LONGITUDINAL ANALYSES OF WASHINGTON STATE STUDENT TRAVEL SURVEYS

FINAL PROJECT REPORT

by

Anne Vernez Moudon, Dr es Sc
Xiao Shi, MRP & MLA

Washington State Transportation Center
Urban Form Lab
University of Washington

Sponsorship
US Department of Transportation

for

Pacific Northwest Transportation Consortium (PacTrans)
USDOT University Transportation Center for Federal Region 10
University of Washington
More Hall 112, Box 352700
Seattle, WA 98195-2700

DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the information presented herein. This document is disseminated under the sponsorship of the U.S. Department of Transportation's University Transportation Centers Program, in the interest of information exchange. The Pacific Northwest Transportation Consortium, the U.S. Government and matching sponsor assume no liability for the contents or use thereof.

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No.

2. Government Accession No.
01723931

3. Recipient's Catalog No.

4. Title and Subtitle
Longitudinal Analyses of Washington State Student Travel Surveys

5. Report Date
June. 2021

6. Performing Organization Code

7. Author(s) and Affiliations
Anne Vernez Moudon, 0000-0001-8485-4799; Urban Form Lab, University of Washington
Xiao Shi, Urban Form Lab, University of Washington

8. Performing Organization Report No.
2019-S-UW-1

9. Performing Organization Name and Address
PacTrans
Pacific Northwest Transportation Consortium
University Transportation Center for Federal Region 10
University of Washington More Hall 112 Seattle, WA 98195-2700

10. Work Unit No. (TRAIS)

11. Contract or Grant No.
69A3551747110

12. Sponsoring Organization Name and Address
United States Department of Transportation
Research and Innovative Technology Administration
1200 New Jersey Avenue, SE
Washington, DC 20590

13. Type of Report and Period Covered
2019-2021 Research Small Project

14. Sponsoring Agency Code

15. Supplementary Notes
Report uploaded to: www.pactrans.org

16. Abstract

Part of a long-term collaboration between the University of Washington (UW) and Washington State Department of Transportation (WSDOT), this project contained two studies: (1) longitudinal changes in active school transport (AST) rates and (2) impacts of Safe Routes to School (SRTS) projects on AST rates.

(1) The average rate of AST for the 241 schools surveyed in 2016 was 21.2 percent, compared to 14.1 percent for the 198 schools surveyed in 2019. The difference in rates was explained primarily by the difference in the schools sampled in the two waves. For the 32 schools that were included in both surveys, rates were similar at 22.3 percent in 2016 and 19.8 percent in 2019. Schools included in only the 2019 survey lacked characteristics that are known to be associated with higher rates of AST: their neighborhood had lower street connectivity; they offered less encouragement for AST; their students were younger; and a higher proportion of them lived farther from school. Differences in walkability scores and walking potential scores between the two waves further confirmed these findings.

(2) Evaluating the association between rates of AST and SRTS project awards was based on 94 projects with complete project information from multiple databases. Most projects (N=53) were accompanied with increases in students walking to/from school; 40 had increases in the number of students biking. For other projects, decreases were observed (N=17 for walking; N=18 for biking). On average, schools with SRTS projects had a 33 percent increase in the number of students walking and a 104 percent increase the number of students biking. Regarding project type (with primarily an engineering, education, or enforcement component), larger effects were found for education projects (17 percent and 37 percent increases in walking and biking, respectively) and enforcement projects (2 percent and 115 percent increases in walking and biking). However, these findings have limited generalizability because of the small sample size (N=32).

17. Key Words
Active transportation, School trips, Travel Surveys

18. Distribution Statement

19. Security Classification (of this report)
Unclassified.

20. Security Classification (of this page)
Unclassified.

21. No. of Pages
15

22. Price
N/A

Form DOT F 1700.7 (8-72) **Reproduction of completed page authorized.**

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^{o}F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^{o}C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^{o}C	Celsius	1.8C+32	Fahrenheit	^{o}F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AST:	Active school transport
No.:	Number
OSPI:	Office of Superintendent for Public Instruction
PacTrans:	Pacific Northwest Transportation Consortium
SRTS:	Safe Routes to School
WSDOT:	Washington State Department of Transportation

EXECUTIVE SUMMARY

This project is part of a long-term collaboration between the University of Washington (UW) and Washington State Department of Transportation (WSDOT) to model environmental determinants of active school transport (AST) and to support increases in safe AST. This phase of the project consisted of two studies, one that analyzes changed in the rates of AST captured in the 2016 and 2019 Washington State Student Travel Surveys and a second that evaluated the likely impacts of Safe Routes to School (SRTS) projects on AST rates.

The average rate of AST for the 241 schools surveyed in 2016 was 21.2 percent, compared to 14.1 percent for the 198 schools surveyed in 2019. The difference in rates was explained primarily by the difference in the schools sampled in the two waves. For the 32 schools that were included in both the 2016 and 2019 surveys, rates were similar at 22.3 percent in 2016 and 19.8 percent in 2019. Schools included in only the 2019 survey lacked characteristics that are known to be associated with higher rates of AST. They were located in neighborhoods with lower street connectivity than schools in the 2016 survey, and they provided less encouragement for AST. In addition, the students included in the 2019 survey were younger, and a higher proportion of them lived farther from school. Differences in walkability scores and walking potential scores between the two waves further confirmed these findings.

