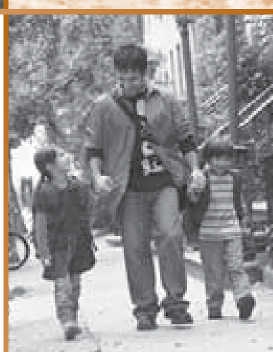
Evaluation of the Safety Benefits of Legacy Safe Routes to School Programs



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Photographer: Dan Burden, www.pedbikeimages.com (Boy walking with boy on bike and crosswalk)

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16. Abstract

This study first examined the feasibility of conducting a crash-based assessment of the safety effects of legacy Safe Routes to School (SRTS) programs. These were SRTS programs operating before the passage of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) that was signed into law on August 10, 2005. A design was developed for collecting detailed classification data on a sample of legacy SRTS programs in order to create a profile of their operations. This classification data also provided a basis for examining pedestrian and bicycle crash data for elementary school children (age 4 to 12) on the school trip. Detailed information including school calendars and bell times was collected on 130 legacy SRTS programs. The State Data System (SDS) crash files maintained by NHTSA were used to conduct three case studies of States containing the largest subsets of these 130 programs. The results for each State showed a significant trend in which the numbers of 4- to 12-year-old pedestrians and bicyclists involved in crashes during the school trip at the SRTS focus sites decreased over time. Similar trends were shown for the same age group and approximate school trip times at the State level in all three studied States. There was either no decrease or inconsistent patterns in the crash involvements of pedestrians and bicyclists of ages other than 4 to 12. The developed profiles of the legacy SRTS programs show heterogeneous motivations and goals as well as a wide range of program size and funding sources. Few programs included any systematic evaluation of outcomes other than changes in school trip mode. The crash results strongly suggest that, because of the significantly declining crash involvements, legacy SRTS programs could not have caused a pedestrian or bicycle safety problem due to increased exposure. Although this study was not capable of reaching a definitive conclusion with respect to SRTS safety effects, the findings are suggestive that legacy SRTS programs may have contributed to improved pedestrian and bicycle safety. A replication of the study approach focusing on SRTS programs generated by SAFETEA-LU would be needed to determine whether this study's findings would remain valid for the SAFETEA-LU SRTS programs.

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The authors are also appreciative of the availability of the State Data System (SDS) within the National Highway Traffic Safety Administration's National Center for Statistics and Analysis (NCSA). This system was a valuable resource that both simplified the crash analyses and supported the data precision needed to conduct the research. We are grateful for the time and effort devoted by the SDS staff within NCSA, particularly Tom Bragan and Rory Austin, in providing the data and codebooks for the various States examined.

EXECUTIVE SUMMARY

Background

This is the final report of a study funded by the National Highway Traffic Safety Administration to assess the safety impact of legacy Safe Routes to School (SRTS) programs in the United States. In the context of the present study, legacy SRTS programs are those that were started before the commencement of the coordinated national SRTS program funded by the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) that was signed into law on August 10, 2005. Since the present study was started well before the national SRTS thrust generated by SAFETEA-LU, it is focused only on legacy SRTS efforts although its findings may have implications for the operation and evaluation of the newer programs.

In the United States, SRTS programs started in 1997 when a nonprofit organization (Transportation Alternatives) developed a program in the Bronx with an engineering focus (NHTSA, 2004; Hubsmith, 2006). The initial SRTS programs were predominately safety-oriented. Their primary goal was to reduce crash occurrence among those already walking and bicycling to school. As additional programs were formed, however, the primary SRTS program focus shifted to encouraging more walking and bicycling on the school trip and less use of motorized vehicles (school buses, private cars). The hope was that this shift would result in numerous individual and societal benefits including improved health, decreased air pollution, decreased congestion at school loading areas, and reduced school transportation costs.

As the SRTS movement grew and more programs were started at the State and local levels, it became apparent that multiple countermeasure modalities were needed for a successful program including education, enforcement, engineering, and encouragement (the "4 E's"). Before SAFETEA-LU, however, there were no standards or guidelines regarding what constituted an SRTS program, and there was little formal program evaluation (the fifth "E"). As a result, some programs covered a single school or a single event in a school while others covered multiple schools and multiple events. Programs calling themselves SRTS could have any number of the 5 E's and varied in tenure from being funded for a single event to being institutionalized within a community.

Objectives

The present study had two related objectives:

- To determine the feasibility of conducting a systematic and practically meaningful crash-based evaluation of SRTS programs.

- If feasibility can be shown, conduct a study to examine the safety effects of implementing legacy SRTS programs.

These two objectives led to a two-phase effort consisting of a feasibility study followed by a crash-based examination of the safety impacts of legacy SRTS programs.

Approach

Phase I, the feasibility study, used secondary source data and idea generation to enumerate possible methods to conduct a crash-based study. It was concluded from Phase I that a definitive crash-based assessment of legacy SRTS program effects was not possible. However, it did appear possible to conduct a preliminary crash analysis that could bound any benefit or problem related to SRTS and indicate to NHTSA whether a more detailed longitudinal study of the SRTS programs generated by SAFETEA-LU was necessary.

The Phase II approach was developed by following the logic derived in Phase I and the basic objective of conducting a crash-based assessment of SRTS programs. In order to conduct a study of the safety impact of legacy SRTS programs, it was considered necessary to collect in-depth information on each program included. The taxonomy used in this study to structure the data collection was designed to be simple and straightforward.

In order to conduct a crash analysis of a set of SRTS programs, the present study required unbiased crash data for the jurisdictions in which studied SRTS programs operated. Generally, "official" crash data files maintained by State or local agencies are best. In the present study, however, the widespread venues of the SRTS programs that could potentially be of interest presented the daunting task of potentially having to work with the crash files of many different States and local jurisdictions. Since these files are dissimilar in format and content, this would have represented a significant task. Fortunately, NHTSA's National Center for Statistics and Analysis (NCSA) maintains the State Data System (SDS), a source of uniform multi-year crash data for many States. The SDS data were used to create series of annual pedestrian and bicycle crash involvements for the years 1996 through the latest year for which the SDS had data. The start point of 1996 was selected because that was the earliest year for which the SDS had data for all three States of interest.

Overall, 130 legacy SRTS programs provided sufficiently detailed data to be included in the study. A subset of the program information was used together with SDS data to prepare case studies of the three States with the largest numbers of programs in the study sample. Additional States could not be used because they contained too few programs to support a stable analysis.

Results

Results included profiles of legacy SRTS elementary school programs and a crash analysis. The profiles showed that:

- Elementary school programs predominated;
- Programs had typically been in operation for five years or less;
- About half of the studied programs had been completed while the other half were still ongoing;
- Most programs were in urban and suburban locations;

- Most of the programs used multiple E's—often three or four—but many of the high dollar value programs consisted only of engineering interventions;

- Some programs measured school trip transportation mode changes, but few programs included safety-related evaluations;

- Almost half of the programs received their funding from their State;

- Highway safety considerations motivated the start of the largest number of programs (the overall percentage motivated primarily by safety concerns was 27.7%); and

- Increasing physical activity was viewed as the primary goal of more programs than was reducing crashes/improving safety.

Crash data were analyzed using crash-involved pedestrians and bicyclists as the primary unit of analysis. Crash-involved pedestrians and bicyclists were examined as a function of the age of the person involved and the location of the crash. Location was divided into statewide and SRTS focus city/county components. Victim age was divided into elementary age school children (4 to 12 years old) and all other ages (0 to 3 years old and 13+ years old).

The crash data for each series were extracted from each State's SDS data for each year. The raw numbers of crashes for each year in each series were then divided by the raw number of crashes that occurred to the same population subgroup in 1996, thus providing a standardized value for crashes each year in relationship to the crashes that occurred in 1996, which were assigned a value of 1.0. This standardization served the dual purpose of simplifying comparisons of series of greatly differing sizes and simultaneously masking the identity of the States that were analyzed. Masking the identity of the States is important since one of the conditions under which States provide data to the SDS is that they not be identified in individual analyses.

The first analysis step was to create a line graph for each State that displayed the time plots for the following groups of crash-involved people:

1. Elementary-age (4 to 12 years old) pedestrians and bicyclists at SRTS focus sites for school calendar dates, days, and times
2. All other ages of pedestrians and bicyclists at the SRTS focus sites for school calendar dates, days, and times
3. Statewide elementary-age pedestrians and bicyclists for all dates and times
4. Statewide pedestrians and bicyclists of all other ages for all dates and times
5. Statewide elementary-age pedestrians and bicyclists Monday to Friday, 6:45 a.m.-9:15 a.m. and 1:30 p.m. to 4:30 p.m.
6. Passengers age 4 to 12 at SRTS focus sites for school calendar dates, days and times
7. Statewide passengers age 4 to 12 Monday to Friday, 6:45 a.m.-9:15 a.m. and 1:30 p.m. to 4:30 p.m..

Series 1 was the basic series of interest while the remaining six series provided comparisons of interest in reaching conclusions.

To accomplish a statistical comparison among the various series, linear regression equations were calculated for each data series. These regressions first indicated if there was a significant upward or downward trend in the various series. The parameters of the regressions were also used to test whether any significant trends were differential among the series.

The results showed that crash-involved elementary school children on the school trip went down significantly in all three States both statewide and at the SRTS focus sites. Although the State and SRTS focus site decreases were not significantly different, the focus sites did show greater reductions than the States as a whole. Over the same period, pedestrian and bicyclist crash involvement of other ages and the involvement of 4- to 12-year-olds as passengers during the school trip showed no consistent patterns.

Discussion

SRTS programs could affect safety in one of three ways. First, they could have no impact on safety, and there would be no observable change in crash involvement rates for pedestrians and bicyclists. Second, SRTS programs could reduce pedestrian and bicyclist crash involvement through safety interventions. Third, the programs could result in an increase in crashes because they generate additional exposure to traffic risks on the school trip for children as pedestrians and bicyclists. The pattern of crash results found in this study from three separate States provides absolutely no support for a conclusion that legacy SRTS programs increased pedestrian and bicycle crash involvements and, by implication, pedestrian and bicycle crashes themselves. On the contrary, the consistent pattern of declining crash involvements of elementary school children on the school trip over the years during which these programs were implemented provides strong support for a conclusion that legacy SRTS programs were at least benign with respect to crashes.

