
Evaluation of the California Safe Routes to School Legislation

Urban Form Changes and Children's Active Transportation to School

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- Background:** Walking or bicycling to school could contribute to children's daily physical activity, but physical environment changes are often needed to improve the safety and convenience of walking and cycling routes. The California Safe Routes to School (SR2S) legislation provided competitive funds for construction projects such as sidewalks, traffic lights, pedestrian crossing improvements, and bicycle paths.
- Methods:** A cross-sectional evaluation examined the relationship between urban form changes and walking and bicycle travel to school. Surveys were distributed to parents of third- through fifth-grade children at ten schools that had a completed SR2S project nearby. Two groups were created based on whether parents stated that their children would pass the SR2S project on the way to school or not.
- Results:** Children who passed completed SR2S projects were more likely to show increases in walking or bicycle travel than were children who would not pass by projects (15% vs 4%), based on parents' responses.
- Conclusions:** Results support the effectiveness of SR2S construction projects in increasing walking or bicycling to school for children who would pass these projects on their way to school. (Am J Prev Med 2005;28(2S2):134-140) © 2005 American Journal of Preventive Medicine
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Introduction

The possibility that the commute to school can play a role in increasing physical activity and reducing obesity among children has received much attention recently.^{1-5,6} Local, state, and federal Safe Routes to Schools programs have been proposed to increase the number of children who walk or bicycle to school, and so to increase those children's physical activity.^{2,7-9} Safe Routes to Schools programs use education, traffic law enforcement, or engineering changes to promote active commuting (walking or bicycling) to and from school. This paper uses data from an evaluation of the California Safe Routes to School (SR2S) program to assess links between changes in the built environment and active travel to school.

Some evidence suggests that walking or bicycling to school is associated with increased total physical activity among children. In a study of 114 children in Bristol, England, Cooper et al.¹⁰ found that male youths who

walked to school were significantly more physically active during the entire day and during after-school hours than were boys who did not walk to school. Tudor-Locke et al.¹¹ found that active commuting to school was associated with increased physical activity in a cross-section of adolescents in Cebu, Philippines. The increase in physical activity associated with walking or bicycling to school could not be explained by differential participation in sports and exercise before or after school in their sample. The energy expenditure associated with inactive (motorized) commuting to school in their sample was equivalent to a 2- to 3-pound/year positive energy balance (weight gain).¹¹ These two studies are consistent with findings from Dale et al.,¹² who found less after-school physical activity among children when physical activity was restricted during school.

While these recent studies give evidence of an association between active travel to school and increased physical activity among youths, transportation surveys indicate that school commuting patterns in the United States have shifted to favor motorized over nonmotorized modes.¹³ As reported in the 2001 National Household Travel Survey, <16% of students aged 5 to 15 walk or bicycle to school now, compared to 48% of students 3 decades ago.⁵ In that context, attention has focused

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on programs that encourage walking and bicycling to school through engineering changes to the built environment, education programs that promote active travel, enforcement of traffic safety laws in school zones, or a combination of these programs.²

The literature includes studies of environmental correlates of adult obesity and physical activity,^{14,15} environmental correlates of adult walking travel,^{16–18} and environmental correlates of walking and bicycling to school.¹⁹ There are, however, few evaluations of the effectiveness of SR2S programs in encouraging behavior change that increases active commuting to school. An exception is Staunton et al.,²⁰ who evaluated an SR2S program in Marin County, California. That program included a large education and traffic enforcement component, although by 2002 >\$2 million in funding had been raised by Marin County SR2S program officials, much of that for infrastructure improvements.²⁰ According to Staunton et al.,²⁰ classroom surveys of Marin County students found a 64% increase in the number of children walking to school, and a 114% increase in the number of children bicycling to school in six to seven schools.²⁰ Those surveys were conducted from 2000 to 2002, and so may not have captured the impact of infrastructure improvements that were funded in the later years of the Marin program. The present study extends previous work by studying engineering and infrastructure improvements funded by the California SR2S construction program in ten schools with varying demographic and built environment settings. The research presented here examines two groups of children at each school site—those who, based on parental reports, did and those who did not pass SR2S construction projects along their usual routes to school. The aim of this research is to assess whether SR2S programs that focus primarily on built environment changes aimed at increasing traffic safety, like the California program, can increase active travel to school.

