Childhood Nutritional Deprivation and Cognitive Aging Among Older Chinese

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Why Should Childhood Nutrition Influence Cognitive Aging Decades Later?

- Negative effects of nutritional deprivation in infancy and childhood associated with children's cognitive development
  - Little evidence linking childhood nutritional deprivation with cognitive aging
- Most research has focused on childhood nutritional deprivation's effects on other degenerative health conditions
  - Diabetes-II
  - CVD

Possible Pathways by which Nutritional Deprivation Affects Cognitive Aging (1)
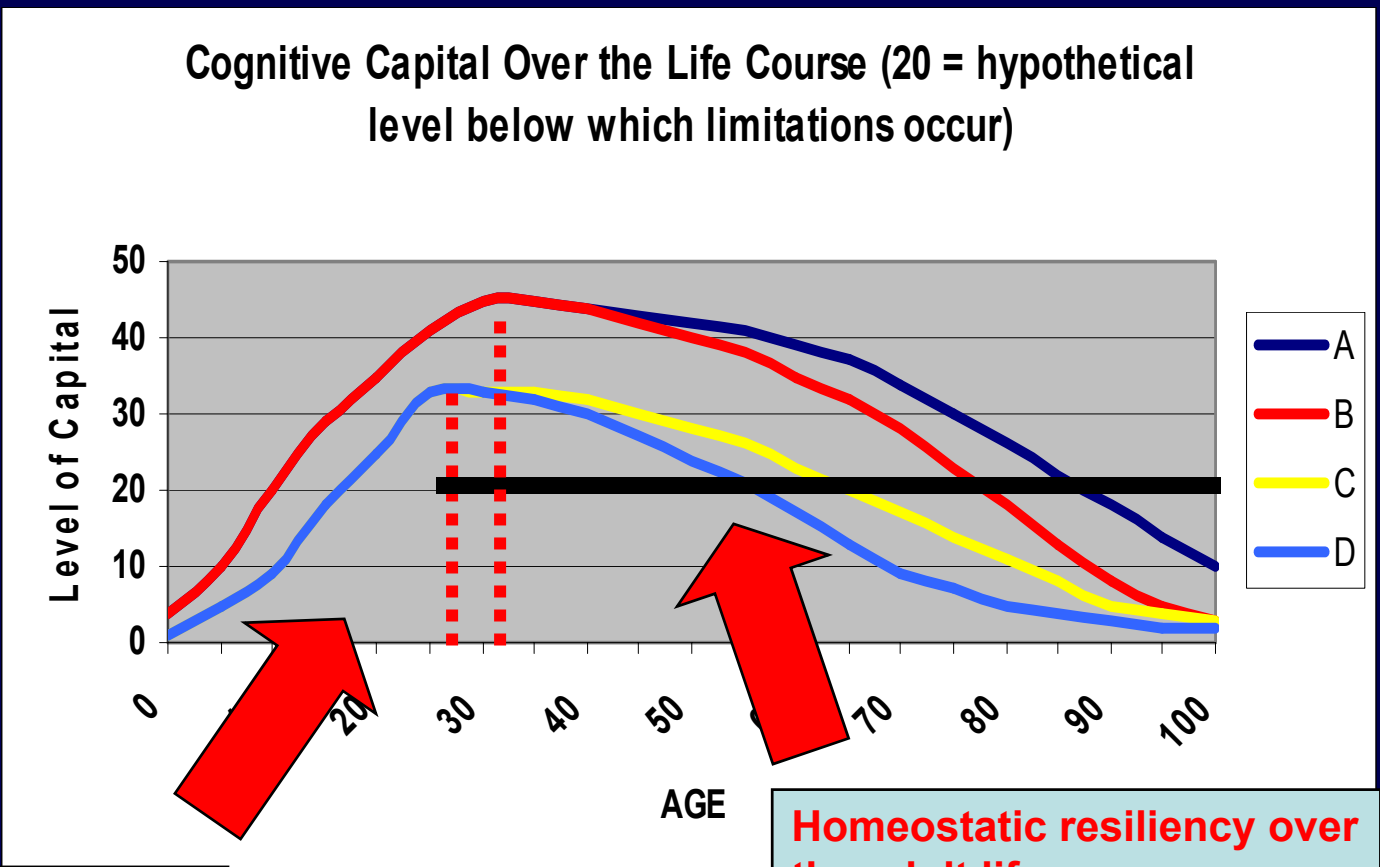
- Impaired brain development and less efficient brain function because of less development of:
  - Myelin
  - Dendrite branching
  - Connectivity patterns
- Brain, however, may still function normally
- Negative effects of impaired brain development may be small until aggravated by aging