The remaining safety-related question is whether legacy SRTS programs can be credited with decreasing crash involvements. The data reported from this study are not sufficient to answer this question with precision because of the assumptions that had to be made to conduct the analyses, particularly the classification of a city or county as an SRTS focus site when only a minority of its elementary schools was involved in the studied programs. In spite of these limitations, the pattern of results is certainly favorable to legacy SRTS programs for several reasons. First, a marked decrease in pedestrian and bicycle crash involvements of 4- to 12-year-olds was noted at the focus sites in all three States. This suggests that the safety of elementary school children on the school trip improved over the time studied. Second, although statewide data for the three studied States suggest a general decrease in the crash involvements of interest, there appears to be some tendency for the SRTS focus sites to show lower crash involvements even though the difference from the statewide values is not statistically significant.

A third consideration when interpreting these findings is that a “spill-over effect” of SRTS programs may contribute to improved safety community-wide even if they are only housed in a subset of the elementary schools. Also, the observed statewide results themselves may be attributable at least in part to the presence of active SRTS efforts other than the studied programs within the three covered States.

The findings of the present study raise no cause for safety concerns from the implementation of legacy SRTS programs. Since the much broader SRTS programs funded under SAFETEA-LU are based in part on the lessons learned from these legacy programs, there should also be little concern that they will be detrimental to safety. Obviously, if the new programs are significantly more successful than the legacy efforts in shifting school trip travel modes to walking and bicycling, the possibility of a negative safety consequence due to increased exposure must again be considered. With the larger number of SRTS programs generated by SAFETEA-LU and the better data they will collect, a future replication of the current study should be facilitated. Moreover, if NHTSA continues to maintain and expand the SDS, a future replication of this type of study will be greatly facilitated.

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1. INTRODUCTION

This is the final report of a study funded by the National Highway Traffic Safety Administration to assess the safety impact of legacy Safe Routes to School programs in the United States. In the context of the present study, legacy SRTS programs are those that were started before the commencement of the coordinated national SRTS program funded by the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users that was signed into law on August 10, 2005.

As described below, there are significant differences between the legacy SRTS programs covered by this study and the SRTS programs generated by SAFETEA-LU. It is important for the reader to understand these differences when interpreting the reported findings.

1.1 Background

In the mid-1970s, Denmark had the highest rate of child traffic fatalities in Western Europe (NHTSA, 2004). To counter the problem, the city of Odense began a pilot program in which all 45 of its schools participated. Specific roadway dangers were identified and corrected by incorporating a variety of traffic calming measures. A network of pedestrian and bicycle paths was created, roads were narrowed, and traffic islands were added. Speed decreased on 12 roads that were studied, as did total crashes. Crashes also became less severe. In addition, both parents and students reported that they felt more secure after the traffic calming measures were incorporated. Over a 10-year period, child pedestrian and bicycle casualties fell by more than 80%. Soon after that, Denmark established what is considered to be the first national SRTS program.

In the United States, SRTS programs started in 1997 when a nonprofit organization (Transportation Alternatives) developed a program in the Bronx with an engineering focus (NHTSA, 2004; Hubsmith, 2006). By mapping crash data around schools and combining the crash analyses with information provided by parents, city planners, and engineers, the borough started an effort to create safe walking corridors around 13 elementary schools. Since most children in the Bronx already walked to school, the engineering changes incorporated were designed to make the roadways safer.

These initial SRTS programs were predominately safety oriented. Their primary goal was to reduce crash occurrence among those already walking and bicycling to school. As additional programs were formed, however, the primary SRTS program focus shifted to promoting more walking and bicycling on the school trip and less use of motorized vehicles (school buses, private cars). The hope was that this shift would result in numerous individual and societal benefits including:

- Improved health due to the physical activity;

- Decreased air pollution due to fewer vehicle trips and less vehicle idling;

- Decreased congestion at school loading areas; and
- Lower school transportation costs.

Safety was also considered by these early programs since the clear objective was to generate more nonmotorized school trips while simultaneously maintaining or even reducing the frequency of pedestrian and bicycle crashes with motor vehicles.

In addition to the Transportation Alternatives program in the Bronx, several other SRTS activities were taking place in the United States in 1997. For example, Florida produced its *Safe Ways to School Toolkit*, a statewide pilot project to improve conditions for children to walk and bicycle safely to school (University of Florida Department of Urban and Regional Planning, undated). Also, Chicago launched its first *Walk to School Day* program that involved thousands of school children in the city. The popularity of *Walk to School Day* eventually led to its becoming an international event that takes place every year during the first week in October. The Chicago program subsequently became known as the *Walking School Bus*—an activity in which children meet volunteers at set locations on the way to school and are escorted to the next volunteer on the pre-defined route. The Chicago program was developed so that children would have a group to travel with and thus be protected from crime.

Early programs often involved only one countermeasure modality, typically engineering or education. Eventually, enforcement components were added as was encouragement. Encouragement countermeasures were designed both to promote more walking and bicycling on the school trip and to foster parent participation in the program.

As the SRTS movement grew and more programs were started at the State and local levels, it became apparent that all four of these countermeasure modalities—education, enforcement, engineering, and encouragement—were needed to maximize program success. They became known as the "4 E's" of SRTS:

- Education—In addition to providing information to parents and the community about the program, education activities included designing and conducting pedestrian and bicyclist training programs and developing and disseminating safety information.
- Engineering—Activities included engineering changes to the roadway to make the roadway safer. Although many types of infrastructure activities were funded, the addition or repair of sidewalks was a major component. Other engineering activities included installation of traffic-calming measures, traffic signs and signals, roadway crossing improvements, and development of pedestrian and bicycle facilities.
- Enforcement—Activities included control of speeding and traffic volumes in areas where students must cross streets and in school loading zones.
- Encouragement—These activities were designed to make walking and biking fun so that children and parents would want to participate. They included *Walk to School Day*, the W*alking School Bus*, contests, and other special events.

In the year 2000, Congressman James Oberstar of Minnesota, a major supporter of *SRTS* programs, worked with NHTSA to fund two SRTS pilot programs (Hubsmith, 2006). These programs were the first in the United States to formally incorporate a fifth "E"—evaluation. Although a subset of earlier programs had included some assessment of outcomes, particularly mode shifts from one school trip transportation method to another, these pilot programs were the first programs to acknowledge and promote the fact that they were based on "5 E's." One was conducted in Marin County, California, and the other in Arlington, Massachusetts. In Marin County, education and encouragement activities achieved increases in biking (from 14% to 23% of all school trips), walking (from 14% to 23%) and car pooling (from 11% to 21%) and decreases in busing (from 6% to 4%) and driving alone (62% to 38%) (NHTSA, 2004). The project in Arlington concentrated on community education as well as parent and student encouragement efforts. In Arlington, there was an increase in students walking to school of 14 percentage points (NHTSA, 2004).

As knowledge of the pilot programs spread so did awareness of SRTS in general, and many large and small programs were started throughout the United States and abroad. Documents were prepared that described the many existing programs and provided guidance on how to start and run an SRTS program. NHTSA produced one such report that was prepared by members of the Marin County program and was based on their experience (NHTSA, 2002). It contained advice on how to get started, gathering data, and types of program events, among other topics. Other reports provided summaries of various existing programs. NHTSA (2004) produced a report that described existing SRTS programs and provided resources, walkability and bikeability checklists, steps in starting an SRTS program and information on funding sources. In addition, Transportation Alternatives (2001, 2002) provided inventories of programs existing in the United States in 2001 and 2002. These inventories described four program models—engineering, enforcement, encouragement/education, and dedicated resources and noted that combined approaches are most effective.

Before SAFETEA-LU, however, there were no widely promulgated standards or guidelines regarding what constituted a SRTS program. As a result, some programs covered a single school or a single event in a school while others covered multiple schools and multiple events. Programs calling themselves SRTS could have any number of the 5 E's and varied in tenure from being funded for a single event to being institutionalized within a community. In addition, there were no standard sources of funding. Some States set up funds specifically for SRTS programs—often for infrastructure improvements—and provided guidelines for their use. In other instances program managers needed to search for funds to cover program expenses. Legacy SRTS program funds came from Federal, State and local governments as well as from private sources. The staffing for some programs was handled largely by volunteers while others had full or part time professionals.

Thus, the SRTS programs established before SAFETEA-LU were heterogeneous in composition. Their size and primary focus varied as did their individual longevity. Notably, the expected effect of these legacy SRTS programs on safety is not at all clear cut. On the one hand, SRTS encouragement efforts should lead to greater exposure as a pedestrian or bicyclist which could be associated with an increase in crash risk. On the other hand, many SRTS programs improve the as-built environment and increase safety training and enforcement significantly, thereby presumably reducing crash risk. This can possibly offset any crash risk increase due to exposure and even lead to a safety improvement.

SAFETEA-LU provided $612 million for The National Safe Routes to School Program from 2005 through 2009. This national program is expected not only to increase the number of SRTS programs around the country but also to change their characteristics. Each State is required to have an SRTS coordinator. Every SRTS program is encouraged to encompass all 5 E's.[1] Significant technical support is available from an SRTS program office in the Federal Highway Administration (FHWA), designated by Congress as the lead Department of Transportation agency for this initiative, and from the National Center for Safe Routes to School (www.saferoutesinfo.org), the designated SRTS clearinghouse congressionally mandated to support this effort. There are also specific guidelines and rules for SRTS programs funded with this new Federal money. These requirements will result in more standardization in new SRTS efforts. Evaluation, including both process and outcome measures, must be included.

The present study was started well before this national SRTS thrust, and, thus, the programs it will generate could not be included in the current analyses. This is not viewed as a limitation of the present effort since the legacy and SAFETEA-LU SRTS programs may be dissimilar. Moreover, even though some legacy programs may ultimately disband or transition into conforming projects, there is potentially much information, both research and programmatic, as well as lessons to be learned from an examination of the safety effects of legacy SRTS programs. The search for this information and these lessons led to the formulation of the specific objectives of the current project.

1.2 Objectives

As discussed above, the dual SRTS goals of increasing non-motorized school trips and reducing pedestrian and bicycle crashes with motor vehicles during the school trip may be at odds. This dilemma holds true for both the legacy SRTS programs examined by the present study and the new SAFETEA-LU SRTS programs that have begun to emerge. With SRTS programs being encouraged nationwide, it is important that safety is not compromised. This is especially true because it has been shown that there are significant differences in relative crash risk across the various school trip travel modes (Transportation Research Board, 2002).

