Does an Evidence-Based Early Childhood Program Reduce Adult Obesity? Results from the Chicago Longitudinal Study

Arthur J. Reynolds
HCRC and Institute of Child Development
University of Minnesota

MPC Seminar Series
December 3, 2018
Key Trends

1. Obesity is a world-wide health problem.
2. Adult prevalence doubled in 3 decades.
3. Lower-income status and black women have shown larger increases.
4. High priority on goals and broad health promotion.
5. Innovative, scalable prevention approaches are needed.
Adult Prevalence, 2015-16

Total: 39.6%

Males: 37.9%

Females: 41.1%

20-39y: 35.7%

Child Prevalence, 2015-16

Total: 18.5%

2-5y: 13.9% >38% from 07

6-11y: 18.4% <6%

12-19y: 20.6% >14%

<table>
<thead>
<tr>
<th></th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>White:</td>
<td>38.1%</td>
<td>36.2%</td>
</tr>
<tr>
<td>Black:</td>
<td>55.9%</td>
<td>37.4%</td>
</tr>
<tr>
<td>Hs grad</td>
<td>47.3%</td>
<td>30.0%</td>
</tr>
<tr>
<td>College grad</td>
<td>29.3%</td>
<td>36.2%</td>
</tr>
</tbody>
</table>

2020 Goals

“Improve the cardiovascular health of all Americans by 20% while reducing deaths from cardiovascular diseases by 20%.” (AHA)

“Reduce the proportion of adults [and children] who are obese.” Goal: 10 percent improvement. (HP 2020).
## AHA Ideal Health Metrics 2016

<table>
<thead>
<tr>
<th>Health Metric</th>
<th>12-19</th>
<th>20-49</th>
</tr>
</thead>
<tbody>
<tr>
<td>No smoking</td>
<td>91%</td>
<td>73%</td>
</tr>
<tr>
<td>BMI &lt; 25</td>
<td>63%</td>
<td>33%</td>
</tr>
<tr>
<td>Cholesterol &lt; 170</td>
<td>80%</td>
<td>64%</td>
</tr>
<tr>
<td>BP &lt; 120/80</td>
<td>89%</td>
<td>61%</td>
</tr>
<tr>
<td>B Glucose &lt; 100</td>
<td>88%</td>
<td>74%</td>
</tr>
</tbody>
</table>

Notes and Source: Physical activity (27% and 42%) and Healthy diet score (<1% and <1%) are not shown. AHA Statistical Fact Sheet and Benjamin et al. (2017), Circulation.
CVD Prevention

“...such efforts must be targeted at youths and young adults because by middle age, most Americans already have poor cardiovascular health.”

Why Early Childhood?

True Prevention

High Dosage of Educational Enrichment

Multi-Component Programs (family services, nutrition, health, readiness)

Growing Public Investment

Existing Service Systems
Classifications

Parenting and home visitation

Early education and care

State PreK (Publicly funded)

Comprehensive Programs

Transition and School-age Programs
GROW Study, 2018

610 parents and 3-5yo children assigned to tiered behavior change over 36 months

Setting: Low-income Nashville areas

Results: No change in BMI trajectories at 3-yr follow up; significant improve. for food insecure group

Source: Barkin et al. (2018), JAMA; Growing Right unto Wellness Trial
INSIGHT Trial, 2018

279 mother-child dyads received 4 home visits focused on play, sleep, and feeding over 3 years plus annual center visits.

**Setting:** Hershey, PA

**Results:** Sig. lower BMI at age 3 ($d = -0.28$); trend for overweight and obesity.

Source: Paul et al. (2018), JAMA; Responsive parenting intervention.
Head Start Study, 2015

19,023 3-to-5yo were compared to 5,405 age-matched Medicaid children using program admin data & e-health records.

Setting: 12 programs in MI over 8 years

Results: Obese & overweight HS children showed greater 2-year declines in BMI.

Source: Lumeng et al. (2015), Pediatrics; Changes in BMI and Head Start participation.
40 low-income children in a 5-year early ed center were compared to 28 controls at age 35 follow up based on exams.

**Setting:** Chapel Hill, NC (1972-1977)

**Results:** No overall differences but trend for females (abdominal; 56% vs. 76%).

Source: Campbell et al. (2014), Science; Early ed and adult health.
Role of Education

Several recent studies confirm negative correlation of years of ed & BMI/obesity.

