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The impact of state safe routes to school-related laws on active travel to school policies and practices in U.S. elementary schools

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ABSTRACT

This study examined the relationship between state laws requiring minimum bussing distances, hazardous route exemptions, sidewalks, crossing guards, speed zones, and traffic control measures around schools and active travel to school (ATS) policies/practices in nationally representative samples of U.S. public elementary schools between 2007–2009. The state laws and school data were compiled through primary legal research and annual mail-back surveys of principals, respectively. Multivariate logistic and zero-inflated poisson regression indicated that all state law categories (except for sidewalks) relate to ATS. These laws should be considered in addition to formal safe routes to school programs as possible influences on ATS.

1. Introduction

Recognizing the myriad of health benefits from physical activity (PA) and that most children do not receive sufficient levels of PA, governments and authoritative bodies worldwide recommend that children receive at least 60 min of physical activity (PA) daily (Canadian Society for Exercise Physiology, 2011; Department of Health and Ageing, 2010; Department of Health and Children, Health Service Executive, 2009; National Institute for Health and Clinical Excellence, 2009; US Department of Health and Human Services, Office of Disease Prevention and Health Promotion, 2008; World Health Organization, 2010). Ideally, the 60 min of daily PA should be spent engaged in moderate-to-vigorous physical activity (MVPA) including, for example, brisk walking or bicycling to school (US Department of Health and Human Services, Office of Disease Prevention and Health Promotion, 2008). Yet, rates of active travel to school (ATS) through walking or bicycling have declined, while rates of car-to-school travel have increased. In the United States (U.S.), ATS rates declined from 48 to 13% between 1969 and 2009 for children aged 5–14 years old (National Center for Safe Routes to School and Safe Routes to School National Partnership, 2010). In Australia, the rates of children of age 5–9 actively commuting to school declined from 57.7% to 25.5% between 1971 and 1999–2003; while the rates of children being driven to school increased from 12.2% to 48.7% over the same period (Van der Ploeg et al., 2008). Similarly, the proportion of children in the United Kingdom who were driven to school increased from 16% to 30% between 1986 and 1998 (Metcalf et al., 2004).

1.1. Barriers to and facilitators of ATS

Most studies of the barriers and facilitators of ATS have been either qualitative research or cross-sectional surveys. Parents and caregivers most commonly report barriers to ATS related to concerns about student safety and distance to school (Ahlport et al., 2008; DiGuiseppi et al., 1998; Faulkner et al., 2010; Greves et al., 2007; Kerr et al., 2006; Martin and Carlson, 2005; Timperio et al., 2006). Additional barriers include, but are not limited to, the following: lack of or discontinuous sidewalks, crossing guards, and bicycle supports; physical obstacles in the road; bussing distance policies; and traffic speeds >30 mph (Ahlport et al., 2008; DiGuiseppi et al., 1998; Greves et al., 2007; McMillan, 2007; Timperio et al., 2006).

At the same time, parents, caregivers, school officials, and community leaders have reported that ATS may be facilitated through shorter distances (e.g., $\leq$1–1.5 miles for walking and <2 miles for biking); the presence of crossing guards, sidewalks and

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sidewalk improvements, bicycle parking, walking paths/trails, and/or speed zones; and living in walkable neighborhoods (Ahlport et al., 2008; Boarnet et al., 2005; Eyler et al., 2008; Fesperman et al., 2008; Schlossberg et al., 2006; Timperio et al., 2006; Yeung et al., 2008).

1.2. Policy actions to facilitate ATS

Recognizing the declining ATS and PA trends among young people, governments and authoritative bodies have increasingly focused on ways to facilitate school-age ATS and PA. In 2000, the 53rd World Health Assembly affirmed physical inactivity as a key risk factor in chronic disease prevention and control and, in 2007, the World Health Organization (WHO) developed guidelines for population-based approaches for increasing PA including implementing policies that would provide safe conditions for walking and cycling to school (World Health Organization, 2007). In 2008, a School Policy Framework was issued to implement the Guidelines; the Framework encouraged governments to consider ways to facilitate safe walking/cycling to/from school (World Health Organization, 2008). Most recently, WHO issued the Global Recommendations on Physical Activity for Health that encouraged PA-facilitating policies including those that "ensure that walking, cycling, and other forms of physical activity are accessible and safe" (World Health Organization, 2010, p. 37).