Methods

The California SR2S Construction Program

The California SR2S program was authorized by Assembly Bill (AB) 1475 in 1999 and reauthorized by Senate Bill (SB) 10 in 2001. The program provides funding for construction projects near schools, with the intent of increasing pedestrian and bicyclist safety and improving the environment for active transportation to and from school. California was the first state to pass legislation that allocated transportation funding specifically for this purpose. The program focused on construction projects, as opposed to education or traffic law enforcement.

As of fall 2003, the California SR2S program had completed three application cycles and approved funding for >270 projects. Over \$66 million of federal funds had been used to support the program through fall 2003. The most common types of projects awarded across the first three cycles of SR2S awards (2000 through 2002) were pedestrian/bicycle

improvements (e.g., installation or widening of bicycle lanes and crosswalks) and sidewalk improvements (e.g., installation of sidewalks and/or curb ramps). For a full description and evaluation of the California SR2S program, see Boarnet et al.^{21,22} The California SR2S program did not include a formal educational component during the time period of this study (spring 2002 through fall 2003), although some schools might have provided active travel education coincident with SR2S project construction.

This study employs a survey of 1244 parents of third-through fifth-grade children in ten California SR2S schools. The survey, administered between 1 month and 18 months after the completion of SR2S project construction at each school, asked parents to assess whether their children walked or bicycled to school more frequently after SR2S project completion. At most school sites, the survey was administered within a year of SR2S project completion. A cross-sectional design with retrospective questions about travel is used to compare changes in child commuting to school (as reported by parents) across two groups of children—those who would versus those who would not pass the SR2S construction project along their usual route to school.

Study Schools

The ten schools in this study are listed in Table 1. Renewal of the authorizing legislation for the SR2S program, SB 10, required that the evaluation of the program be delivered to the legislature by December 31, 2003. This deadline limited potential study sites to projects that had not started construction in spring 2002, when funding for the research was released, but that would be completed by fall 2003. Because elementary schools comprised 70% of all project locations funded by the California SR2S program as of 2001, attention was restricted to elementary schools. The project team contacted all 25 elementary schools that fit the SR2S construction timeline. Not all schools were willing to participate in the study, which required that teachers distribute the parent survey to children in their classes, and then collect and return surveys to the research team. Sixty-four percent (16 of the 25) of the schools contacted agreed to participate; all were accepted to participate in the study.

Although this was a “convenience” sample of schools, the schools span a broad range of locations, demographic characteristics, and neighborhood types, from wealthy, low-density areas such as Malibu, which have exceptionally long blocks with sparse sidewalk networks, to lower-income, older, inner-city neighborhoods with smaller blocks and more complete sidewalk networks (Table 1). Urban design data were collected via on-site observations conducted by the research team.

Of the ten schools studied, the SR2S projects were within a quarter mile of seven of the schools. For another two schools, part of the SR2S project was within a quarter mile, and part was outside a quarter-mile radius. At a third school, the SR2S project was slightly outside a quarter-mile radius around the school. The SR2S projects constructed at the ten study schools were classified into three types: sidewalk improvements, crossing improvements, and traffic control. Sidewalk improvements at these schools included construction of new sidewalks, filling gaps in the sidewalk network, construction of a walking path, and the installation of curbs and curb cuts.

Table 1. Median household income (of ZIP code) and student demographics, by school, and neighborhood urban form within 0.25 mile of schools