Wisconsin Longitudinal Study
--reduction of .15 BMI for each year.

Young Finns Study
--reduction of .22 BMI for each year.

Child-Parent Education Centers
Goal

“The Child-Parent Education Centers are designed to reach the child and parent early, develop language skills and self-confidence, and to demonstrate that these children, if given a chance, can meet successfully all the demands of today’s technological, urban society.” (Sullivan, 1968)
## Age 35 Ed Attainment, PreK

<table>
<thead>
<tr>
<th></th>
<th>Prog</th>
<th>Comp</th>
<th>Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA and above</td>
<td>15.7%</td>
<td>10.7%</td>
<td>5.0*</td>
</tr>
<tr>
<td>BA and above</td>
<td>11.0%</td>
<td>7.8%</td>
<td>6.1t</td>
</tr>
<tr>
<td>Masters+</td>
<td>4.2%</td>
<td>1.5%</td>
<td>2.7*</td>
</tr>
<tr>
<td>Years of ed</td>
<td>12.81</td>
<td>12.32</td>
<td>0.49*</td>
</tr>
</tbody>
</table>

Source. Reynolds, Ou, & Temple (2018). JAMA Pediatrics. 1 or 2 years of CPC vs. comparison adjusted for school-age, selection and attrition by IPW. t < .10; *p<.05
Questions

1. Is CPC preschool participation associated with BMI and obesity in early midlife?
2. Are there differences by child, family, and neighborhood characteristics?
3. Does educational success and related child, family, and school experiences mediate the relationship?
Theoretical Frameworks

Developmental Origins of Health/Disease

Ecological Systems Theory

Risk and Protection
Five-Hypothesis Model Paths to Education and Health Outcomes in the CLS from early life to education and health outcomes. Paths among mediators not shown.
CLS Paths of Influence from CPC to Adult Health

Note. Pathways of CPC Impacts from prior CLS Findings Leading to Physical Health in Midlife. The path coefficients to physical health are from self-reported AHA index scores from the age 35-37 survey. Initial CPC impacts on cognitive skills (b = .36) and parent involvement (b = .15) are not shown.
CPC History

First preschool program funded by Title I (1967)

Original P-3 program, providing integrative services

District 8 Supt. Lorraine Sullivan developed program with much local collaboration
Parent Resource Room
CPC Core Features

1. School-based and P-3 continuity
2. Whole-child approach to readiness
3. Free meals and nutrition education
4. Health screening and services
5. Parent Resource Room workshops
6. Community outreach.
CPC Staffing

- Head Teacher
- Parent Resource Teacher
- School-Community Representative
- Teachers and assistants
- School nurse, psychologist, social worker
- Preschool class size was 17 to 2
- School-age services K to 3
Child-Parent Center Structure

Child-Parent Center
Preschool/Kindergarten
(Wing or Building)

Principal

Elementary School
Grades 1 to 3

Curriculum/Parent Liaison

Head Teacher

Outreach Services

Parent Component

Curriculum Component

Health Services

Parent Component

Curriculum Component

School-Wide Services

School-Community Representative
Resource Mobilization
Home Visitation

Parent Resource Teacher
Parent Room Activities
Classroom Volunteering
Home Support

Language Focus
Class Sizes 17/2
Balance of Activ.
Whole-Child Prof. Develop.

Health Screening
Nursing Services
Free + Reduced-Price meals

Parent Room Activities
Classroom Volunteering
School Activities
Home Support

Class Sizes 25/2
Teacher Aides
Instructional Materials
Individualized Instruction
Inservice Training

Health Services
School-Community Representative
Free + Reduced-Price meals
Resource Mobilization

Age 3

To

Age 9
Chicago Longitudinal Study

1. Effects of CPC program for a complete cohort born in 1979-80

2. Assess timing and duration of impacts

3. Early influences across the life course

4. Identify mechanisms and processes of change to midlife.
CLS Sample Description

- Cohort of 1,539 young children who attended publicly funded PreK programs in 1983-85 for children at risk in Chicago public schools and completed K in 1986.

- Data collected annually from many sources with 90% or higher recovery into adulthood. Mobility measured starting in K from school records and supplemented with parent/student reports.
Program Groups

- 989 complete cohort of CPC participants in 20 sites; they participated from 2 to 6 beginning at age 3. Centers are located in the highest poverty areas of Chicago.

