Childhood Origins of Adult Economic Burden
Childhood Origins of Adult Economic Burden
Research to prepare today’s children for tomorrow

- **FEWER CHILDREN**
  children will become increasingly valuable

- **MORE OLD PEOPLE**
  each young worker will have to support more old people

- **LIFE EXPECTANCY HAS BEEN GROWING LONGER**
  today’s children must prepare for a longer old age tomorrow
Brazil Population Age Distribution

<table>
<thead>
<tr>
<th>Year</th>
<th>MALE</th>
<th>FEMALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2050</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Population (In Millions)

Age Group:
- 0-4
- 5-9
- 10-14
- 15-19
- 20-24
- 25-29
- 30-34
- 35-39
- 40-44
- 45-49
- 50-54
- 55-59
- 60-64
- 65-69
- 70-74
- 75-79
- 80-84
- 85-89
- 90-94
- 95-99
- 100+

Brazil 2000 Population Age Distribution

Brazil 2020 Population Age Distribution

Brazil 2050 Population Age Distribution
THE RESEARCH QUESTION

- Can research generate an evidence base that encourages investment in children?
Return on Investment
http://www.heckmanequation.org/

Source: Heckman, 2008

RETURNS TO A UNIT DOLLAR INVESTED

- Programs targeted towards the earliest years
- Preschool programs
- Schooling
- Job training

Rate of Return to Investment in Human Capital

0-3 4-5 School Post-school

Job training
DOES CHILDHOOD PREDETERMINE ADULT LIFE CHANCES?

• YES. Childhood risks predict adult outcomes with strong effects, mandating early-years intervention policies.
DOES CHILDHOOD PREDETERMINE ADULT LIFE CHANCES?

- **YES.** Childhood risks predict adult outcomes with strong effects, mandating early-years intervention policies.

- **NO.** Childhood risks predict adult outcomes with only weak effects, so even if early-years intervention were able to correct all childhood risks, intervening would bring little benefit to society.
THE MYTH OF THE FIRST THREE YEARS

A New Understanding of Early Brain Development and Lifelong Learning

JOHN T. BRUER, Ph.D.
SHOULD WE INVEST MORE OF GOVERNMENT BUDGET INTO EARLY YEARS INTERVENTIONS? OR NOT?
MARKET SEGMENTATION
THE OUTLINE

• Introduction
• The Dunedin Study
• High-cost actors
• Childhood risks
• Concentration of high-cost actors
• The high-need/high-cost population segment
• How early can we tell?
• Implications
Dunedin Longitudinal Study

<table>
<thead>
<tr>
<th>Age</th>
<th>Year</th>
<th>Number</th>
<th>Percent*</th>
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</thead>
<tbody>
<tr>
<td>Birth</td>
<td>1972-73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1975-76</td>
<td>1037</td>
<td>100%</td>
</tr>
<tr>
<td>5</td>
<td>1977-78</td>
<td>991</td>
<td>96</td>
</tr>
<tr>
<td>7</td>
<td>1979-80</td>
<td>954</td>
<td>92</td>
</tr>
<tr>
<td>9</td>
<td>1981-82</td>
<td>955</td>
<td>92</td>
</tr>
<tr>
<td>11</td>
<td>1983-84</td>
<td>925</td>
<td>90</td>
</tr>
<tr>
<td>13</td>
<td>1985-86</td>
<td>850</td>
<td>82</td>
</tr>
<tr>
<td>15</td>
<td>1987-88</td>
<td>976</td>
<td>95</td>
</tr>
<tr>
<td>18</td>
<td>1990-91</td>
<td>993</td>
<td>97</td>
</tr>
<tr>
<td>21</td>
<td>1993-94</td>
<td>992</td>
<td>97</td>
</tr>
<tr>
<td>26</td>
<td>1998-99</td>
<td>980</td>
<td>96</td>
</tr>
<tr>
<td>32</td>
<td>2004-05</td>
<td>972</td>
<td>96</td>
</tr>
<tr>
<td>38</td>
<td>2010-12</td>
<td>961</td>
<td>95%</td>
</tr>
<tr>
<td>45</td>
<td>2017-18</td>
<td>??</td>
<td>??</td>
</tr>
</tbody>
</table>

* Percent assessed, of those who were alive at each age.
THE OUTLINE

• The Dunedin Study
• High-cost actors: A minority of adults accounts for a disproportionate share of every social problem.
  • Childhood risks
  • Concentration of high-cost actors
  • The high-need/high-cost population segment
  • How early can we tell?
  • Implications
The Pareto Principle

20% of the Actors Account for 80% of the Results.