School	City	Median household income	Student demographics					Neighborhood form		
			White (%)	African American (%)	Hispanic (%)	Asian (%)	Other (%)	Blocks with complete sidewalk (%)	Average block length (ft)	Average street width (ft)
Cesar Chavez	Bell Gardens	\$30,029	0.4	0.2	99.0	0.2	0.2	94	684	48
Glenoaks	Glendale	\$41,674	48.3	1.7	18.5	18.3	13.2	36	467	40
Jasper	Alta Loma	\$66,668	62.1	7.3	22.6	1.8	6.2	57	636	38
Juan Cabrillo	Malibu	\$100,857	79.6	0.6	17.0	2.1	0.7	17	1544	34
Mt. Vernon	San Bernardino	\$23,498	3.6	9.3	84.9	0.5	1.7	63	547	44
Murrieta	Murrieta	\$61,583	61.1	5.9	20.0	2.5	10.5	8	879	33
Newman	Chino	\$55,185	36.1	3.1	56.4	1.9	2.5	86	439	41
Sheldon	El Sobrante	\$61,494	32.3	26.3	22.1	11.4	7.9	53	477	39
Valley	Yucaipa	\$39,286	71.6	1.8	24.1	0.1	2.4	22	526	37
West Randall	Fontana	\$35,008	5.1	1.7	92.1	0.1	1.0	36	528	39

Sources: U.S. Bureau of the Census,²³ and Education Data Partnership.²⁴

Crossing improvements included adding crosswalks, installing in-pavement crosswalk lighting, and installing a pedestrian-activated, “count-down” street-crossing signal that warns pedestrians of the amount of time remaining to cross. Traffic control projects included the installation of a traffic signal.

Research Design

The study, while based on cross-sectional data, takes advantage of retrospective questions, comparing parent survey responses about their children’s travel across two groups, that is, children who would pass the SR2S project on their usual route to school and children who would not pass the SR2S project. For each group, comparisons were made between the percentage of parents reporting that their child walked or bicycled to school more after SR2S project completion as compared to before SR2S project completion.

This research design is similar to the untreated control group design with pre-test and post-test described in Cook and Campbell.²⁵ Pre-test information is based on survey respondents’ comparison of their child’s travel to school before versus after construction of their school’s SR2S project. Thus, pre-test information is retrospective rather than a comparison of “before construction” baseline data with data collected after SR2S project construction. The analysis uses two-sample *t*-tests to examine differences in the proportion of the students who are reported to walk or bicycle to school more after SR2S construction across the group of students who would pass the project along their usual route to school (the treatment group), and the group who would not pass the project along their usual route to school (the control group). The analysis reports two-sample *t*-tests for each of the ten study schools, and also for schools pooled by SR2S construction project type and for the full sample.

Safe Routes to School project location was likely not correlated with factors that might influence changes in child travel to school. Additionally, because each control group is from the same school as its corresponding treatment group, children in both groups were likely exposed to the same changes in the environment, school-sponsored active travel education programs, and societal factors that might induce

changes in walking or bicycling. Hence, this research design controls for several threats to internal validity.

Data Collection

Three types of data were collected at each school: (1) observations of traffic flows and pedestrian counts in the vicinity of the proposed SR2S project; (2) observations of the urban design within a quarter mile of the school, using a detailed urban design audit instrument developed as part of the evaluation; and (3) a survey of parents of third- through fifth-grade students. Only the last data source, the survey of parents, is used in this study. Full descriptions of all data collection methods are provided in Boarnet et al.²¹

After the construction of each SR2S project was completed, the survey was distributed to students in the third, fourth, and fifth grades of participating elementary schools. Teachers instructed students to give the surveys to their parents and to return surveys within 1 week. Surveys were printed in both English and Spanish. All students received a ruler or a pencil at the end of the week regardless of whether they returned the surveys. At the end of 1 week, classroom teachers returned surveys to the University of California–Irvine via pre-addressed, prepaid Priority Mail envelopes. Nonrespondent survey subjects were not contacted a second time, as that would have increased the burden on classroom teachers. The total number of respondents was 1244, corresponding to an overall response rate of 39% of the 3222 surveys distributed. The response rate by school ranged from 23% at Juan Cabrillo Elementary School to 57% at Glenoaks Elementary School.