- 550 children enrolled in an alternative early childhood program in kindergarten in five randomly selected schools serving low-income families and in six CPC sites. They matched on socioeconomic status.
## Characteristics of CPC Groups

<table>
<thead>
<tr>
<th>Sample</th>
<th>CPC Intervention</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete cohort</td>
<td>Complete cohort</td>
<td>Random sample of K sites + 6 CPC areas</td>
</tr>
<tr>
<td>Recovery, by age 35</td>
<td>904 of 989 (91%)</td>
<td>494 of 550 (90%)</td>
</tr>
<tr>
<td>Key attributes</td>
<td>Reside in highest poverty areas</td>
<td>Reside in high poverty areas</td>
</tr>
<tr>
<td></td>
<td>Over 80% of children enroll</td>
<td>Had school-based enrichment</td>
</tr>
<tr>
<td></td>
<td>Mean no. of risks = 4.5; 73% with 4 or more risks</td>
<td>Mean no. of risks = 4.5; 71% with 4 or more risks</td>
</tr>
<tr>
<td></td>
<td>Parent ed &gt; than compar.</td>
<td>Area poverty &gt; than prog.</td>
</tr>
</tbody>
</table>

### Intervention levels

<table>
<thead>
<tr>
<th>Intervention levels</th>
<th>CPC Intervention</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preschool</td>
<td>100% 1 or 2 years</td>
<td>15% in Head Start</td>
</tr>
<tr>
<td>Kindergarten</td>
<td>60% full day</td>
<td>100% full day</td>
</tr>
<tr>
<td>School age</td>
<td>69% 1 year</td>
<td>7% 1 year</td>
</tr>
<tr>
<td></td>
<td>56% 2-3 years</td>
<td>23% 2-3 years</td>
</tr>
</tbody>
</table>
CPC Preschool and Readiness

National Percentile

Two Years: 57
One Year: 44
None: 28
Nat. Norm: 50
<table>
<thead>
<tr>
<th></th>
<th>Prog</th>
<th>Comp</th>
<th>Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Juvenile arrest</td>
<td>16.9%</td>
<td>25.1%</td>
<td>-8.2%*</td>
</tr>
<tr>
<td>Child maltreat.</td>
<td>6.9%</td>
<td>14.2%</td>
<td>-7.3%*</td>
</tr>
<tr>
<td>HS completion</td>
<td>79.4%</td>
<td>70.7%</td>
<td>8.7%*</td>
</tr>
<tr>
<td>Felony arrest</td>
<td>16.3%</td>
<td>21.2%</td>
<td>-4.9%*</td>
</tr>
<tr>
<td>Depression</td>
<td>12.8%</td>
<td>17.4%</td>
<td>-4.6%*</td>
</tr>
<tr>
<td>Health Insur.</td>
<td>76.7%</td>
<td>66.6%</td>
<td>10.1%*</td>
</tr>
</tbody>
</table>
Age 35 Data Collection

1,104 completed interviews by phone (n=885) and other modes (20 partials)

Collected over 5 years (2012-2017)

2 hours and 130 questions

Effective completion rate of 79%
Collaborators, BMI and Health Studies

Suh-Ruu Ou
Lauren Eales
Christina Mondi-Rago
Allie Giovanelli
CLS and HCRC Team
Staff on Age 35 Adult Survey

- Suh-Ruu Ou
- Christina Mondi
- Leila Jones
- Kyungin Park
- Sangok Yoo
- Bri Warren
- Esperanza Bautista
- Sangyoo Lee
- Nicole Smerillo
- Suh-Liang Ou
- Brian Valley
- Yeonjin Kim
- Ju Ae Kim
- Erika Diaz
- Heidi Schaus
- Ashley Bratrud
- Annie Goerdt
- Amy Harms
- Regina Thompson
- Abigail Furry
- Sarah Weiss
- Sydney Langaas
- Raj Wijewardane
- Naomi Roderick
- Amy Stein
- Joseph Mulford
- Stephanie Radel
- Kayla Williamson
- Haydee Perez
- Raish Kerns
- Charles David Tillery
Organizations

• Public Opinion Lab, Northern Illinois University
• Chicago Public School District
• Illinois Department of Corrections
• COFI
• University of Minnesota Survey Center
BMI Questions

Q89: What is height with your shoes off? (___feet __inches)

