Evaluating the Impact of Safe Routes to School Infrastructure on Active Commuting and Child Physical Activity in Central Texas Schools

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Healthier Texas Summit
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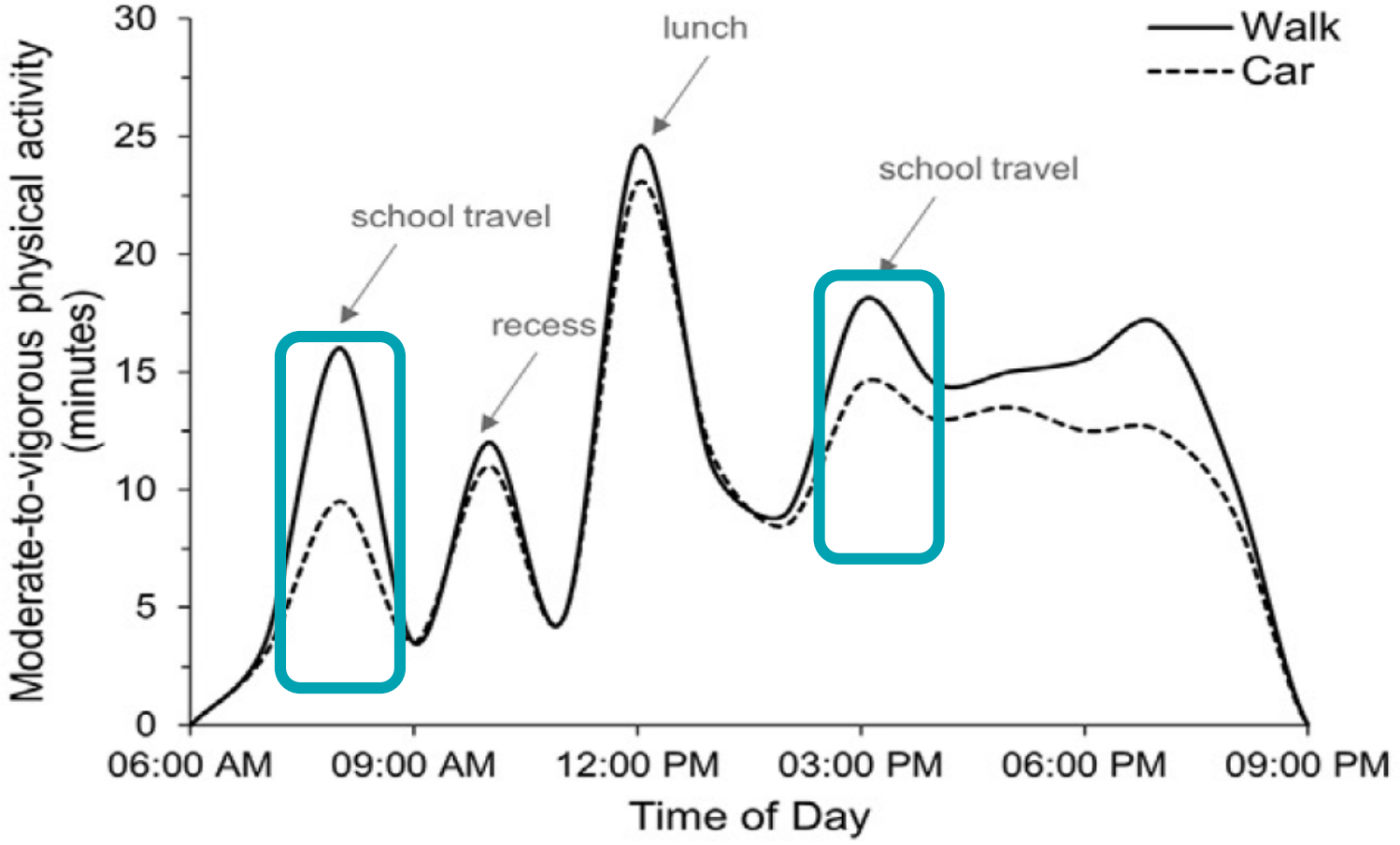
Importance of Active Travel for Children

Martin et al (2016); Cooper et al (2003); Cooper et al (2012); Campos-Garzón et al (2023)



Active school travel may contribute up to **48%** of the physical activity recommendations in young people on school days.

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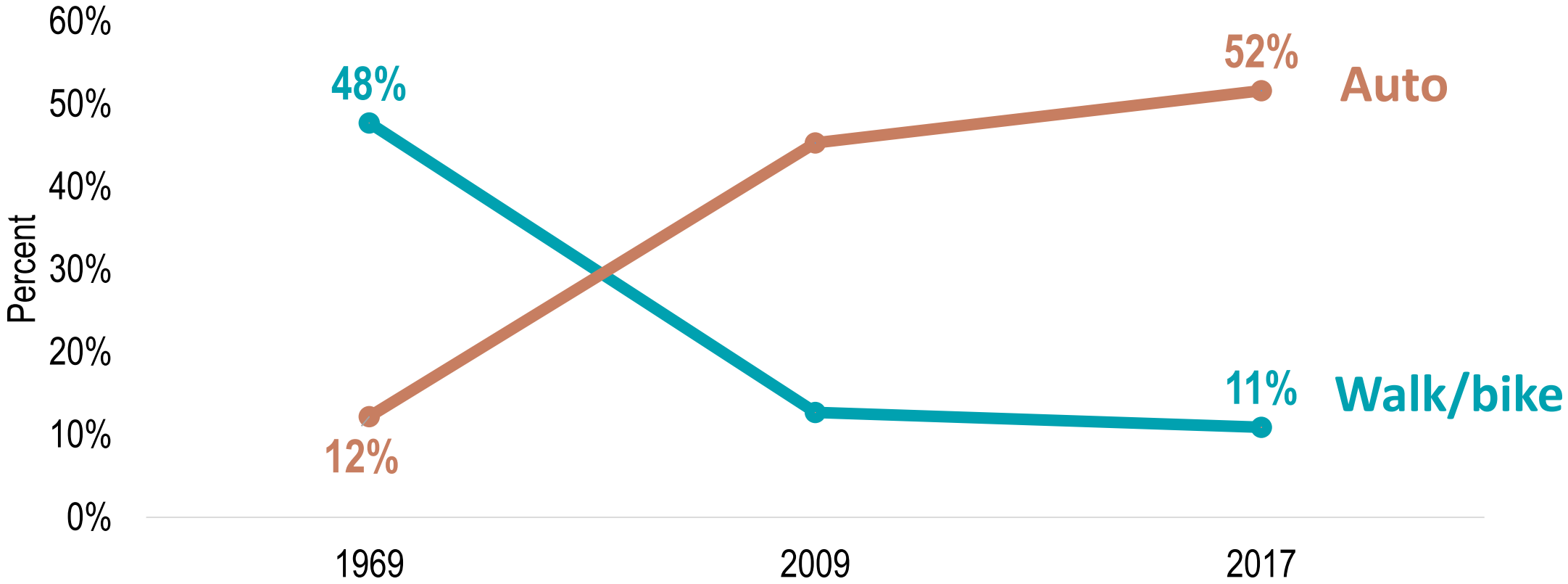
Status of ACS in Children in the US