Measures

The survey briefly described the SR2S project at that school in neutral language, including a one-sentence description of the project itself and its location. To assess increases or decreases in walking or bicycling to school after the construction of the SR2S project, the outcome variable for this study, parents were asked the following question: Think about how often your child walked or bicycled to school before the project

Table 2. Percentage difference in walking and bicycling after SR2S project construction, by whether project is along child's usual route to school

	Walk/bike more (%)	No change (%)	Walk/bike less (%)
Project along route	15.4 (75/486)	67.1 (326/486)	17.5 (85/486)
Project not along route	4.3 (16/376)	77.1 (290/376)	18.6 (70/376)
Total	10.6 (91/862)	71.5 (616/862)	18.0 (155/862)

Note: Numbers in parentheses are numerator and denominator for percentages, that is, the number of children reported walking or bicycling more, no change, or less, and the total number of usable survey responses for each cell.

described above (the SR2S project at the school) was built. Would you say that your child now walks or bicycles to school:

- (1) Less than before the project described above was built.
- (2) The same amount as before the project was built.
- (3) More than before the project was built.

A separate question asked parents to determine whether their child passed the SR2S project on his or her way to school. That question was:

Is this project along the usual route that your child travels to school? Answers allowed for comparisons in the differences between the reported changes in walking or bicycling to school across two different groups—those children for whom the SR2S project was along their usual route to school (i.e., children who pass the project) and those children for whom it was not (i.e., children who do not pass the project).

Additionally, the survey asked parents whether they had noticed the SR2S project at their child's school: Have you noticed this new project?

Data

From a total of 1244 respondents across the ten study schools, the number of usable observations was reduced to 862 (69% of responding parents), as the first two questions described above had to be answered to be included in the paired *t*-test analyses. The corresponding total number of usable observations at each school were as follows: Cesar Chavez, 133 (of 207); Glenoaks, 115 (of 142); Jasper, 56 (of 77); Juan Cabrillo, 31 (of 38); Mt. Vernon, 77 (of 138); Murrieta, 93 (of 125); Newman, 94 (of 130); Sheldon, 57 (of 80); Valley, 89 (of 125); and West Randall, 117 (of 181).

A total of 20.9% of the sample reported walking or bicycling as their primary mode of travel to school. Across each school, the percentages that reported walking or bicycling as their primary method of getting to school were approximately as follows: Cesar Chavez, 46%; Glenoaks, 10%; Jasper, 14%;

Juan Cabrillo, 8%; Mt. Vernon, 44%; Murietta, 6%; Newman, 17%; Sheldon, 5%; Valley, 6%; and West Randall, 22%.

Results

This section reports on findings from the analysis of the usable 862 surveys. Statistical analysis used the two-sample *t*-test for proportions, calculated using Microsoft Excel.

More parents stated that their child walked or bicycled less (18.0% [155 of 862]) after construction of the SR2S project, than said their child walked or bicycled more (10.6% [91 of 862]) following construction of the SR2S project (Table 2). Additionally, 71.5% (616 of 862) of parents reported that their child walked/biked the same amount before and after construction. When asked about their child's usual route to school, 56.4% of parents responded that their child passed the SR2S project along their usual route to school, and 43.6% of parents stated that their child did not pass the SR2S project. The proportion of children who walked or bicycled more after SR2S project construction was significantly greater ($p < .01$) among children for whom the SR2S project was along their usual route. Specifically, 15.4% of children who passed the project on the way to school walked more following construction of the SR2S project, compared to only 4.3% of children who did not pass the project on the way to school who walked more following construction (*t* statistic for difference in proportions=5.71, $p < .01$). There were no differences by group in the percentage of children who walked or bicycled less after the SR2S project (Table 2). In Table 3, the same comparison is

Table 3. Percentage of parents reporting that child walked or bicycled to school more after SR2S project construction, by improvement type and whether project is along child's usual route to school

Improvement type	Walk/bike more, project along route (%)	Walk/bike more, project not along route (%)	Difference	<i>t</i> statistic	<i>n</i>	<i>p</i>
Sidewalk	17.0 (39/230)	3.2 (5/157)	13.8	4.84	387	<0.01*
Crossing	12.1 (15/124)	5.6 (7/124)	6.5	1.80	248	0.07
Traffic control	15.9 (21/132)	4.2 (4/95)	11.7	3.08	227	<0.01*

Note: Numbers in parentheses are numerator and denominator for percentages, that is, the number of children reported walking or bicycling more, and the total number of usable survey responses for each cell.

* $p < 0.01$ (bolded).

SR2S, California Safe Routes to School legislation.