In the U.S., the 2005 federal transportation reauthorization bill, *The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users* (SAFETEA-LU, P.L. 109–59), provided $621 million in federal funding to states for safe routes to school (SRTS) programs at the K-8 levels. The law required both non-infrastructure (e.g., awareness campaigns and trainings) and infrastructure projects aimed at improving students' ability to walk/bike to school. The infrastructure projects included improvements in sidewalks, speed reduction, and traffic diversion; traffic calming devices; street crossings; bicycle parking.

The U.S. Task Force on Community Preventive Services also has identified several policy strategies to combat the declining rates of PA in the U.S. They found sufficient evidence that community-scale and street-scale urban design and land use policies (e.g., traffic calming and street connectivity) are effective in increasing walking and biking, particularly for smaller geographic areas such as neighborhoods where schools are located (Heath et al., 2006). However, at the time of their review (mid-2000s), the Task Force found insufficient evidence that transportation or travel policies—including requiring sidewalks and bike lanes—increased PA (Heath et al., 2006).

Most recently, the U.S. Department of Health and Human Services included two ATS-related developmental goals (PA-13 and PA-14) in *Healthy People 2020* for children aged 5–15 years: (1) increase the proportion of walking trips to school of ≤ 1 mile and (2) increase the proportion of bicycling trips to school of ≤ 2 miles (US Department of Health and Human Services, Office of Disease Prevention and Health Promotion, 2011).

Several U.S. states also created SRTS programs or had ATS policies prior to the adoption of SAFETEA-LU, although not all were funded (Eyler et al., 2008). Additionally, many states have policies, which may impact ATS, but which are not part of SAFETEA-LU, such as minimum bussing distance policies as well as laws addressing safety issues and sidewalk infrastructure around schools. Yet, we are not aware of any study to date to examine the relationship between these laws and ATS or factors influencing ATS.

1.3. Study purpose

This study sought to examine the relationship between state ATS-related laws (described below) and elementary school-level ATS-related policies and practices in the U.S. We examined whether the school policies and practices differed in states with these laws as compared to schools located in states without these laws in terms of (1) school-reported barriers to walking/biking to school, (2) allowing all students to walk/bike to school, and (3) the proportion of students walking/biking to school.

2. Methods

A pooled, cross-sectional analysis examined the relationship between the state laws and the school policies and practices.

2.1. Data sources

2.1.1. State laws (independent variables)

Six categories of state statutory (legislative) and administrative (regulatory) laws (hereafter collectively referred to as "state laws") were compiled as independent variables for this study: minimum bussing distance requirements; hazardous route exemptions to the distance requirement; and requirements for sidewalks, crossing guards, traffic safety, and speed zones around schools. State laws effective as of January 1 of each year, 2007 through 2009, were obtained through primary legal research methods (Cohen and Olson, 1996; Mersky and Dunn, 2002) using keyword searches, statutory indices, and tables of contents available from the state law databases commercially available from Westlaw and Lexis-Nexis.

State laws governing minimum bussing distances (i.e., laws that specify that students must live a certain distance away from school in order to be provided with bus transportation) were compiled by researchers in the Bridging the Gap (BTG) Program at the University of Illinois at Chicago (UIC). All distance requirements were confirmed via telephone/electronic mail with Department of Education officials in each state. The minimum bussing distance variable was a continuous measure, in miles, and was used as control variable in all of the analyses involving the other state law variables. An ordinal variable was created to examine bussing distance as a predictor: 0 (no minimum distance), 1 (≤ 1 mile), 2 (>1–2 miles), and 3 (≥ 2 miles); where 0 was used as the referent category.

We also coded whether the laws allowed exceptions to the distance requirement for hazardous routes to school (1 = hazardous route exception, 0 = no exception). These exceptions typically indicate that bussing may be provided for shorter distances (i.e., shorter than the minimum distance requirement) when conditions are such that walking to or from school/bus stop constitutes a hazard to student safety due to traffic and/or unsafe crossings (e.g., over highways, on rural roads with no pedestrian lanes, over railways, etc.). These exceptions were examined as a potential barrier to ATS or to the proportion of students walking/biking to school. We also controlled for the exemptions in all other models except in the analyses where the minimum bussing distance laws were the predictor variable due to multicollinearity since the hazardous route exception variable was perfectly correlated with minimum bussing distance laws of ≤ 1 mile.

