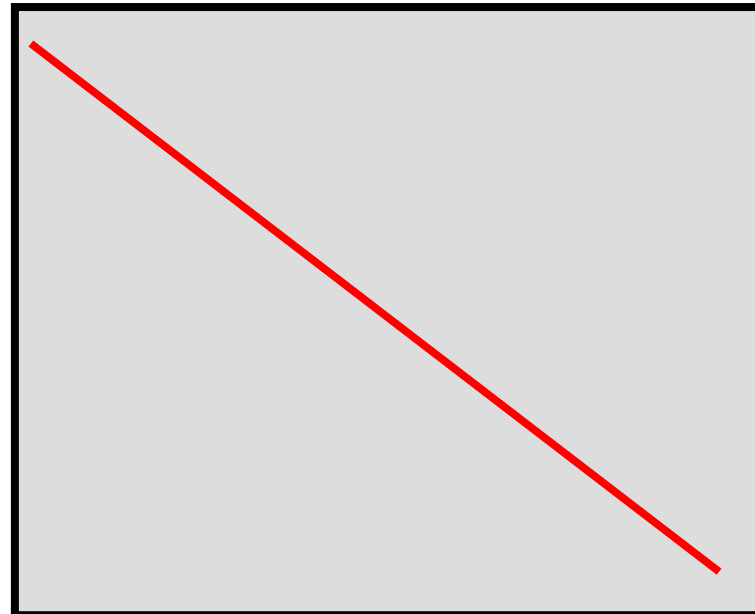Which form(s) best describes the association between education and all-cause mortality for…

- men?

- women?

- race-gender-age subgroups?
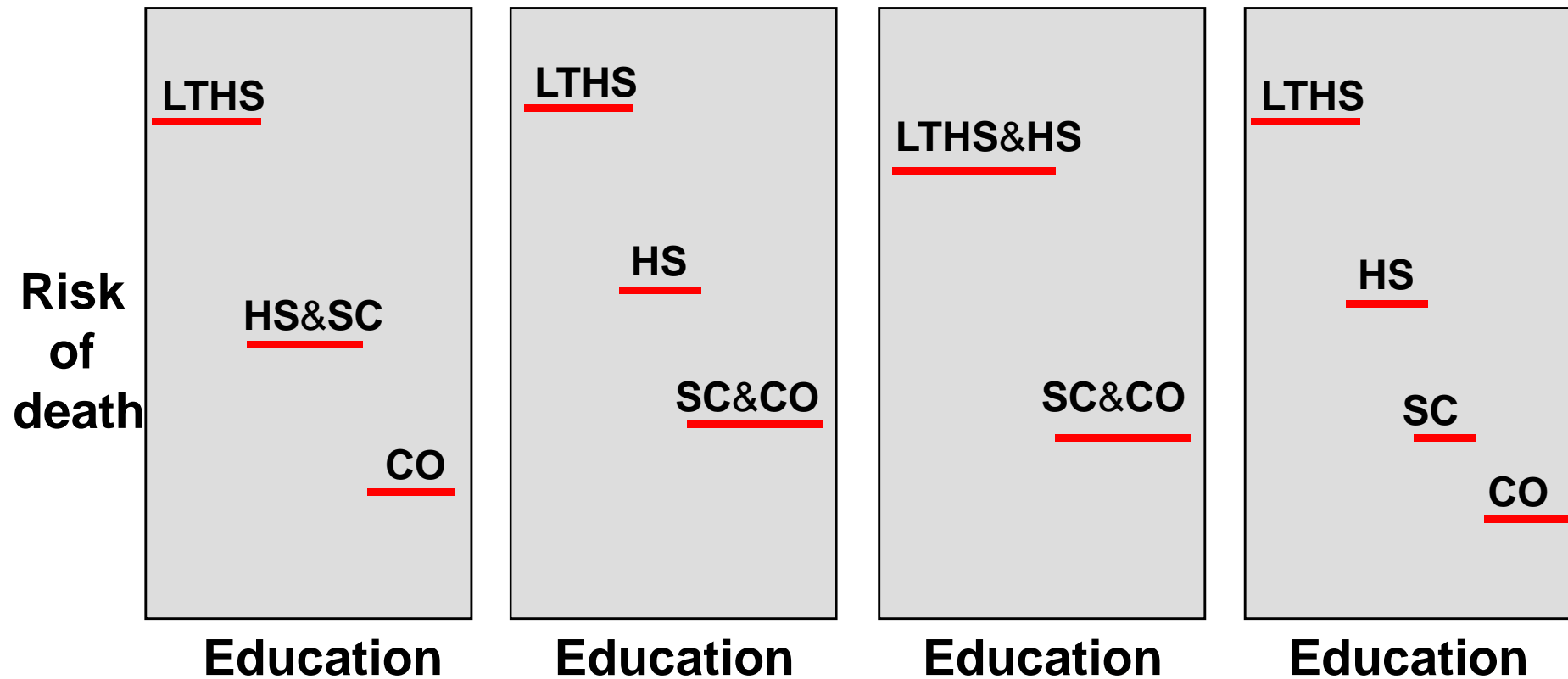
Form 1: Non-parametric