Vilfredo Pareto, 1848-1923
Social Welfare Benefits

- Source: Ministry of Social Development
- Measure: Number of months that study members drew government welfare benefits
- The cohort of 1000 people has received 24,977 monthly benefit support payments
Social Welfare Benefit Months

20% of Cohort Members = 80% of Total Social Welfare Benefit Months

% of Total Social Welfare Benefit Months
\( N = 24,997 \) months

% of Cohort Members
Social Welfare Benefit Duration, by sex

Females: 20% = 81%
- 20% of Cohort Members
- 81% of Total Social Welfare Benefit

Males: 20% = 78%
- 20% of Cohort Members
- 78% of Total Social Welfare Benefit
Absent-Father Parenting

- Source: Life History Calendars
- Measure: Number of years that the offspring of study members lived without their biological father
- The cohort’s children have lived 2,755 years without their biological fathers
Absent-Father Parenting

20% of Cohort Members = 82% of Total Fatherless Child-Years
### Absent-Father Parenting, by sex

<table>
<thead>
<tr>
<th></th>
<th>Women</th>
<th></th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20% =</td>
<td>81%</td>
<td>20%  =</td>
</tr>
<tr>
<td>Of Cohort Members</td>
<td>Of Total Child-Years Spent Single Parenting</td>
<td>Of Total Child-Years Spent Non-Residential Parenting</td>
<td></td>
</tr>
</tbody>
</table>

**Women**
- 20% of cohort members
- 81% of total child-years spent single parenting

**Men**
- 20% of cohort members
- 78% of total child-years spent non-residential parenting

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**Graphs**
- % of Total Proportion Child-Years Spent Single Parenting (N = 1215 years)
- % of Total Proportion Child-Years Spent Non-Residential Parenting (N = 1531 years)

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**Legend**
- MAX
- Percentage
- % of Cohort Members with Kids
Cigarette Smoking

- Source: Repeated interviews
- Measure: Number of pack-years consumed by the study members
  - A pack-year is smoking 20 cigarettes per day for one year
  - Number of pack-years =
    \[
    \text{No. of cigarettes smoked per day} \times \text{No. years smoked} \\
    \text{20 cigarettes in a pack}
    \]
- The cohort has smoked 5,760 pack-years
  (over 42 million cigarettes)
Cigarette Smoking Pack-Years

20% of Cohort Members = 68% of Total Tobacco Smoking Pack-Years

% of Total Smoking Pack Years
(N = 5,360 Pack-Years)

% of Cohort Members
Excess Body Weight

- Source: Height and weight measured at age 38 years
- Measure: Number of kilos of weight over the BMI=30 cut-off for obesity by each study member
- The cohort carries 2,924 kilos of excess weight
Excess Weight in Kilograms

20% of Cohort Members = 98% of Total Excess Obese Kilograms

% of Total Excess Obese Kilograms ($N = 2,924$ kg)

% of Cohort Members

MAX

Percentage

0

10

20

30

40

50

60

70

80

90

100
Hospital Bed Nights

- Source: Ministry of Health
- Measure: Number of nights spent in hospital by study members
- The cohort has spent 8,958 nights in hospital
Hospital Bed-nights

20% of Cohort Members = 77% of Total Hospital Bed-Nights

% of Total Hospital Bed-Nights
(N = 8,958 nights)

% of Cohort Members

MAX

0
Prescription Fills

- Source: Ministry of Health
- Measure: Number of prescriptions filled by study members
- The cohort has filled 66,811 pharmacy prescriptions
Prescription Drug Fills