Additional state law data were compiled by The MayaTech Corporation under subcontract to UIC. These data were compiled using the same legal research methods described above and were specifically focused on whether they required or encouraged the following around schools: (1) sidewalks, (2) crossing guards, (3) traffic control measures (e.g., speed humps, traffic calming devices), and/or (4) speed zones. Laws were coded as 2 = required, 1 = encouraged/suggested, and 0 = no law. For this analysis, coded law data were collapsed into four binary variables that measured whether each category of law was required (=1) versus not

required (=0; either encouraged/suggested or no law). A consensus coding was used for these categories of laws, with all laws independently coded by two, trained legislative analysts. A senior legislative analyst and study co-author (KML) conducted a confirmatory review of the state law collection on these topics and also determined the final disposition in the few cases of coding disagreement.

2.1.2. Elementary school policies and practices (dependent variables)

Data on school policies and practices were compiled by BTG through its annual Food & Fitness Survey (Turner et al., 2010). The survey is an annual, cross-sectional, mail-back survey of principals (or their designee) at nationally representative samples of public elementary schools. Data collection primarily occurred between February and June of each year of interest for this study (2007–2009). The survey included questions related to the food and PA environments and correspondingly contained 92, 81, and 76 items in each year. A $100 incentive was offered to the respondent for survey completion and submission. Surveys were processed and double-entered for quality assurance. Response rates were calculated using the American Association for Public Opinion Research method, counting partial responses as complete (Smith, 2009). Response rates and number of responding cases by year were the following: 54.6% (responders=578 schools); 70.6% (responders=748 schools); and 61.8% (responders=641 schools). The survey was fielded in 47 of the 48 contiguous states (Wyoming was not sampled due to its small population density). The survey protocol was approved by the UIC Institutional Review Board.

There were three ATS-related survey questions. The first question asked whether students were allowed to walk or bike to school. The response options were: 'no,' 'yes—in certain grades,' and 'yes—in all grades.' Separate responses were provided for allowing walking (only asked in 2008–09) and allowing biking (asked in all years). The second question asked "about what percentage of students in your school would you estimate walk or bike from home to school on an average school day?" Respondents provided an estimated percentage of students. The final question used a five-item Likert-type scale (i.e., 'not at all,' 'to a little extent,' 'to some extent,' 'to a great extent,' and 'to a very great extent') to assess respondents' perceptions as to the extent to which any of eight different factors may have served as barriers to 3rd grade students walking/biking to school: 'school is too far away,' 'traffic danger,' 'lack of sidewalks,' 'no crossing guards,' "bad weather," "crime," "lack of bike racks," and "other." For this analysis, focus was on the first four barriers as we had a direct correspondence with the state law predictors; however, descriptive information on the remaining three barriers is reported below. The barrier question was anchored to the 3rd grade because of the likelihood that certain issues, such as traffic danger or distance, may be more of a barrier for younger children.

2.1.3. Contextual factors

To control for school-level factors that could confound the relationship between the state laws and school-reported practices, school-level demographic and socioeconomic data were obtained from the National Center for Education Statistics' (NCES) Common Core of Data (CCD). Data were obtained from the 2006–07 CCD for the corresponding year of survey data, and from the 2007–08 CCD for the 2007–08 and 2008–09 survey data (2008–09 CCD data were not available at the time of the analysis). CCD data were obtained on the total number of students in the school; the percentage of students eligible for free-/reduced-price lunch (continuous measure); race/ethnicity of the schools' students; census region (northeast, south, Midwest, and west); and locale (urban, suburban/town, and rural). An ordinal variable was created to reflect school size tertiles: small ($\leq$440 students), medium (441–611 students), and large ($\geq$612 students). Race/ethnicity of the schools' students was measured with a binary indicator equal to 1 if the school had a majority White student population ($\geq$66%) and equal to 0 otherwise.

To control for the possible influence of SAFETEA-LU funding for SRTS projects on the relationship between the state laws and school-reported policies and practices, county-level funding data were obtained from Harvard School of Public Health researchers who compiled a county-level SRTS funding measure from the Federal Highway Administration's Fiscal Management Information System (FMIS) (Cradock et al., in this issue). A binary indicator (coded 1=yes, 0=no) indicated whether the school was located in a county that received any SRTS funding.

2.2. Sample size

A stacked, cross-sectional data set containing 1967 schools over the combined period, 2007–2009, comprised the final study sample (with 578, 749, and 641 schools included in each of the three corresponding study years). After accounting for non-response on individual questions and missing county funding data for three cases, the final adjusted sample sizes ranged from 1770 schools (lack of crossing guard) to 1894 schools (allow all students to bike to school) for the variables with three years of data. The question on allowing walking to school was only asked in 2008–09, with a sample size of 620 schools included in the adjusted models.