Q90: How much do you currently weigh with your shoes off? (___lbs)

BMI = weight (kg) / height (m*m)
## R, BMI Self Report & Physical Exam

<table>
<thead>
<tr>
<th>Sample</th>
<th>Corr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>.85</td>
</tr>
<tr>
<td>Males</td>
<td>.90</td>
</tr>
<tr>
<td>Females</td>
<td>.81</td>
</tr>
<tr>
<td>Bottom 50%</td>
<td>.70</td>
</tr>
<tr>
<td>Top 50%</td>
<td>.66</td>
</tr>
<tr>
<td></td>
<td>BMI</td>
</tr>
<tr>
<td>-------</td>
<td>--------</td>
</tr>
<tr>
<td>Total</td>
<td>30.4 (6.8)</td>
</tr>
<tr>
<td>Female</td>
<td>31.5</td>
</tr>
<tr>
<td>Male</td>
<td>29.1</td>
</tr>
</tbody>
</table>

Ns=543, 499; U.S. rate =36%; 56%(BF), 37%(BM).
<table>
<thead>
<tr>
<th></th>
<th>CPC</th>
<th>Comp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (% ret.)</td>
<td>689 (70)</td>
<td>353 (64)</td>
</tr>
<tr>
<td>Total</td>
<td>44%</td>
<td>46.7%</td>
</tr>
<tr>
<td>Female</td>
<td>46.8%</td>
<td>59.2%</td>
</tr>
<tr>
<td>Male</td>
<td>40.6%</td>
<td>35.3%</td>
</tr>
<tr>
<td>Covariates</td>
<td>Sources</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>----------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Birthweight (B)</td>
<td>Birth records</td>
<td></td>
</tr>
<tr>
<td>SES/family risk, e.g. parent ed (D)</td>
<td>Birth/admin parent report</td>
<td></td>
</tr>
<tr>
<td>Home env, 0-5, e.g., adversity (H)</td>
<td>Retros. report/child welfare</td>
<td></td>
</tr>
<tr>
<td>Program</td>
<td>School-age CPC</td>
<td></td>
</tr>
<tr>
<td>School/neigh. (SN)</td>
<td>Poverty context, sites (S)</td>
<td></td>
</tr>
</tbody>
</table>
Estimated Models

1. Baseline:
   \[ BMI = C + BCPC-P + BCPC-SA + e \]

2. Full Regression:
   \[ ..+ BBD + BHome + BSN + e \]

3. School fixed effects:
   \[ ..+ BS + e \]

4. IPW for attrition (all models)
   \[ W = 1/P \]
   \[ P_{i(SR)} = C + B_{jBD} + B_{jHome} + B_{jP} + B_{jSN} + e \]
### Selective attrition by CPC?

<table>
<thead>
<tr>
<th>Variable</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birthweight</td>
<td>0.47</td>
</tr>
<tr>
<td>Family Risk</td>
<td>0.17</td>
</tr>
<tr>
<td>Neigh. Poverty</td>
<td>0.76</td>
</tr>
<tr>
<td>Neigh. Advantage</td>
<td>0.85</td>
</tr>
<tr>
<td>Word analysis skills, K</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Note. N=1531; Prog x retention interaction term.
Predictors, Sample Retention (OR)

<table>
<thead>
<tr>
<th>Predictor</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black participants</td>
<td>1.7</td>
</tr>
<tr>
<td>Home env. adversity</td>
<td>1.2</td>
</tr>
<tr>
<td>Parent involvement</td>
<td>1.1</td>
</tr>
<tr>
<td>PreK by sch poverty</td>
<td>1.03</td>
</tr>
<tr>
<td>Sch-age by sch poverty</td>
<td>0.97</td>
</tr>
</tbody>
</table>

Note. 31 predictors in full logit regression model.
CPC Differences for BMI

<table>
<thead>
<tr>
<th></th>
<th>BMI</th>
<th>SD units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Baseline</td>
<td>-0.62</td>
<td>.09</td>
</tr>
<tr>
<td>2 Covariates</td>
<td>-0.99*</td>
<td>.15</td>
</tr>
<tr>
<td>3 Fixed effects</td>
<td>-1.19*</td>
<td>.18</td>
</tr>
<tr>
<td>4 W covariates</td>
<td>-0.96*</td>
<td>.14</td>
</tr>
</tbody>
</table>