Travel Mode to/from School in Elementary Schools in the US



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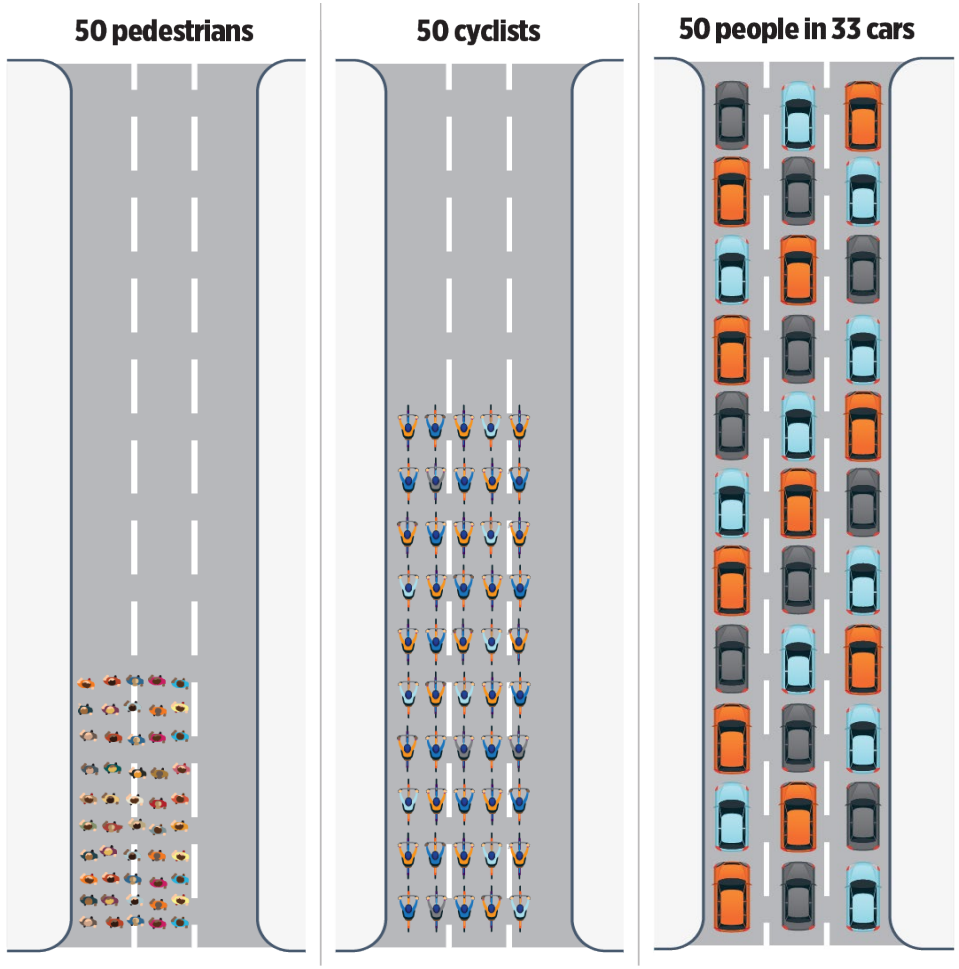
Environmental Benefits of ACS

- Small form factor
- Clean transportation
- Fewer wastes and resources



Hong et al (2018)

STREETS Study Aims

To evaluate the effects of $27.5 million USD allocated to Safe Routes to School infrastructure in Austin, Texas, USA.

STREETS
SAFE TRAVEL ENVIRONMENT EVALUATION IN TEXAS SCHOOLS

Aim 1

Determine effects of SRTS infrastructure changes on **child physical activity**.

Aim 2

Determine effects of SRTS infrastructure changes on **active commuting to school**.

Aim 3

Examine the **cost effectiveness** of SRTS infrastructure changes on child physical activity levels.

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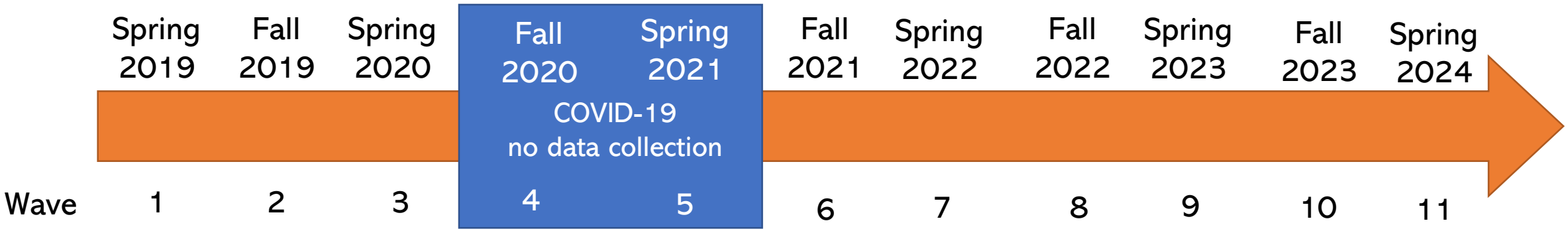
Study Design & Data Collection

- Serial cross-sectional sample; longitudinal study
- Data collection:
  - Jan 2019-May 2024 each spring and fall - 11 waves
  - 92 elementary schools
    - 69 Infrastructure schools (municipal-funded)
    - 23 Comparison schools (surrounding school districts, no infrastructure funding)
  - No data collection for Wave 4 (fall 2020) and Wave 5 (spring 2021) due to COVID-19

