Effects of Head Start on Children’s Outcomes: Evidence from a Propensity Score Matching Approach

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Outline of the Talk

 gì What are the short-term effects of Head Start on school readiness?
 gì What are the long-term effects of Head Start from K to 5th grade?
 gì What are the impacts of classroom-based interventions that improve the quality of Head Start programs?
Head Start

- Largest publicly financed early education program in U.S.
  - Launched in 1965 as part of the War on Poverty
  - Target population: 3- and 4-year olds in low-income families
  - Comprehensive & high-quality services

- Improve school & home environments:
  - HS classrooms: significantly higher quality than other centers
  - HS teachers: less harsh and more sensitive
  - HS homes: overall better quality of home environment
  - HS parents: more supportive, read to children more, less detached

- Expect significant beneficial effects on participants:
  - Theories in neuroscience, developmental psychology, & economics
  - Short- and long-term benefits
Effects of Head Start in Prior Studies

Early studies found negative or no effects

Recent well-designed studies:
- Sibling comparison or mother-fixed effects: Currie & Thomas (1995, 1999); Garces, Thomas, & Currie (2002)
- Regression discontinuity: Ludwig & Miller (2007)
- Randomized experiments: Puma et al. (2005)

Short- and long-term benefits:
- Cognitive development: improvement in cognitive development, school achievement, and college attendance; reduction in grade retention, special education, & high-school dropout
- Social-emotional skills: increases in social skills; reduction in delinquency, crime, & teen pregnancies
- Health: increases in health status & medical care; decreases in mortality rates
Issues in Prior Head Start Studies

**Selection bias:**
- HS target population: disadvantaged preschool-age children
- Young disadvantaged children: worse outcomes before HS
- Observable & unobservable factors: HS enrollment & outcomes

**Lack of clearly defined reference group for HS:**
- Compare HS to all other children

**Focus on selected outcomes:**
- Well studied: cognitive & school outcomes
- Understudied: social-emotional & health outcomes

**Out-of-date or unknown long-term effects:**
- HS programs in many studies in 60s/70s
- HS Impact Study: on preschoolers but later years unknown
How Do I Address the Issues

- Propensity score matching to address selection bias
- Two approaches to define reference group:
  - Head Start vs. non-Head Start
  - Head Start vs. other specific types of care arrangements
- Outcomes in multiple dimensions:
  - Cognitive, social-emotional, & health outcomes
- Recent data and short- & long-term effects
Short-term Effects of HS on School Readiness

Fragile Families and Child Wellbeing Study (FFCWS)

- 76% born to unmarried parents in low-income & minority families
- Data collection: birth (baseline), ages 1, 3, & 5
- In-home assessments at ages 3 & 5: about 60%

Analysis sample:

- Valid data on care arrangements prior to K & outcome variables from in-home assessments at age 5
- n = 2,803 (66% of full sample)
- Analysis sample vs. original sample: no significant differences
Outcome Measures at Age 5

**Cognitive development:**
- Peabody Picture Vocabulary Test-3rd Edition (PPVT-III): $\alpha = 0.95$
- Woodcock-Johnson Psycho-Educational Battery-Revised (WJ-R) Letter-Word Identification: $\alpha = 0.92$

**Social competence:**
- Adaptive Social Behavior Inventory (ASBI) Expressive Subscale
- Positive behaviors: 12 items, $\alpha = 0.82$

**Attention and behavior problems:**
- Child Behavior Checklist for Ages 1½-5 (CBCL/1½-5)
- **Attention problems:** 11 items, $\alpha = 0.73$
- **Internalizing behavior problems:** 22 items, $\alpha = 0.76$
- **Externalizing behavior problems:** 30 items, $\alpha = 0.85$
Control Variables at Age 3

**Child covariates:**

- **Demographics:** age, gender, race/ethnicity, low birth-weight, mother’s first child or not, and fair/poor health status
- **Pretreatment scores:** PPVT-III, social competence, attention problems, internalizing behavior problems, and externalizing behavior problems