2.3. Statistical analysis

Data were weighted to account for non-response bias and reflect the population of public elementary schools nationwide. All analyses were clustered on state to account for correlation among schools within states.

Logistic regression models were used to estimate the association between state laws and principal-reported barriers to walking/biking to school and whether all students were allowed to walk/bike to school. All models controlled for region (referent: South), locale (ref: urban), school size (tertile), county funding (binary), free-/reduced-lunch participation (continuous), and majority White student population (binary). Additionally, in the analyses where distance was not the barrier, we controlled for the state minimum bussing distance requirement (continuous) and in models where hazardous route exemptions were not the predictor, we controlled for such exemptions (binary). Preliminary models controlled for year of data collection to account for time trends; however, neither the laws nor the school-level outcomes changed over the study period (see Table 1), and because year was not significant in any model, year was dropped for parsimony reasons.

The distribution of students who walk/bike to school was positively skewed with a large percentage of schools (17.6%) reporting no students walking/biking to school. On the basis of the Vuong statistic (Vuong, 1989), we used a zero-inflated Poisson model to estimate the association between state laws and the percentage of students walking/biking to school. The zero-inflated model allowed us to estimate the difference in the percentage of students walking/biking to school, as well as the difference in the excess number of schools in which zero students walk/bike to school, among schools with and without state laws. The odds of zero students walking/biking to school were estimated using a logistic model. Both the Poisson and logistic portions of the model controlled for all of the contextual factors noted above.

The regression models assumed a 95% confidence interval with significance levels of $p<.05$, $p<.01$, and $p<.001$. All analyses were conducted using Stata, Version 11.

Table 1
Distribution of state safe routes to school-related laws across all states[a] and all schools[b], 2007–2009.

State law	All states		All schools	
	% of all states	Percentage point change, 2007–2009	% of schools	Percentage point change, 2007–2009
Minimum bussing distance law (any)				
None	51.0	0.0	60.1	−3.7
≤1 mile requirement	13.7	0.0	4.4	+2.2
>1–2 mile requirement	27.5	0.0	30.0	+2.0
>2 mile requirement	7.8	0.0	5.6	−0.5
Hazardous routes exemption in distance law				
No exemption	70.6	0.0	76.6	−3.9
Exemption exists	29.4	0.0	23.4	+3.9
Sidewalk construction				
None/encourage	77.8	−1.9	68.8	−1.8
Require	22.2	+1.9	31.2	+1.8
Employ crossing guards				
None/encourage	90.2	0.0	85.5	−1.1
Require	9.8	0.0	14.5	+1.1
Traffic control measures				
None/encourage	61.4	+1.9	42.9	+0.2
Require	38.6	−1.9	57.1	−0.2
Speed zones				
None/encourage	19.0	−2.0	13.5	+1.2
Require	81.0	+2.0	86.6	−1.2

[a] All states includes the 50 states and the District of Columbia.
[b] Weighted to reflect public elementary schools nationwide in 47 contiguous states (Wyoming excluded). Unweighted sample includes a total of 1967 public elementary schools in 3 survey years (2007–2009) combined.

3. Results

3.1. Prevalence of state laws

Table 1 presents the prevalence of the state laws across all states (panel 1) and across all sample schools (panel 2) over the combined, three-year period. As indicated in the table, there was little change in the laws over time.

Twenty-six states overall and 24 study states had a minimum bussing distance policy (data not shown). One-half of the study states with such laws required bussing for students living >1–2 miles from school. Seven of the study states required bussing for students living >2 miles from school with South Dakota (5 miles), Nebraska (4 miles), Missouri (3.5 miles), and Kansas (2.5 miles) having the largest distance requirements. In contrast, five study states (Delaware, Louisiana, Mississippi, New Mexico, and Oregon) required bussing for elementary students living ≤1-mile from their school. Notably, each of these states provided an exception to the distance requirement in their law due to hazardous routes. Overall, 29.4% of all states include a hazardous route exemption in their bussing distance law.

Outside of the minimum distance and hazardous route exemption laws, the state laws were least likely to require crossing guards (9.8%) and most likely to require speed zones around schools (81%). Only 22.2% and 38.6% of states required sidewalk construction or traffic control measures around schools, respectively.