Analytic Sample



- The baseline measurement (1st measured wave) for participating schools ranged from Wave 1 (Spring 2019) to Wave 7 (Spring 2020)
- To control for confounding effects, only schools with the baseline at Wave 1 or Wave 2 were included in the analysis:
  - 84 elementary schools (91%)
    - 64 infrastructure schools
    - 20 comparison schools

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Variables and Measures

School-level ACS

- SRTS tally recorded by teachers
- Grade 3-5 classrooms
- Tuesday, Wednesday, and Thursday: AM & PM
- School-level total ACS trips:
  - Number of trips to/from schools made by walking or biking
  - Summed across classrooms; average of percentages in each school

SRTS infrastructure

- Intention-to-treat analysis: Infrastructure schools vs. comparison schools
  - Expose to SRTS infrastructure vs. not exposed to SRTS infrastructure
- Policy implementation analysis: Infrastructure implementation status in infrastructure schools at each wave
  - Pre, during, and post-construction

Analysis

- Mixed-effect linear models using R and SAS, with the school as the level of analysis, controlling for school-level covariates
  - School-level characteristics:
    - Texas Education Agency – academic year 2018
      - Total school enrollment, number of girls, % race/ethnicity, community type (urban versus suburban), % economically disadvantaged students, % students with limited English proficiency.
  - Daily weather information:
    - NOAA Local Climatological Data.
    - Average daily weather measurements across Tuesday, Wednesday, and Thursday:
      - Mean daily maximum dry bulb temperature, mean daily precipitation, mean daily average wind speed

Participating School Characteristics

	Infrastructure vs. Comparison	
Total school enrollment	558	656
The number of girls	271	321
% major urban communities	86%	15%
% economically disadvantaged students	58%	38%
% limited English proficiency students	37%	17%
Number of measured waves	6.2	4.6

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School-level ACS over time: Analysis 1

Analysis 1: "Intention-to-Treat" policy intervention

Infrastructure schools
N=64

- Municipal bond funding in Central Texas
- Exposed to SRTS construction: infrastructure status at each wave

Comparison schools
N=20

- Similar to infrastructure schools located in central Texas
- No municipal funding
- Not exposed to SRTS construction

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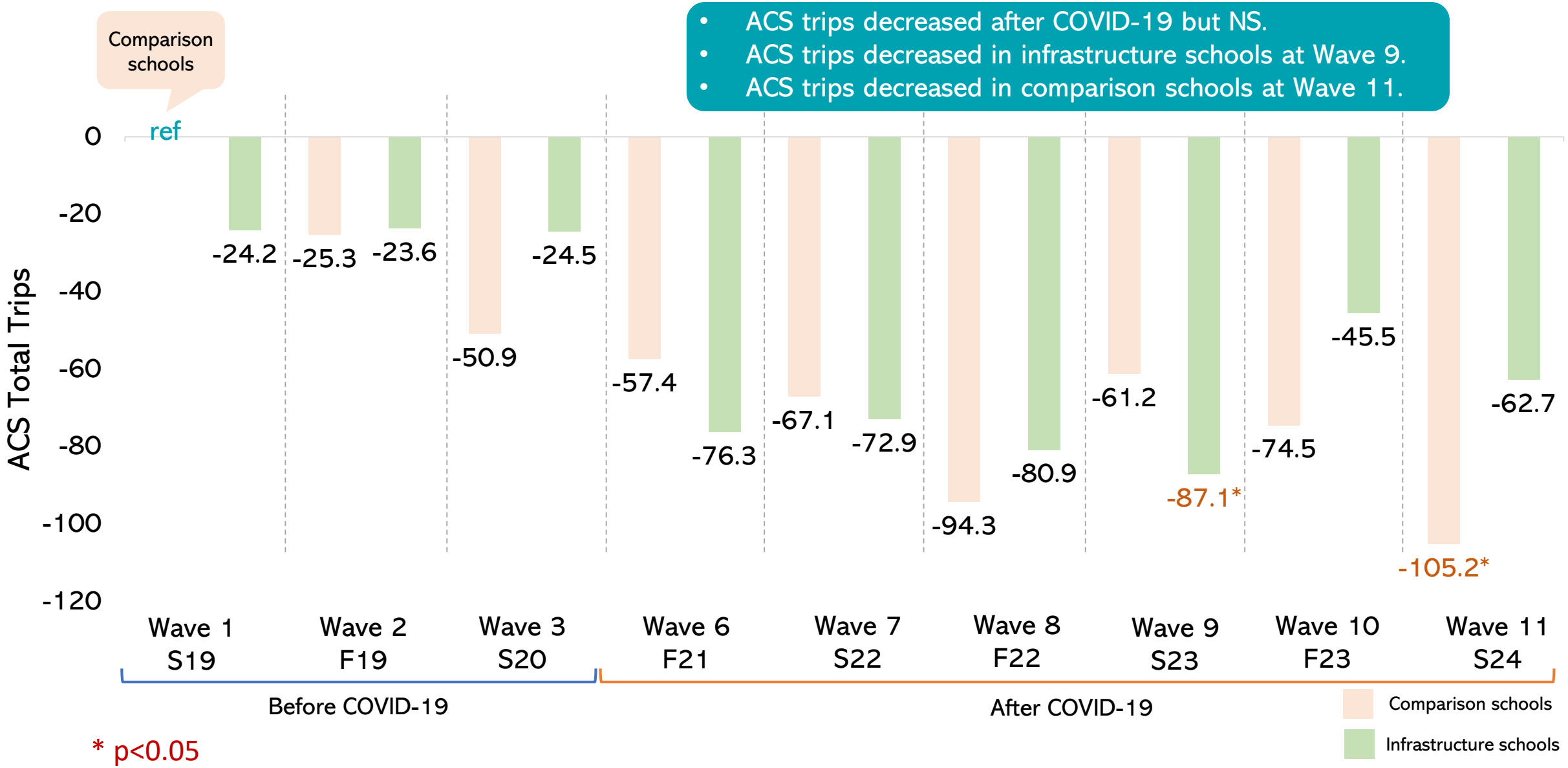
School-level ACS over time: Intention-to-Treat policy intervention in schools (Analysis 1)

- ACS trips decreased after COVID-19 but NS.
- ACS trips decreased in infrastructure schools at Wave 9.
- ACS trips decreased in comparison schools at Wave 11.