With this in mind, the present study followed two related objectives:

- To determine the feasibility of conducting a systematic and practically meaningful crash-based evaluation of SRTS programs.
- If feasibility could be shown, to conduct a study to examine the safety effects of implementing legacy SRTS programs.

These two objectives led to a two-phase effort consisting of a feasibility study followed by a crash-based examination following the proposed design. The adopted approach for each phase is discussed in the next section.

[1] SAFETEA-LU provides that no more than 90% and no less than 70% of the funds should go to infrastructure and 10% to 30% should go toward noninfrastructure activities.

2. APPROACH

The study was divided into two phases—a feasibility study and a crash-based investigation.

2.1 Phase I: Feasibility Study

The first phase used secondary source data and idea generation to enumerate possible methods to conduct a crash-based study. Several important constraints and considerations were assessed. One basic problem is that the expected number of pedestrian and bicycle crashes among the students covered by any single SRTS program is extremely small. Another issue is that many SRTS countermeasure approaches, particularly as-built changes such as new sidewalks and bicycle paths, take a long time to install and become fully effective. Thus, a "classic" pre/post crash study using newly instituted SRTS programs as a sampling basis was not a reasonable approach because of the small expected crash numbers involved, the relatively low rate of new program startups and the relatively long time it takes for a program to become fully operational.

Since the use of new SRTS programs was not considered feasible, an examination was made of the possibility of conducting a retrospective examination of SRTS programs already in operation. This approach could potentially amass a sufficiently large sample of programs so that a statistically viable number of crashes would be expected. The major problem with this approach was that the literature and project staff contacts with SRTS directors suggested that few ongoing programs collected the type of pre/post mode information that a comprehensive evaluation would require. Thus, adoption of a retrospective study basis would preclude examining pre/post transportation mode changes in the same sample of SRTS programs that would be used to reach a conclusion on crashes. In addition, there was significant methodological variability among the small subset of programs that did examine mode shifts that precluded aggregation of the results. Nevertheless, it is a reasonable conclusion from programs such as those in Marin County, California, and elsewhere that did measure mode shift that a successful legacy SRTS program would produce some shift in transportation mode choice that would increase walking and bicycling to school. Moreover, the magnitude of any shift accomplished by these legacy programs would be operationally meaningful but not pervasive, e.g., Marin increased the percentage of walkers from 14% to 23% and the percentage of bicyclists from 7% to 15% (NHTSA, 2004).

A final methodological challenge to a crash-based assessment of legacy SRTS programs is that SRTS programs are typically school-based while crash data are aggregated at the jurisdiction (e.g., city, county) level. Thus, it is not possible to associate a specific crash with a particular school and/or SRTS program without determining the precise location of the crash and the school enrollment of the victim. This cannot be accomplished from standard crash data sources such as local police or State transportation department records without accessing all crash reports for the jurisdictions of interest. These would then have to be geocoded, and the victim's school enrollment traced—processes that are extremely time consuming and costly.

The limitations produced by the need to use jurisdiction-wide crash data in any evaluation would be largely overcome if enough jurisdictions could be found in which homogeneous SRTS programs existed in all or most schools. Unfortunately, analyses of ongoing SRTS programs showed that few communities could be characterized as having pervasive SRTS programs. This was even true at the elementary school level, where most legacy SRTS programs are focused. This added a further constraint to any study design for Phase II.

Given these considerations, it was concluded from Phase I that a definitive crash-based assessment of legacy SRTS program effects was not possible. However, it appeared feasible to conduct a preliminary crash analysis that could bound any benefit or problem related to SRTS and indicate to NHTSA whether a more detailed longitudinal study of the SAFETEA-LU SRTS programs was indicated. The logic driving this conclusion proceeded as follows:

- If an SRTS program did not produce a mode shift to nonmotorized school travel methods (i.e., walking and bicycling), any *increase* in crashes at the program's site could *not* reasonably be attributed to the program.

- If school trip pedestrian and bicycle crashes *decreased* at the sites of SRTS programs, the program was potentially effective as a crash countermeasure. Moreover, if the extent of any observed crash reduction at SRTS sites was greater than that experienced statewide or at the same sites but not during the school trip, there would be further support for a potential safety benefit of SRTS.

- If an SRTS program increased the use of non-motorized school trip modes, there would be a potential for a crash increase due to additional exposure. However, if no crash increase was observed or, in fact, there were a *reduction* in crashes, there would be at least a circumstantial case for both safety and societal benefits arising from SRTS programs.

- If a study focused on jurisdictions in which SRTS programs were known to be operating and a crash *reduction* was documented, there would be virtually no chance that the SRTS programs were counterproductive. Further, if the observed crash reduction was in excess of that seen in comparison jurisdictions without SRTS programs, there would be a strong suggestion that the SRTS programs had created or at least potentiated the crash reduction.

The Phase II approach was developed by following this logic and the basic objective of conducting a crash-based assessment of SRTS programs.

2.2 Phase II: Taxonomy and Crash Analysis

In order to conduct a study of the safety impact of legacy SRTS programs, it was considered necessary to collect in-depth information on each program included. Because of the heterogeneity of the legacy programs, these data were important to understand the subset of programs assessed and to help avoid erroneous conclusions. It was decided that any evaluation of the impact of legacy SRTS programs on crashes must first classify the studied programs on the basis of their objectives, their components and the extent of their implementation. For example, two programs might have been focused on educational objectives related to choosing routes with the least risk. Those programs would fall into the same classification on the first dimension (objectives). However, if one program promulgated a curriculum with repetitive and continuing interactions with the students while the other simply handed out a one-time flyer, their classification on the second dimension would have to be quite different.

2.2.1 Taxonomy Development

The taxonomy used in this study was designed to be simple and straightforward so that its dimensions could be used as independent variables in the crash analysis if possible and necessary. At the outset, however, the taxonomy had to be sufficiently detailed so that it classified programs along all relevant dimensions related to their objectives/motivations, activities and the intensity of their implementations. The categories in the initial detailed classification were subsequently collapsed, and some categories were removed after it became apparent that programs could not provide the data for them.

The taxonomy was defined in terms of the following categories considered descriptive of an SRTS program:

- Program particulars including:
  - Name
  - Point of contact
  - Administration, i.e., was the program autonomous or part of a larger program?
  - Location
  - Start date
  - End date or current program status
  - Size of elementary school population in program's district
  - Number of elementary schools in program's district
  - Number of elementary schools in the program
  - Urbanization of the program locale
  - Budget
  - Source of funds (Federal, State, local, private, self-derived)

- Situation prior to the program:
  - Speed limit in elementary school zones
  - Extent of traffic congestion around school zones
  - Changes in traffic congestion

- Motivations for starting the program:
  - One or more serious crashes in the jurisdiction
  - Concern about possible crashes
  - Environmental concerns (such as air pollution)
  - Student obesity
  - Other student health issues
  - Availability of outside SRTS funds
  - Parental pressure
  - School board/official directive
  - Traffic congestion at schools
  - Complaints of dangerous conditions

- Program goals:
  - Promotion of increased bicycling and/or walking
  - Obesity reduction
  - Crash reduction
  - A healthier environment
  - Transportation cost savings
  - Vehicle speed reduction near schools
  - Identification of best routes to walk or bicycle to school
  - Reduction of crime risk on school trips
  - Improvement of infrastructure

- Program components:
  - Engineering
  - Education
  - Encouragement
  - Enforcement

- Subjective assessment of pre/post program changes in:
  - Percent of students who could walk to school on a sidewalk
  - Adequacy of traffic signals near elementary schools
  - Number of crossing guards
  - Percentage of students bused
  - Percentage of students walking

- Program evaluation:
  - Existence
  - Focus (crashes, mode shift, both)
  - Identity of the evaluator
  - Existence of report

- Percentage of goals achieved to date.

2.2.2 Crash Measures

It was clear from the outset that the number of legacy SRTS programs that could be identified and included in the study would be somewhat restricted. It was also apparent from the literature and discussions with people associated with legacy SRTS programs that the vast majority were focused at the elementary school level. It was therefore decided to restrict the present study to elementary school programs. Thus, crashes involving children age 4 to 12 were considered of interest.[2]

Of particular interest, however, were those crashes involving 4- to 12-year-olds while on school trips to and from SRTS schools. As mentioned earlier, it was not possible within the present study to associate each pedestrian or bicycle crash victim with a particular school in

[2] Because schools vary with regard to the dates for entry into kindergarten (i.e., in some schools children have to be 5 years old by December 2nd), age 4 was used as the youngest age for children in kindergarten.

order to determine if the victims were exposed to an SRTS program. Likewise, it also was not possible to determine with certainty that a particular crash occurred while the child was on a trip to or from school. This is exactly the problem faced by the Transportation Research Board (2002).

The solution used by the Transportation Research Board (2002) and adopted here with modifications is the use of a surrogate crash measure. The surrogate consists of a temporal component that limits the crash data to the school trip and one or more age categories to extract school children from the total population of crash victims.

The Transportation Research Board (2002) study was examining nationwide data and therefore had to use "average" or estimated values for the school calendar (September 1 through June 15) and school bell times (6 a.m. to 8:59 a.m. and 2 p.m. to 4:59 p.m.). Since the present study only focused on a subset of States and specific locales within them and was going to contact individual programs for data, it was possible to obtain the actual school calendar and bell times for each included program. This permitted crash measures to be more closely associated with the actual school trip in each locale.

2.2.3 Source of Crash Data

The present study required unbiased crash data for jurisdictions containing identified SRTS programs. Generally, "official" crash data files maintained by State or local agencies are best. In the present study, however, the widespread venues of the SRTS programs of interest presented the daunting task of potentially having to work with the crash files of many different States and local jurisdictions. Since these files are dissimilar in format and content, this would have represented a significant task. Fortunately, NHTSA's National Center for Statistics and Analysis maintains the State Data System, a source of multi-year and multi-State crash data. At the time this study was analyzing data, the SDS contained crash data from 29 States in easy-to-use SAS datasets that had been "cleaned" and validated by the NCSA staff and its contractors.

2.2.4 SRTS Program Identification

Legacy SRTS programs were identified from a number of sources. First, a literature review was conducted to identify programs that had been evaluated or at least described in reports, journals and in Web sites. It was reasoned that such programs would represent the larger more prominent efforts from which detailed data would likely be available.

The literature review was supplemented by input from the NHTSA Regional Offices, SRTS promotion groups, requests within the highway safety community, and interactions at the SRTS National Training Course held in Tucson, Arizona, from February 28 to March 4, 2005.