Possible Pathways by which Nutritional Deprivation Affects Cognitive Aging (2)

- Malnourishment may also reduce energy & motor skills to learn in school
  - Fewer years of schooling
  - Poorer academic achievement
  - Possible negative consequences for adult achievement and exposure to adverse occupational conditions (e.g., lack of creative work) that would accelerate cognitive aging
- Malnutrition is also related to physical degenerative conditions which influence cognitive impairment (e.g., hypertension, stroke, heart disease, diabetes)
  - Barker Hypothesis

Determinants of Cognitive Impairment (e.g., occupation, disease, genes)

Determinants of Cognitive Development (e.g., nutrition, education, family resources, genes)

Cognitive Capital Over the Life Course (20 = hypothetical level below which limitations occur)

Level of Capital

AGE

A
B
C
D

Developmental phase of human life course

Homeostatic resiliency over the adult life course

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Adapted from Kuh (2007)

Contributions of our Study

- We evaluate key associations at the population level
  - Prior studies limited to small regional and clinical samples
- This is the first study to evaluate key associations for a non-Western, developing country where early life conditions were much worse and more prevalent than those in developed countries
- We use anthropometry as well as self-reports of hunger in childhood as markers of childhood nutritional deprivation

Data Set and Sample Characteristics (1)

- 3rd Wave of Chinese Longitudinal Healthy Longevity Survey
  - Representative of ~85% of total Chinese population
  - CLHLS specially designed with age matching, oversampling of oldest-old males, and institutionalized persons

Data Set and Sample Characteristics (2)

- Age range 65-105 in 2002 (N = 15,798)
  - 4,845 aged 65-79
  - 4,239 aged 80-89
  - 3,747 aged 90-99
  - 2,967 aged 100-105
  - Persons reporting being aged 106 or older were excluded because of inability to validate age report

Measuring Cognitive Function in the CLHLS (1)

- Chinese version of MMSE
- MMSE tests 4 aspects of cognitive function
  - Orientation, calculation, recall, and language
- Chinese version tries to meet cultural and SES conditions among older Chinese & to make questions easily understandable & answerable among Rs whose cognitive function is normal
  - E.g., Rs were asked to name as many foods as possible instead of write a sentence which is an impossible task since majority are illiterate

Measuring Cognitive Function in the CLHLS (1)

