Measuring weather in active living research: Agreement between objective and perceived weather conditions from the national Safe Routes to School tally

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Background

- As extreme weather becomes more frequent and intense, reliable and validated weather measures are needed to evaluate the effects of climate change on children's physical activity (PA), including active commuting to and from school (ACS).
- The Safe Routes to School (SRTS) tally is a standard instrument for assessing student ACS, but teacher's perception of weather within this instrument has yet to be evaluated.

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Study Aim

To determine the agreement between teachers' perceived weather from the national SRTS tally and objectively measured weather conditions.

Methods

- The Safe TRavel Environment Evaluation in Texas School
- Secondary data analysis
    - Safe Routes to School tally data

STREETS
SAFE TRAVEL ENVIRONMENT EVALUATION IN TEXAS SCHOOLS

Hoelscher, D. M., Ganzar, L. A., Salvo, D., Kohl III, H. W., Pérez, A., Brown, H. S., ... & Durand, C. P. (2022). Effects of large-scale municipal safe routes to school infrastructure on student active travel and physical activity: design, methods, and baseline data of the safe travel environment evaluation in Texas schools (STREETS) natural experiment. *International Journal of Environmental Research and Public Health*, *19*(3), 1810.

Methods (cont.)

Teacher-perceived weather

- SRTS tally data collected from **January to May 2019**
- Collected using standard teacher-administered classroom tally among 3rd, 4th, and 5th grade classrooms
- Weather categories: sunny, rainy, overcast, snow

Key	Weather	Student Tally	Walk	Bike	School Bus	Family Vehicle	Carpool	Transit	Other
	S= sunny R= rainy O=overcast SN=snow	Number in class when count made	-	-	-	Only with Children from your family	Riding with children from other families	City bus, subway, etc.	Skate-board, scooter, etc.
Sample AM	S N	2 0	2	3	8	3		3	1
Sample PM	R	1 9	3	3	8	1	2	2	

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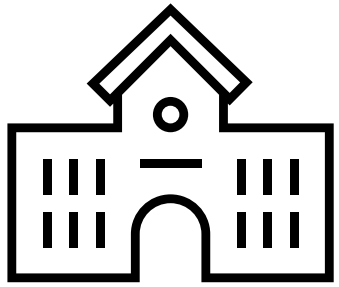
Methods (cont.)

Create school-level teacher-perceived weather variable per grade, date, day, and time based on reported weather mode among teachers per grade, date, day, and time



Grade 3 Classrooms

Grade 4 Classrooms

Grade 5 Classrooms

Tuesday	AM
	PM
Wednesday	AM
	PM
Thursday	AM
	PM

For example – School A has 7 grade 3 classrooms. All classrooms filled out the tally on Tuesday, January 8, 2019. In the morning, five teachers reported being overcast, and 2 reported being rainy. Since more teachers reported overcast, we used overcast as the teacher-perceived weather for grade 3, on Tuesday morning.

If mode could not be obtained, we excluded this school in the analysis.

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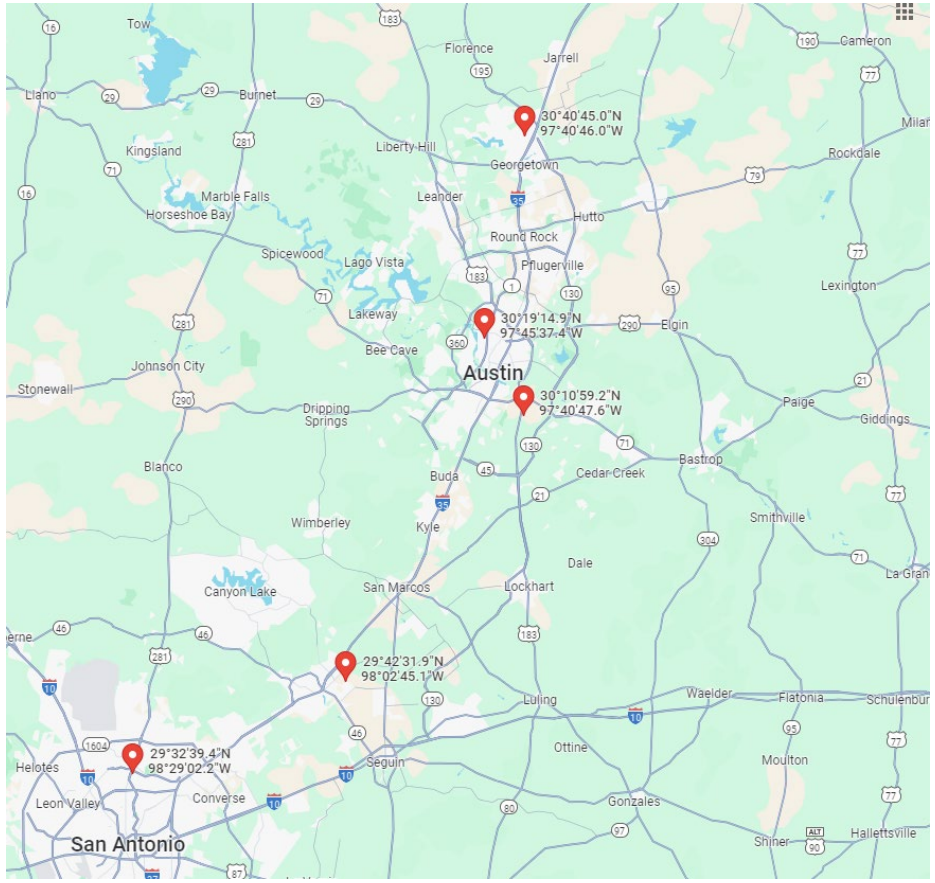
Methods (cont.)

