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Active Commuting to School and Association with Physical Activity and Adiposity among US Youth

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Background

- Increasing childhood physical activity (PA) to prevent childhood obesity
  - Healthy People 2010
  - American Heart Association
  - American Cancer Society
  - 2008 Physical Activity Guidelines for Americans
Decline in Physical Activity

Average Weekday and Weekend Minutes of MVPA by Gender

Nader, P. R. et al. JAMA 2008;300:295-305.
Active Commuting to School (ACS)

- ACS and PA: 28 more minutes MVPA (Lee 2008)
  - Self/parent reported PA (16 of 25 studies)
- ACS and adiposity: mixed findings
  - Compensation for increased PA of ACS by decreasing other types of PA?
- Limitations of previous studies:
  - Small or regional samples
  - PA subjectively measured by recall
  - None controlled for dietary energy intake
Hypotheses

1. ACS positively related to MVPA
2. ACS inversely related to adiposity
NHANES 2003-2004

- Continuous series of cross-sectional surveys conducted by CDC
- Complex, stratified, multistage, probability cluster sampling design
- Nationally representative sample of the civilian, non-institutionalized US population
  - Surveillance for Healthy People 2010
Methods

- Subjects
  - Inclusion: 12-19 years old (in school)
  - Age range for questions on ACS

- Main outcome measures (adiposity)
  - BMI-z score
  - Sum of triceps + subscapular skinfolds (mm)
Outcomes

- MVPA: Accelerometers (Actigraph 7164)
  - Valid Day: \( \geq 10 \) hours of wear
  - Data used if \( \geq 4 \) valid days of wear
  - 1-min epochs
  - MVPA threshold set at 4 METs
  - Mean total min. MVPA/day
  - Before- and after school min. MVPA/day: Mon-Fri 6:30 to 9 am and 2:30 to 4 pm

*Troiano et al 2008*
Covariates

- Age
- Gender
- Race/ethnicity
- Poverty to income ratio
- Dietary energy intake (kcal)
  - Mean of two, 24-hour dietary recalls using USDA Automated Multiple Pass Method
Main Exposure: ACS (min/d)

- Over the past 30 days, have you walked or bicycled as part of getting to and from work, or school, or to do errands? (yes/no)
- Over the past 30 days, how often did you do this? (times per day, week, month)
- On those days when you walked or bicycled, about how long did you spend altogether doing this? (minutes)
Analyses: DV=MVPA

- Multivariate linear regression
  - Independent variable: ACS
  - Dependent variable: MVPA (total daily or before- and after-school)
  - Covariates: sociodemographics and energy intake (kcal)
Multivariate linear regression
- Independent variable: ACS
- Dependent variable: BMI-z score or skinfolds
- Covariates: sociodemographics and energy intake (kcal)
- $\alpha = 0.05$ for significance
## Participants

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n</th>
<th>% (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>379</td>
<td>48.6 (1.7)</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic White</td>
<td>198</td>
<td>64.7 (5.2)</td>
</tr>
<tr>
<td>Non-Hispanic Black</td>
<td>276</td>
<td>15.2 (2.3)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>276</td>
<td>12.3 (3.1)</td>
</tr>
<tr>
<td>Other</td>
<td>39</td>
<td>7.8 (2.0)</td>
</tr>
</tbody>
</table>
Results: Daily min. MVPA

R²=0.31, p=0.024

*controlling for age, gender, race/ethnicity, and income, and energy intake
**Results: Skinfolds**

![Graph showing the relationship between skinfolds and active commuting minutes per day.](image)

- Skinfolds (mm): 27.5 to 30.5
- Active Commuting (min/day): 0 to 60

**R\(^2\)=0.12, p=0.029**

*controlling for age, gender, race/ethnicity, and income, and energy intake*
Results: BMI-z score

\[ R^2 = 0.05, \ p = 0.046 \]

*controlling for age, gender, race/ethnicity, and income, and energy intake*
Strengths

- Nationally representative sample
- Objective measure of physical activity
- Controlled for energy intake (kcal)
  - MVPA model $R^2 = 0.31$
Limitations