* p<0.05

School-level ACS over time: Analysis 2

Analysis 1: "Intention-to-Treat" policy intervention

Analysis 2:
Policy implementation in infrastructure schools

Infrastructure schools
N=64

- Municipal bond funding in Central Texas
- Exposed to SRTS construction: infrastructure status at each wave

Comparison schools
N=20

- Similar to infrastructure schools located in central Texas
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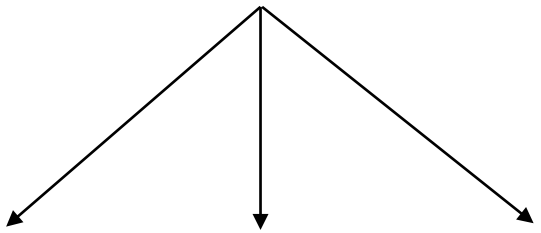

Pre During Post (at least 1 construction done)

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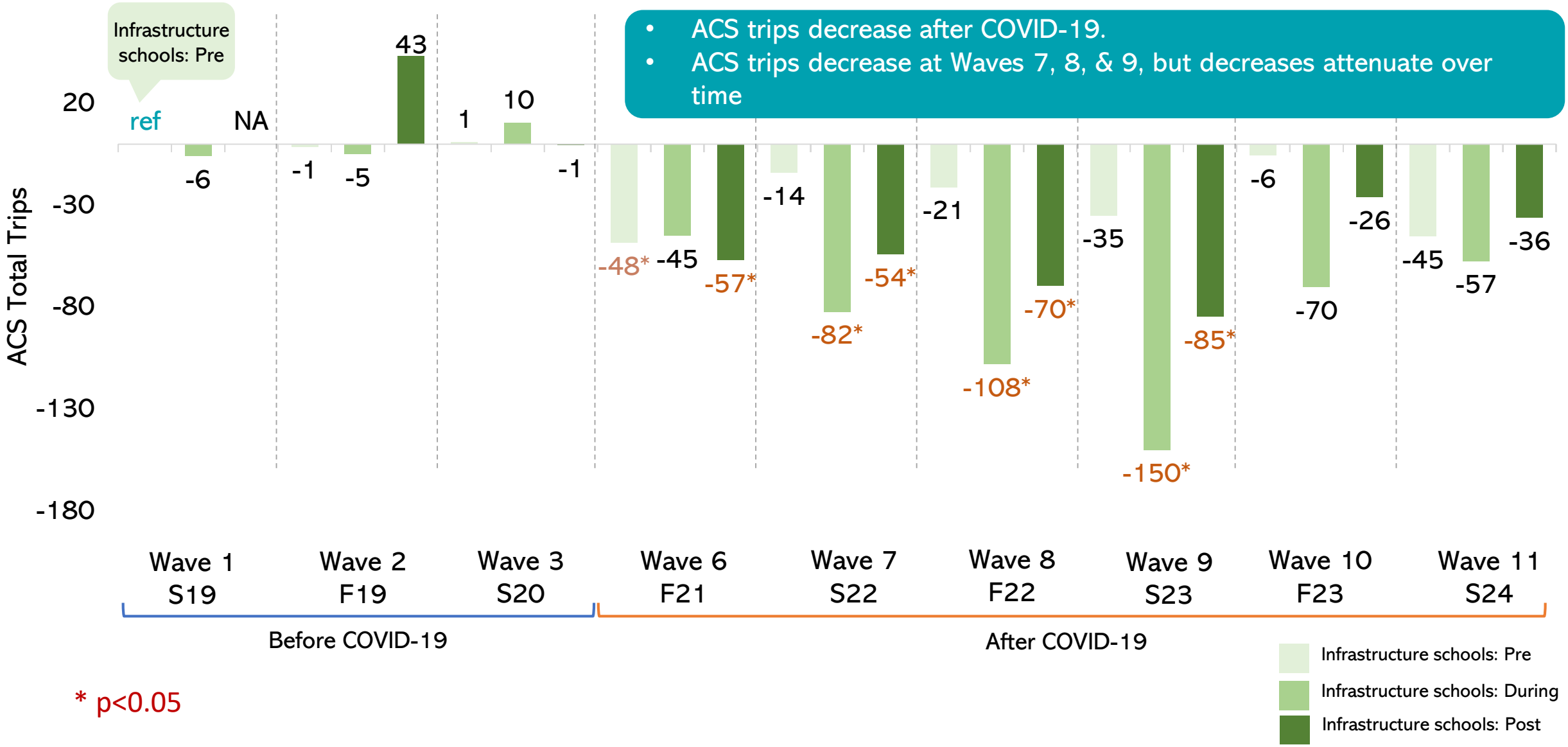
School-level ACS over time: Policy implementation in infrastructure schools (Analysis 2)



* p<0.05

Conclusions

- SRTS infrastructure negatively affects ACS in the short-term because of construction periods.
- Attaining positive effects in ACS after urban transformations may require longer follow-up periods.
- Infrastructure changes are essential, but other promotional, educational, and cultural supports are needed to promote and sustain behavior change.
- ACS behaviors changed after COVID-19, but longer follow-up is needed to see if these changes persist.

STREETS Project Findings:

Examining changes in overall physical activity levels using device-based data

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Overarching Question:

Do Safe Routes to School infrastructure improvement projects make a difference for overall child physical activity levels over time?

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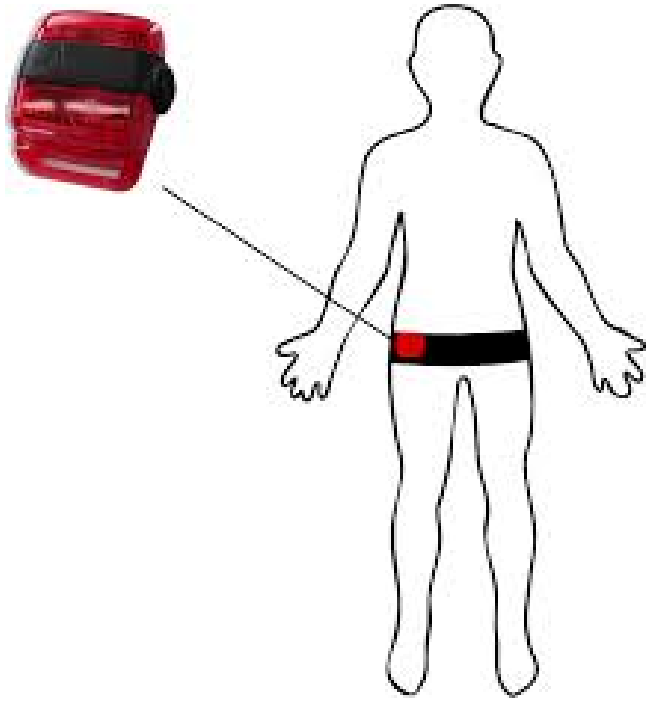
Why It Matters

- Only 24% of children and adolescents in the United States meet physical activity guidelines.
- Participation in physical activity declines with age, with steep declines as children transition into adolescence.
- Active travel can be a major contributor to overall physical activity among school-age children, but most children in the U.S. have limited active travel opportunities.
- Safe and supportive built environment infrastructure is critical for active travel at all ages, and it is especially true for the youngest and youngest road users.