The objective of the identification task was to amass as many program names as possible from which a selection for inclusion in the study could be made.

2.2.5 Program Selection

The following criteria were used to select SRTS programs to include in the crash analysis:

- Located in States covered by the SDS data;
- Focused on elementary schools (including any subset of grades K-6);
- Actually accomplished some of their process objectives, i.e., had been (or were still) operating as an SRTS program; and
- Could provide data for the taxonomy.

Using only programs located in SDS States was an expedient to ensure that uniform quality and easily accessible crash data would be available. The focus on grades K-6 positioned the study to examine the most prevalent legacy SRTS programs. Considering only programs that had actually implemented some activities in any of the E's avoided the possibility of finding no effect because there had been no activity. The ability to provide at least the primary data for the taxonomy was necessary to classify the SRTS project and to delimit the crashes examined to the school trip for each site.

2.2.6 Data Collection and Analysis

Data for the taxonomy were collected by contacting the identified programs or their sponsors. A data checklist was prepared to guide discussions and ensure that all major categories were covered. In some cases, especially for legacy SRTS programs that were still in operation, it was easy to speak directly with someone in the program's management. In other cases, it was necessary to speak to someone in the funding agency for the program, e.g., in a State agency, who was either familiar with its operations or had access to reports the program prepared. Where reports concerning the program were available (published or unpublished), they were obtained and used to supplement the classification data as appropriate.

If little or no information on the program could be obtained, or there was reason to believe that the acquired data were inaccurate, the program was dropped. In addition, if there were only one or a few programs in a particular State, they were also excluded from the crash analysis because there would be insufficient data to support a stable picture of crash trends. They were, however, retained for the development of profiles of the various types of legacy SRTS programs based on the classifications inherent in the taxonomy.

The remaining set of legacy SRTS programs formed the basis for the crash analysis. This analysis was not intended as a definitive inferential examination of the safety effects of the SRTS programs being studied. Rather, it was focused on shedding light on the basic issue of the *possible* safety effects of legacy SRTS programs by examining the general crash trend of elementary-school-age children during the school trip[3] in the context of other pedestrian and bicycle crashes occurring within the same State.

The States included in the crash analysis were selected from those States for which both SDS data and sufficient program descriptive information were available. States were processed in descending order of the number of studied programs they contained beginning with the State with the most legacy programs in the present study's database. This resulted in three States being retained in the final analysis. The State with the fourth largest number of programs in the study database was analyzed, and its year-to-year crash results were clearly unstable due to the small number of crashes in the communities covered by the studied legacy SRTS programs. Thus, the crash analyses contained herein represent case studies of three States. The data were not aggregated for the analyses because of the varying numbers of programs and crashes within the three States. Details of the specific analyses conducted are provided in the analysis section itself.

One of the conditions under which States provide crash data to NHTSA for the SDS is that any resulting analyses not specifically identify the State. Therefore, within the remainder of this report, the analyzed States will simply be identified as "State 1," State 2" and "State 3."

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[3] With respect to the reporting and discussion of all analyses within this report, "crashes occurring during the school trip" and similar statements refer to those crashes whose location was within the SRTS focus communities and whose occurrence was within a time window defined by the school bell times for that community. This is discussed more fully in the crash results section.

3. CLASSIFICATION DATA RESULTS

Before turning to the analyses of crash data, it is important to have a picture of the nature of the specific legacy SRTS programs that were studied. This can be derived from the taxonomy or classification data in two ways. First frequencies of the various descriptive parameters that were collected are presented. These describe the total sample of programs that were examined. Second, "profiles" (narrative descriptions) of seven different permutations and combinations of the four intervention E's (education, enforcement, engineering, and encouragement) are included. These describe the operations of major subcategories of the studied programs as determined by the project staff member who interacted with each program to obtain its data.

3.1 Descriptive Classification Data

This section contains frequency counts and percentages for the categories of the major classification data included in the taxonomy. Overall, 130 legacy SRTS programs[4] were able to provide a sufficient amount of the key desired taxonomy information and were retained in the database. Approximately 40 additional legacy SRTS programs were identified. Attempts to obtain similar information from these programs failed either because the program could not provide the requested information or simply because a spokesperson for the program could not be located.

3.1.1 Starting Grade for Included Schools

As mentioned earlier, only elementary school programs were included in the study data. Table 1 and Figure 1 on the next page show the frequency of starting grades for the schools included in the sample. It can be seen that the vast majority of programs studied (91.5%) began with either pre-kindergarten or kindergarten.

[4] For the purposes of these descriptions, a "program" is a single school running a legacy SRTS activity. In some cases, multiple schools were part of a single funded legacy SRTS activity. These schools were counted separately in the frequency tables in this section.

Table 1. Starting grade

Starting Grade Level	Frequency	Percent
Pre-kindergarten	48	36.9
Kindergarten	71	54.6
Grade 1 or higher	11	8.5
Total	130	100.0*

* Table totals may not sum to 100.0% due to rounding

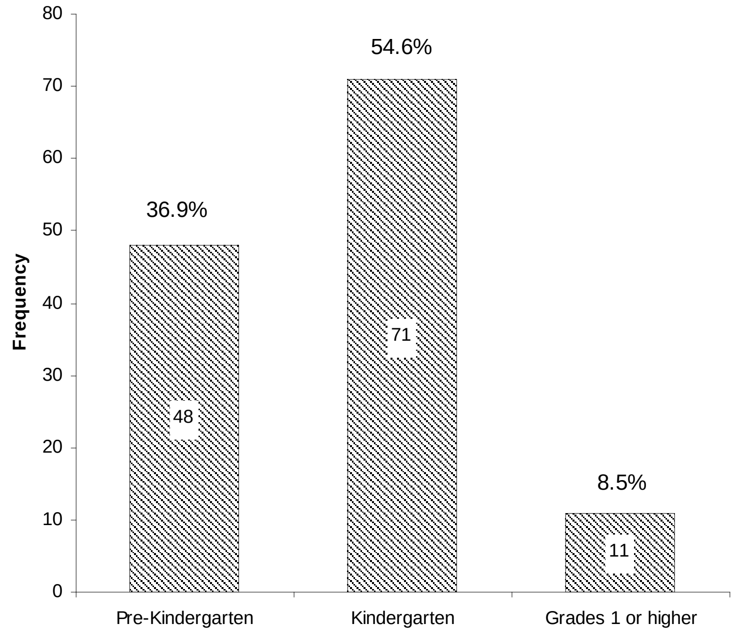

Figure 1. Starting grade

3.1.2 Grades Included in the Program

Table 2 and Figure 2 show the grade levels included in each of the 130 programs. Over 80% of the programs covered either pre-kindergarten or kindergarten through the fifth or sixth grade.

Table 2. Grades included

Grade	Frequency	Percent
K-5	42	32.3
K-6	22	16.9
K-8	5	3.8
PK-5	29	22.3
PK-6	12	9.2
PK-8	6	4.6
Other combinations	14	10.8
Total	130	100.0

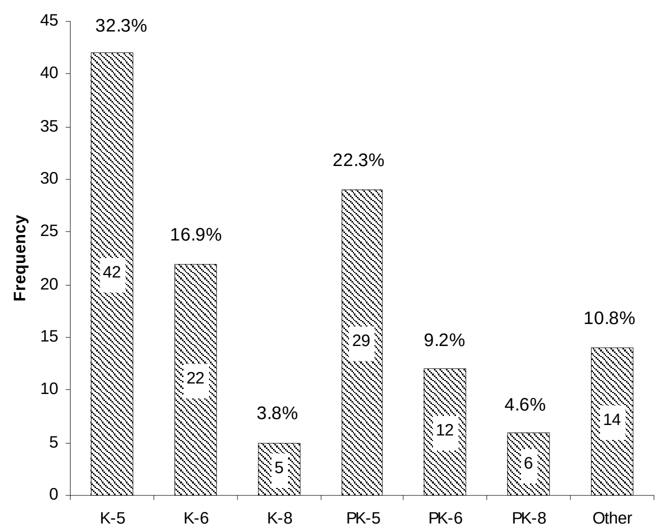

Figure 2. Grades included

3.1.3 Number of Years in Operation

Table 3 and Figure 3 present distributions of the number of years each of the 130 programs had been in operation at the time they were contacted. Almost 31% of the programs were a year or less old, and 24.6% had been in operation for 5 or more years.

Table 3. Years in operation

Years Operating*	Frequency	Percent
<1	17	13.1
1	23	17.7
2	20	15.4
3	31	23.8
4	7	5.4
5	13	10.0
6	7	5.4
7	12	9.2
Total	130	100.0

*For ongoing programs, ending year was assumed to be Fall 2006 when determining duration

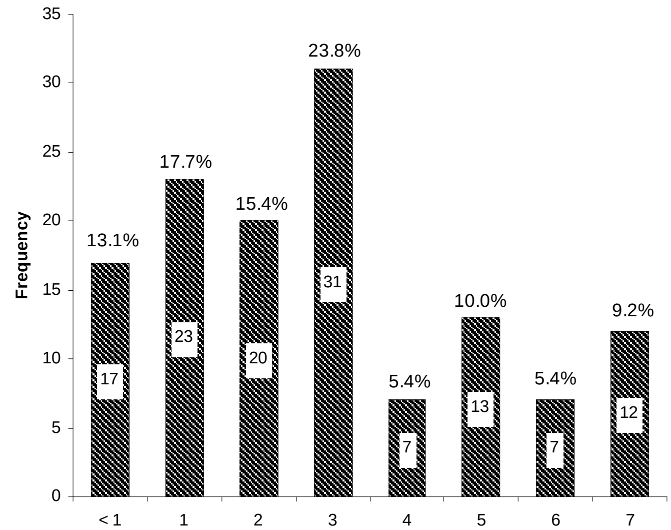

Figure 3. Years in operation

3.1.4 Program Status

The split between completed and ongoing programs is shown in Table 4 and Figure 4. There was almost an even division among the 130 programs between those that were finished and those still in operation.