- 3 response categories: correct, wrong & unable to answer
- ~2% unable to answer due to cognitive problems indicated by interviewer (scored as MMSE=0)
- ~2% unable to answer any question & ~8% unable to answer some questions due to hearing, illness, or other reasons
  - Used 1) multiple imputation, 2) exclusion of missing data, & 3) unable = incorrect to assess sensitivity of results and all approaches yielded almost identical results (we thus use the 3rd approach in the analysis)
- MMSE (max 30, min 0), reliability -- Cronbach α = .98
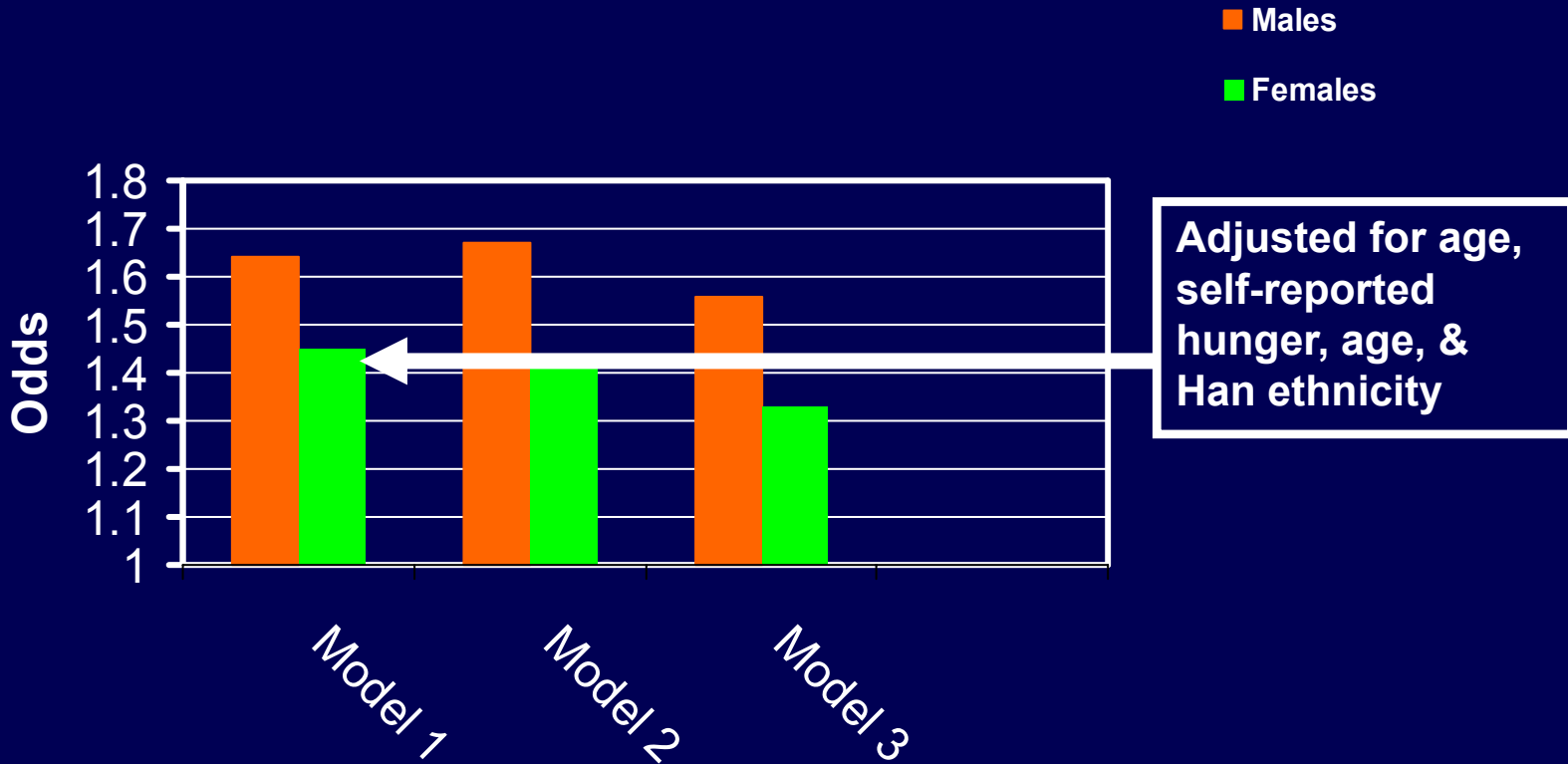- Cognitively impaired is MMSE < 18; results insensitive to cutoff point (e.g., 24)