**Mother and family covariates:**

- **Mother characteristics:** age, first child born under age 19, relationship with father at child’s age 3, employment, education, cognitive ability, and depression in past year
- **Family characteristics:** Home Observation for Measurement of the Environment (HOME) scores (i.e., harsh parenting, maternal responsivity, & cognitively stimulating materials), and poverty status at child’s birth and age 3
Child Care Arrangements Prior to K

- Care arrangements:
  - Parental care
  - Head Start
  - Pre-kindergarten
  - Other center-based programs: day care centers, nursery schools, and preschool programs
  - Other non-parental care: grandparent care, other relative care, non-relative care, family care, & other care

- Two approaches to define reference group:
  - Head Start vs. non-Head Start
  - Head Start vs. other specific types of care arrangements
Methods

🌟 Propensity score matching

🌟 OLS regression with city-fixed effects:

\[ O_{imc} = \beta_0 + \beta_1 HS_{imc} + \beta_2 X_{imc} + \beta_3 M_{ic} + \psi_c + \varepsilon \]

- Outcome intercept
- HS(yes/no)
- child-vars
- mom-vars
- city-fixed
- error term
Pretreatment covariates at age 3: child demographics, pretreatment scores, mother & family covariates

City-fixed effects
### Balance Check: non-HS children before & after matching

<table>
<thead>
<tr>
<th></th>
<th>Non-HS Children Before Matching (n = 2,417)</th>
<th>HS Participants (n = 386)</th>
<th>Non-HS Children After Matching (n = 375)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child race/ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic White</td>
<td>0.18(0.39)**</td>
<td>0.07(0.26)</td>
<td>0.07(0.26)</td>
</tr>
<tr>
<td>Non-Hispanic Black</td>
<td>0.47(0.50)**</td>
<td>0.60(0.49)</td>
<td>0.60(0.49)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.20(0.40)</td>
<td>0.21(0.41)</td>
<td>0.22(0.41)</td>
</tr>
<tr>
<td>Biracial/other</td>
<td>0.15(0.36)+</td>
<td>0.11(0.32)</td>
<td>0.11(0.32)</td>
</tr>
<tr>
<td>Mother’s first child</td>
<td>0.40(0.49)**</td>
<td>0.32(0.47)</td>
<td>0.35(0.48)</td>
</tr>
<tr>
<td>Pretreatment scores at age 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPVT-III scores</td>
<td>0.13(1.03)**</td>
<td>-0.03(1.03)</td>
<td>-0.02(1.00)</td>
</tr>
<tr>
<td>Social competence</td>
<td>0.08(0.94)+</td>
<td>-0.02(0.91)</td>
<td>-0.04(1.06)</td>
</tr>
<tr>
<td>Attention problems</td>
<td>-0.14(1.00)*</td>
<td>-0.01(0.96)</td>
<td>-0.02(1.02)</td>
</tr>
<tr>
<td>Internalizing problems</td>
<td>-0.01(0.93)+</td>
<td>0.02(0.97)</td>
<td>0.00(0.99)</td>
</tr>
<tr>
<td>Externalizing problems</td>
<td>-0.14(0.96)**</td>
<td>0.00(0.98)</td>
<td>-0.03(1.00)</td>
</tr>
<tr>
<td>Mother 1st child born &lt; age 19</td>
<td>0.30(0.46)**</td>
<td>0.40(0.49)</td>
<td>0.39(0.49)</td>
</tr>
<tr>
<td>Mother relationships child age 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>0.32(0.47)**</td>
<td>0.19(0.39)</td>
<td>0.19(0.39)</td>
</tr>
<tr>
<td>Cohabitating</td>
<td>0.20(0.40)</td>
<td>0.20(0.40)</td>
<td>0.20(0.40)</td>
</tr>
<tr>
<td>Friends/visiting</td>
<td>0.23(0.42)**</td>
<td>0.30(0.46)</td>
<td>0.33(0.47)</td>
</tr>
<tr>
<td>Other</td>
<td>0.24(0.43)**</td>
<td>0.31(0.46)</td>
<td>0.28(0.45)</td>
</tr>
</tbody>
</table>