Table 4. Program status

Status	Frequency	Percent
Ongoing	62	47.7
Completed	68	52.3
Total	130	100.0

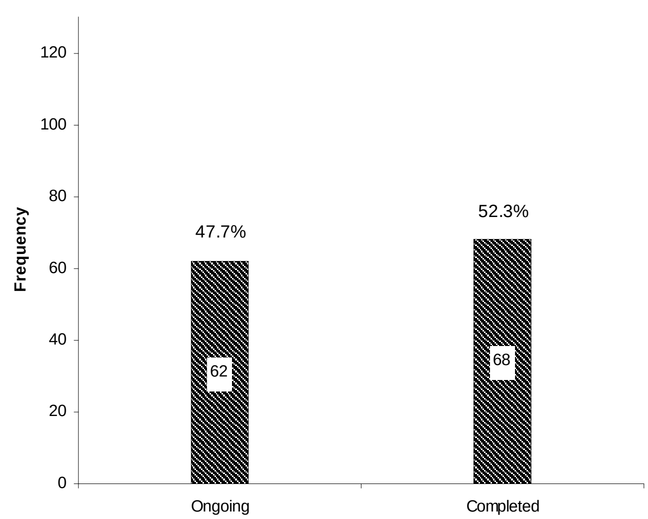

Figure 4. Program status

3.1.5 Land Development Nature

Most of the schools included in the sample were in areas characterized as urban or suburban by the program personnel who provided the data as shown in Table 5 and Figure 5.

Table 5. Land development nature in school area

Land Development Nature	Frequency	Percent
Urban	58	44.6
Suburban	35	26.9
Rural	6	4.6
Mix	1	.8
Village/small town	14	10.8
Unknown	16	12.3
Total	130	100.0

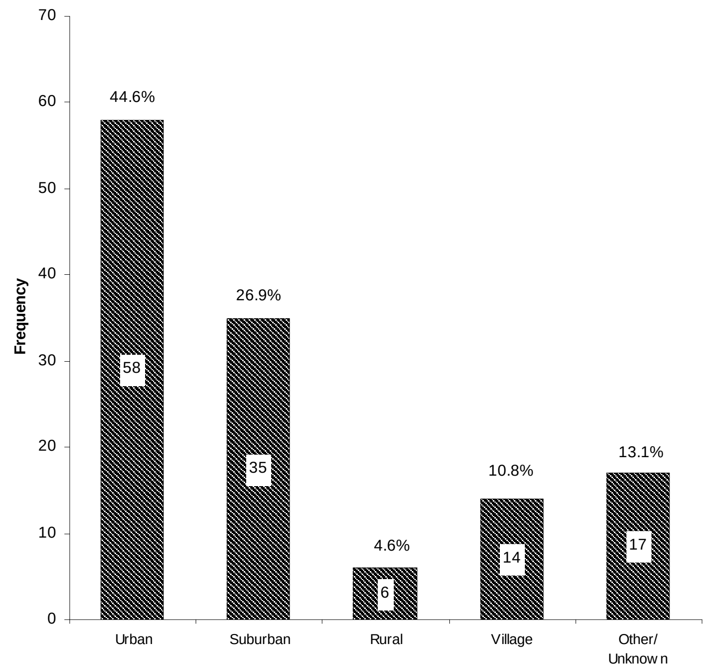

Figure 5. Land development nature in school area

3.1.6 Coverage of the E's

Each school was asked which of the four intervention E's its program covered (multiple activities were accepted). Table 6 and Figure 6 on the next page show the frequencies of the various combinations of the E's included in the programs based on the key below the table and figure. For example, two programs had encouragement activities only (code 3); 16 had engineering activities only (code 1), and 45 schools engaged in all four activities—engineering, education, encouragement and enforcement (code 1234). Likewise, six programs included education and enforcement (code 24).

Table 6. Activity categories included

Activity Code	Frequency	Percent
1	16	12.3
14	12	9.2
134	1	.8
124	5	3.8
123	28	21.5
1234	45	34.6
24	6	4.6
23	1	.8
234	14	10.8
3	2	1.5
Total	130	100.0

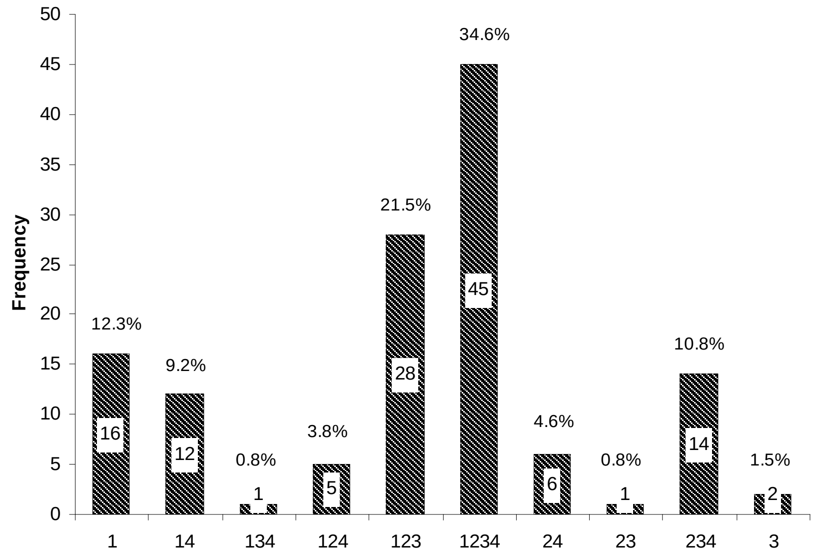

Figure 6. Activity categories included

Key to Activity Codes in Table 6 and Figure 6
1 = Engineering activities
2 = Education activities
3 = Encouragement activities
4 = Enforcement activities

Some of the engineering activity included above in Table 6 and Figure 6 consisted of engineering surveys rather than the execution of specific infrastructure changes. These engineering surveys were always conducted in combination with other activities. That is, none of the 16 programs that had engineering alone (code 1) were simply a survey. Also, engineering surveys were never the engineering activity conducted together with enforcement (code 14).

The predominant engineering project was building or improving sidewalks. There were also some projects that included the addition of signals, installation of signs and markings, campus redesign, installation of traffic calming, the addition of bicycle lanes or facilities and/or the addition of pedestrian and bicycle trails.

Overall, 99 of the 130 programs (76.2%) included some form of educational activity. No single type of educational approach was pervasive, although pamphlets, flyers, and similar material as well as maps showing recommended safe walking/bicycling routes were widely used. Across the sample, the following types of education activities were catalogued:

- Development of maps showing safe routes to school;
- Ped/bike safety training programs for students;
- Ped/bike safety training programs for teachers;
- Creation/distribution of brochures, flyers, etc.;
- Involvement of parents;
- Involvement of community;
- Radio or TV announcements; and
- Bicycle rodeos.

Eighty-nine of the programs (68.5%) included some form of encouragement activities. These included participation in *Walk to School Day*/*Week*, conduct of *Walking School Bus* activities, participation in *Walking Wednesday/Friday* or other similar walking programs, games/contests and/or bicycle helmet giveaways.

Seventy-nine of the programs (60.8%) included some type of enforcement activity. Of these, 25 (31.6% of the programs using enforcement) focused exclusively on speeding in the school zone. An additional 23 programs (29.1% of those using enforcement) combined speed enforcement with activities focused on the law requiring motorists to stop for a stopped school bus. The remaining 31 programs that included enforcement focused on various combinations of speed, school bus stop law, restrictions on access to the school campus, and bicycle helmet law enforcement.

3.1.7 Primary Source of Funds

Table 7 and Figure 7 indicate the primary funding sources for the studied programs. Almost half of these legacy SRTS programs (46.2%) received their primary funding from their States (although some or all of this funding could have been Federal block grants to the State). Private funding was next prevalent at 20.8% followed by direct Federal funding (17.7%) and local funding (11.5%).

Table 7. Primary source of funds

Primary Funds Source	Frequency	Percent
Federal	23	17.7
State	60	46.2
Local	15	11.5
Private	27	20.8
Volunteer	5	3.8
Total	130	100.0

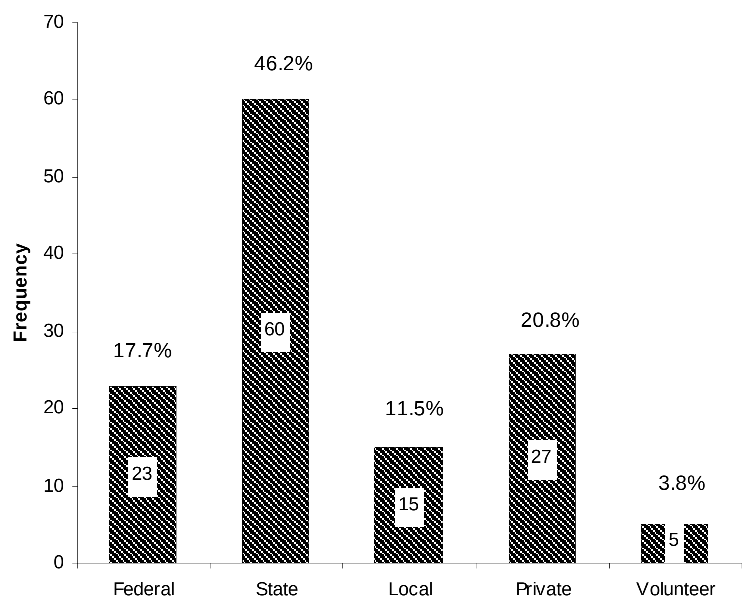

Figure 7. Primary source of funds

3.1.8 Motivations and Goals

Program representatives were asked to indicate the primary motivating factor that prompted the program's creation. As discussed earlier, initial motivations could cover a broad range including safety improvement, increasing mobility, improving fitness or taking advantage of available funding. Table 8 and Figure 8 show the distribution of primary initial motivating factors among the 130 studied programs. Highway safety considerations motivated the start of the largest number of programs. The overall percentage motivated primarily by safety, however, was only 27.7%. This is not surprising given the multiple emphasis areas for legacy SRTS programs including improving health and the environment. The relatively high number of unknown motivations (12.3%) arose from the turnover of personnel in the older programs.