Table 4. Percentage of parents reporting that child walked or bicycled to school more after SR2S project construction, by school and whether project is along child's usual route to school

School	Improvement type	Walk/bike more, project along route (%)	Walk/bike more, project not along route (%)	Difference (%)	<i>t</i> statistic	<i>n</i>	<i>p</i>
Juan Cabrillo	Sidewalk	6.7 (1/15)	0.0 (0/16)	6.7	1.04	31	0.31
Murrieta	Sidewalk	13.7 (7/51)	2.4 (1/42)	11.3	2.12	93	0.04*
Sheldon	Sidewalk	15.6 (5/32)	0.0 (0/25)	15.6	2.43	57	0.02*
Valley	Sidewalk	11.6 (8/69)	0.0 (0/20)	11.6	3.01	89	<0.01**
West Randall	Sidewalk	28.6 (18/63)	7.4 (4/54)	21.2	3.15	117	<0.01**
Glenoaks	Crossing	12.0 (6/50)	7.7 (5/65)	4.3	0.76	115	0.45
Jasper	Crossing	3.1 (1/32)	0.0 (0/24)	3.1	1.02	56	0.31
Mt. Vernon	Crossing	19.0 (8/42)	5.7 (2/35)	13.3	1.85	77	0.07
Cesar Chavez	Traffic control	20.6 (14/68)	6.2 (4/65)	14.4	2.52	133	0.01*
Newman	Traffic control	10.9 (7/64)	0.0 (0/30)	10.9	2.80	94	0.01*

Note: Numbers in parentheses are numerator and denominator for percentages, that is, the number of children reported walking or bicycling more, and the total number of usable survey responses for each cell.

* $p < 0.05$; ** $p < 0.01$

SR2S, California Safe Routes to School legislation.

shown for the three types of SR2S projects. The greater increase in walking among children for whom the SR2S project was along the usual route to school is statistically significant at the 5% level for sidewalk improvements and traffic control projects (primarily traffic signals).

Table 4 shows the proportion of parents responding that their child walked or bicycled to school more after the SR2S project, stratified by whether the project was along the child's route to school, for each of the ten schools. The difference between the two groups is significant at the 5% level at six schools, and marginally significant ($p = .07$) at another school. The sample sizes were small at two of the three schools with statistically insignificant results (Juan Cabrillo and Jasper).

One concern related to the above results is that parents who noticed or had a favorable opinion of the SR2S project might have reported that their child walked more, regardless of the child's true walking behavior. If those parents were disproportionately represented among the group whose children passed the SR2S project, this would bias the results. Two tests were used to examine this concern. Dividing the survey respondents into two groups, those who noticed the SR2S project and those who did not, revealed a difference of only 3.2% in the proportion of children reported to walk or bicycle to school more ($t = 1.33$, $p = 0.18$). We also found no significant correlation between parents' assessment of the importance of the SR2S project near their child's school and the parents' report of whether their child walked more ($r = 0.39$, $p = 0.258$). Another test further examined the robustness of the results. Because walking or bicycling to school is related to age, the ages of children who did and did not pass the SR2S project along their usual route to school were compared. The age difference between these two groups was only 0.06 years ($t = 0.97$, $p = 0.33$).

Discussion

The current study suggests that urban design changes like those supported by the California SR2S program appear to be associated with increases in children's active travel to school. Against a backdrop of reduced active transportation to school in the ten SR2S study sites, the evidence here suggests that the children who passed the SR2S project were more likely to increase their walking or bicycling to school than were other children in the neighborhood. This finding confirms those of Staunton et al.²⁰ in their study of the SR2S program in Marin County, and expands those findings to more schools and to more diverse settings, showing an association between SR2S improvements and increased active transportation among students from ten schools with varied demographic and built environment settings and varied engineering improvements. The association between the SR2S projects and increased walking or bicycling is encouraging news for people who advocate using urban design to encourage changes in active transportation. By accommodating increased levels of walking and bicycling to school, the California SR2S program may support valuable health benefits for children that include prevention of obesity and of type 1 and type 2 diabetes.