Only 39.9% of schools were located in a state with a minimum bussing distance requirement and only 23.4% were located in a state with a hazardous route exemption (panel 2). The sample schools were situated in states least likely to require crossing guards (14.5%) and most likely to require speed zones (86.6%). Thirty-one percent of the schools were in states that required sidewalks and 57.1% were located in states that required traffic control measures around schools.

3.2. School characteristics

Table 2 presents the characteristics of the study schools. At the school level, the most commonly reported barriers to walking/biking to school were traffic (53.7%) and distance (46.2%) followed by lack of sidewalks (30.2%), lack of crossing guards (21.4%), bad weather (23.3%), lack of bike racks (18.5%), and crime (12.7%). Over 78% of the schools allowed all students to walk to school and 53.6% allowed all students to bike to school. On average, schools reported that 21.5% of students walk/bike to school.

Across all study states, the average minimum bussing distance requirement was 0.8 miles (range 0 to >2 miles); in the 24 study states with the minimum bussing distance, the average minimum bussing distance was 2 miles (the latter not shown in Table 2). Nearly 28% of the schools were in a county that received SRTS funding.

3.3. Association between state laws and school-reported barriers

Schools were less likely to report barriers for sidewalks, crossing guards, or traffic if a state law existed (Table 3). Adjusted for control variables, the odds of schools reporting lack of crossing guards as a barrier were 64% lower (Odds Ratio [OR]: 0.36, 95% Confidence Interval [CI]: 0.22–0.58) if the state required crossing guards. Similarly, the odds of schools reporting traffic as a barrier were 29% lower (OR: 0.71, 95% CI: 0.53–0.95) if the state required traffic control measures.

3.4. Association between state laws and allowing students to walk or bike to school

Overall, more schools allowed all students to walk to school if the state had a minimum bussing distance law of >1 mile or a law requiring sidewalks or traffic control measures (Table 4, Panel 1). Adjusted models indicate that the odds of allowing all

students to walk to school were only significantly higher in states with minimum bussing distance requirements of >1 to 2 miles as compared to schools located in states with no minimum bussing distance law (OR: 1.91, 95% CI: 1.17–3.13).

Table 2
Descriptive statistics[a] of the study sample, 2007–2009.

Characteristic	%/Mean (SE)
School policies and practices (outcome variables)	
Barriers to walking/biking[b] (%)	
Lack of sidewalks (N=1813)	30.2 (1.6)
Lack of crossing guard (N=1776)	21.4 (1.4)
Traffic (N=1863)	53.7 (1.7)
Distance (N=1846)	46.2 (1.7)
Weather (N=1775)	23.3 (1.2)
Crime (N=1750)	12.7 (1.1)
Lack of bike racks (N=1758)	18.5 (1.3)
Allow all students to walk[c] (%) (N=624)	78.7 (1.8)
Allow all students to bike (%) (N=1900)	53.6 (1.8)
% kids walk/bike to school, mean (N=1843)	21.5 (1.0)
Contextual factors (control variables)	
Minimum bussing distance-state, mean	0.8 (0.2)
Any county-level SRTS funding[d] (%) (N=1964)	27.8 (1.7)
Region (%)	
Northeast	17.0 (1.2)
South	34.2 (1.5)
Midwest	25.8 (1.5)
West	23.0 (1.4)
Locale (%)	
Urban	30.7 (2.3)
Suburban/town	43.3 (2.1)
Rural	26.0 (1.8)
School size (%)	
Small (≤ 440 students)	46.5 (1.8)
Medium (441–611 students)	30.4 (1.6)
Large (≥ 612 students)	23.1 (1.4)
% Students on free-/reduced-price lunch (N=1964)	48.4 (1.1)
Majority White students (%)	49.8 (2.1)

Note: Unweighted N=1967 public elementary schools in 3 years combined (2007–2009) unless otherwise noted.

[a] All statistics are weighted by school.
[b] Barrier to a 'great' or 'very great' extent.
[c] 2009 only.
[d] Per student.

More schools allowed all students to bike to school if the school was located in a state with a minimum bussing distance requirement, a hazardous route exemption, or a requirement for crossing guards, traffic control measures, or speed zones around schools (Table 4, Panel 2). Adjusted models indicated that the odds of allowing all students to bike to school were only significantly different with regard to hazardous route exemptions (1.79 times more likely to allow all students to bike if the exemption existed) and crossing guards (2.70 times more likely to allow all students to bike if the state law required crossing guards around schools).