Table 8. Primary initial motivation

Primary Motivation	Frequency	Percent
Highway safety/crashes	36	27.7
Environment	7	5.4
Obesity/health	6	4.6
Increase physical activity	16	12.3
Funds availability	15	11.5
Traffic congestion	16	12.3
Infrastructure improvement	10	7.7
Other	8	6.2
Unknown	16	12.3
Total	130	100.0

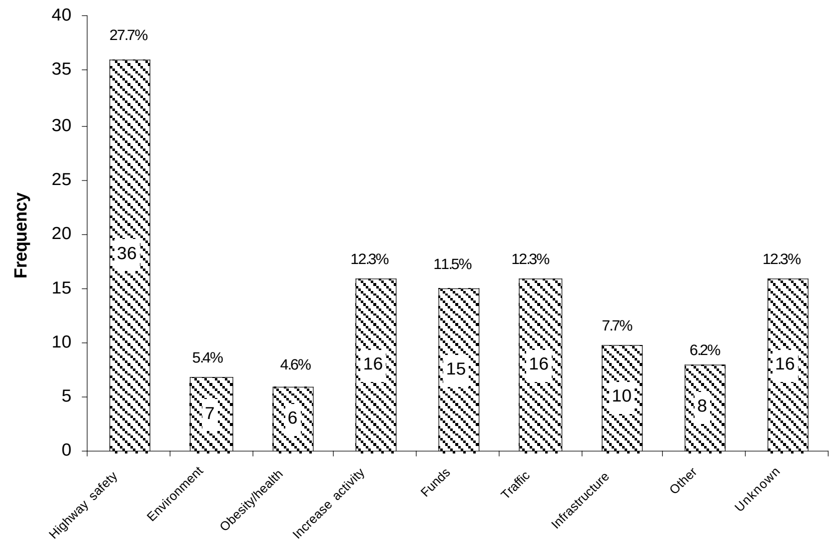

Figure 8. Primary motivation

In the taxonomy, goals were considered to be the primary specific achievement being sought at the time the program was created. As shown in Table 9 and Figure 9, increasing physical activity was viewed as the primary goal of more programs than was reducing crashes/improving safety. This further emphasizes the multifaceted nature of these legacy programs.

Table 9. Primary program goal

Specific Program Goal	Frequency	Percent
Provide healthier environment	1	.8
Increase physical activity	44	33.8
Reduce crashes/improve safety	26	20.0
Identify best routes	8	6.2
All goals--none primary	6	4.6
Comply with legislature directive	2	1.5
Improve infrastructure	24	18.5
Other	3	2.3
Unknown	16	12.3
Total	130	100.0

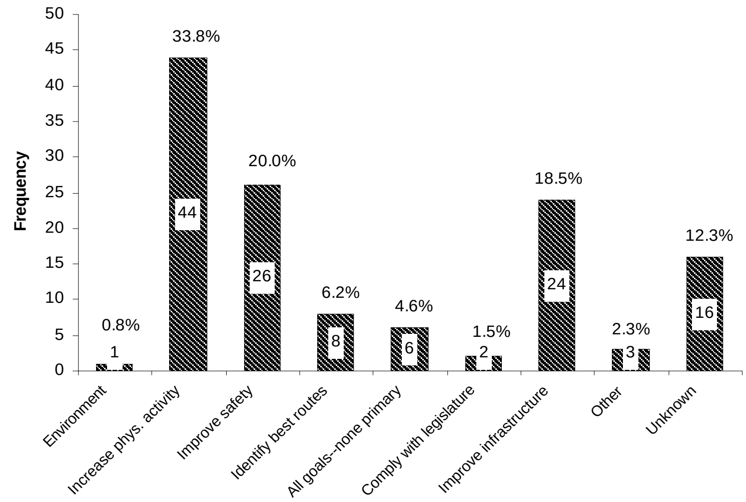

Figure 9. Primary program goal

The programs representatives were also asked to indicate what percentage of their goals they had already achieved. Almost half (43.8%) could not answer this question. Among the remaining programs, the answers varied widely but were clearly clustered above 50%. Of the 73 programs that could provide a response to this inquiry, 57 (78.1%) said they had completed half or more of their goals.

3.2 Program Profiles

In order to describe further the characteristics of legacy SRTS programs, seven program profiles were developed. The profiles were prepared beginning with the most prevalent cluster of the four E's as shown previously in Table 6. The process of profile preparation continued through the remaining clusters in descending order of number of programs until there was insufficient information to differentiate the new cluster from those previously defined. The profiles are presented below in descending order of their frequency in the sample of 130. Although the profiles were generated based on the clusters of activities from the 130 analyzed programs in Table 6, the profiles themselves were based on the collective information obtained from all of the programs contacted even if they could not provide sufficient quantitative information to have been included in the 130 programs. When reviewing the profiles, it must be remembered that they are conglomerates or aggregates describing the types of activities typically found in each cluster. As such, they are exemplars of the totality of activities in each group of the present study's sample rather than descriptions of the modal program of all legacy SRTS programs in the defined cluster types.

3.2.1 All Four E's—Education, Engineering, Enforcement, and Encouragement

This category represents the most complete selection of components typically used by pre-SAFETEA-LU programs. Although some attempts were made to evaluate mode change, program evaluation was not an integral part of most of these programs. Located in urban and suburban schools, these programs were usually part of a larger organization or agency that was established in the jurisdiction. Forming partnerships with other organizations, such as the police, health agencies, and transportation planning groups was common and served to expand program activities and give the programs needed community publicity and support. SRTS programs in this group were typically motivated by child safety and health (actual or perceived risks) and the desire to increase bicycling and walking.

Typically, programs were funded by grants from public agencies. Funds for infrastructure changes as part of these programs were often substantial and required an application to a designated agency. Small grants were often obtained to cover miscellaneous costs, or such funds were solicited from local businesses. These supplementary funds were important for program success since they could be used to purchase such items as brochures, reflective bracelets, and bicycle helmets that were distributed as prizes or used to publicize the program and maintain program interest. Use of dedicated volunteers eased budget problems and also provided community publicity and program support.

In general, the programs were long-term and lasted as long as funding was available, although some were pilot projects with specified start and end dates. Others had the goal of continuing indefinitely if funding continued to be available. The program activities were often integrated with other school, parent and community activities, e.g., PTA. In time, ongoing programs tended to increase the scope of their activities since program coordinators were alert to the existence of activities that helped maintain student and parent interest and participation in the programs. Over time, the number of schools involved in the program within a community tended to increase as a result of ongoing recruitment and word of mouth.

Typically, the programs started with a formative evaluation. This research phase involved learning from both parents and students how the students usually travel to and from school, why they travel as they do, and what could make them increase their use of bicycling and walking. This formative evaluation also involved a detailed audit of the school neighborhood in order to identify needed infrastructure improvements and problems with vehicle congestion and traffic flow.

There was no set formula or requirement for the activities to be included in each "E." The activities chosen depended on the local SRTS coordinator, program task force members, program participants and available funds. Some typical profiles included:

- Engineering events were likely to be one-time events that resulted from a school audit. The audit itself may have been the primary engineering activity. Engineering activities frequently involved construction of sidewalks. They may have required making an application to an agency that dispenses funds for capital improvements or accomplished directly by the agency responsible for the program.

- Education activities typically involved creating SRTS maps and conducting pedestrian/bicycle training programs. A variety of educational materials and techniques were used often involving parents and the community as well as students and school staff.

- Encouragement activities typically involved participation in *Walk to School Day* events as well as other walking/biking events and contests.

- Enforcement activities typically involved control of speeding near the school campus and ensuring safe vehicle actions around pedestrians.

3.2.2 Engineering, Education and Encouragement

Located largely in suburban and rural areas, these schools used all but enforcement in their programs. There were typically multiple factors that motivated them to start a SRTS program, especially traffic congestion and hazardous conditions around the schools. They adopted such goals as reducing speeds, increasing walking and biking and improving pedestrian safety. Typically the programs were in operation for about three years with funds available from the State.

Engineering activities were typically identified through school audits or during SRTS program activities. For example, sidewalks in need of repair may have been identified while school representatives were conducting specific walk to school events. Engineering activities typically included construction and repair of sidewalks, installation of signals and signs, installation of traffic-calming measures, installation of bike lanes, and construction of trails.

These programs also conducted education and encouragement activities. Education activities consisted of maps showing safe routes to schools and pedestrian safety training programs. Bicycle rodeos were sometimes included. Educational information was disseminated through brochures, flyers, radio, and television. Both parents and members of the community were typically involved in education efforts. Almost all of the schools participated in *Walk to School Day* and conducted games and contests. Some programs used *Walking School Buses* and helmet giveaway segments.

Some of the programs focused on a combination of engineering, education, and encouragement were only funded for a very short period by private sources for program activities centered around *Walk to School Day* events. Even though the funding period was brief, the programs themselves likely continued beyond the funding period. For example, engineering activities in these short programs consisted largely of formal or informal audits in which problems with the infrastructure were noted and referred to the responsible people who could arrange for their correction and supervise their repair or alteration. Thus, although these programs themselves were short-duration efforts, their effects could have been far-reaching if these recommendations were acted upon and corrected unsafe or dysfunctional roadway conditions.

3.2.3 Engineering Only

Some of the studied programs were funded only for engineering/infrastructure changes even though additional supporting activities such as education to parents and students was likely provided without special funding. Requirements for infrastructure improvements were handled in a number of ways depending on the requirements of the State funding programs. Prior to SAFETEA-LU, there was an agency in some States with the responsibility of overseeing the process from initiation of a program call to completion of the engineering effort. The process typically started with a specific request that came from a State or local agency to accommodate a perceived need. Motivation for the program was provided by the identified need for infrastructure improvements and the availability of funds to implement those improvements. The goal was to design and construct these improvements. For example, many parents in a community might request a sidewalk connecting their homes with their children's school. These requests would create a need and a request for funding.

An application was made to the State agency responsible for overseeing highway capital improvements. The application then went through a standard review and approval process before the project was selected for funding. First, it had to satisfy that State's program requirements. For example, the application might have been required to be submitted by an eligible agency, and only specific types of engineering activities might be eligible for funding at a particular time. However, depending on the State, other activities were occasionally permitted. Even after funding approval, there were often other programmatic and/or technical requirements. For example, the construction contract might have had to be let within a set time period or the effort was cancelled.

The efforts in this category usually involved a one-time funding event for any one project, e.g., the application was made and reviewed, the project was recommended and selected, funds were awarded, construction was let and completed and then the program ended. The time span for construction was relatively brief—usually a few months in duration from when the contract was let. In many cases, the planning and approval processes took significantly longer than the actual construction.

Some projects constituting an engineering-only SRTS program were awarded without an application from the affected school. There may have been no pre-award interaction between the agency responsible for infrastructure improvements and the school, parents, or the community. In these cases, a government agency, such as a local streets department, identified a needed improvement near a school and applied for the funding to execute it. Obviously, once the project was underway and after it was completed, the school itself would be aware of its existence and often supplemented the engineering with education and/or encouragement.