Evaluating the association between rates of AST and SRTS project awards was based on 94 projects with complete project information from multiple databases. Projects before 2014 (N=82) were joined with audit AST data. Those after 2014 (N=12) were joined to data from the Washington State Student Travel Survey waves I (2014), II (2016), and III (2019). The majority of projects (N=53) produced increases in students walking to/from school; 40 produced increases in the number of students biking; and a few projects resulted in no change in the number of students walking (N=4) or biking (N=21). In addition, several schools observed decreases in

walking (N=17) and biking (N=18) after SRTS projects. On average, schools with SRTS projects had a 33 percent increase in the number of students walking and a 104 percent increase the number of students biking.

A total of 32 projects had information on project type (with primarily an engineering, education, or enforcement component). Larger effects were found with education projects (17 percent increase in walking, 37 percent increase in biking) and enforcement projects (2 percent increase in walking and 115 percent increase in biking). However, these findings have limited generalizability because of the small sample size.

CHAPTER 1. INTRODUCTION

Built on a long-term collaboration between the University of Washington and Washington State Department of Transportation (WSDOT), this project was part of a continuing data development, model testing, and tool building effort to study the environmental determinants of active school transport (AST) and the impacts of AST promotion programs in Washington state. This phase of the project consisted of two consecutive studies, which are summarized in this report. The first study analyzed the changes in AST rates in Washington's longitudinal student travel survey. The second study evaluated the impacts of Safe Route to School (SRTS) projects on AST rates.

1.1. Longitudinal Student Travel Data in Washington State

Longitudinal student travel data are essential for understanding changes in student travel behavior as well as barriers to AST (Statistics (US), 2010; Dalene et al., 2018).

The Washington State Student Travel Survey is one of the largest longitudinal travel surveys of school children in the U.S (Finch and Smith, 2011; Washington State Department of Transportation, 2017, 2015). It collects data on how children, in kindergarten through 8th grade, get to and from school, and on possible barriers to walking, biking, or riding the bus. The survey was developed as a joint effort between the state's Department of Transportation and Department of Health, with support from the Office of the Superintendent for Public Instruction (OSPI) and the State Legislature. Its main purpose is to help improve student transportation safety and efficiency. A total of three surveys have been conducted to date, with the first wave in 2014, the second wave in 2016, and the third wave in 2019. In each wave, the survey reached around 10,000 students in about 200 K-8 schools in Washington state.

Preliminary analyses of the survey data have been encouraging, showing a 16.4 percent increase in children walking and a 56 percent increase in children biking to school between 2014 and 2016 (Washington State Department of Transportation, 2017). However, the recently collected 2019 survey showed a sudden unexpected drop in the number of students walking and biking to school from 2016. An analysis of the longitudinal data set was needed to identify the factors that led to the drop in that number. It was important to know whether the drop in AST over the three years could be explained by possible technical differences, such as differences in sampling schemes or it reflected an actual drop in the AST rate across the state caused by possible physical, social, and political factors.

The first study examined differences in the surveyed population between Wave II (2016) and Wave III (2019) to identify factors that may have contributed to changes in AST rates.

1.2. Safe Route to School Programs

Safe Routes to School (SRTS) programs are designed to enable more children to safely use AST and have the potential to realize the positive health and educational outcomes associated with AST (Stewart, 2010). State SRTS programs provide grants to projects by any and all local schools that support student walking and bicycling to school. The projects generally fall under one or more of the five aspects essential to transportation systems: engineering, education, encouragement, enforcement, and/or evaluation. As relatively small programs within departments of transportation, SRTS programs compete with other high-need surface transportation funding areas such as maintenance, operations, traffic management, freight, facilities, and more. As a result, these programs greatly benefit from access to data-driven evidence of their performance to clearly show the efficiency and effectiveness of their funding (Moudon, Stewart and Lin, 2011).

A few studies have shown that SRTS projects effectively increase the number of children who walk or bike to school (Stewart, Moudon and Claybrooke, 2014; McDonald et al., 2014).

However, the number of studies and projects that have been evaluated remains limited. A major impediment to evaluating the programs is the lack of data on the number of youth pedestrians and bicyclists (non-motorized users in general) using the facilities, as well as detailed project information.

The second study aimed to (1) assemble a database of SRTS and AST longitudinal data in Washington state using multiple data sets from various WSDOT programs, (2) conduct an up-to-date preliminary assessment of the impacts of SRTS projects, and (3) identify gaps and takeaways for future SRTS project data collection at state agencies.

1.3. Objectives

In sum, the main objectives of this project were the following:

1. Identify factors leading to the decrease in the state's AST rate from 2016 to 2019 by using the Washington student travel survey.
2. Assess and integrate SRTS project data for Washington and estimate changes in AST rates after the implementation of SRTS projects.