Means with standard deviations in parentheses; ** p<0.01, * p<0.05, + p<0.1 for two-tailed t-statistics testing mean differences between HS and non-HS before & after matching, respectively.
### Balance Check: non-HS children before & after matching

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<tr>
<td><strong>Mother’s education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than high school</td>
<td>0.27(0.44)</td>
<td>0.29(0.45)</td>
<td>0.34(0.47)</td>
</tr>
<tr>
<td>HS diploma/GED</td>
<td>0.28(0.45)**</td>
<td>0.38(0.49)</td>
<td>0.32(0.47)</td>
</tr>
<tr>
<td>Some college/tech school</td>
<td>0.32(0.47)</td>
<td>0.29(0.46)</td>
<td>0.29(0.46)</td>
</tr>
<tr>
<td>BA/graduate</td>
<td>0.13(0.34)**</td>
<td>0.04(0.19)</td>
<td>0.04(0.20)</td>
</tr>
<tr>
<td><strong>Mother’s cognitive ability score</strong></td>
<td>6.89(2.58)**</td>
<td>6.44(2.29)</td>
<td>6.59(2.50)</td>
</tr>
<tr>
<td><strong>HOME scores at age 3</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harsh parenting score</td>
<td>0.47(1.03)+</td>
<td>0.61(1.14)</td>
<td>0.61(1.13)</td>
</tr>
<tr>
<td>Cognitively stimulating</td>
<td>9.55(1.13)+</td>
<td>9.44(1.19)</td>
<td>9.45(1.20)</td>
</tr>
<tr>
<td><strong>Poverty status at child’s age 3</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below 50% poverty line</td>
<td>0.22(0.41)**</td>
<td>0.31(0.46)</td>
<td>0.32(0.47)</td>
</tr>
<tr>
<td>50-100% poverty line</td>
<td>0.18(0.38)**</td>
<td>0.27(0.44)</td>
<td>0.25(0.43)</td>
</tr>
<tr>
<td>100-200% poverty line</td>
<td>0.25(0.44)</td>
<td>0.26(0.44)</td>
<td>0.26(0.44)</td>
</tr>
<tr>
<td>200-300% poverty line</td>
<td>0.14(0.35)*</td>
<td>0.10(0.30)</td>
<td>0.09(0.29)</td>
</tr>
<tr>
<td>300%+ poverty line</td>
<td>0.21(0.40)**</td>
<td>0.06(0.24)</td>
<td>0.08(0.27)</td>
</tr>
</tbody>
</table>

Means with standard deviations in parentheses; ** p<0.01, * p<0.05, + p<0.1 for two-tailed t-statistics testing mean differences between HS and non-HS before & after matching, respectively
Effect sizes of Head Start compared to any other arrangement

- PS matching
- OLS city-fixed

** p<0.01, * p<0.05, + p<0.10

<table>
<thead>
<tr>
<th>Measure</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPVT-III</td>
<td></td>
</tr>
<tr>
<td>WJ-R</td>
<td></td>
</tr>
<tr>
<td>Social Competence</td>
<td></td>
</tr>
<tr>
<td>Attention Problems</td>
<td>**</td>
</tr>
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<td>Internalizing Problems</td>
<td></td>
</tr>
<tr>
<td>Externalizing Problems</td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- ** p<0.01
- * p<0.05
- + p<0.10

- ** p<0.01
- * p<0.05
- + p<0.10

- ** p<0.01
- * p<0.05
- + p<0.10
Long-term Effects of HS from K to 5th Grade

Early Childhood Longitudinal Study, K Class of 98-99 (ECLS-K):
- Nationally representative sample of kindergarteners: N = 21,260