Although many types of construction activities were funded, sidewalks were predominating. Other engineering-only construction activities included traffic calming, installation of traffic signals and school zone flashers, roadway crossing improvements, and development of bicycle facilities.

3.2.4 Education, Encouragement, and Enforcement

These urban schools used all the E's except engineering activities in their legacy SRTS programs. Typically the program planners were motivated to start a program by the availability of funds, which were provided directly or indirectly from Federal sources. A grant application was prepared and submitted to the appropriate agency. That application typically described program goals and the activities that would be undertaken to achieve those goals. Goals for these programs largely revolved around improving pedestrian safety and reducing crashes. The programs at each school had set start and end dates and were designed to be in operation for two to three years.

The programs were typically started with the establishment of a task force that oversaw program plans and accomplishments. Task force size depended on the needs of the particular program and the number of schools involved. It was usually initiated by the agency or agencies that prepared the grant application. An attempt was typically made to include in the task force those individuals or groups that could help ensure that the various planned program activities took place and that the program received any needed publicity/earned media. The schools involved in the program were also represented on the task force. The various agencies in the program task force worked together to help create a healthy and safe traffic environment. Frequent meetings ensured continuing progress on program goals and the maintenance of the program schedule.

These programs included a number of education activities. For instance, maps were developed showing safe routes to schools, and pedestrian and bicycle safety training programs were conducted. Brochures and flyers, as well as radio and television, were typically used to publicize and gain community support for the programs.

These programs also included several encouragement and enforcement activities. Encouragement activities typically included participation in *Walk to School Day* events, a *Walking School Bus* and other walking programs. Games and contests were frequently conducted, and helmet giveaways were occasionally included. Enforcement activities usually concentrated on vehicle speed control, ensuring driver compliance with vehicle and traffic laws and ensuring safe vehicle actions around pedestrians.

In some instances, programs in this category were only funded for very brief periods—as brief as one or two days to a week. These shortened programs were typically funded by a private source, and their activities revolved around *Walk to School Day*. The activities were similar to those for longer programs except for the shortened time frame and the elimination of the *Walking School Bus*. The programs were planned and overseen by representatives from the private funding source (with support from the involved schools) who handled a set of planned program events from year-to-year in different schools. Often, some of the program components were continued after the funding period was over.

3.2.5 Engineering and Enforcement

Schools with engineering and enforcement SRTS programs were located primarily in urban areas where the local governments managed and funded the construction activities on their own streets. These construction programs were typically in operation for about five years following detailed audits of each of the schools in the designated communities. Basically, this grouping was primarily a construction program supplemented by police enforcement.

The pre-intervention program audits resulted in a series of recommended improvements ranging from simple "fixes" that could be quickly and inexpensively incorporated (such as improved signage in school zones) to long-term and more expensive projects (e.g., incorporation of traffic-calming measures). The programs resulted in a variety of design and construction activities. The typical activity was the construction of sidewalks on streets near the schools in order to provide safer access by the students.

The primary motivating factor for starting these construction programs was typically the existence of one or more serious crashes in the area of the affected schools. The SRTS programs set out to make design improvements to the streets in the communities to prevent a recurrence of these crashes.

Special enforcement of the speed limits around the schools was typically added to the programs to enhance the effects of the construction activities. Speed trailers that alert drivers to their operating speeds were deployed. Appropriate enforcement actions were taken when unsafe vehicle actions around pedestrians were noted. The law requiring vehicles to stop when a school bus is loading or unloading students was also enforced.

3.2.6 Education and Enforcement

Schools that used only education and enforcement in their legacy SRTS programs were typically neighborhood schools located in small towns. They used small grants provided by the State to carry out their programs. The programs at each school had usually been in operation for approximately three years at the time of data collection and were still ongoing. The primary motivating factor for starting these programs was the personal interest of the program staff in SRTS. The primary goal of the programs was to ensure the safety of the children when they travel to and from school. The schools attempted to accomplish their goals with a yearly program that was limited in both duration within the school year and scope.

At the beginning of the fall term, the schools typically provided maps to assist the parents and students in planning a safe route to school. In collaboration with law enforcement, the maps defined the area around each school that can safely accommodate walkers. In essence, each school established a "walking zone." The maps typically showed all traffic control devices in the zone and any topological features that might affect vehicle traffic flow or student travel to and from school. Typically, the schools also sent letters to parents that provided pedestrian safety tips and special school safety rules. These education activities served to alert students and parents to the SRTS program and efforts that each school was taking to ensure the safety of its students as they travel to and from school.

Speed limits around the schools were also enforced, but special enforcement was primarily used only at the beginning of the school year. At that time, the police were particularly alert to identifying any special traffic safety problems so that they could be corrected before they became ingrained habits. The police paid particular attention to excessive speeds and traffic volumes in areas where students cross streets and where they are picked up and dropped off. As appropriate, education on vehicle or pedestrian traffic safety was added to enhance overall student safety.

3.2.7 Engineering, Education, and Enforcement

The programs at these schools used all but encouragement activities. The schools were typically located in small towns and rural areas. Directed at the safety of children around the schools, the programs had been in operation for about two to three years at the time the data were collected. Using State funds, the programs included construction of sidewalks and installation of signs, markings and traffic calming. Programs also included construction of walkways that serve to permit safe crossings over particularly dangerous sections of the roads near school.

Education activities included student participation in pedestrian and bicycle training programs. The children developed maps showing safe routes to school and were given flyers and letters on school safety issues to take home to their parents.

Extensive personnel support for the programs was typically provided by the local police. Speeds near schools were enforced, and speed trailer displays were used as an aid in keeping speeds at safe levels. The law requiring vehicles to stop when a school bus is loading or unloading students also received vigorous enforcement. Another enforcement activity involved police control of which vehicles were permitted to enter the school campus as an aid to minimizing congestion at individual schools. Inclusion of a crossing guard training program served to protect the children as they cross streets as well as to inform them of safety rules and procedures.

4. CRASH ANALYSES

As described in Section 2, crash analyses were completed for three States using data available from NHTSA's SDS. These States had the largest numbers of the 130 legacy SRTS programs described in Section 3, and the communities in which these programs were resident produced a sufficiently large sample of school trip pedestrian and bicycle crashes with motor vehicles to support an analysis. This section first discusses the specifics of the analysis approach and then presents the results.

4.1 Analysis Parameters

For the purposes of this study, the primary unit of analysis consisted of crash-involved pedestrians and bicyclists. Crash-involved pedestrians and bicyclists were examined as a function of the age of the person involved and the location of the crash. Location was divided into SRTS focus city and statewide (including the focus cities) components.[5] The decision was made to retain the focus series data within the statewide totals as an expedient because focus site crashes were such a small subset that they could not have affected the statewide data. Across all three States, there was an annual average of 44 pedestrians and bicyclists involved in crashes in the focus cities at school trip times compared to annual statewide averages of 12,750 total pedestrian and bicyclist crash involvements and 2,434 statewide pedestrian and bicyclist crash involvements among 4- to 12-year-olds.

Crash data were examined at the city or county level, depending on the variables available in the SDS file.[6] Whenever possible, data were examined at the city level. Victim age was divided into elementary age school children (4 to 12 years old) and all other ages (0 to 3 years old and 13+ years old).[7] The start point for crash data was 1996 because that was the earliest year for which the SDS had data for all three States of interest.

Data series for crash-involved passengers age 4 to 12 are also included for comprehensiveness of crash involvement of the target population as well as to serve as a possible indicator of mode shift. All other things being equal, if more children were riding in vehicles to school, an increase in elementary-age crash-involved passengers would be expected during school trip times. On the other hand, if fewer children were riding to school, there should be a reduction in the number of elementary-school-age crash-involved passengers during school trip times.

4.2 Standardizing the Data

The crash data for each series were extracted from each State's SDS data for each year. The raw numbers of crashes for each year in each series were then divided by the raw number of

[5] The focus cities or jurisdictions were those that contained a subset of the 130 studied programs. For these locales, school bell times and the school calendar were known as a result of the collection of the taxonomy data.

[6] State 1 only had data available at the county level. States 2 and 3 had data available at the city level.

[7] Ages 4 to 12 were chosen to represent elementary school children since many of the programs included pre-kindergarten students who would be approximately 4 years old and most programs covered ages through sixth grade—typically 12-year-olds.

crashes that occurred to the same population subgroup in 1996 (the first year available), thus providing a standardized value for crashes each year in relationship to the crashes that occurred in 1996 (which were assigned a value of 1.0). Thus, the values for all years subsequent to 1996 can be viewed as an increase (values greater than 1.0) or decrease (values less than 1.0) in crashes relative to 1996. For example, a standardized value of 0.5 for 2001 would indicate that there were half as many crash-involved pedestrians and bicyclists in the 2001 series when compared to 1996. Standardizing the values makes the comparisons between series much easier than comparing raw numbers, since the raw numbers vary so greatly when examining statewide crash involvement rates versus rates for one or two cities. For example, a reduction of 10 crash-involved pedestrians or bicyclists at the SRTS focus cities might represent a 50% reduction in crash involvement rate, whereas a reduction of 500 victims might be needed at the State level to achieve the same percentage reduction.

4.3 Crash Plots and Testing Differences in Slopes

The first crash analysis step was to create a line graph for each State that displays the time plots of crash-involved persons. The standardized values for each data series described below are presented for each State for each year of available data. These time plots allow for a visual comparison of crash involvements at the SRTS focus sites versus all of the other series.

In order to test for any statistically significant differences between the various data series, linear regression equations were calculated for each crash series for each State. These equations provide a statistical look at the change in crashes over time and whether or not a significant linear pattern or slope (positive or negative) exists. Normally, a simple correlation would suffice to examine the linear relationship between two variables. However, since the interest here is in comparing one series to another, more information is needed than a simple correlation can provide. Using linear regression equations provides a coefficient that represents the slope of the regression line as well as the standard error of the coefficient. With these two values, the significance of a difference between any two regression equations can be tested. Thus, if, for example, the crash series for the SRTS sites and statewide both exhibit a decrease, it is possible to determine if the extent of decrease between the two is significantly different.