- Cross-sectional
- No data on distance from school, built environment, neighborhood safety
- Main exposure assessed by recall
Implications

- ACS as potential means to broadly improve physical activity and prevent obesity among US youth
- Need for RCTs to assess ACS and impact on physical activity and adiposity
Acknowledgements

- Kathy Watson and Nga Nguyen (statistics)
- Collaborators: Ester Cerin, PhD, Tom Baranowski, PhD, and Theresa Nicklas, DrPH
- Colleagues and staff in CNRC and Academic General Pediatrics, Baylor College of Medicine
- Funding: USDA
Active Commuting to School and Association with Physical Activity and Adiposity among US Youth

February, 2009

Author:
Jason Mendoza, M.D., M.P.H., Kathy Watson, M.S., Ester Cerin, Ph.D., Tom Baranowski, Ph.D., & Theresa Nicklas, Dr.P.H.

Topic:
Schools, Walking and Biking to School

Population Served:
African American, Latino/Hispanic, Multiple Race/Ethnic Sample, School-age Youth (K-12), White

Location by State:
National

Study Type:
Correlates

Description:
Presentation at the 2009 Active Living Research Annual Conference

Background:
Studies have reported inconsistent findings for the relationship between active commuting to school (ACS) and physical activity or weight status/adiposity among youth. These mixed findings may be due to reliance on self-report measures of physical activity, samples drawn from specific populations, inadequate statistical power, or lack of data on dietary energy intake, which may confound the relationship. No reports have examined physical activity as a mediator of active commuting and weight status/adiposity.

Objectives:
To examine (1) the relationship between ACS and weight status/adiposity and (2) whether moderate-to-vigorous physical activity (MVPA) mediates the relationship between ACS and weight status/adiposity among a nationally representative sample of US youth.

Methods:
We conducted a cross-sectional analysis using multiple linear regression models on a nationally representative sample of participants aged 12-19 years from NHANES, 2003-2004 (n=827 unweighted, n= 15,946,216 weighted). The main exposure variable of ACS was assessed by recall of walking or bicycling as part of getting to and from school over the past 30 days. Anthropometric measurements (height and weight for BMI-z, waist circumference, skinfold thicknesses [sum of subscapular and triceps]) were obtained using standardized techniques and equipment. Physical activity was objectively measured by
accelerometers, using 1-minute epochs. Besides overall daily MVPA, we also examined the subset of before- and after-school MVPA (Mon - Fri: 6:30-9 am and 2:30-4 pm). Dietary energy intake was a covariate and calculated from the mean of two 24-hour recalls. Other covariates included age, gender, race/ethnicity, and poverty-to-income ratio. We used the product-of-coefficients method to test for mediation.

Results:
32.9% of participants aged 12-19 years actively commuted to school at least two days per week. In multivariate models, controlling for age, gender, race/ethnicity, poverty-to-income ratio, and energy intake, ACS was inversely associated with BMI-z score (std. beta=-0.08, p=0.040, \(R^2=0.06\)) and skinfold thicknesses (std. beta=-0.06, p=0.033, \(R^2=0.13\)). ACS was positively associated with overall daily MVPA (std. beta=0.11, p=0.039, \(R^2=0.28\)) and with before- and after-school MVPA (std. beta=0.20, p<0.001, \(R^2=0.22\)). Before- and after-school MVPA significantly mediated the relationship between ACS and waist circumference (p=0.03) and skinfold thicknesses (p=0.03). Total minutes of MVPA mediated no relationships.

Conclusions:
Among a nationally representative sample of US youth, active commuting to school was associated with lower BMI-z and adiposity. Additionally, those who actively commuted to school achieved greater MVPA. Before- and after-school MVPA was a mediator between ACS and measures of obesity and body fatness. ACS appears to be an important behavior to target for population-based physical activity promotion and obesity prevention interventions.

Support:
US Department of Agriculture Current Research Information System

RELATED TOOLS & RESOURCES
All Tools & Resources
Pilot and Feasibility Evaluation of a Walking School Bus Policy Intervention for Elementary School Students

Document Type: Project Profile
Topics:
Schools, Safe Routes to School, Walking and Biking to School