CHAPTER 2. LITERATURE REVIEW

2.1. Longitudinal Student Travel Survey

2.1.1. Importance of Longitudinal Student Travel Survey

Longitudinal data have been essential for transportation planning in general, providing measures of change and trends related to new policies, programs, or simply social, economic, and other circumstances. Student travel is no exception. The many SRTS programs need data to monitor trends and to gauge the effects of their policies, whether they relate to removing social and physical barriers to walking to school (Villanueva et al., 2012; Giles-Corti et al., 2011) or to meeting “Target Zero” thresholds aimed at zero tolerance of fatalities resulting from collisions. Unfortunately, the availability of longitudinal data on children and youth travel to school is limited. As noted, Washington state is one of the few states dedicated to collecting statistics on AST. At the national level, the Safe Routes Partnership (initially the National Center for Safe Route to School, https://www.saferoutespartnership.org/) has recently focused on changes in state-level policies related to supporting “walking, bicycling, and active kids and communities” and has produced State Report Cards in 2018 and 2020. Also, children’s travel can be extracted from national Household Surveys. However, those surveys typically do not collect data on the school(s) that are attended.

2.1.2. Determinants of AST

Previous studies have identified a range of built environment and socioeconomic factors that influence student active travel to school. Our 2020 report (Moudon and Shi, 2020), using the 2016 Washington State Student Travel Survey and machine learning methods, identified five factors most relevant to school-level AST rates in Washington K-8 schools:

- ***School neighborhood street connectivity***: Measured as the ratio of street length within a 2-km pedestrian street network area to street length within a 2-km Euclidian buffer area, this factor was found to be positively related to student AST (Christiansen et al., 2014; Giles-Corti et al., 2011).

- ***School neighborhood traffic exposure***: Using traffic volumes as a proxy, this factor was measured as the ratio of the lengths of higher-volume or wide streets (e.g., arterial streets) to the lengths of all the streets and was found to be negatively related to student AST (Christiansen et al., 2014; Giles-Corti et al., 2011).
- ***Percentage of students younger than 4th grade***: Students of younger age are less likely to walk or bike to school. Studies noted that for safety reasons, children under age 10 (around 4th grade) should not walk to school alone (Kim and Heinrich, 2016).
- ***Percentage of students living more than 1 mile away from school****:* Distance to school is among the top barriers to AST, with 1 mile being a recognized distance threshold related to more children practicing AST (Ewing, Schroeer and Greene, 2004; Zhu and Lee, 2009).
- ***Percentage of parents who think the school encourages AST****:* Having school administrators and teachers actively support AST, or having them provide promotional materials to students or families walking to school, was found to be associated with more students walking (Jones and Sliwa, 2016).

The Washington Student Travel Survey was analyzed on the basis of these five factors.

2.2. Safe Route to School Projects

2.2.1. Benefits

Safe Routes to School (SRTS) programs have been shown to effectively increase the number of children who walk or bike to school (Stewart, Moudon and Claybrooke, 2014). As such, these programs have a multi-pronged effect on mobility. First, fewer children being driven to school helps reduce traffic congestion at school commute times (Rickman, 2011; Xue et al., 2010). Second, the children who use active school travel (AST, walking and biking) gain freedom and mobility for themselves (Mitra, 2013). Thus children who use AST not only have the potential to reduce school-related vehicle trips by their parents, but they may also have the opportunity to reach other destinations on their own (e.g., friend's house, park, ice cream shop), further reducing the number of vehicular trips made with parents. Third, AST contributes to improved children's health through added physical activity and lowered risk of obesity (Faulkner et al., 2009). Finally, it is known that experience with multiple travel modes during childhood carries through to adulthood (Baslington, 2008). Thus AST may help the next generation to travel more sustainably.

2.2.2. Previous Studies

Two studies used exposure data (one with self-reported data from schools and the other with data from the National Center for SRTS) to model the effects of SRTS programs on AST. Both yielded promising results. One study of 48 SRTS projects and 53 schools in Florida, Wisconsin, Mississippi, and Washington found statistically significant increases in AST across projects in all four states (Stewart, Moudon and Claybrooke, 2014). All AST modes increased from 12.9 percent to 17.6 percent; walking from 9.8 percent to 14.2 percent; and bicycling from 2.5 percent to 3.0 percent. A subsequent study of 801 schools in the District of Columbia, Florida, Oregon, and Texas, also found increases in walking and bicycling after schools implemented SRTS programs (McDonald et al., 2014). Engineering improvements were associated with an 18 percent relative increase in AST, and the effects of education and encouragement programs were cumulative. Over the course of five years, education and encouragement programs could lead to as much as a 25 percent relative increase in walking and bicycling.

2.2.3. Research Gap

Apart from the studies mentioned above, knowledge of the impacts of SRTS projects remains limited. By integrating underused data sets of diverse sources, we aimed to add to the existing knowledge on SRTS project performance and to support and enable data-driven decision making by the state agencies running SRTS programs, with a particular focus on Washington state.