3.5. Association between state laws and percentage of students walking/biking to school

Table 5 presents the results of the zero-inflated poisson regression models. The logistic panel predicts the odds of zero students walking/biking to school. The poisson panel predicts the rate (proportion) of students walking/biking to school among schools where students do walk/bike to school.

The odds of zero students walking/biking to school were 68% lower (OR: 0.32, 95% CI: 0.17,0.61) in states requiring crossing guards and 55% lower in states requiring speed zones (OR: 0.45, 95% CI: 0.23,0.85). The proportion of students walking/biking to school was lower in states with minimum bussing distances of ≤1 mile (RR: 0.57, 95% CI: 0.39, 0.84) relative to states with no minimum bussing distance. The other state laws did not significantly affect the rate of students walking/biking to school.

4. Discussion

To our knowledge, this is the first study to examine the relationship between state laws and ATS policies and practices in a nationally representative sample of U.S. public elementary schools. Notably, relatively few states have laws requiring crossing guards or traffic calming around schools; however, when they do, they can help to reduce barriers to and/or facilitate ATS. Consistent with the literature (Ahlport et al., 2008; Dumbaugh and Frank, 2007; Greves et al., 2007), we found that state laws that require crossing guards around schools appear to be effective at reducing barriers to walking/biking to school, increasing the odds of allowing all students to bike to school, and reducing the

Table 3
Association between state safe routes to school-related laws[a] and principal-reported barriers to elementary students walking/biking to school, 2007–2009.

State law	Barrier	% Schools where principal reported barrier		Adjusted OR[b]	
		State Law	*No State Law*	**OR**	**95% CI**
Minimum bussing distance					
≤1 mile	Distance	47.1	44.2	1.31	0.74, 2.31
>1–2 miles	Distance	50.5	44.2	1.21	0.88, 1.66
>2 miles	Distance	43.2	44.2	0.65	0.38, 1.13
Hazardous route exemption	Traffic	49.2	55.0	0.88	0.63.1.25
Sidewalk construction required	Sidewalks	22.0	33.9	0.76	0.52, 1.11
Crossing guards required	Crossing guards	12.3	23.0	**0.36[d]**	**0.22, 0.58**
Traffic control measures required	Traffic	50.2	58.3	**0.71[c]**	**0.53, 0.95**
Speed zones required	Traffic	53.0	58.2	0.75	0.53, 1.08

[a] Comparing states that require to states that encourage or have no law (ref). Hazardous route exemptions were not analyzed for the barrier item because of a lack of a corresponding survey response item.
[b] Adjusted for school size (tertile), locale (ref: urban), region (ref: South), minimum bussing distance (continuous; except in distance model), hazardous route exemption (except in hazardous route models, ref: none), county funding (binary, ref: none), majority White (ref: not majority White), and free-/reduced-lunch participation (%).
[c] $p < 0.05$.
[d] $p < 0.001$.

Table 4
Association between state safe routes to school-related laws[a] and whether U.S. public elementary schools allow students to walk or bike to school, 2007–2009.

State law	Panel 1: Allow all students to walk to school[b]				Panel 2: Allow all students to bike to school			
	% Yes		Adj.[c] OR	95% CI	% Yes		Adj.[c] OR	95% CI
	State Law	*No State Law*			*State Law*	*No State Law*		
Minimum bussing distance[d]								
≤1 mi	74.9	75.9	0.87	0.36–2.10	57.4	52.3	1.12	0.61– 2.06
>1–2 mi	81.8	75.9	**1.91**[e]	**1.17–3.13**	52.9	52.3	1.27	0.91–1.78
>2 mi	94.2	75.9	3.75	0.81–17.34	67.6	52.3	1.85	0.89–3.87
Hazardous route exemption	87.1	75.6	1.40	0.82–2.39	66.9	49.7	**1.79**[f]	**1.24–2.57**
Sidewalk construction	81.8	77.2	1.28	0.74–2.28	49.7	55.4	0.69	0.46–1.03
Crossing guards	77.9	78.8	1.30	0.58–2.87	66.3	51.4	**2.70**[g]	**1.71–4.27**
Traffic control	81.1	75.6	1.26	0.78–2.04	56.1	50.2	1.26	0.94–1.68
Speed zones	78.6	79.3	1.18	0.68–2.06	53.8	52.5	1.27	0.82–1.96

[a] Comparing states that require ('Yes') to states that encourage or have no law.
[b] 2009 only.
[c] Adjusted for school size (tertile), locale (ref: urban), region (ref: South), minimum bussing distance (continuous; except in minimum bussing distance models), hazardous route exemption (except in hazardous route models, ref: none), county funding (binary, ref: none), % free/reduced lunch, and majority White (ref: not majority White).
[d] Comparing states with specified distance requirement to states that have no requirement.
[e] $p < 0.05$.
[f] $p < 0.01$.
[g] $p < .001$.