Measuring Childhood Nutritional Deprivation

- Anthropometry (in home measurement)
  - Arm length (right arm; more sensitive measure of earlier stature than adult height)
  - Knee height (frequently used in epidemiological studies, e.g., BWHHS)
- Self report of "frequently went to bed hungry in childhood" (yes/no)
- Research suggests that anthropometric measures capture initial growth in very early childhood while self reports reference malnutrition affecting growth in later childhood
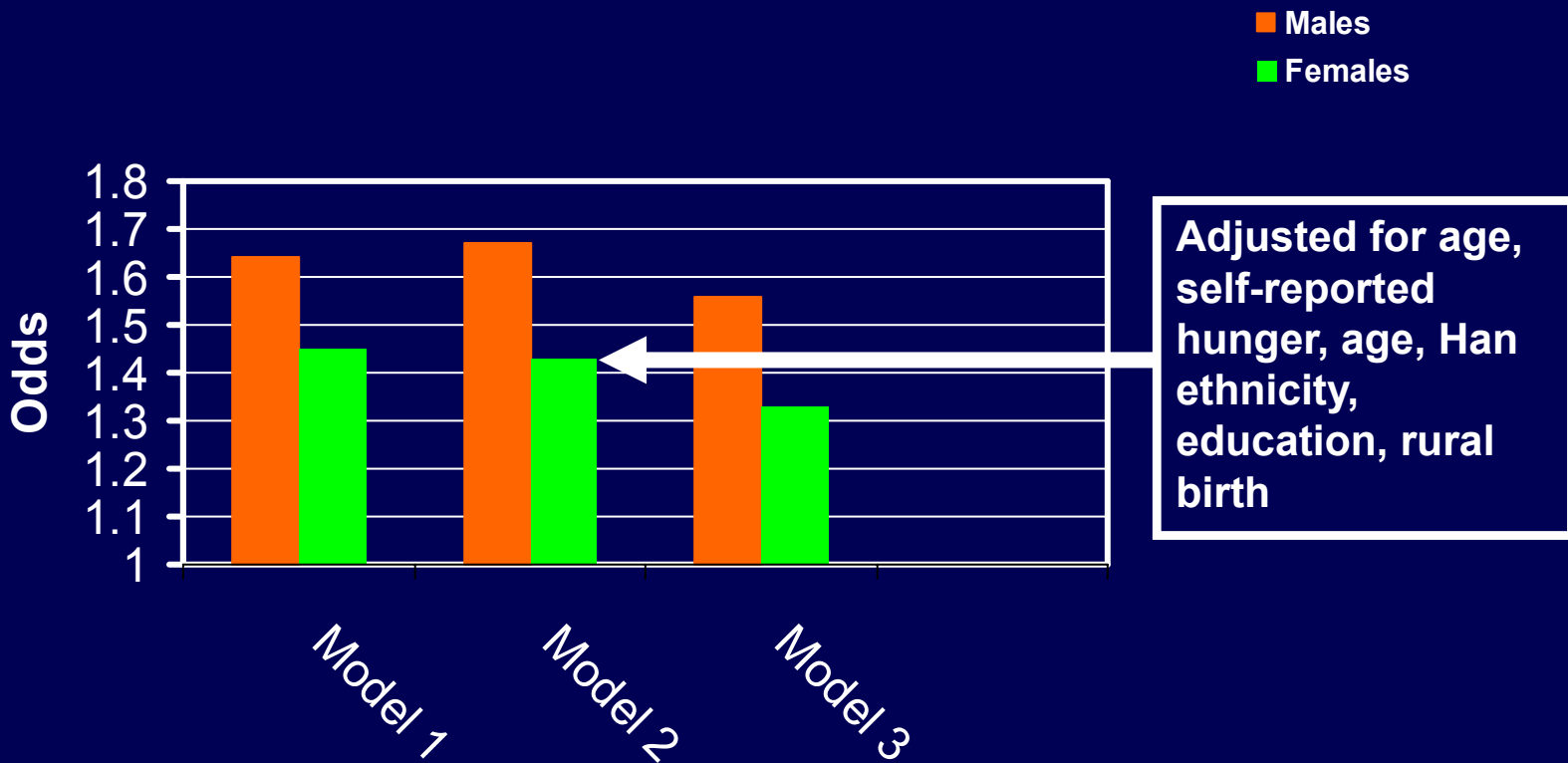
Other Key Measures

- Childhood SES
  - Rural birth (disadvantage)
  - Education (had schooling vs no schooling)
- R's or spouse's occupation before age 60
  - Professional/administrative vs other
- Disease risk (hypertension, cerebra-vascular disease, heart disease, diabetes, & stroke)
- ADL disabled (cannot perform 1 or more ADLS)

Childhood Nutritional Deprivation and Odds of Cognitive Impairment, CLHLS 2002

Legend: ■ Males ■ Females

Y-axis: Odds (1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8)