CHAPTER 3. DATA AND METHODS

3.1. Data

3.1.1. Washington State Student Travel Survey Waves II and III.

The 2016 and 2019 surveys used the same instrument with the same questions. They were managed using the same procedures. They sampled different schools. The 2016 survey invited 330 schools to participate. Those included 180 schools that had received previous WSDOT funding for infrastructure improvements and 250 schools that were selected randomly proportional to size. A total of 242 schools agreed to participate, representing 26 counties of Washington state (Washington State Department of Transportation, 2017).

For the 2019 survey, 590 schools were invited to participate. Unlike in previous years, the sample was drawn from all schools statewide, and there was no focused effort to include schools that had been awarded an SRTS project. A total of 198 schools decided to participate, and the 2019 sample included only 32 schools that had been awarded an SRTS project.

School districts used a secure portal to provide phone number lists of the parents or guardians of all students enrolled in grades K–8th at participating schools. Within each school, phone numbers were randomly selected by grade, and a trained interviewer contacted parents and administered the survey via phone. The survey was conducted in English and Spanish. Parents were asked to identify approximately how far their child lived from school; the mode of transportation used most days to travel to/from school; potential reasons why the child did not walk, bike or take the school bus to or from school; their perspective on whether schools supported active transportation (i.e., walking or biking) to/from school, and basic sociodemographic questions. Survey questions remained the same across waves. Parents had the option to not participate or end the survey at any time.

In 2016, of the 45,381 parents contacted for participation in the survey, 11,421 (25 percent) completed the survey. In 2019, of the 41,774 parents contacted, 9,009 (22 percent) completed the survey.

3.1.2. Walkability Score and Walking Potential Score

A walkability score and a walking potential score were linked to schools for the 2016 and 2019 surveys to compare the characteristics of schools included in each wave. The walkability score, computed on the basis of street connectivity and traffic exposure, was a composite score reflecting the built environment conditions in a school's neighborhoods. The walking potential score reflected the probable school AST rate and was calculated on the basis of student characteristics in addition to school built environment factors. Details on the development of the scores are documented elsewhere (Moudon and Shi, 2020).

3.1.3. SRTS Project Data Sets

We incorporated SRTS project information from two data sets provided by WSDOT to assemble an integrated database on SRTS projects with detailed project information and longitudinal AST data.

The first data set, named **"SRTSEvaluationNumbers7.xlsx,"** contained 137 SRTS projects awarded between 2006 and 2013. The unit of the data set was at the project level, with some projects awarded to multiple schools and some unidentifiable. The counts of students walking and/or biking before and after the completion of the projects were reported for each project. A total of 82 projects contained data both before and after the projects, while 54 had only data for before projects and one had only post project data. The 82 projects with AST data both before and after the projects were included in later analysis.

The second data set, named **"SRTS Funded Schools 2005 to 2019.xlsx,"** contained all SRTS projects (n=434) between 2005 and 2019 with project type information (engineering, educational, and enforcement) but without AST rate information for either before or after projects. The unit of the data set was at the project level, and schools could receive multiple projects in different years. To obtain AST data before and after awards, projects awarded between 2015 and 2018 (n=124) were matched with Washington Student Travel Survey data in 2014, 2016, and 2019. Twelve projects could be matched with surveys providing both before and after data. This represented about 5 percent of the schools included in each survey. The ***12*** projects with complete AST data were included in the following analysis.

A total of 94 (82 + 12) projects with complete AST data from both data sets were joined as one data set for later analysis (n=***94***). Table 3-1 summarizes the characteristics of the data.

Table 3-1. Data sources and characteristics for SRTS projects

	"SRTS Evaluation.xlsx"	**"SRTS Funded Schools 2005 to 2019.xlsx"**
Year Coverage	2006-2013	2005-2019
Unit	Project, school, school district	Project, school School level
No. of projects	137	434
No. of projects with complete before and after AST Data	82	12
No. of schools impacted	Currently unidentifiable	Currently unidentifiable (without unique ID before 2015, ID for those after 2015 were manually added)
Project Type Information	Currently unidentifiable	available
AST Data Source	Audit by staff from local school, city, or nonprofit organizations	WA Student Travel Surveys 2014, 2016, and 2019
AST Data Type	Number of students walking, Number of students biking	Number of surveyed students walking, Number of surveyed students biking

3.2. Method

3.2.1. Comparison of 2016-2019 Washington State Student Longitudinal Travel Surveys

Data on school ID needed to be added to the WSDOT data. The unique national school ID assigned by the National Center for Education Statistics (NCES) was used and manually linked to each school in the surveys on the basis of school name, school district, and county. Schools covered in both surveys were identified by using the unique ID.

Differences between the characteristics of both the schools and the students included in each survey were analyzed by using factors known to affect AST rate. Descriptive analysis included the use of school level factors (street connectivity, traffic exposure, school encouragement) and student level factors (grade, distance to school). The analysis first looked at the longitudinal changes in schools included in both surveys. It then examined the differences with schools that were included in only one survey.