Objective weather measurement

- National Oceanic and Atmospheric Administration (NOAA) – Local Climatological Data
- Used ArcGIS Pro to match the closest weather station to each school
  - Five weather stations
  - Hourly measured records
  - Obtain records at the time closest to **7:10** and **15:25** for the same days of tally to approximate school start and end times.



Local Climatological Data (LCD) | Data Tools | Climate Data Online (CDO) | National Climatic Data Center (NCDC). Accessed March 19, 2024. https://www.ncdc.noaa.gov/cdo-web/datatools/lcd

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Methods (cont.)

NOAA weather

Two variables of interest from the NOAA data

- Hourly precipitation → rainy vs. not rainy
- Hourly sky condition → sunny vs. overcast

Objective weather conditions: three-level categorical variable

- if rainy in Hourly precipitation → Rainy
- if not rainy in Hourly precipitation and sunny in Hourly sky condition → Sunny
- if not rainy in Hourly precipitation and overcast in Hourly sky condition → Overcast

Methods (cont.)

- School-level characteristics
  - Data were obtained from the 2018-2019 Texas Education Agency

- Kappa test statistics were calculated to assess the level of agreement between perceived and objective weather conditions in the morning and afternoon for each tally day per grade

Texas Education Agency - Student Enrollment Reports. Accessed March 19, 2024. https://rptsvr1.tea.texas.gov/adhocrpt/adste.html
Texas Education Agency - Student Program Reports. Accessed March 19, 2024. https://rptsvr1.tea.texas.gov/adhocrpt/adspr.html

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School-level Characteristics

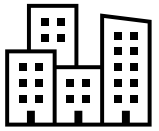
Schools = 65

Average student enrollment = 557

Race/ethnicity distribution (%)

- Hispanic = 59%
- Non-Hispanic White = 24%
- Non-Hispanic African American = 9%
- Non-Hispanic Other = 9%

Girls (%) = 49%



Community types (%)

- Major urban = 79%
- Urban = 21%

Economically disadvantaged = 61%

Bilingual or ESL student = 44%

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Agreement between perceived and objective weather

Grade	Day	Time	Number of schools	Kappa Statistic (95% CI)
3	Tuesday	AM	64	0.42 (0.2, 0.6)
		PM	62	0.34 (0.15, 0.5)
	Wednesday	AM	59	0.49 (0.31, 0.7)
		PM	64	0.40 (0.23, 0.57)
	Thursday	AM	61	0.32 (0.13, 0.50)
		PM	63	0.13 (-0.10, 0.35)
4	Tuesday	AM	62	0.35 (0.13, 0.57)
		PM	53	0.31 (0.10, 0.52)
	Wednesday	AM	62	0.48 (0.30, 0.67)
		PM	58	0.49 (0.30, 0.67)
	Thursday	AM	59	0.20 (0.04, 0.37)
		PM	60	0.20 (-0.02, 0.41)
5	Tuesday	AM	54	0.39 (0.16, 0.63)
		PM	53	0.37 (0.15, 0.60)
	Wednesday	AM	55	0.55 (0.36, 0.73)
		PM	53	0.49 (0.31, 0.68)
	Thursday	AM	51	0.35 (0.15, 0.55)
		PM	54	0.48 (0.25, 0.70)

Strength of Agreement

→ Poor to Moderate

→ poor to Moderate

→ Fair to Moderate

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Discussion

Poor agreement between teacher-perceived and objectively measured weather

Teacher-perceived weather

- No exact time
- Lack of consensus among teachers

Objective measure weather

- Different distances between schools and weather stations

“Mismatch” between perceived and actual measures

- Not sufficient to use perceived weather to represent the actual weather
- Need to develop more reliable and feasible teacher-reported weather measures
- Need to understand the factors that affect the “mismatch”

Orstad SL, McDonough MH, Stapleton S, Altincekic C, Troped PJ. A systematic review of agreement between perceived and objective neighborhood environment measures and associations with physical activity outcomes. *Environment and Behavior*. 2017;49(8):904-932.

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Thank you!

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