*p < .05; **p < .01; t=p < .10
CPC Marginal Effects for Obesity

<table>
<thead>
<tr>
<th></th>
<th>Diff.</th>
<th>%reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Baseline</td>
<td>-2.7p</td>
<td>.09</td>
</tr>
<tr>
<td>2 Covariates</td>
<td>-4.6p</td>
<td>.15</td>
</tr>
<tr>
<td>3 Fixed effects</td>
<td>-0.8p</td>
<td>.18</td>
</tr>
<tr>
<td>4 W covariates</td>
<td>-4.1p</td>
<td>.14</td>
</tr>
</tbody>
</table>

*p < .05; **p < .01; t=p < .10
<table>
<thead>
<tr>
<th></th>
<th>CPC and BMI, Women</th>
<th>BMI</th>
<th>SD units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Baseline</td>
<td>-2.01</td>
<td>.30</td>
</tr>
<tr>
<td>2</td>
<td>Covariates</td>
<td>-2.28</td>
<td>.34</td>
</tr>
<tr>
<td>3</td>
<td>Fixed effects</td>
<td>-2.79</td>
<td>.42</td>
</tr>
<tr>
<td>4</td>
<td>W covariates</td>
<td>-2.33</td>
<td>.35</td>
</tr>
</tbody>
</table>

Note. All values p<.01.
## CPC and Obesity, Women

<table>
<thead>
<tr>
<th>1 Baseline</th>
<th>Diff.</th>
<th>%reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Covariates</td>
<td>-14.2p</td>
<td>24%</td>
</tr>
<tr>
<td>3 Fixed effects</td>
<td>-15.2p</td>
<td>26%</td>
</tr>
<tr>
<td>4 W covariates</td>
<td>-13.6p</td>
<td>22%</td>
</tr>
</tbody>
</table>

**Model 3 (P, C):** 40% vs. 59.2%

Note. All values $p < .01$, except Model 3 ($p<.05$).
CPC PreK and Age 35 BMI by Birthweight

Effect Size BMI (SD), Absolute Value

- Lowest
- 2nd Birthweight Quartile
- 3rd Birthweight Quartile
- Highest
Mediation Findings

1. Educational attainment and 5HM factors accounted for 10 to 15 percent of main effects (overall and women).

2. Contributors were years of education, magnet high school attendance, and socio-emotional skills.

3. Modeling complex processes and indirect effects is a next step.
PreK Instruction Differences

1. Prior study found that CPC children with instruction high in child-initiated learning had highest rates of HS graduation.

2. IPW results found a similar pattern. Relative to the high teacher-directed group, the high child-initiated/low teacher-directed group had lower mean BMIs (d = -0.17, total; d = -0.20, women). Weaker obesity findings.

CLS Health Exam Study

With Preventive Medicine at Northwestern U, health exams are conducted in Chicago.

Exams assess all AHA metrics, mental health, health history, and blood storage.

Modeled after CARDIA and MESA.

257 completed exams to date.
Child-Parent Centers

The Child-Parent Center preschool to 3rd grade (CPC P-3) model is a school reform effort currently in three Midwestern states. The program aims to strengthen overall well-being and achievement of preschool through elementary school-aged children from low-income families.

Who's involved in running a CPC P-3 site? Learn more here.

CPC P-3 ROLES & RESPONSIBILITIES
New Book on Early Childhood

Edited by Arthur Reynolds and Judy Temple.
Next Steps

1. Further examine mediators of CPC impacts and by subgroups.
2. Dosage analysis across ages 3-9.
3. Compare different approaches to incorporating missing data.
4. Generalize to AHA and other domains of well-being.
Summary

1. CPC preschool shows evidence of benefits on BMI in midlife, especially women.
2. Stronger benefits for those in the highest poverty contexts.
3. Limited evidence of mediation.
4. Routine, comprehensive programs have promise for obesity prevention.
5. Program scaling is feasible.
Funding Support from:

National Institute of Child Health and Human Development

Bill & Melinda Gates Foundation

Web: hcrc.umn.edu; cpcp3.org
     icd.umn.edu/cls; clstudy.org
Key Impacts of Obesity

Although AHA metrics show sizeable correlations, causal impact reviews show obesity most linked to:

Type 2 Diabetes: 1.67 OR

Coronary Artery Disease: 1.20 OR