Benefits of Light-Intensity Physical Activity

- Active travel (walking, cycling) usually involves physical activity of light-to-moderate intensity.
- **Light-intensity physical activity:**
  - Increases cerebral blood flow in children.
  - Optimizes learning outcomes.
  - Is associated with weight control in children and adolescents above and beyond the effects of MVPA.
  - Is associated with healthier cardiometabolic profiles in adolescents.

Assessing Changes in Physical Activity in the STREETS Project



Actigraph wGT3X-BT

- A cohort of children attending STREETS Project schools was **recruited in the 3rd grade** and **followed through the 4th and 5th grades**.
- Accelerometers are piezoelectric devices that measure movement through acceleration.
- The device belt was worn for a full week during waking hours.
- Accelerometer data can be used to derive total time spent in physical activities of different intensities.

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Accelerometer Measurement Schedule

Measure timepoint	Measure start pre-COVID		Measure start Post-COVID
	Cohort 2018-2019	**Cohort 2019-2020**	**Cohort 2021-2022**
Spring 2019	Grade 3 (baseline)		
Fall 2019	Grade 4	Grade 3 (baseline)	
Fall 2020	Grade 5 (1)	Grade 4	
Spring 2021	Grade 5 (2)		
Fall 2021		Grade 5 (1)	Grade 3 (baseline)
Spring 2022		Grade 5 (2)	
Fall 2022			Grade 4
Fall 2023			Grade 5 (1)
Spring 2024			Grade 5 (2)

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Spring 2022		Grade 5 (2)	
Fall 2022			Grade 4
Fall 2023			Grade 5 (1)
Spring 2024			Grade 5 (2)

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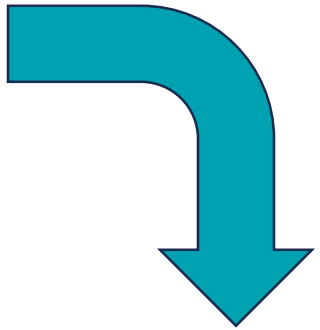
Fall 2020	Grade 5 (1)	Grade 4
Spring 2021	Grade 5 (2)	
Fall 2021		Grade 5 (1)
Spring 2022		Grade 5 (2)



Measurement	Grade	Semester
Baseline measure	Grade 3	Spring 2019, Fall 2019
Second Measure	Grade 4	Fall 2019, Fall 2020
Last Measure: the furthest one in Grade 5	Grade 5 (1)	Fall 2020, Fall 2021
	Grade 5 (2)	Spring 2021, Spring 2022

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Analysis

- Mixed-effects linear regression models:
  - **Model 1 Outcome:** Total Physical Activity (LMVPA); **Model 2 Outcome:** MVPA
  - **Main exposure:** grade*infrastructure status (2-way interaction term)
  - **Covariates:** baseline physical activity, total school enrollment, percentage of economically disadvantaged students, percentage of students with limited English, proportion of sidewalk coverage at 1-mile buffer in 2018, child sex, child race, and parent education

Infrastructure schools (N=21), students at baseline (N=275)

- Municipal bond funding in Central Texas

Infrastructure status at each measurement time

- No construction
- During 1st construction
- 1st construction completed
- During 2nd construction
- 2nd construction completed

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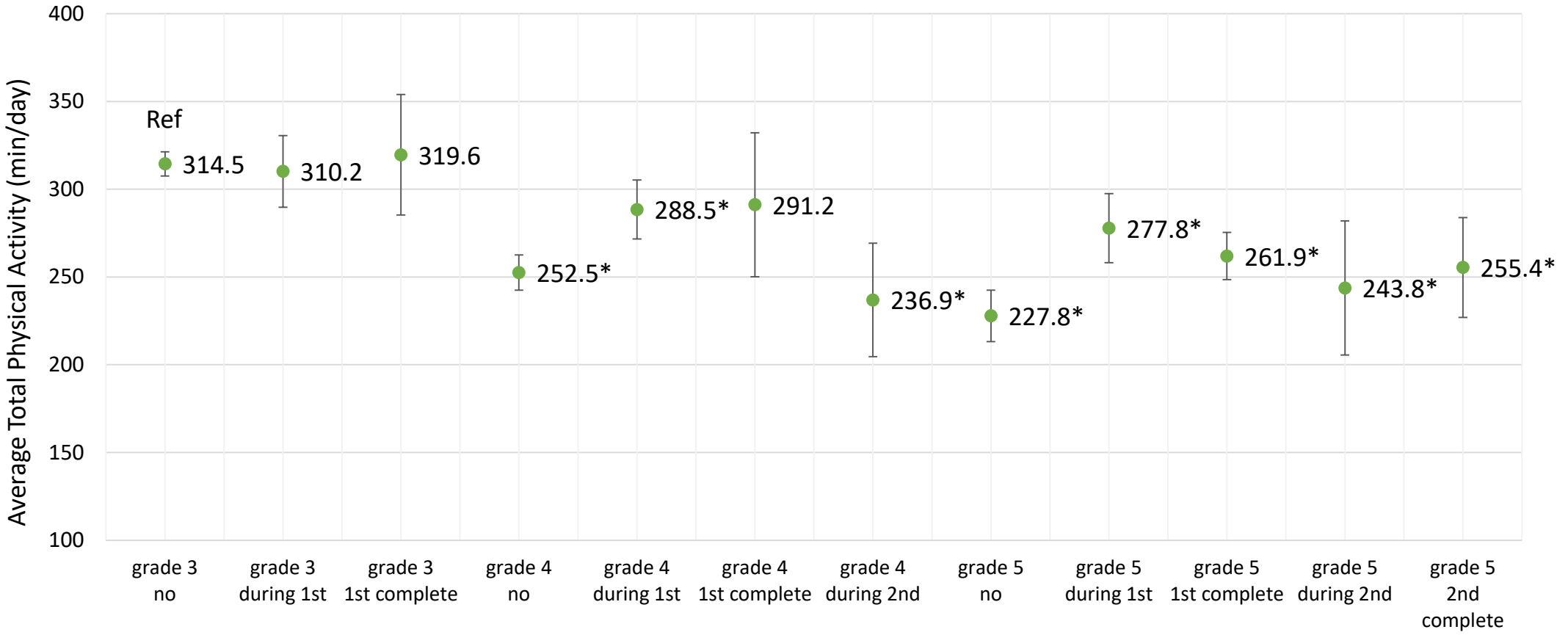
Results: Accelerometer-based Total Physical Activity (LMVPA)