Yet when looking at the aggregate survey data (Table 2), the analysis found a larger decrease than increase in walking and bicycling after the SR2S projects. This finding was unexpected and could be due to several factors. A highly publicized daylight abduction of a 5-year-old in a suburban southern California neighborhood in the summer of 2002 may have led to decreases in the amount of walking and bicycling to school. For some schools in this study, the "before construction" and "after construction" observations spanned the summer 2002 time period. Another possibility is that disruption caused by construction of some SR2S projects

(e.g., sidewalk projects that temporarily disrupted walking paths) might have caused some children to switch from nonmotorized to motorized travel during construction. Once the child changes travel modes, habit might inhibit the parent and child from changing back to an active travel mode after the SR2S project construction is completed. This explanation would be inconsistent with the finding of greater increases of walking among those who passed SR2S projects along their routes to school, however. Neither of these explanations was examined further, but against the backdrop of survey results that suggest an overall decrease in walking, children passing the SR2S project walked more than children who did not pass the project.

The research goals and funding level required some departures from an ideal study design. First, measures of walking and bicycling employed in this study were retrospective and based on parents' self-reports, which may reduce the accuracy of these measures. The survey did not include measures of total physical activity, either through a questionnaire or through activity monitoring with a pedometer or accelerometer. The survey also did not measure actual distance to school.

Second, it is possible that some education of parents and children on the importance of active transportation occurred coincident with this study. If so, such education may have increased the propensity of active transportation at these schools, although education would not explain differences in active transportation between children who did and did not pass SR2S projects. To understand whether schools provided education or information materials on active travel coincident with SR2S project construction, administrators at the ten study schools were queried in fall 2003 as to whether they had participated in National Walk to School Day during the period immediately before and immediately after SR2S project construction. Five of the ten study schools stated that they did not participate in National Walk to School Day; two schools had participated. At three schools, no official was available who could verify whether they participated. While participation in National Walk to School Day does not cover the full range of active travel education, it suggests that many schools in the study did not change their education or information programs related to active travel during SR2S project construction, implying that what is reported in this paper is an evaluation of primarily built environment changes.

Third, funding did not allow the same individuals to be tracked before and after SR2S project construction. Instead, change is inferred based only on the survey administered after SR2S construction, asking parents to assess whether their child's travel to school changed.

Fourth, there is no control group of schools that did not receive funding for an SR2S project. Such control schools were contemplated, but limited funding made it impossible to include those controls. Using the fact

that some children in a neighborhood will pass the SR2S project on their way to school while others will not, the study was able to produce a control group/experimental group comparison within the same school neighborhood.

The research presented here suggests that small but strategic pedestrian or bicycle facility improvements may impact the propensity of children to walk or bicycle to school. Improvements to sidewalks and traffic control systems look especially promising. How well these results generalize beyond the study sites or, more importantly, beyond the age groups studied here, remains to be seen.

One lesson from this research is that retrospective questions coupled with naturally occurring variation in exposure to changes in the built environment can provide evidence of association that improves upon that obtained from simple cross-sectional correlations. It is also true, however, that research on the effect of urban form on travel or physical activity poses some challenges. Of the 16 projects originally included in this research, construction of several was delayed, and only ten had been completed at the time of the scheduled end date for this research. This fact suggests that evaluation research should track programs, like California's SR2S, that seed many projects roughly simultaneously, to allow for circumstances that delay or eliminate planned projects, rather than trying to study only one project. Other insights from this research include the possibility of using variation within a neighborhood site to obtain the control/experimental variation, which can be less costly and can bring advantages over research designs that select "control group" sites that are outside of the areas being studied.

Future research can build on these findings by helping to elucidate the most effective engineering interventions for promoting active travel to school in varied settings. Researchers could usefully examine SR2S projects stratified by type of improvement (various sidewalk improvements, traffic control devices, etc.). It may also be that engineering improvements make greatest sense, at least in the short term, when improvements address critical missing "links" in settings that are otherwise "walkable." Researchers could explore this question by examining the relative impact of SR2S improvements in settings that are otherwise more or less "walkable." Additionally, future research should investigate the combined impacts of SR2S programs that include education and enforcement components, as well as engineering changes. This comprehensive approach may offer the greatest possible impacts in promoting active travel to school.

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