X-axis: Model 1, Model 2, Model 3

Callout: Adjusted for age, self-reported hunger, age, & Han ethnicity
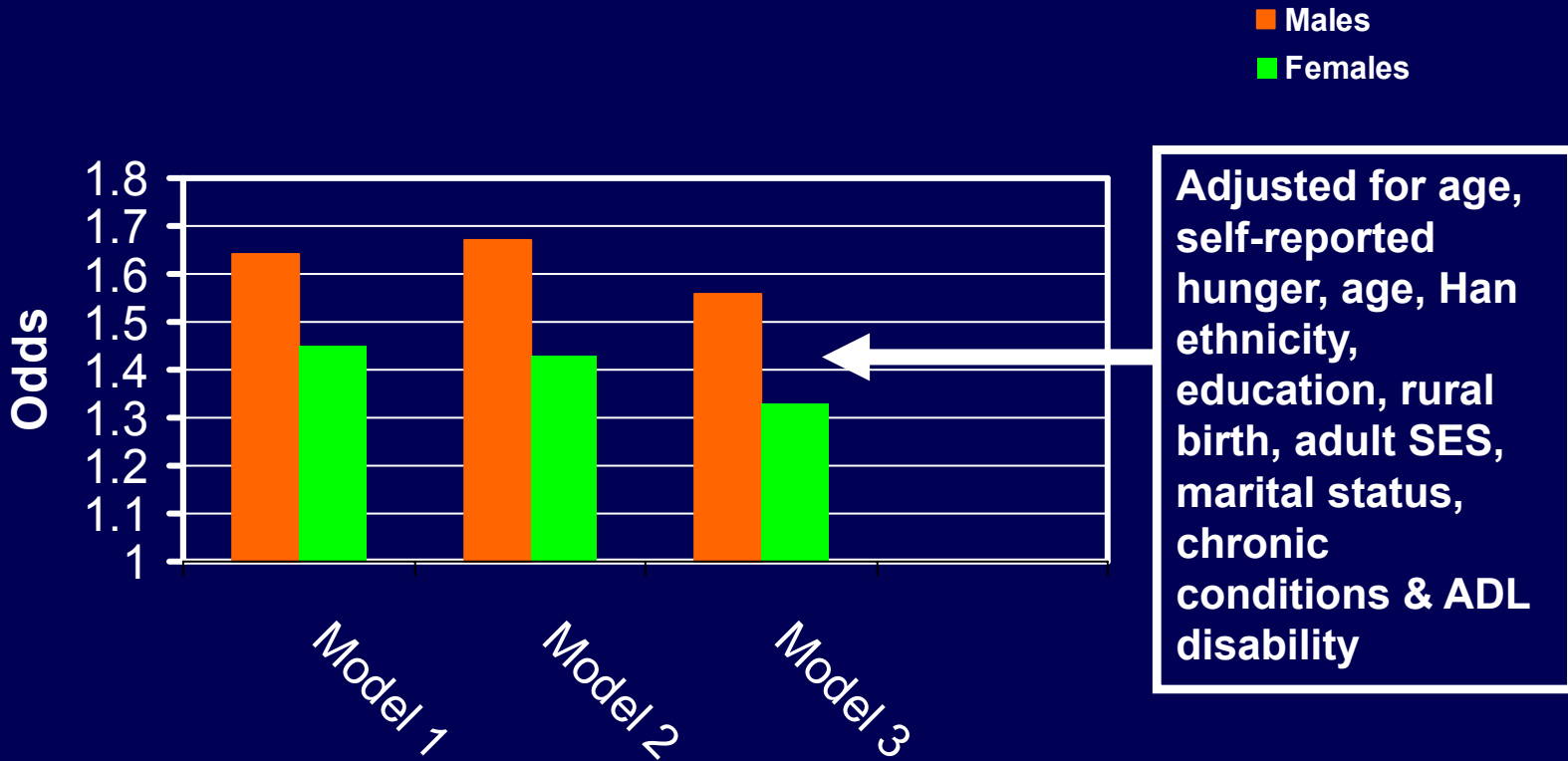
Nutritional deprivation is defined as arm length in the bottom 10th percentile (gender-specific).
Source: Zhang, Gu & Hayward (in progress)

Childhood Nutritional Deprivation and Odds of Cognitive Impairment, Chinese Longitudinal Healthy Longevity Survey 2002


Males
Females

Adjusted for age, self-reported hunger, age, Han ethnicity, education, rural birth

Nutritional deprivation is defined as arm length in the bottom 10th percentile (gender-specific).
Source: Zhang, Gu & Hayward (in progress)