3.2.2. Evaluation of Safe Route to School Projects

The changes in AST rates before and after SRTS project implementation ere analyzed by using descriptive analysis. The differences in impact by project type were further assessed on the basis of available data.

CHAPTER 4. FINDINGS

4.1. Comparison of Washington State Student Longitudinal Travel Survey

4.1.1. Wave II (2016) and Wave III (2019) Survey Results

Table 4-1 shows a comparison of walking rates, participating schools, and participating student parents in the two waves. The Wave II survey (2016) reached out to 241 schools and 11,419 parents. The percentage of students walking to/from school was on average 21.2 percent at each school. The Wave III survey (2019) reached out to 198 schools and 9,007 parents. The percentage of students walking to/from school was on average 14.1 percent.

The rate of walking to/from school was higher in Wave II than in Wave III. The Wave III survey reached out to fewer schools (n=43) and students (n=2412) than Wave II. For schools surveyed in both years, fewer students (n=2281) were reached in Wave II.

The decrease in walking rate appeared to come mainly from the differences between the two groups of schools surveyed only once in either year (21.0 percent versus 13.0 percent, underlined in table 4-1).

Table 4-1. Characteristics of the Wave II and III surveys

	Wave II survey (2016)			**Wave III survey (2019)**		
	No. school	*No. student*	*% of walking*	*No. school*	*No. student*	*% of walking*
Only in Wave II (2016)	209	1578	21.0%	-	-	-
In both waves	32	9841	22.3%	32	7623	19.8%
Only in Wave III (2019)	-	-	-	166	1384	13.0%
Total	241	11419	21.2%	198	9007	14.1%

Note: this summary excluded the two schools with low response rate (only two student parents were surveyed, % of walking=0).

4.1.2. *Characteristics of Schools Surveyed in Both Waves*

In comparison to Wave II (2016), the Wave III (2019) survey included more students **living farther than ½ mile** from school (4 percent more) and attending classes **below 4th grade** (3 percent more). On the basis of previous literature and analyses, both factors indicate that students in these schools would be less likely to walk to/from school. This may explain the small difference in walking rate for the schools surveyed in both waves (figure 4-1).

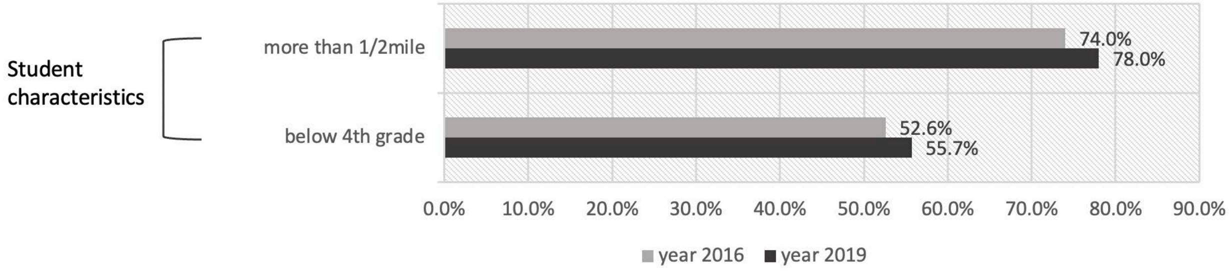


Figure 4-1. Comparison of students in schools surveyed in both waves

4.1.3. *Characteristics of Schools Surveyed Once*

Although schools covered solely in the Wave III (2019) survey had lower traffic exposure and fewer younger students, schools in the Wave II (2016) survey had **higher street connectivity** (0.023 in z-score), **more parents who thought the school encouraged AST** walking (10.2 percent more), and fewer students **living farther** from school (7.6 percent less), thus resulting in the higher rate of walking in 2016. This confirmed previous analyses that street connectivity, school policy, and distance to school are dominant determinants of walking (figure 4-2).