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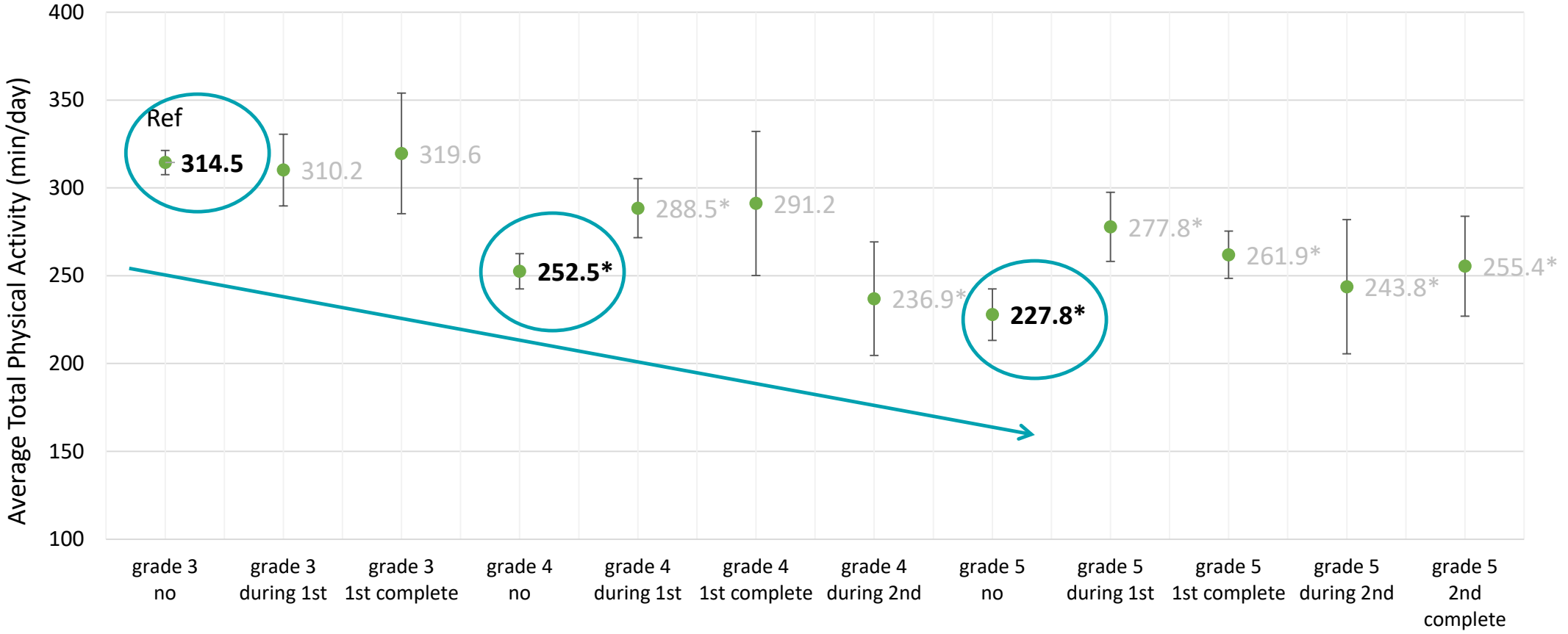

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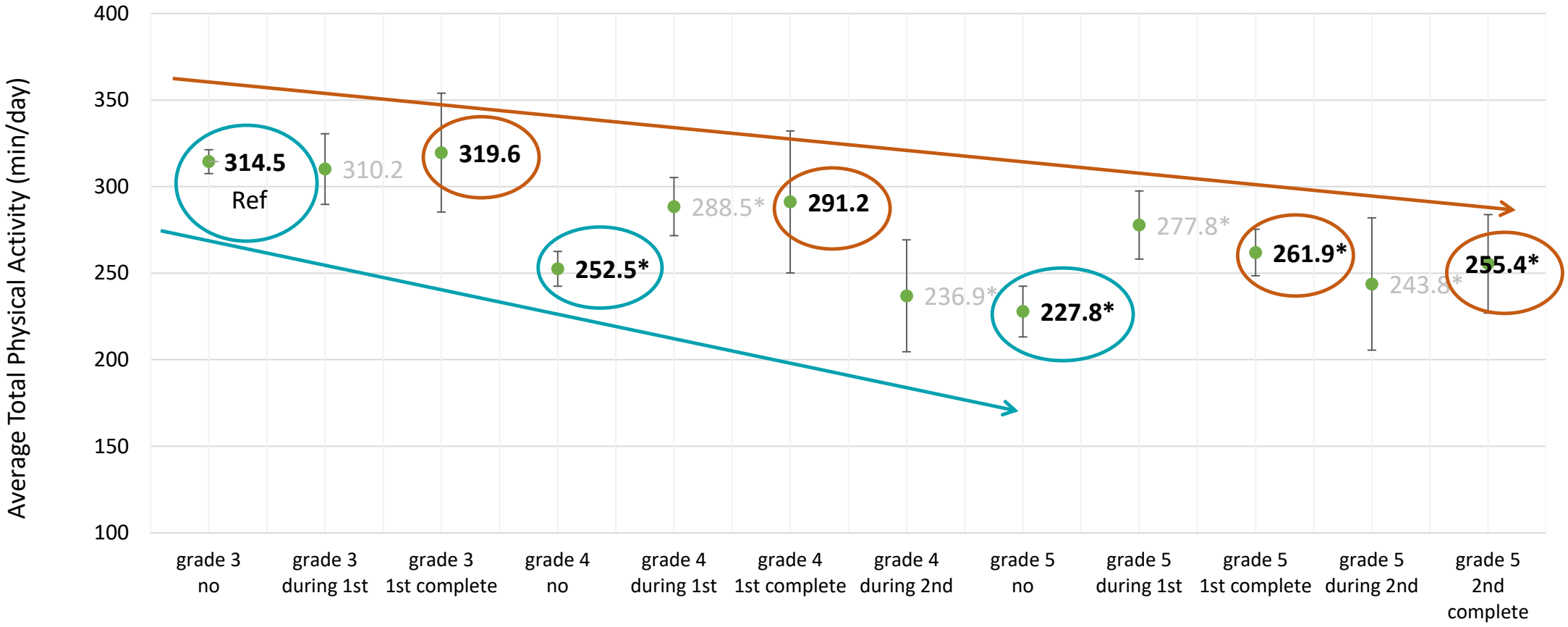