Childhood Nutritional Deprivation and Odds of Cognitive Impairment, Chinese Longitudinal Healthy Longevity Survey 2002
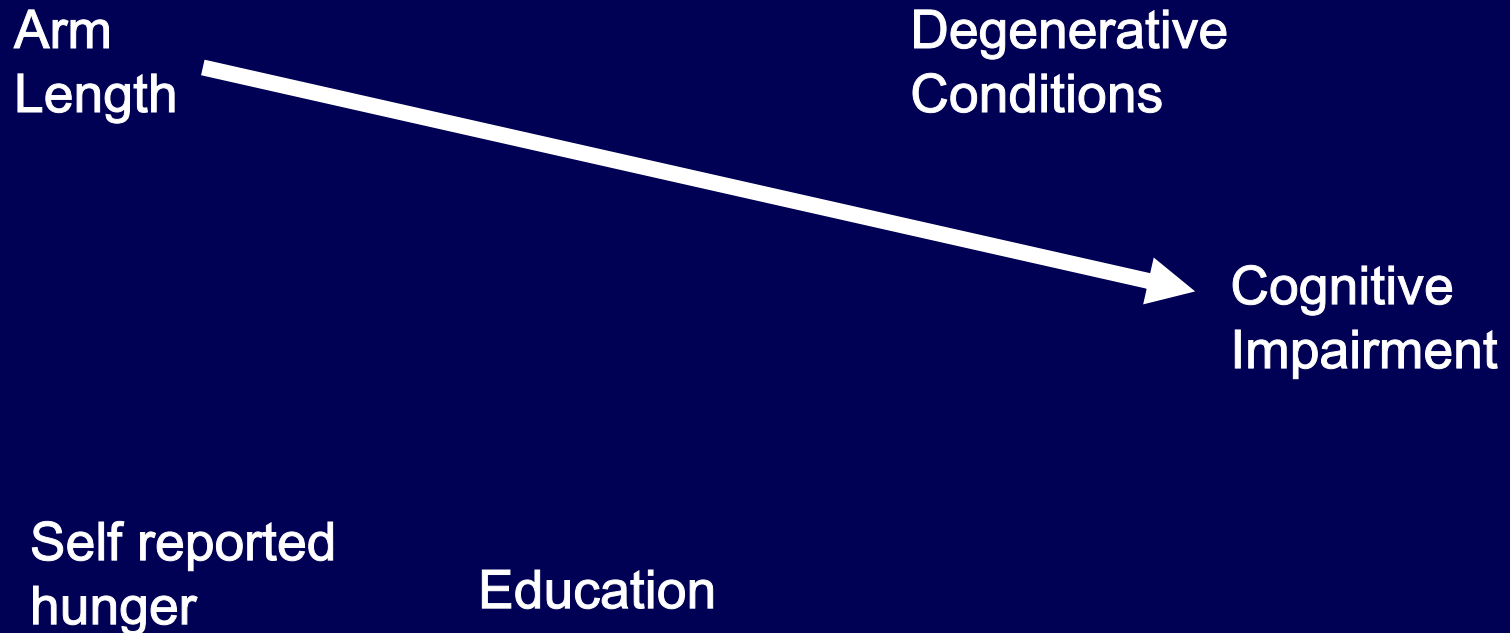

Males
Females

Adjusted for age, self-reported hunger, age, Han ethnicity, education, rural birth, adult SES, marital status, chronic conditions & ADL disability

Nutritional deprivation is defined as arm length in the bottom 10th percentile (gender-specific).
Source: Zhang, Gu & Hayward (in progress)

