

# A GEOSPATIAL-TEMPORAL ANALYSIS OF ADOLESCENT MOVEMENT PATTERNS TO UNDERSTAND RESILIENCE IN AREAS OF VULNERABILITY

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## Background

The built environment impacts adolescents' physical and mental health and their resilience to social stressors. (Renalds, Smith & Hale, 2010). Characterizing where adolescents go and spend their time can be used to evaluate how different environments influence resilience and health, particularly in vulnerable communities. We conducted the Mapping Observations in Vulnerable Environments (MOVE) Study, which aims to understand where adolescents spend their time and assess if the proportion of time spent at community resources or pollution sites impacts adolescent resilience using movement patterns and data collected as part of the California Air Resources Board (CARB) Air Pollution and Community Resource Mapping Project.

## Objectives

1. Understand where adolescents spend their time within the communities of Richmond and San Pablo
2. Determine the proportion of time that adolescents spend at community-identified resources and pollution sites
3. Assess whether spending a greater proportion of time near community resources and pollution sites is associated with adolescent resilience

## Resilience

**Definition:** One's ability "to navigate their way to the psychological, social, cultural, and physical resources that sustain their well-being" (Ungar, 2008, p. 225)

- Resilience allows us to shift the impact that negative and positive exposures have on our life outcomes



## Methods

### Participants

- Recruited 54 adolescents (ages 8-16) from the Richmond and San Pablo CA communities. Participants were predominantly Hispanic/Latine (94.4%)

### Data

- **Exposures:** Proportion of time spent at community-identified resources and pollution sites