Form 2: Linear

Risk of death vs. Education (linear decreasing relationship)

Ross & Mirowsky 1999
Zajacova 2006

Forms 3-6: Step-changes with Zero Slopes

Risk of death

LTHS
HS&SC
CO
Education

LTHS
HS
SC&CO
Education

LTHS&HS
SC&CO
Education

LTHS
HS
SC
CO
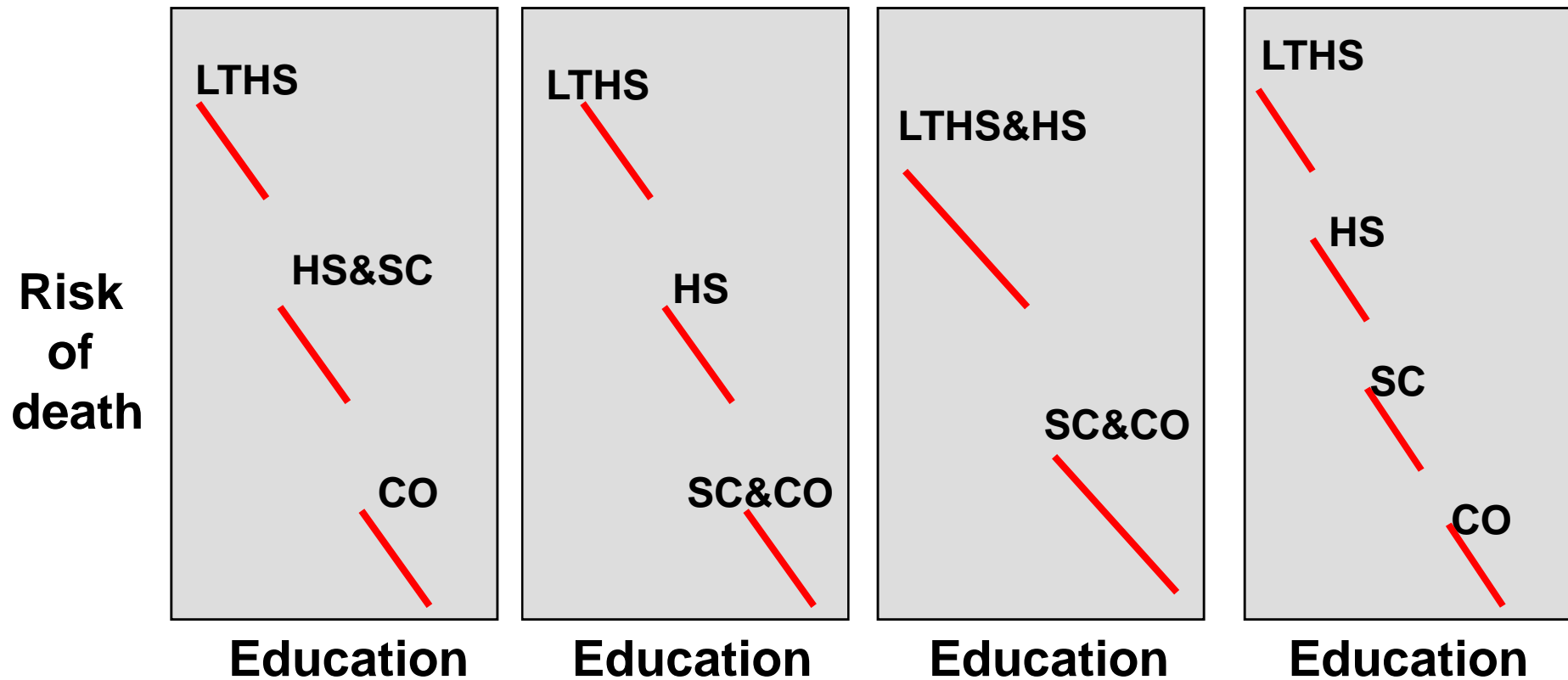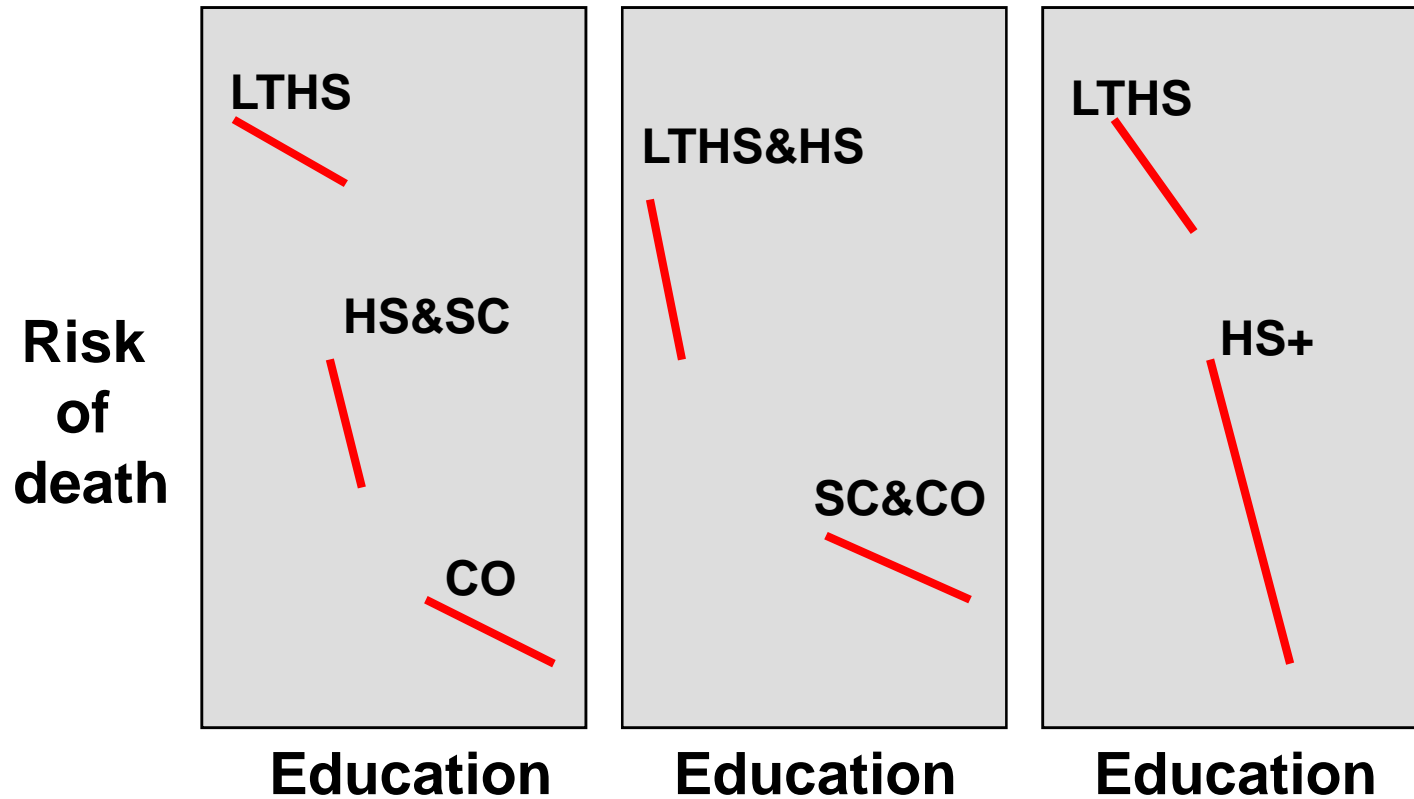Education