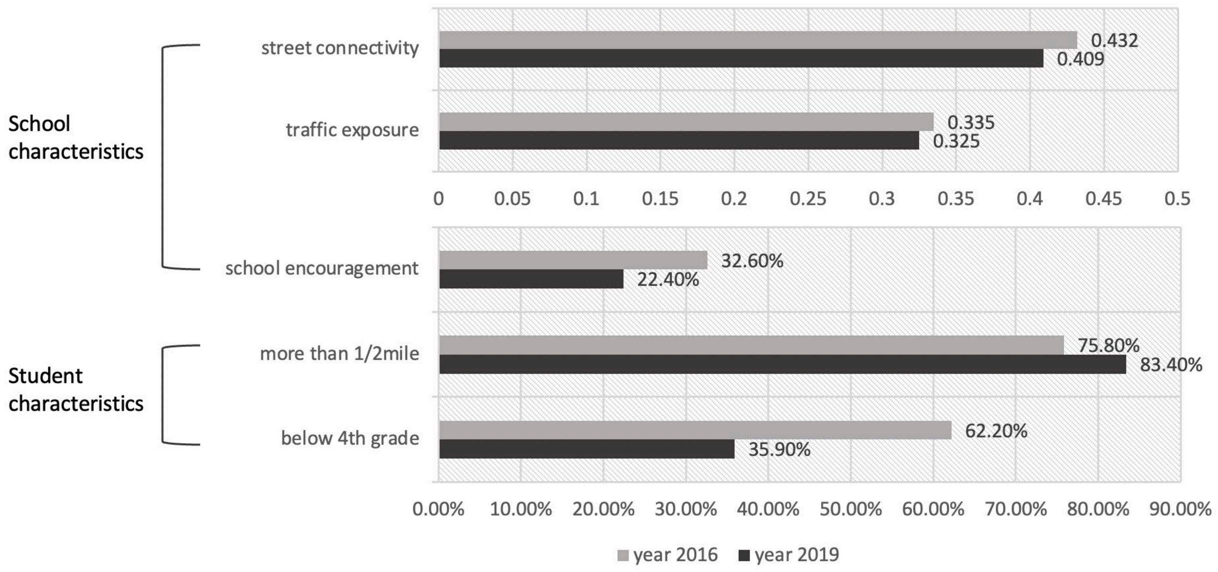
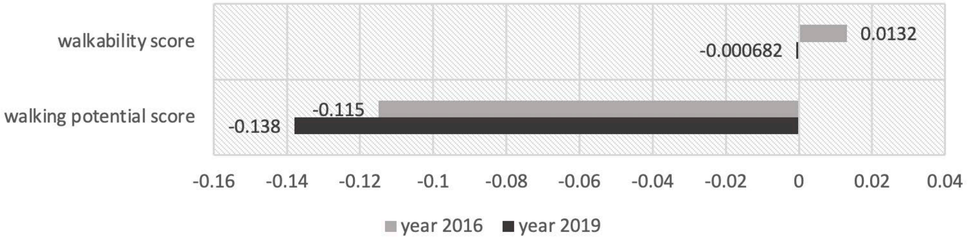


Figure 4-2. Comparison of schools surveyed only in Wave II (2016) or Wave III (2019)

4.1.4. Comparison of Walkability Scores and Walking Potential Scores in Both Waves

In comparison to schools surveyed in 2016, those in the 2019 survey had a **lower** walkability score (0.014 lower) and a lower walking potential score (0.023 lower), which corresponded to a lower walking rate (figure 4-3).



Note: the walkability score and walking potential score were calculated based on z-score thus range between -3 to +3, with higher values indicating higher walkability and walking potential and zero corresponding to an average score.

Figure 4-3. Comparison of school walkability score and walking potential score

4.2. Evaluation of Safe Route to School Projects

4.2.1. SRTS Project Data

After joining multiple data sets, 94 projects with complete project information and AST data were identified. Projects conducted before 2014 (N=82) were joined with audit AST data. Those after 2014 (N=12) were joined to the Washington State Student Travel Survey Wave I (2014), II (2016), and III (2019) (figure 4-4).