20% of Cohort Members = 89% of Total Prescription Drug Fills

% of Total Prescription Drug Fills
(N = 66,811 fills)

% of Cohort Members
Criminal Convictions

- Source: New Zealand Police
- Measure: Number of convictions in adult criminal courts, including property, court-order violations, drug, and violence convictions (but excluding traffic violations)
- The cohort has accumulated 2,141 convictions
20% of Cohort Members = 97% of Total Criminal Court Convictions

% of Total Criminal Court Convictions
(N = 2,141 Convictions)

% of Cohort Members

MAX

0
Injury Insurance Claims

- Source: Accident Compensation Corporation (ACC), the sole provider of accident insurance for all work and non-work injuries in New Zealand
- Measure: Number of injury claims by study members
- The cohort has made 6,919 insurance claims for injuries
Injury Insurance Claims

20% of Cohort Members = 52% of Total Injury Insurance Claims
THE OUTLINE

• The Dunedin Study
• High-cost actors
• Childhood risks: For every sector, the same risk factors describe the high-cost actors.
• Concentration of high-cost actors
• The high-need/high-cost population segment
• How early can we tell?
• Implications
Childhood Risk Factors to Describe High-cost Actor Groups: Composites across ages 3, 5, 7, 9, 11

• IQ
• Self-control
• SES (socio-economic status)
• Maltreatment
THE PREDICTION CHALLENGE: HOW WELL CAN WE PREDICT A...

- **Categorical Outcome**: Who will be a welfare recipient?
- **Dimensional Outcome**: How much welfare someone will draw?
- **Segment Outcome**: Who will receive the vast majority of welfare benefits in the population?
How well do childhood risk factors predict adult outcomes?

The sample case of predicting social-welfare use

CATEGORICAL  DIMENSIONAL  SEGMENT

Large Effect

Medium Effect

Small Effect

IQ  Self-Control  SES  Maltreatment

Large Effect: 0.38, 0.36

Medium Effect: 0.31, 0.29

Small Effect: 0.19, 0.16, 0.15, 0.07

CATEGORICAL  DIMENSIONAL  SEGMENT
What have we learned so far?

- Members of the high-cost group in every sector differ from their peers on childhood risks: IQ, self-control, SES, maltreatment

- Effect sizes increased from small to moderate when predicting a concentrated segment of high-cost users

Research has been underestimating the link between childhood and adulthood
THE OUTLINE

- The Dunedin Study
- High-cost actors
- Childhood risks

- Concentration of high-cost individuals: The different high-cost actor groups overlap beyond chance.

- The high-need/high-cost population segment
- How early can we tell?
- Implications
Are high-cost groups independent sets of individuals, or does their membership overlap?
### Overlap of high-cost user groups

<table>
<thead>
<tr>
<th></th>
<th>Social Welfare</th>
<th>Fatherless Children</th>
<th>Smoking</th>
<th>Excess Weight</th>
<th>Hospital Stays</th>
<th>Prescription Fills</th>
<th>Injury Claims</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatherless Children</td>
<td>0.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking</td>
<td>0.5</td>
<td>0.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excess Weight</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
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<tr>
<td>Hospital Stays</td>
<td>0.4</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prescription Fills</td>
<td>0.5</td>
<td>0.3</td>
<td>0.3</td>
<td>0.2</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injury Claims</td>
<td>0.1</td>
<td>0.3</td>
<td>0.2</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Crime</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>-0.1</td>
<td>0.1</td>
<td>0.2</td>
<td>0.4</td>
</tr>
</tbody>
</table>

*Polychoric Correlation*
High-need/high-cost users:
22% of cohort members belong to three or more high-cost user groups
Big footprint of the High-need/High-cost Group: How many health/social services do they use?