- **Outcome:** Child and Youth Resilience Measure 12-item (CYRM-12) z-scores

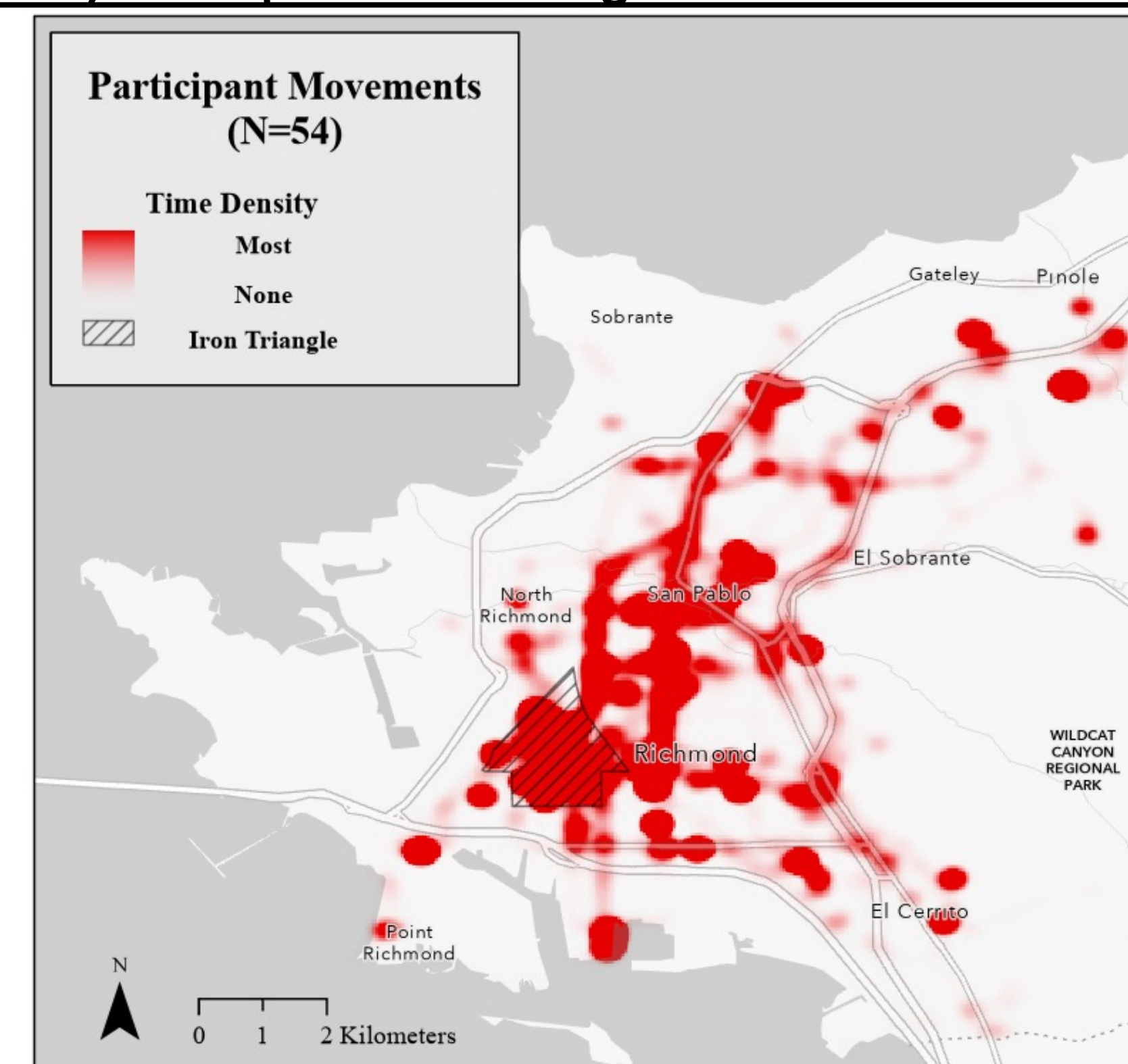
Community Mapping Tool

### Analysis

- **Spatial temporal:** GPS Super Tracksticks to determine how long participants spent at community resources, pollution sites, and other areas in the community
- **Linear regression:** Estimate associations between proportion time at community resources/pollution sites and resilience