Pathways Connecting Childhood Nutritional Deprivation with Cognitive Impairment
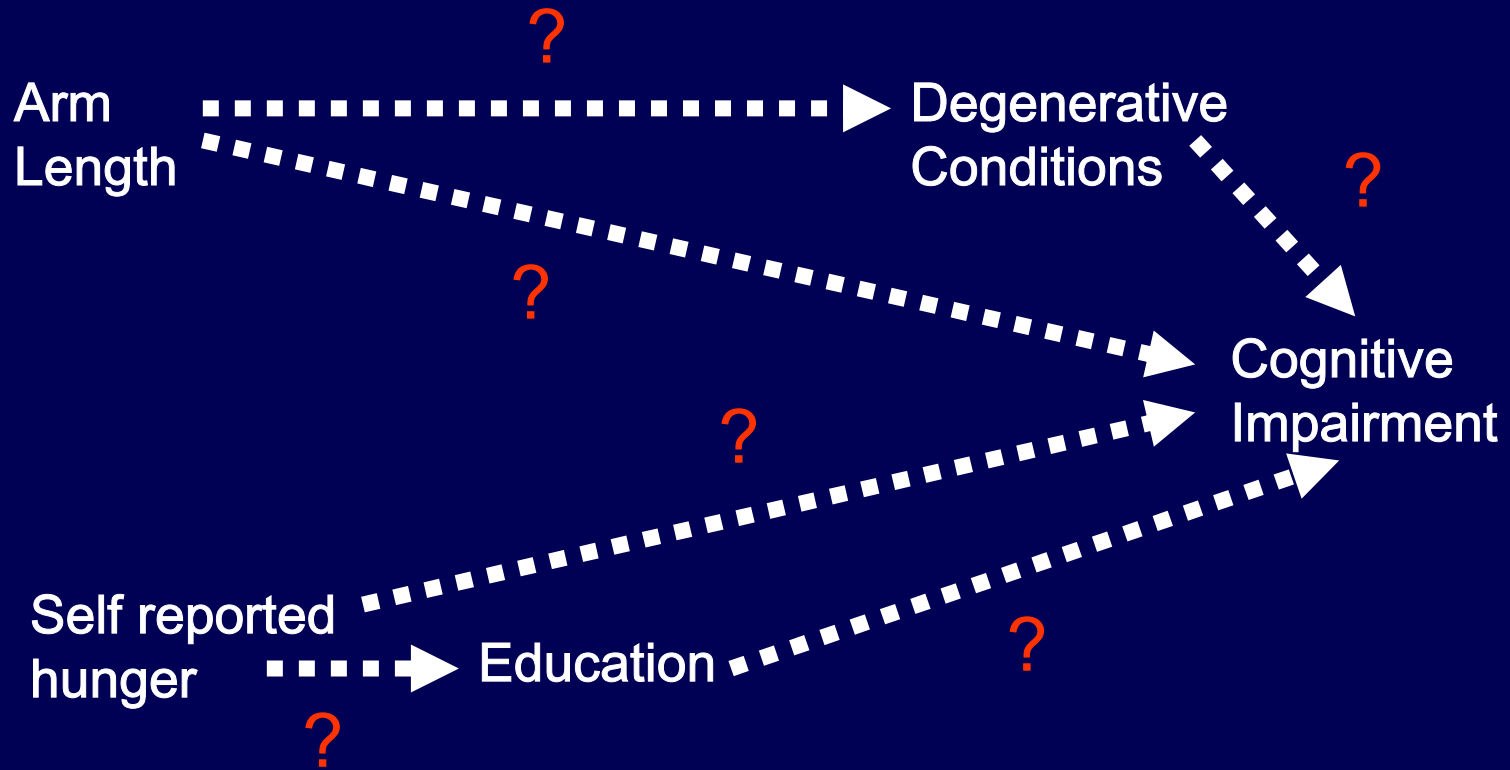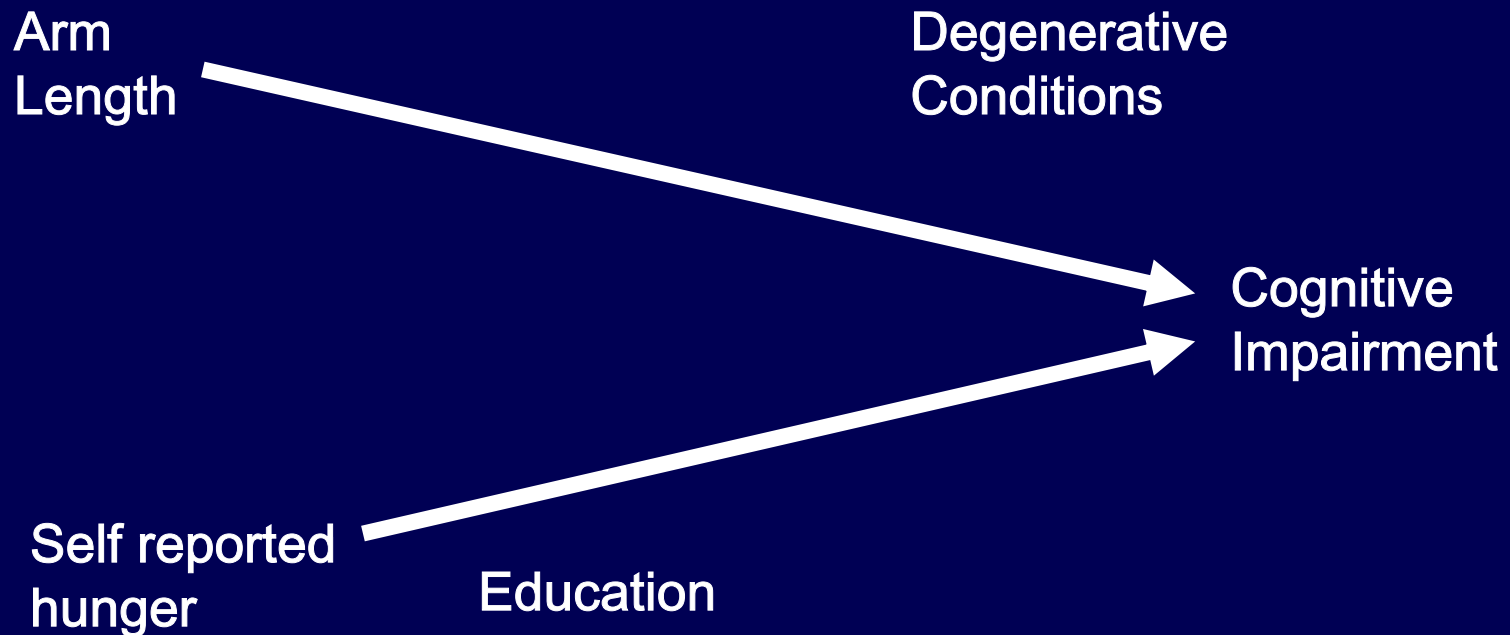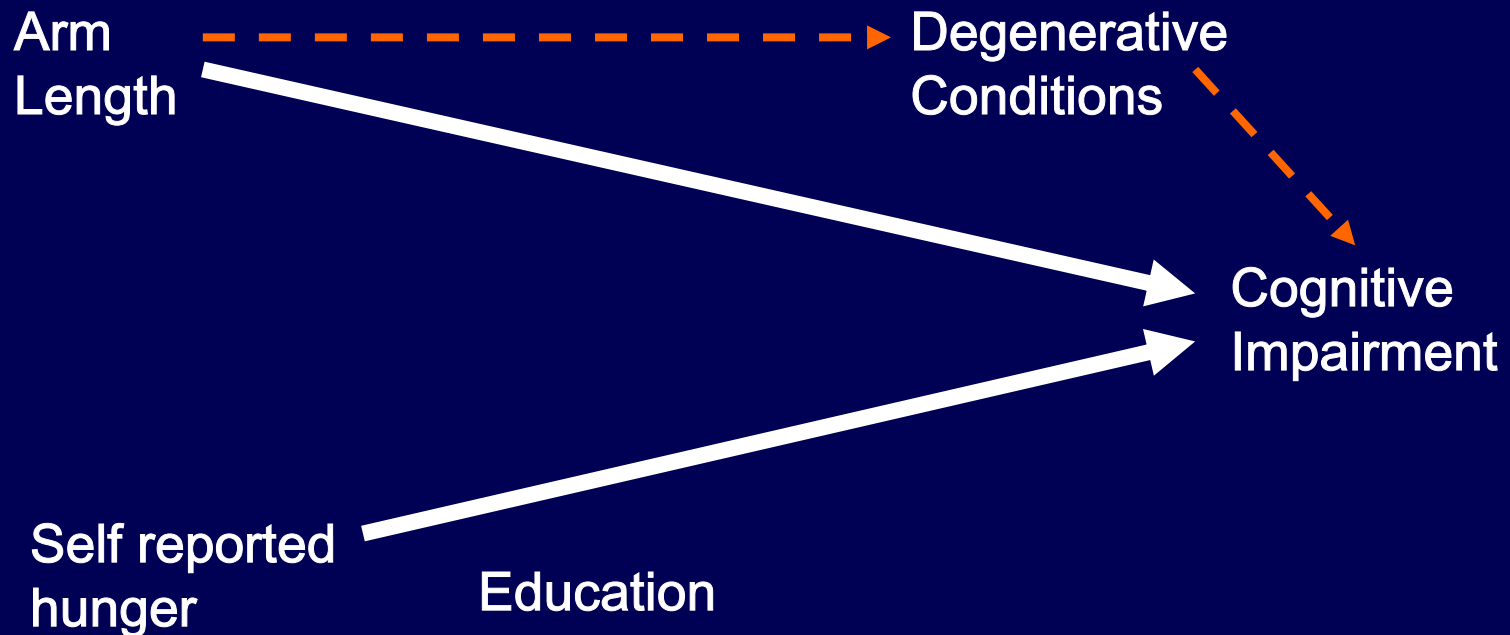
Arm Length