- Cohort: 22%
- Social Welfare: 66%
- Fatherless Children: 77%
- Smoking: 54%
- Excess Weight: 40%
- Hospital Stays: 78%
- Prescription Fills: 81%
- Injury Claims: 36%
- Crime: 81%
Small Footprint of cohort members never in any high-cost group:

- Cohort: 30%
- Social Welfare: 6%
- Fatherless Children: 3%
- Smoking: 7%
- Excess Weight: 1%
- Hospital Stays: 7%
- Prescription Fits: 3%
- Injury Claims: 15%
- Crime: 0%
THE OUTLINE

- The Dunedin Study
- High-cost actors
- Childhood risks
- Concentration of high-cost actors
- High-need/high-cost population segment: Can it be predicted?
- How early can we tell?
- Implications
How well do childhood risk factors predict adult outcomes? Predicting a single sector vs. high-need/high-cost group

<table>
<thead>
<tr>
<th>Categorical</th>
<th>Dimensional</th>
<th>Segment</th>
<th>Ultra-High Cost group</th>
</tr>
</thead>
<tbody>
<tr>
<td>IQ</td>
<td>Self-Control</td>
<td>SES</td>
<td>Maltreatment</td>
</tr>
<tr>
<td>Large Effect</td>
<td>0.38</td>
<td>0.36</td>
<td>0.52</td>
</tr>
<tr>
<td>Medium Effect</td>
<td>0.19</td>
<td>0.26</td>
<td>0.29</td>
</tr>
<tr>
<td>Small Effect</td>
<td>0.07</td>
<td>0.15</td>
<td>0.32</td>
</tr>
</tbody>
</table>

- Large Effect indicates a large effect size.
- Medium Effect indicates a medium effect size.
- Small Effect indicates a small effect size.
Elaboration of the ROC-AUC

- 2 kinds of prediction combined...
  - Sensitivity (true positives): Proportion of study members who grew up to be high-cost users who were correctly predicted
  - Specificity (false positives): Proportion of study members who did not become high-cost users who were correctly predicted

- Area Under the Curve:
  - AUC=0.5 is random, no better than chance
  - AUC=1 is perfect prediction
  - **AUC > .80 supports medical decision-making**
ROC-Curve Discriminating Individuals in 0 vs. 1 User Group

1 grp Area Under the Curve = 0.60

2 grps Area Under the Curve = 0.73

3+ grps Area Under the Curve = 0.87
Each Childhood Predictor Does Well on its Own

- True Positive Rate vs False Positive Rate for different predictors:
  - All Predictors (0 vs 3+)
  - IQ Only
  - Self-Control Only
  - Socio-Economic Status Only
  - Maltreatment Only
  - Chance Guess
THE OUTLINE

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Age-3 Brain Health:
45-minute standardized assessment of Dunedin cohort 3-year-olds in 1975

- Neurologist’s examination of soft signs
- Peabody Picture IQ test
- Reynell Receptive Language test
- Bayley Motor Skills test
- Examiner-rated poor behavior control
Age-3 Brain Health predicts high-need/high-cost group

- 0 vs. 3+ High-Cost Groups = Ultra-High-Cost Group* (AUC = 0.79)
- 0 vs. 2 High-Cost Groups* (AUC = 0.68)
- 0 vs. 1 High-Cost Group* (AUC = 0.62)
MORE OF THE HIGH-NEED HIGH-COST SEGMENT MADE A SUICIDE ATTEMPT LIFETIME

**Percent with Suicide Attempt**

<table>
<thead>
<tr>
<th>Number of High Cost User Groups</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
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<td>None</td>
<td>4%</td>
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<td></td>
<td></td>
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<tr>
<td>1</td>
<td>7%</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>8%</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3 or more</td>
<td>38%</td>
<td></td>
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</tbody>
</table>
THE OUTLINE

- The Dunedin Study
- High-cost actors
- Childhood risks
- The high-need/high-cost population segment
- How early can we tell?
- Implications: A Pandora’s box?
Implications: Pareto Principle
Compare across nations, age-groups, economic-historical periods
Summary of findings

• 20% of people contribute 80% of social/health problems.

• A high-need/high-cost population segment uses ~half of public resources.

• Most people in this segment share risk factors in the first decade of life;

• Prediction is stronger than thought; AUC approaches .90.

• Brain integrity in the first years of life is important.

Seen in this way, early-life risks seem important enough to warrant investment in early-years preventions.
High-need/high-cost vs. Low-cost segments
The prosperity of a nation is closely linked to the health and wellbeing of its children.