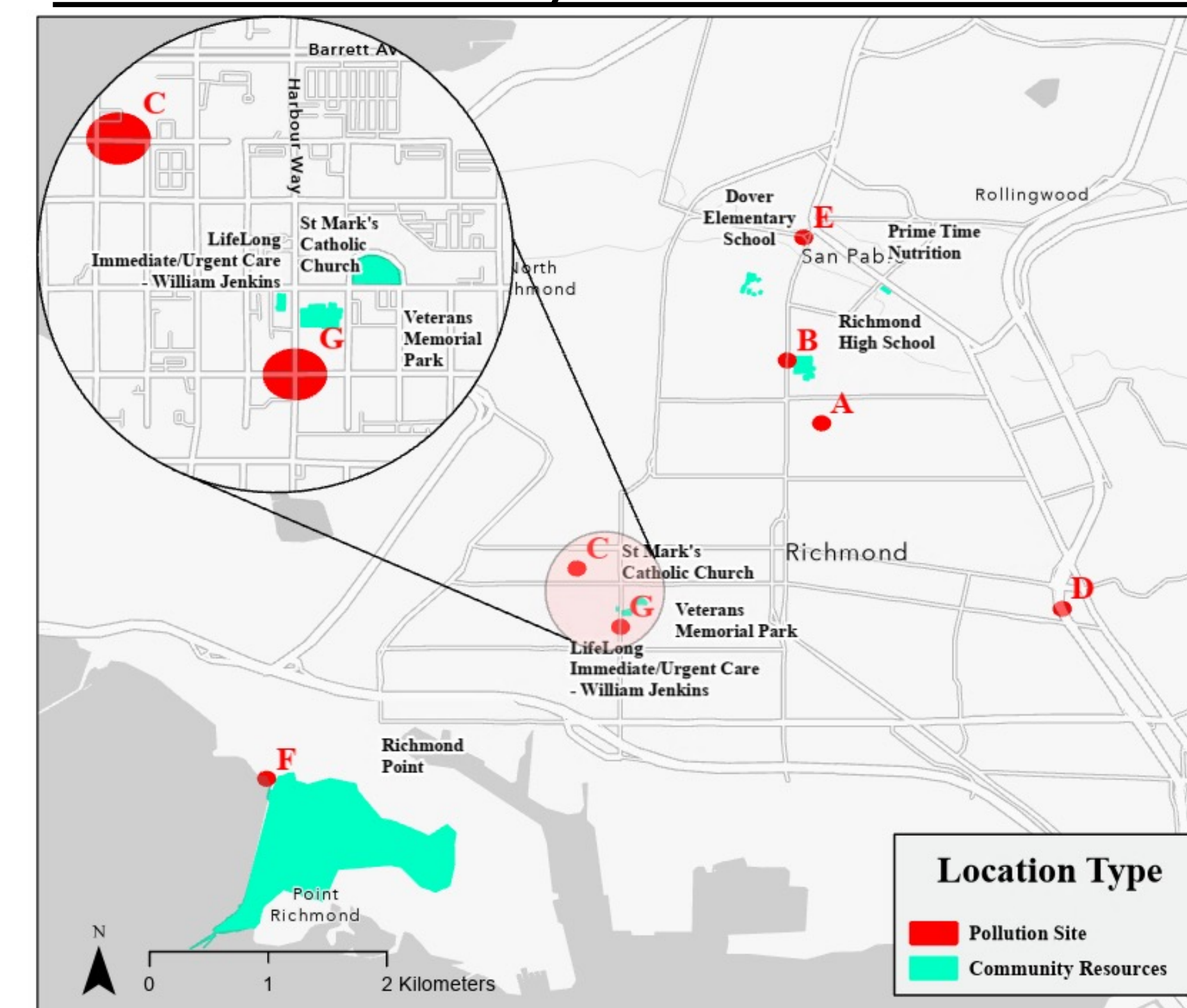
## Participant Movement Findings

### Study Participants Time Weighted Movement Densities



**Image 1:** Time-weighted densities of study participants in Richmond and San Pablo

### Most Visited Community Resources and Pollution Sites



**Image 2:** Top 7 community resource and pollution sites where participants spent the greatest amount of time.

- Participants spent most of their time in the Iron Triangle neighborhood of Richmond, CA. An area surrounded by three major railroad tracks.
- On average participants spent a **greater** proportion of time at community resources than pollution sites (2.91% vs 0.31%)

Most Time Spent	Community Resource Site	Type	Pollution Site	Reported Source
1	LifeLong Immediate/Urgent Care - William Jenkins	Clinic	A	Vehicle
2	Dover Elementary School	School	B	Gas leak
3	Richmond High School	School	C	Missing
4	Richmond Point	Park	D	Car smoke
5	St Mark's Catholic Church	Church	E	Pollution
6	Veterans Memorial Park	Park	F	Chevron related
7	Prime Time Nutrition	Grocery Store	G	Trash/litter

**Table 1:** Community resources ranked 1 to 7 by greatest time spent by participants

## Results

- Greater **prop. time at community resources** was associated with **increased resilience** in the unadjusted model (P-value = 0.043), but association was no longer statistically significant after adjusting for age and gender (P-value = 0.108)

- **No association** was observed between **prop. time at hazard sites** and resilience in both unadjusted (P-value = 0.988) and adjusted (P-value = 0.963) models

Variables	Unadjusted N=50			Adjusted N=50		
	Coefficient (β)	SE	P-Value	Coefficient (β)	SE	P-Value
Prop. Time at Community Resource	0.059	0.029	0.043*	0.049	0.029	0.108

**Table 2:** Linear regression analysis on proportion time at community resources and impact on adolescent resilience scores excluding outliers +/- 3 standard deviations and adjusting for gender and age.

Variables	Unadjusted N=51			Adjusted N=51		
	Coefficient (β)	SE	P-Value	Coefficient (β)	SE	P-Value
Prop. Time at Hazard Sites	0.004	0.238	0.988	0.012	0.251	0.963

**Table 3:** Linear regression analysis on proportion time at hazard sites and impact on adolescent resilience scores excluding outliers +/- 3 standard deviations and adjusting for gender and age.

## Discussion

### Incorporating Findings

- CARB should prioritize air pollution reduction strategies in locations most visited by study participants
- Community resources where participants spend the greatest amount of time also presents a potential opportunity for the implementation of interventions that promote resilience, lower inflammation, and reduce asthma impairment (Chen & Miller, 2012).

### Limitations

- Small sample size
- Potential exposure misclassification
- Possible reverse causation

### Future Research

- Larger study needed to increase statistical power
- Incorporate air pollution monitoring measures from the Berkeley Environmental Air-quality & CO<sub>2</sub> Network (BEACO<sub>2</sub>N) along with GPS tracker data to identify exposure hotspots
- Least-Cost path analysis to determine routes leading to the lowest air pollution exposures

## Conclusion

Our geospatial temporal analysis showed that adolescents spent the greatest amount of time within the Iron triangle neighborhood of the community and a greater proportion of their time at community resources compared to pollution sites. We also found that the resources most utilized were a local clinic, parks, schools, and church. As for pollution sources, participants spent the most time at locations with reported vehicular and refinery-related air pollution concerns. Regression analysis found no association between proportion time at pollution sites and resilience. Our results suggest that spending more time at community resources may be associated with greater resilience and warrants further investigation in a larger study.

## Acknowledgments

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## References

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