Table 5
Adjusted[a] association between state safe routes to school-related laws[b] and % of students who walk/bike to school based on zero-inflated Poisson model, 2007–2009.

State law	Logistic portion[c]		Poisson portion[d]	
	OR	95% CI	RR	95% CI
Minimum bussing distance				
≤1 mi	2.54	0.93, 6.95	**0.57**[f]	**0.39, 0.84**
>1–2 mi	0.71	0.27, 1.86	0.94	0.74, 1.19
>2 mi	1.06	0.25, 4.48	1.14	0.88, 1.46
Hazardous route exemption	0.66	0.26, 1.69	1.11	0.79, 1.38
Sidewalk construction	0.66	0.40, 1.08	1.08	0.89, 1.31
Crossing guards	**0.32**[f]	**0.17, 0.61**	1.08	0.88, 1.32
Traffic control measures	0.58	0.33, 1.00	1.06	0.88, 1.27
Speed zones	**0.45**[e]	**0.23, 0.85**	1.07	0.88, 1.30

[a] Adjusted for school size (tertile), locale (ref: urban), region (ref: South), minimum bussing distance (continuous; except in minimum bussing distance models), hazardous route exemption (except in hazardous route models; ref: none), county funding (binary, ref: none), % free/reduced lunch, and majority White (ref: not majority White).
[b] Comparing states that require either specific minimum bussing distance, sidewalk construction, employment of crossing guards, traffic control measures, or speed zones to states that require none or only encourage (where appropriate) (ref).
[c] The logistic portion reflects the odds of zero students walking/biking to school.
[d] The Poisson portion reflects the percentage of students walking/biking to school.
[e] $p < 0.05$.
[f] $p < 0.01$.

odds of zero students walking/biking to school. Although the relationship between the state crossing guard requirements and schools reporting allowing all students to walk to school was not statistically significant, the odds of schools allowing all students to walk to school were greater in states with these laws (OR=1.30, 95% CI: 0.58,2.87). Given that this latter association was based on only one-year (2009) of data, further study is required to determine if this relationship intensifies with additional years of data.

The literature also indicates that traffic speeds can either facilitate or inhibit walking/biking to school (Deehr and Shumann, 2009; Eyler et al., 2008; Martin and Carlson, 2005). We found that state laws requiring speed zones around schools lowered the odds of zero students walking/biking to school by 51% but these laws did not reduce the reported traffic-related barriers nor did such laws significantly increase the odds of allowing all students to walk/bike to school or the proportion of students walking/biking to school. On the barrier question, however, we did not have an exact question "match" so we were unable to assess whether schools were less likely to report traffic *speed* specifically as a barrier or just traffic in general (which was included in the survey). Thus, future studies might seek to assess whether traffic speed is a reported barrier to walking/biking to school and whether having a state law with a speed zone requirement around schools reduces this barrier.

Distance from school and, to some extent, bussing policies have been reported as key barriers and shorter distances have been reported as key facilitators of ATS in the U.S., Australia, London, and Canada (Ahlport et al., 2008; DiGuiseppi et al., 1998; Faulkner et al., 2010; Greves et al., 2007; Kerr et al., 2006; Martin and Carlson, 2005; Rodriguez and Vogt, 2009; Schlossberg et al., 2006; Timperio et al., 2006; Yeung et al., 2008). Using state minimum bussing distance laws as a proxy for distance from school, we only found the bussing distance laws related to whether schools allowed all students to walk to school and to the proportion of students walking/biking to school; schools were 1.9 times more likely to allow all students to walk to school if the state required that students living from >1 to 2 miles be transported by bus as compared to schools in states without the minimum bussing distance law. This finding should be viewed with some caution given that it was only based on one year (2008–09) of school-level data. Future studies should examine whether such relationships continue to be found over time. Additionally, we found that schools located in states with laws that required that students living ≤1 mile to be bussed to school had significantly lower rates of students walking/biking to school as compared to schools in states without bussing distance laws.