Backlund et al 1999; Collins 1979

Forms 7-10: Step-changes with Constant Slopes

Forms 11-13: Step-changes with Varying Slopes

Data and Sample

<u>Data</u>

- National Longitudinal Mortality Study (NLMS)

  - Links adults in the 1979-1998 Current Population Surveys with death records in the National Death Index through 2001

- Contains ~3 million adults and ~250,000 deaths

<u>Sample</u>

- Non-Hispanic white & black adults 25-97 years at survey

- Contains 1,008,215 adults and 164,289 deaths

10 Demographic Subgroups

Two large groups:

1. Non-Hispanic white and black males 25+

2. Non-Hispanic white and black females 25+

Eight subgroups defined by race x gender x age

3. NHW	men	25-64
4. NHW	men	65+
5. NHW	women	25-64
......		
9. NHB	women	25-64
10. NHB	women	65+

Methods

1. Create a person year file

2. For each of 10 demographic subgroups, estimate:

$$\ln[p/(1-p)] = \beta_0 + \beta_1 \text{age} + \beta_2 \text{race} + \beta_3 \text{education}$$

Form 1: …+ $\beta_3 x_0 + \beta_4 x_1 + \beta_5 x_2$ … + $\beta_{22} x_{19}$

Form 2: …+ $\beta_3(\text{ed})$

…

Form 13: …+ $\beta_3(\text{ed}) + \beta_4(\text{lths}) + \beta_5(\text{ed} \times \text{lths})$