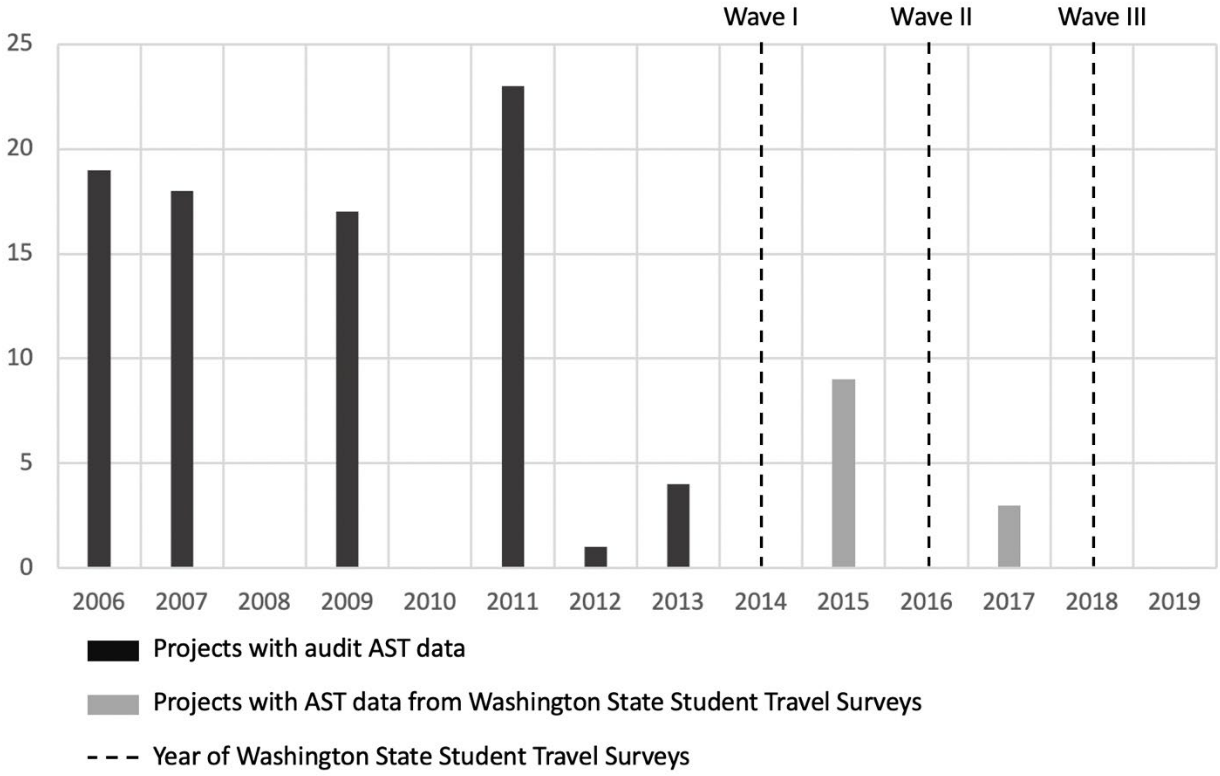


Figure 4-4. Number of projects with AST data by year (N=94)

4.2.2. Changes in Active School Transport Rates

Overall, more schools with SRTS projects experienced increases than decreases in AST after implementing the projects (table 4-2). A total of 53 projects had increases in students walking to/from school, and 40 had increases in the number of students biking. Four had no change in the number of students walking, and 21 had no change in biking. Several schools also observed decreases in walking (N=17) and biking (N=18) after SRTS projects.

Table 4-2. Number of schools with changes in AST rates before and after SRTS projects (N=94)

	Walk to/from school	**Bike to/from school**	**AST (walk + bike)**
No. of projects with increase	53	40	73
No. of projects with no change	4	21	3
No. of projects with decrease	20	15	17
Missing Values[1]	17	18	0
Total	94	94	94

Note: 1-these schools provided total count of walking and biking instead of separate count for each.

More schools experienced increases in the number of students walking than biking, but the magnitude of change was larger for biking (table 4-3). On average, schools with SRTS projects had a 33 percent increase in the number of students walking and a 104 percent increase the number of students biking.

Table 4-3. Percentage change in AST rates before and after SRTS projects (N=94)

% increase[1]	**Walk to/from school**	**Bike to/from school[2]**	**AST (walk + bike)**
mean	33%	104%	50%
Min, max	(-84%, 250%)	(-80%, 1000%)	(-100%, 500%)

Note: 1 - % increase = (after-before)/before. 2 - the number of students biking prior to SRTS projects is relatively small, thus % of change tends to be larger.

4.2.3. Changes in AST Rates by Project Type

Among the projects with details on project information and type, ten had primarily an engineering component, six had an educational component, and six had an enforcement component (table 4-4). Larger effects were found in educational projects (17 percent increase for walking, 37 percent increase for biking) and enforcement projects (2 percent increase in walking and 115 percent increase in biking). The findings have limited generalizability because of the small sample size.

Table 4-4. Changes in average AST rate by project type (n=12)

Project Type[1]	**N**	**Walk to/from school**	**Bike to/from school**	**AST (walk + bike)**
Engineering	10	1%	69%	12%
Educational	6	17%	37%	19%
Enforcement	6	2%	115%	20%

Note: 1-a SRTS project could have components of different type, namely a project could have an educational component as well as an enforcement component.

CHAPTER 5. CONCLUSIONS

5.1. Comparison of Washington State Student Longitudinal Travel Survey

5.1.1. Findings

Only 32 schools were in both the 2016 (Wave II) and 2019 (Wave III) surveys. The main difference in AST rates were from the schools that were surveyed only once. The 2019 survey reached out to a different sample of schools than those included in 2016; schools in the former provided less encouragement for AST and were located in neighborhoods with lower street connectivity. In addition, the students included in the 2019 survey were younger, and a higher proportion lived farther from school. Differences in walkability score and walking potential score between the two waves further confirmed these findings.

An important step in developing and analyzing longitudinal student survey data is to identify and match schools across waves. Matching by school names can be time consuming and sometimes of lower accuracy, as schools in different school districts may have similar names, and different interviewers may enter data with different terms (e.g., Saint vs. St, junior high vs. middle school). Longitudinal student travel surveys could benefit greatly by using unique school IDs during data collection throughout waves.

5.1.2. Future Work

The use of weighting methods could be applied to adjust the differences in sampling between two waves and to obtain an unbiased estimation of AST changes over time.

5.2. Evaluation of Safe Routes to School Projects

5.2.1. Findings

The preliminary assessment of the 94 SRTS projects in Washington between 2006 and 2019 produced findings that were consistent with previous studies. We observed an overall increase in the number of students walking and bicycling to/from school after implementation of SRTS projects.

5.2.2. Future Work

This analysis was conducted at the project level. An analysis of performance at the school and school district levels would require project allocation records that matched projects to individual schools and school districts, ideally using unique IDs. In addition, detailed project information would be needed to further assess the different impacts associated with each project type (e.g., engineering, educational etc.).

