The Effect of School Physical Education Instruction Time on Child Obesity

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Our research questions

- How does length of physical education (PE) instruction time relate to obesity development for a national cohort of children between 1st and 5th grade?

- Is PE instruction time more effective in obesity prevention for children with certain characteristics?

- Most prior studies evaluate PE class content changes for schools in a limited geographic area
- One national study evaluating 1-year change (Datar and Sturm, 2004)
- We extend on this study
Early Childhood Longitudinal Survey (ECLS-K)

- Base sample is representative of kindergartners across the United States in 1998-1999
- Our panel data consists of three waves
  - spring of 1st, 3rd and 5th grades
- Includes teacher, school administrator, parent and child assessment surveys
- Our 1st grade sample includes 8,930 children in 1,043 schools across 40 states
**Key variables**

- **Outcome measures**
  - BMI percentile (continuous)
  - Indicator for overweight (binary)
  Height and weight measured in every round of data collection

- **Explanatory measure**
  - Hours of PE instruction time per week (continuous)

“How many **times each week** do children in your class usually have physical education?”

“How much **time each day** do children in your class usually spend when they participate in physical education?”
BMI percentile distribution change

1st grade
5th grade
# Patterns over time

<table>
<thead>
<tr>
<th></th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Grade</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; Grade</th>
<th>5&lt;sup&gt;th&lt;/sup&gt; Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BMI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentile, average</td>
<td>62.1</td>
<td>66.0</td>
<td>67.2</td>
</tr>
<tr>
<td>Overweight, %</td>
<td>13.7</td>
<td>18.7</td>
<td>21.4</td>
</tr>
<tr>
<td><strong>PE instruction time</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minutes, average</td>
<td>64.3</td>
<td>68.0</td>
<td>77.1</td>
</tr>
<tr>
<td>Children meeting recommended amount, %</td>
<td>6.8</td>
<td>8.8</td>
<td>13.3</td>
</tr>
<tr>
<td><strong>Risk Behaviors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TV hours per week, average</td>
<td>6.3</td>
<td>6.3</td>
<td>6.9</td>
</tr>
<tr>
<td>Outside school sports participation, %</td>
<td>65.2</td>
<td>72.1</td>
<td>75.0</td>
</tr>
</tbody>
</table>


**Growth curve modeling (1)**

- Also known as random coefficients models.
- Motivation is nested structure of data – number of children per school ranges from 1 to 30 with an average of 9.
Growth curve modeling (2)

- Not a new statistical method, but a new application.
- Random intercepts are child and school.
- Fixed effects include child demographics, child risk behaviors, school characteristics and state dummies.
- Random slopes tested are PE class length at the school-level and age at the child-level.
- Fixed effect interactions tested to determine if PE instruction time is *more* effective for children with certain characteristics.
Main findings

- We find a significant effect for children who do not participate in sports outside school.
  - These children are more likely to be a minority and from a low-income household.
- We also find an effect for children who attend urban schools.
- Similar effects for boys and girls.
- Possible greater effect for overweight children.
**PE instruction time effective for children with no outside sports**

<table>
<thead>
<tr>
<th></th>
<th>No Outside Sports</th>
<th></th>
<th>Outside Sports</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>#1</td>
<td>#2</td>
<td>#1</td>
<td>#2</td>
</tr>
<tr>
<td><strong>Fixed Effects, coefficients</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE instruction time, hours</td>
<td>-0.56 *</td>
<td></td>
<td>0.62</td>
<td></td>
</tr>
<tr>
<td>Male (ref: female)</td>
<td>4.16***</td>
<td></td>
<td>1.8*</td>
<td></td>
</tr>
<tr>
<td>TV watched in past week, hours</td>
<td>0.15**</td>
<td></td>
<td>0.21***</td>
<td></td>
</tr>
<tr>
<td>School in rural area</td>
<td>7.34*</td>
<td></td>
<td>8.8***</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>65.8***</td>
<td>58.3***</td>
<td>63.3***</td>
<td>62.7***</td>
</tr>
<tr>
<td><strong>Random Effects, standard errors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School intercept</td>
<td>6.0</td>
<td>4.9</td>
<td>5.8</td>
<td>4.3</td>
</tr>
<tr>
<td>Child intercept</td>
<td>26.1</td>
<td>26.0</td>
<td>25.5</td>
<td>25.6</td>
</tr>
<tr>
<td>Child slope</td>
<td>4.4</td>
<td>4.1</td>
<td>4.0</td>
<td>3.9</td>
</tr>
<tr>
<td>Measurement intercept</td>
<td>9.2</td>
<td>8.8</td>
<td>9.4</td>
<td>9.1</td>
</tr>
<tr>
<td>ICC-within school</td>
<td>0.05</td>
<td>0.03</td>
<td>0.05</td>
<td>0.03</td>
</tr>
<tr>
<td>ICC-within child</td>
<td>0.89</td>
<td>0.90</td>
<td>0.88</td>
<td>0.89</td>
</tr>
</tbody>
</table>
However - we do not find differential effects

PE instruction time has associated level effects on BMI percentile, but does not appear to be more effective for certain subgroups.

We do not find trajectory slope differences with:

Cross-level interactions with age, gender, outside sports participation and risk behaviors

Same-level interactions with urbanicity and school management type
Random effects

- In the empty model with no fixed effects we find:
  - An ICC of 0.05 for children within schools.
  - An ICC of 0.89 for repeated measurements within a child.
- The addition of fixed effects does not substantially reduce the level of unexplained variation.
- A random slope on age indicates that the growth trajectory of children is age-dependent.
Interpretation

- One hour more of PE instruction time results in -0.56 BMI percentile units between 1st and 5th grade for children who do not participate in sports outside of school.
- This is roughly equivalent to 9% of the average BMI percentile increase between 1st and 5th grade for the sample (5.8 units).
- Similar effects found for males and females.
Conclusions

- PE programs as currently implemented in schools may affect obesity development for some children.
- Length of PE instruction time has a significant negative impact on BMI percentile for children who do not participate in sports outside school.
- However, length of PE instruction time has no effect on the slope of BMI percentile trajectory.
Limitations of our study

- Length of PE instruction time is only one dimension of quality.
- Changes to improve other aspects of program quality may improve effectiveness of current time allocation to PE class.
Comments/Questions?