Other than distance, student safety was the predominant barrier to walking/biking to school reported in Canadian and US studies (Ahlport et al., 2008; Eyler et al., 2008; Faulkner et al., 2010; Greves et al., 2007; McDonald, 2008). Since we did not have a direct correspondence between the state laws and the topic of

"student safety," we used hazardous route exemption provisions and requirements for traffic control measures as a proxy for student safety and, likewise, we used traffic-related barriers as a school-level proxy for student safety. Our analysis revealed that only state laws requiring traffic control measures were effective at reducing traffic-related barriers. This seems consistent with the finding by McDonald and Alborg that traffic safety improvements alone are not sufficient to change ATS practices (McDonald and Alborg, 2009), particularly in urban areas and higher density suburban areas (which comprise the majority of our elementary school sample). Contrary to our expectation, the odds of schools reporting that all students were allowed to bike to school was nearly 1.8 times greater in states with hazardous route exemptions, suggesting that such exemptions do not inhibit ATS.

Interestingly, laws requiring sidewalks around schools did not affect the reported walking/biking policies or practices. This finding was not particularly surprising given the mixed evidence on the role that sidewalks may play in ATS with some studies finding sidewalks as an important precursor to successful ATS programs (Davison et al., 2008; Fesperman et al., 2008) and others finding that having supportive physical environments such as sidewalks is necessary but not enough on its own to encourage ATS (Ahlport et al., 2008; Boarnet et al., 2005; McMillan, 2007).

4.1. Study limitations

Although we tried to account for potential limitations in our study design, we recognize that there are still several factors that must be considered when interpreting the study findings. First, this was a pooled, cross-sectional study based primarily on three years of data and, in the case of allowing all students to walk to school, only one year of data. However, given the limited change in the laws over the study time-period, we would not expect significant changes with a longitudinal study design. Second, there are other state laws and programs that may impact ATS beyond those examined herein including, but not limited to, state school siting laws, liability laws, and state-level SRTS programs. Future studies should examine the relationship between these laws/programs and school policies and practices. Third, we were unable to account for school district-level bussing distance requirements but anecdotal information from district policies compiled (but not reported) for districts nationwide for another study (Chriqui et al., 2010) revealed that districts usually repeat the state requirement or include language in their parent handbooks that cites to the relevant state law. Fourth, the school survey employed for this study did not examine whether lack of funding, hazardous routes, or student safety, specifically, were barriers to ATS so we were unable to fully examine some of the barriers that have been reported in the literature and we noted where we included other measures as proxies for these items. Fifth, as with any self-report survey, there is the potential for survey response bias based upon principal's knowledge or for misinterpretation of questions/unclear response options. For example, if a school only allows 3rd grade children to walk to school when accompanied by an adult, it is unclear how the principal would have responded given that there was not a response option for "being accompanied by an adult." However, we do not expect response bias or misinterpretation to be particularly problematic for the walking/biking-related questions given that we pre-tested the survey to verify comprehension, face validity, clarity, and feasibility of completing the questions (Turner et al., 2010). Sixth, and perhaps most importantly, is the potential error in principal reporting of walking/biking rates at their school. Given that the principal-reported rates of walking/biking to school in this study (21.5%) are higher than rates reported by parents elsewhere (National Center for Safe Routes to School and Safe Routes to School National Partnership, 2010), one has to consider the potential over-reporting of walking/biking rates reported herein. Finally, this was not a study of factors influencing state policy development in this area. Our research indicates that most of these laws were on the books for a number of years prior to our study time frame and they only changed marginally during our study so we do not expect that they were developed in reaction to safety concerns or advocacy efforts, for example. Future studies should further explore the genesis of these laws.

4.2. Conclusions

This study builds on the existing literature by illustrating that state laws, which were originally designed to improve student safety around schools, have the added benefit of reducing barriers to and facilitating ATS at the elementary level. Requirements for crossing guards, in particular, which do not require any structural improvements, appear to be particularly effective in reducing barriers to and facilitating ATS. Policy makers, planners, advocates, and others should consider the role that these more "safety" oriented measures can have in affecting ATS when making future SRTS-related expenditures or funding decisions. Furthermore, while the findings presented in this study were specific to U.S. public elementary schools, lessons learned from this study should provide important insights for policy makers, researchers, and practitioners in other countries.

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