REFERENCES

Baslington, H., 2008. School travel plans: overcoming barriers to implementation. *Transport Reviews*, 28(2), pp.239–258.

Christiansen, L.B., Toftager, M., Schipperijn, J., Ersbøll, A.K., Giles-Corti, B. and Troelsen, J., 2014. School site walkability and active school transport–association, mediation and moderation. *Journal of transport geography*, 34, pp.7–15.

Dalene, K.E., Anderssen, S.A., Andersen, L.B., Steene-Johannessen, J., Ekelund, U., Hansen, B.H. and Kolle, E., 2018. Cross-sectional and prospective associations between sleep, screen time, active school travel, sports/exercise participation and physical activity in children and adolescents. *BMC public health*, 18(1), pp.1–10.

Ewing, R., Schroeer, W. and Greene, W., 2004. School location and student travel analysis of factors affecting mode choice. *Transportation research record*, 1895(1), pp.55–63.

Faulkner, G.E., Buliung, R.N., Flora, P.K. and Fusco, C., 2009. Active school transport, physical activity levels and body weight of children and youth: a systematic review. *Preventive medicine*, 48(1), pp.3–8.

Finch, M. and Smith, B., 2011. *Washington State Collision Data Summary 2011*. Washington State Department of Transportation.p.158.

Giles-Corti, B., Wood, G., Pikora, T., Learnihan, V., Bulsara, M., Van Niel, K., Timperio, A., McCormack, G. and Villanueva, K., 2011. School site and the potential to walk to school: The impact of street connectivity and traffic exposure in school neighborhoods. *Health & place*, 17(2), pp.545–550.

Jones, S.E. and Sliwa, S., 2016. Peer Reviewed: School Factors Associated With the Percentage of Students Who Walk or Bike to School, School Health Policies and Practices Study, 2014. *Preventing chronic disease*, 13.

Kim, H.J. and Heinrich, K.M., 2016. Built environment factors influencing walking to school behaviors: a comparison between a small and large US city. *Frontiers in public health*, 4, p.77.

McDonald, N.C., Steiner, R.L., Lee, C., Rhoulac Smith, T., Zhu, X. and Yang, Y., 2014. Impact of the safe routes to school program on walking and bicycling. *Journal of the American Planning Association*, 80(2), pp.153–167.

Mitra, R., 2013. Independent Mobility and Mode Choice for School Transportation: A Review and Framework for Future Research. *Transport Reviews*, 33(1), pp.21–43. https://doi.org/10.1080/01441647.2012.743490.

Moudon, A.V. and Shi, X., 2020. Washington State School Walk Score. [online] Available at: <https://digital.lib.washington.edu:443/researchworks/handle/1773/45599> [Accessed 9 Apr. 2021].

Moudon, A.V., Stewart, O. and Lin, L., 2011. *So Many Choices, So Many Ways to Choose: How Five State Departments of Transportation Select Safe Routes to School for Funding*. [online] Washington State Department of Transportation. Available at: <https://rosap.ntl.bts.gov/view/dot/20608> [Accessed 26 May 2021].

Rickman, J., 2011. A Methodology to Measure Emissions Generated by Automobile Trips to Schools Participating in Safe Routes to School. *Landscape Architecture & Regional Planning Masters Projects*. [online] Available at: <https://scholarworks.umass.edu/larp_ms_projects/28>.

Statistics (US), N.F. on E., 2010. *Traveling Through Time: The Forum Guide to Longitudinal Data Systems: Planning and Developing an LDS.* US Department of Education, National Center for Education Statistics ....

Stewart, O., 2010. Findings from Research on Active Transportation to School and Implications for Safe Routes to School Programs: *Journal of Planning Literature*. [online] https://doi.org/10.1177/0885412210385911.

Stewart, O., Moudon, A.V. and Claybrooke, C., 2014. Multistate Evaluation of Safe Routes to School Programs. *American Journal of Health Promotion*, 28(3_suppl), pp.S89–S96. https://doi.org/10.4278/ajhp.130430-QUAN-210.

Villanueva, K., Giles-Corti, B., Bulsara, M., McCormack, G.R., Timperio, A., Middleton, N., Beesley, B. and Trapp, G., 2012. How far do children travel from their homes? Exploring children's activity spaces in their neighborhood. *Health & place*, 18(2), pp.263–273.

Washington State Department of Transportation, 2015. Washington State Student Travel Survey State Report. p.16.

Washington State Department of Transportation, 2017. *Washington State 2016 Student Travel Survey State Report*. Washington State Department of Transportation.p.37.

Xue, J., McCurdy, T., Burke, J., Bhaduri, B., Liu, C., Nutaro, J. and Patterson, L., 2010. Analyses of school commuting data for exposure modeling purposes. *Journal of Exposure Science & Environmental Epidemiology*, 20(1), pp.69–78. https://doi.org/10.1038/jes.2009.3.

Zhu, X. and Lee, C., 2009. Correlates of walking to school and implications for public policies: survey results from parents of elementary school children in Austin, Texas. *Journal of Public Health Policy*, 30(1), pp.S177–S202.