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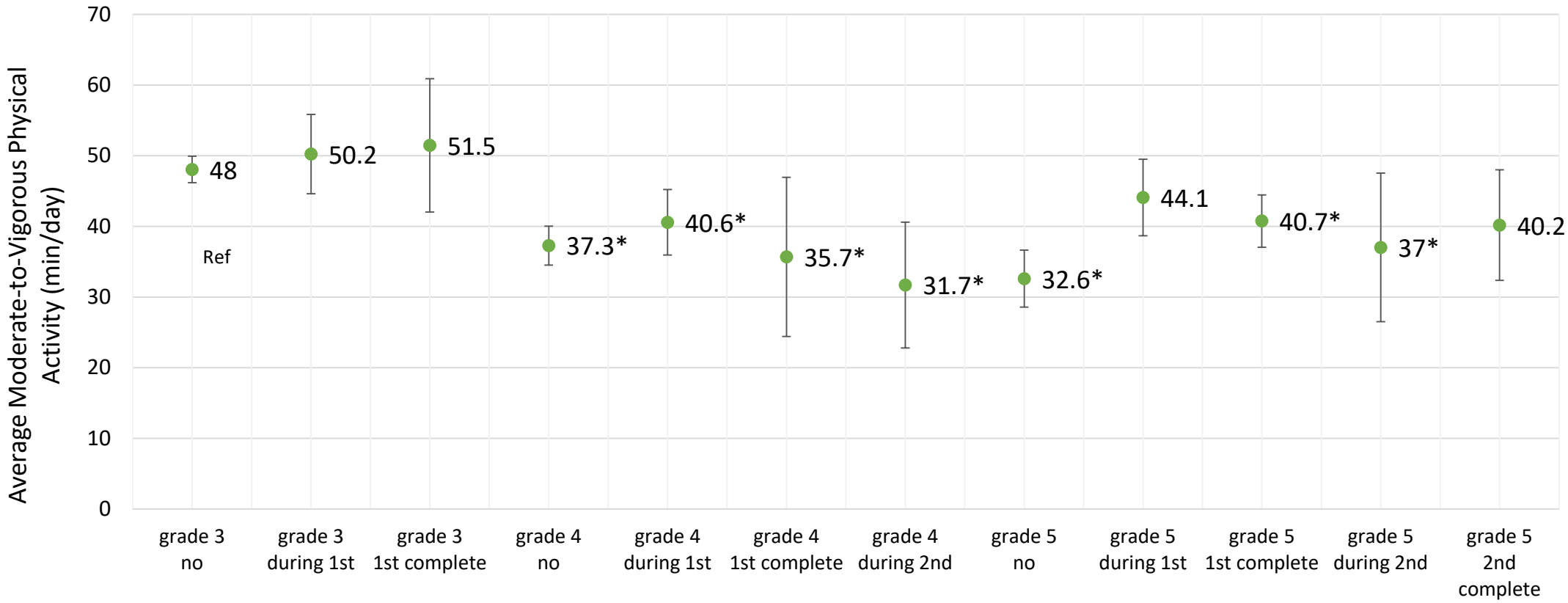
Results: Accelerometer-based MVPA



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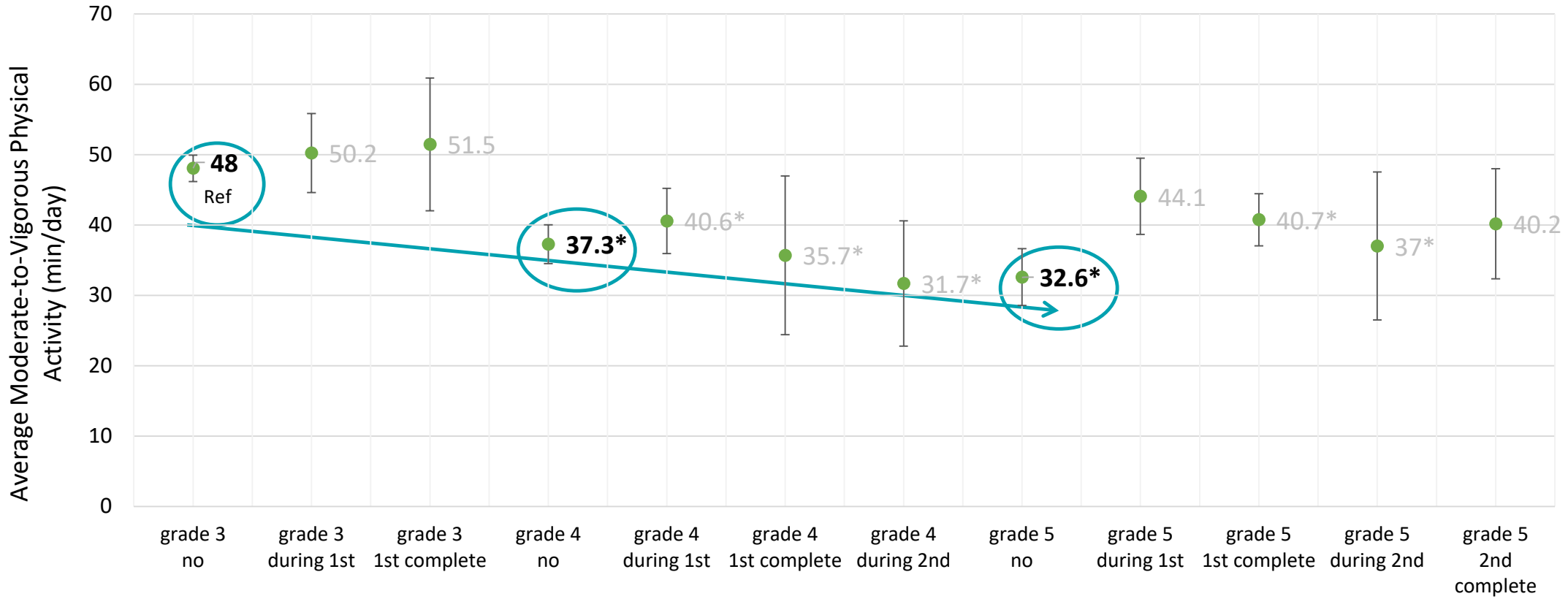