Degenerative Conditions

Cognitive Impairment

Self reported hunger

Education

Pathways Connecting Childhood Nutritional Deprivation with Cognitive Impairment

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Education

Effects of Self Reported Hungry Parallel Results for Arm Length

- However…
  - Associations for self reported hunger are more sensitive to controlling for education
  - Associations for arm length are more sensitive to controlling for disease conditions
  - Suggests that arm length may reference growth from early in childhood while self reported hunger taps into nutritional deprivation later in childhood
- Still – effects of all measures are robust when controlling for childhood and adult social conditions
- Nutritional deprivation throughout childhood appears to play a fundamental role influencing early life cognitive development – and ultimately cognitive aging decades later.

Some Thoughts About Limitations

- We lack information about infectious diseases which were rampant in China early in the 20th Century

  - Infectious diseases may affect stature (Crimmins and Finch)

- MMSE is only a screening measure of impairment

- Potential recall bias in self reports of hunger – but bias should be in a conservative direction

Conclusions and Implications

- Our results confirm prior research based on small samples and from studies in developed nations
- Both arm length and self reported hunger are robust and stable predictors of cognitive impairment
- Part of effect of nutritional deprivation is indirect
  - Biomedical pathway via physical degenerative conditions
  - Socio-biomedical pathway via education
- Origins of cognitive impairment free life expectancy are partially rooted in early life nutritional deprivation

Thanks!

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