3. For each subgroup, select the form with smallest BIC

Results

Subgroup 1: All men 25+

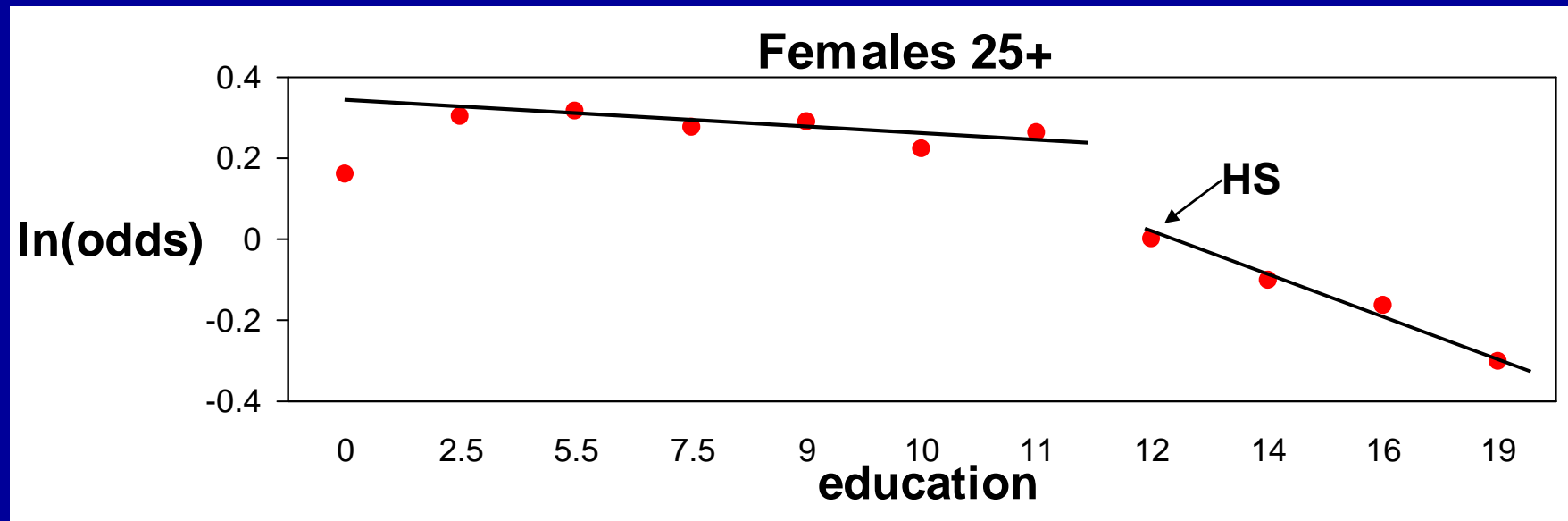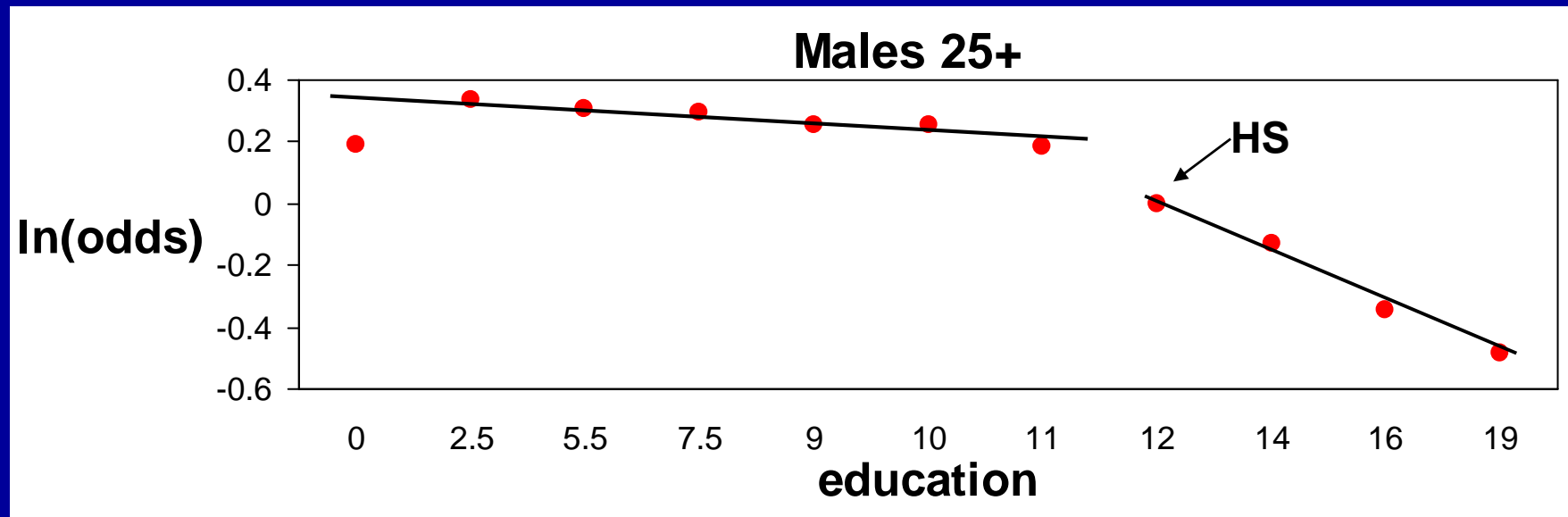→ **Step-changes with varying slopes**

Subgroup 2: All women 25+:

→ **Step-changes with varying slopes**

Optimal functional form:

$\ln[p/(1-p)] = \beta_0 + \beta_1 \text{age} + \beta_2 \text{race} + \beta_3 \text{ed} + \beta_4 \text{lths} + \beta_5 (\text{ed} \times \text{lths})$
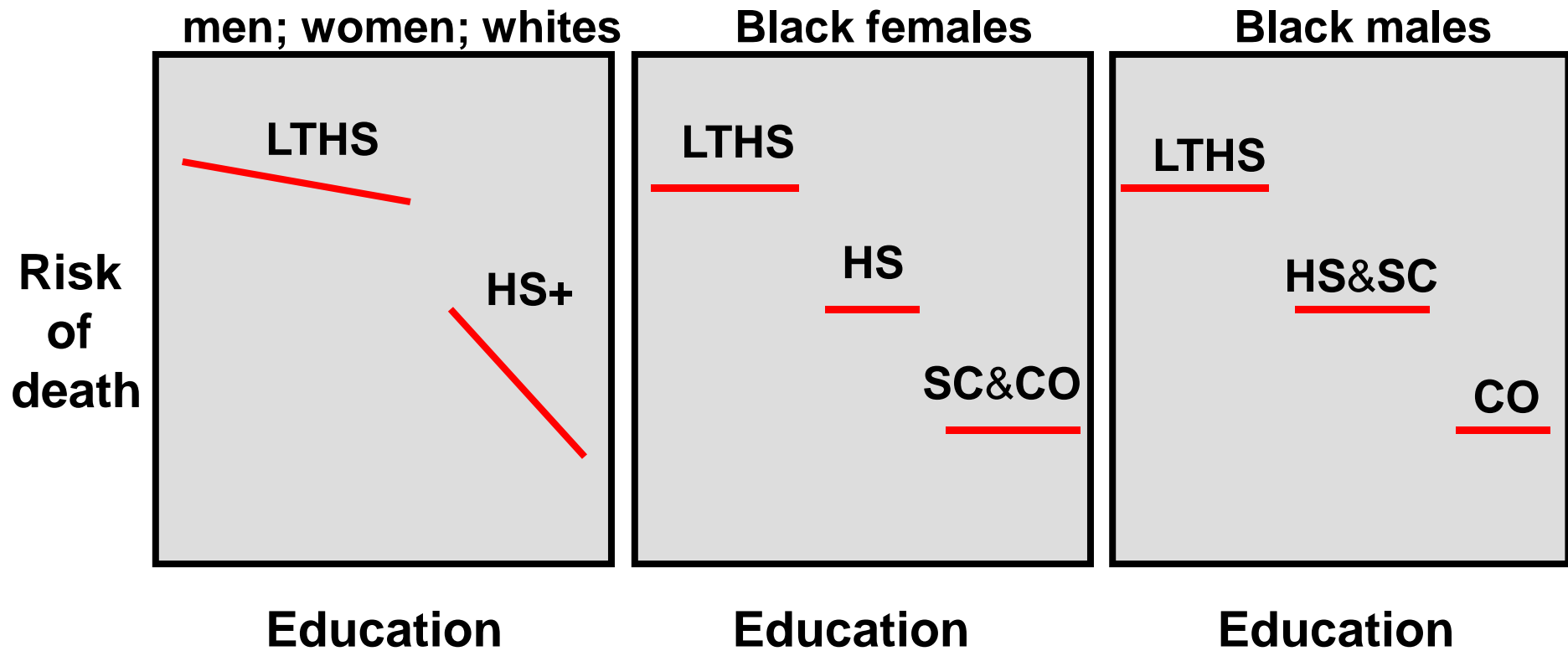
Optimal form for all men and all women

Males 25+

In(odds)

HS

education

Females 25+

In(odds)

HS

education

Results

Subgroups 3-6:

→ **White adults (men, women) x (25-64, 65+)**

→ **Step-changes with varying slopes**

Subgroups 7-10:

→ **Black adults (men, women) x (25-64, 65+)**

→ **Step changes with zero slopes**

→ **Step-changes with varying slopes is close alternative**

The Optimal Form by Subgroup

Conclusions

- For men overall, for women overall, and for whites…..

  - Hybrid of human capital & credential explanations

  - Given the different slopes, the mediators prior to a HS diploma may be different from those afterwards

- For black adults…

  - Credential explanations received strongest support, although the form that was selected for whites was a close alternative

Next Steps

- Identify mediators of the "optimal" functional forms

  - Need dataset that contains labor market outcomes, health behaviors, psychosocial resources, biological indicators, et cetera

- Why do black adults not reduce mortality risks (as much as whites) in between credentials?

  - Quality of schools? Labor market discrimination?

- Examine cause-specific mortality

Thank you

Methods

For each of the 10 subgroups, the optimal functional form is the form with the smallest value for the Bayesian Information Criterion (BIC)

$$BIC = -1 \times [-2LL_0 - (-2LL_1)] + [(\text{number of } \beta_i) \times \ln(N)]$$

$-2LL_0$ reflects the deviance of intercept-only model

$-2LL_1$ reflects the deviance of the estimated model