Outcome variables from K to 5th grade:
- Cognitive development: test scores in reading & math
- Social-emotional development: approaches to learning, self-control, interpersonal skills, and internalizing & externalizing behavior problems
- Childhood overweight and obesity: based on gender- & age-specific body mass index (BMI): overweight (85th ≤ BMI < 95th percentiles) and obesity (BMI ≥ 95th percentiles)

Reference group of HS:
- Five mutually exclusive categories: parental care, other center-based care, other non-parental care, HS combined with other non-parental care, and other combined non-parental care

Method: propensity score matching
Summary of HS Effects from K to 5th Grade

- Compared to parental and other non-parental care:
  - Increase test scores in math and reading: k to 5th grade

- Compared to other center-based care:
  - Increase self-control and interpersonal skills: k to 3rd grade
  - Reduce internalizing & externalizing problems: k to 5th grade
  - Reduce risk of childhood overweight & obesity: k to 5th grade

- Compared to multiple non-parental care arrangements:
  - Increase social-emotional development: k to 5th grade
  - Reduce risk of childhood overweight & obesity: k to 5th grade

- Effects not moderated by child gender, race/ethnicity, or language spoken at home
Impacts of Classroom-based Interventions in HS

Chicago School Readiness Project (CSRP):
- Clustered randomized controlled trial (RCT) & pairwise matching
- 602 children & 94 teachers in 35 classrooms at 18 Head Start sites
- Children in study: 4 years old; 66% non-Hispanic Blacks, 26% Hispanics, & 8% other racial/ethnic groups

Three components of intervention:
- 30-hour teacher training on behavior management strategies
- Placement of mental health consultants (MHCs) in classrooms
- Individual MHC services for a small number of children (3-4/class)

Intervention and data collection:
- Intervention: fall to spring HS 2004-05 (Cohort I) & 2005-06 (Cohort II)
- Data collection: fall HS (pre-treatment), spring HS (post-treatment), K, & 1st grade; currently 3rd grade data
**CSRP Treatment Effects**

*Treatment effects in spring HS after intervention:*

- Intention-to-treat (ITT) analysis: average treatment effects
- Multilevel modeling: children nested in classrooms and sites

*Three-level HLM:*

- Level 1: child & family covariates, & pretreatment scores ($\mathbf{X}$)
  \[ Y_{ijk} = \pi_{0jk} + \sum_m \pi_{mjk} X_{mijk} + \epsilon_{ijk} \]
- Level 2: teacher & classroom covariates ($\mathbf{C}$)
  \[ \pi_{mjk} = \beta_{m0k} + \sum_n \beta_{mnk} C_{mnjk} + r_{mjk} \]
- Level 3: treatment assignment ($\mathbf{T}$) & site covariates ($\mathbf{S}$)
  \[ \beta_{m0k} = \gamma_{m00} + \gamma_{001} T_k + \sum_p \gamma_{m0pk} S + u_{m0k} \]
Dosage: level of participation (e.g., take-up or not, attendance rates, or the length of “treatment”)

CSRP Dosage Effects

Low Dosage
- 30-60% Training
- (10 classes 144 kids)

High Dosage
- 87-100% Training
- (7 classes 97 kids)
CSRP Dosage Effects

**Issue of self-selection:**
- After randomized assignment: choices for individuals in treatment
- Dosage level in control group: potential variable

**Principal score matching**
Control

Treatment

Propensity

Principal scores

Coefficients
Figure 3. Effect Sizes of CSRP Intervention on Children's School Readiness

Legend:
- ITT
- low-training
- high-training
- low-MHC
- high-MHC
- child MHC

** p<0.01, * p<0.05, + p<0.10
Policy Implications of HS Studies

Allocating scarce public funds:
- Largest cognitive effects relative to parental & other non-parental care
- Target children who otherwise would receive these two forms of care

Design of Head Start programs:
- Some propose to emphasize cognitive school readiness
- Benefits of HS are found in multiple dimensions
- Maintaining traditional focus on the whole child

Improving quality of Head Start programs:
- High-quality classroom-based interventions: additional benefits
- High-dosage interventions: larger effects