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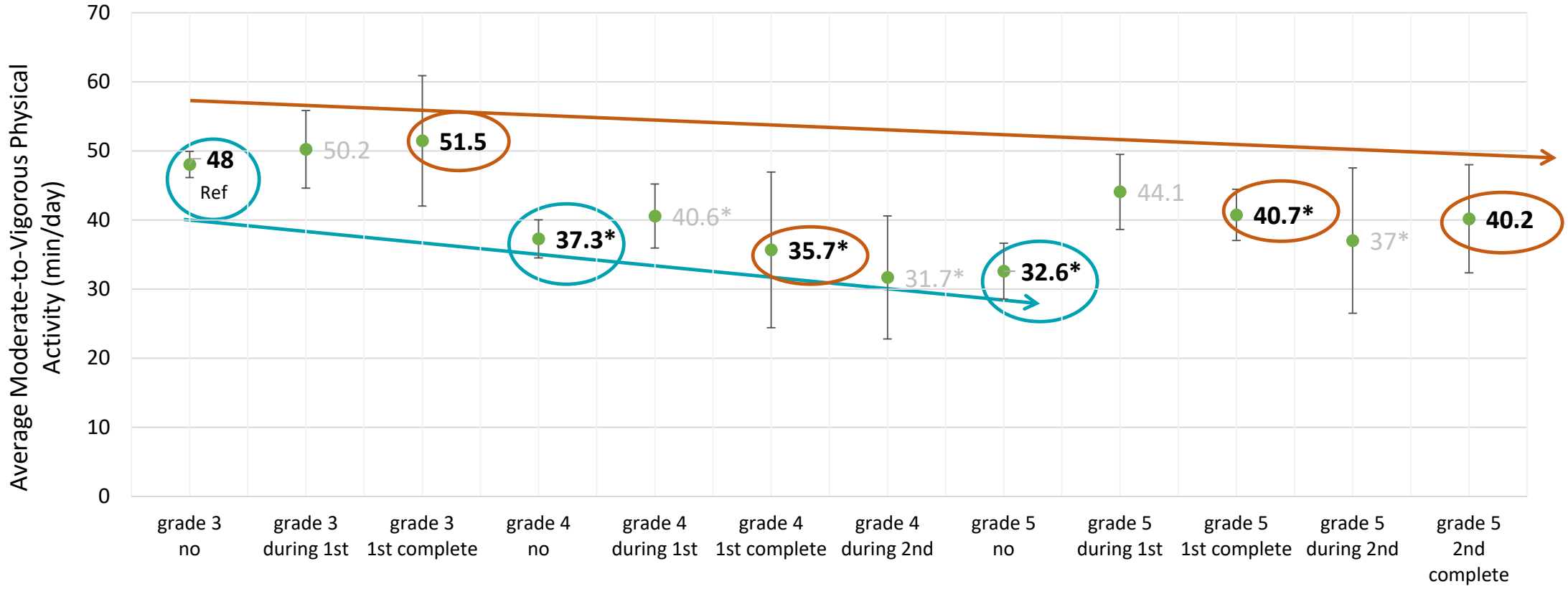
Results: Accelerometer-based MVPA



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Conclusions

- Children followed from the 3rd to the 5th grade that were never exposed to infrastructure changes showed an apparently steeper decline in both total and moderate-to-vigorous-intensity physical activity than children who were eventually exposed to infrastructure changes.
- Infrastructure changes may be supporting more light-intensity physical activity, presumably through increases in active community to school.
- Children exposed to 2 infrastructure projects by the 5th grade have no significant declines in MVPA relative to their levels in the 3rd grade, suggesting that high doses of SRTS infrastructure may slow down expected age-related declines.
- More work is needed to confirm these associations.

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THANK YOU!

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Team members

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- Dr. Deb Salvo
- Dr. Adriana Pérez
- Dr. Leigh Ann Ganzar
- Dr. Yuzi Zhang
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- Sarah Bentley, MPH
- Dr. Katie Burford
- Dr. Kaitlyn Swinney
- Dr. Kevin Lanza

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- UTHealth Houston, School of Public Health in Austin
- Michael & Susan Dell Center for Healthy Living
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Number of Participating Schools & School-level %ACS

	Infrastructure Schools, N=64				Comparison Schools, N=20			
Wave	N	Total	To School	From School	N	Total	To School	From School
1	60	13.1 (9.7)	10.3 (7.7)	16.0 (12.7)	6	14.4 (10.9)	13.3 (11.4)	17.6 (11.1)
2	54	14.4 (12.0)	12.9 (10.5)	15.9 (14.4)	19	14.4 (9.6)	11.6 (8.4)	17.3 (11.3)
3	44	13.6 (10.5)	10.2 (8.5)	16.9 (13.5)	15	14.3 (10.4)	10.4 (9.1)	18.3 (12.8)
4	No data collection during COVID-19							
5								
6	45	13.8 (10.2)	12.0 (9.4)	15.5 (11.4)	9	15.2 (12.0)	12.4 (11.4)	18.0 (12.7)
7	41	12.3 (10.5)	10.0 (8.6)	14.6 (12.8)	12	11.9 (9.6)	8.4 (7.2)	15.5 (12.3)
8	41	13.2 (10.7)	11.8 (10.0)	14.6 (11.7)	8	9.0 (7.3)	5.8 (5.4)	12.6 (9.8)
9	35	12.7 (10.4)	11.6 (10.7)	13.8 (10.6)	8	11.4 (9.3)	9.0 (9.4)	13.8 (9.7)
10	42	14.3 (12.8)	12.7 (12.1)	15.9 (14.2)	8	17.6 (11.2)	14.8 (10.3)	20.7 (12.4)
11	37	13.0 (12.7)	11.1 (11.7)	15.0 (14.0)	7	13.6 (8.5)	9.4 (6.6)	17.8 (11.0)