The primary comparisons of interest were between the series detailing pedestrian and bicycle crash involvements for 4- to 12-year-olds at the SRTS focus sites compared to each of the other series. These comparisons permit a determination of whether the patterns of crash involvements at the SRTS sites were different from the patterns found statewide or for other age groups. A variety of other comparisons can also be made, and some of interest to this study are detailed later in this section.

4.4 Limits of Data and Analyses

The data in the SDS for each State are extensively verified and are made as uniform in quality as possible across States. This generally provides a very “clean” set of data that are consistent and allows for comparisons across years and, to the extent possible, across States. Also, to further increase consistency across States, SDS uses a uniform SAS format for storing data. The present study converted the SAS data files into SPSS data files for analysis. After the conversion, the data were screened and cross-tabulations were compared across formats to ensure that no data were corrupted or lost.

When using crash datasets regardless of the source, there are some systemic issues that are not easily addressed. For example, a State may change its crash reporting form, which in turn affects how law enforcement or others report the data. In some instances this may lead to more detailed data, but in many cases information that was previously on the form is no longer available. This could affect the frequency of crashes input into a database or the details about those crashes. Also, some States may report crashes that other States do not report. An example relevant to this study would be whether or not a State reports pedestrian and bicycle crashes that occur on private property. This can vary among States as well as among police agencies within a State. Because of the potential differences in reporting between States and because of the differing sample sizes of legacy SRTS programs in each of the three States, the States included in this study were analyzed as case studies. No statistical comparisons are made between States, but the extent to which the States follow the same patterns of results is discussed here and in Section 5.

For this study, data were not examined at the individual school level since the SDS does not provide any data for individual schools. Also, the number of crashes for any one particular school would likely be too small to allow for any valid statistical analyses. For this reason crashes were examined at the city or county level for those cities or counties where legacy SRTS schools were located. The level of the data, city or county, was dependent on the data provided to the SDS.

The accuracy of data series created for the SRTS focus sites is dependent on the information provided by the individual schools. For example, the program start and end dates were obtained directly from the schools, but many of the programs were phased in over time and had no true start date. Likewise, many of the programs took years to fully develop, and some are still in the development stage. Overall, however, it is believed that the information obtained is largely accurate. Moreover, small errors, such as assuming Christmas vacation was the same for all years of the program, could only account for a few days of variance. The expected number of crashes in these few days of uncertainty is essentially zero and should therefore not have a meaningful impact on the results discussed below. Also, no schools could readily provide previous years' school calendars. For this reason the same school calendar date ranges were used for each school for all years of available data when determining if a crash occurred on a school day.

With any analysis similar to the one conducted here, it is nearly impossible to account for the effects of other ongoing safety programs in the focus communities or for other changes in the environment that may be affecting crashes. The use of comparative series from other parts of each State and an examination of crash trends for other ages is helpful in determining if any observed effect in the focus series are the result of a general trend. Nevertheless, no causal inferences are made here; rather, the data are described in terms of crash patterns and the differences among the patterns for the various crash series that were examined.

It is also important to note that the safety data used here are only based on police-reported crashes between motor vehicles and pedestrians or bicyclists. In particular, no data on incidents involving pedestrians or bicyclists alone (e.g., falls) or their interaction is included because there are no standardized reports of these events. Any future in-depth analysis of the safety effects of

SRTS programs might profitably include an examination of these non-motor vehicle-related events from data such as emergency room records or self-reports.

Finally, the regression analyses employed in this study are largely descriptive in nature. They are univariate and therefore do not take into consideration any possible crash correlates. It is therefore theoretically possible that exogenous factors could have produced the patterns found. While multivariate analyses can examine the effects of potential confounding factors, the present crash sample sizes were not sufficient to support these more definitive examinations and therefore data on potential correlates were not collected.

4.5 Data Series

The following five time-based series of data were created for the sum of crash-involved pedestrians/bicyclists in each State:[8]

1. Elementary-age children (4 to 12 years old) at SRTS focus sites for school calendar dates, days, and times;
2. All persons of other ages at the SRTS focus sites for school calendar dates, days, and times;
3. Statewide elementary-age children for all dates and times;
4. Statewide people of all other ages for all dates and times; and
5. Statewide elementary-age children Monday to Friday, 6:45 a.m.-9:15 a.m. and 1:30 p.m. to 4:30 p.m.

The first series consists of elementary-school-age pedestrians/bicyclists involved in crashes during the school trip at the SRTS focus sites. Inclusion of a victim in this series was based on the actual school calendar and bell time information. Crash victims (pedestrians and bicyclists) were included in this series if their crash occurred between an hour before and 15 minutes after the school start bell. Victims were also included if their crash occurred between 15 minutes before and one hour after the school end bell. These criteria were part of the delimitation of the crash data to the school trip. In some instances a single city or county had multiple schools with different bell times. Since data could only be analyzed at the city/county level, the time range for crash inclusion used was broadened as necessary to encompass the bell times of all schools in the city or county.

The second series listed above used the same time, day, and date restrictions as the first, but included crash-involved pedestrians/bicyclists who were not of elementary school age (0 to 3 years old or 13+ years old). These data provide a picture of what was happening to non-elementary school aged persons at the SRTS focus sites during the same times and dates as children walking/biking to school.

The third series listed above provides a look at elementary-school-age pedestrian/bicycle involved crash victims statewide for all dates, days, and times. This series provides a global look at crashes for elementary school aged children for the whole State. The fourth series provides the same statewide information for non-elementary-age people.

[8] Pedestrians and bicyclists involved in crashes with motor vehicles were summed because of the small crash sample sizes, particularly for bicyclists.

The fifth series examines elementary-age crash-involved pedestrians and bicyclists statewide during times and days (Monday through Friday) when elementary-school-age children are likely walking to school. The time ranges are wider than those used for crash inclusion at the SRTS focus sites since school bell times vary widely across a State and, therefore, a "universal" set of bell times had to be used. Also, no date ranges were excluded since the school calendars can vary widely across a State. This series provides a general view of the whole State for child crash victims likely walking to or from school.

Two additional series describing elementary aged crash-involved passengers were also used as a means to explore any potential mode shift. These series could be indicators of whether more or fewer children were riding in automobiles to school. The two series of crash-involved passengers were:

6. Passengers age 4 to 12 at SRTS focus sites for school calendar dates, days, and times; and
7. Statewide passengers age 4 to 12, Monday-Friday, 6:45 a.m.-9:15 a.m. and 1:30 p.m. to 4:30 p.m.

4.6 Series Comparisons

The data for each State are first presented in a series of figures that cumulatively introduce time plots of crash-involved pedestrians and bicyclists for all seven of the data series described above for that particular State. The data points represent the standardized values for each year. These figures permit a visual examination of the patterns that emerge for the crash-involved groups represented in the data series.

These visual comparisons can be quite compelling. When marked differences in series seem apparent, however, there is a need to examine whether the observed series differences are, in fact, statistically significant. To accomplish this statistical comparison, linear regression equations were calculated for each data series. A table is included for each State that summarizes the values obtained when the regression equations were calculated. The values in the table include the *R, R Square, Unstandardized Coefficient, Standard Error,* and the *Significance (p value)* of the regression equation. The year of the crash data was the predictor/independent variable for these equations and the standardized value of crash-involved pedestrians and bicyclists for each year was the outcome/dependent variable. Higher values for *R* and *R Square* indicate a stronger relationship between standardized number of crash-involved individuals and time. The *Unstandardized Coefficients* and *Standard Errors* are used in the comparisons calculated in later tables. The *Significance (p)* values indicate whether the association revealed by the linear model is greater than can be expected based on chance alone. If this value is less than 0.05, it indicates that there was a statistically significant increase or decrease in crashes over time for the particular series.

It was necessary to calculate linear regression equations in order to obtain unstandardized coefficient and standard error values. These values were used in the following equation to test the significance of any differences in the regression coefficients between two data series:[9]

[9] Snedecor, G. and Cochran, W. (1967). Statistical Methods. Ames, Iowa: Iowa University Press.

$$(\text{Coefficient A} - \text{Coefficient B}) \,/\, \sqrt{(\text{Standard error A})^2 + (\text{Standard error B})^2}$$

For small N's, the test statistic obtained from the equation above follows the T-distribution. For this study, two-tailed values were used to test significance since no directional hypotheses were formulated.

Three tables were created for each State to summarize the findings of the comparisons between a target series and the other data series. Such comparisons demonstrate whether or not a particular series has a trend (regression equation) that is significantly different from the series it is being compared to. The first of these tables for each State presents the results of the statistical comparison of the series representing crash-involved pedestrians/bicyclists 4 to 12 years old at the SRTS focus sites during the school calendar dates, days and times versus each of the other data series. The data in these tables answers the basic question concerning whether the trend in the number of crash-involved pedestrians and bicyclists that could have been directly affected by the studied legacy SRTS programs is different from the trend for other groups studied.

The second table for each State provides the results of the comparison of crash-involved pedestrians/bicyclists 4 to 12 years old statewide for all dates and times versus each of the other data series. The last table for each State displays the results of the comparison of crash-involved pedestrians/bicyclists 4 to 12 years old statewide Monday-Friday for times children would likely be walking or biking to school versus the other data series. There is some overlap in the tables, and the values obtained for the overlapping comparisons will be the same except they will have opposite signs, negative or positive, depending on which variable was entered into the comparison equation first for the particular table. Other comparisons besides those outlined in these three tables could be made, but this study is primarily concerned with crashes involving 4- to 12-year-olds at the SRTS focus sites and how the pattern of these crashes is different from patterns observed for the other series.

4.7 Results for State 1

State 1 contained 29 of the studied programs in 21 different cities. The focus series of crashes involving 4- to 12-year-olds on school trips represented 0.26% of all pedestrian and bicyclist crash involvements statewide and 1.41% of all statewide pedestrian and bicyclist crash involvements of 4- to 12-year-olds. Figures 10–13 display the crash series time plots for State 1. Data for nine years (1996–2004) are included. A brief description of the pattern for each series is provided below.

The primary series of interest for this study are those displaying pedestrian and bicycle crash involvements for 4- to 12-year-olds. Crashes for this group in State 1 were examined through three data series: (1) counties of the SRTS focus sites during school dates, days and possible walking/biking times to and from school based on bell times, (2) statewide for all dates and times, and (3) statewide for school trip times (6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m.). As seen in Figure 10, each of these series shows a large decrease in pedestrians/bicyclists involved in crashes over time. All three series demonstrate a steady decline over time, with the SRTS focus site series showing the greatest overall reductions by 2004.

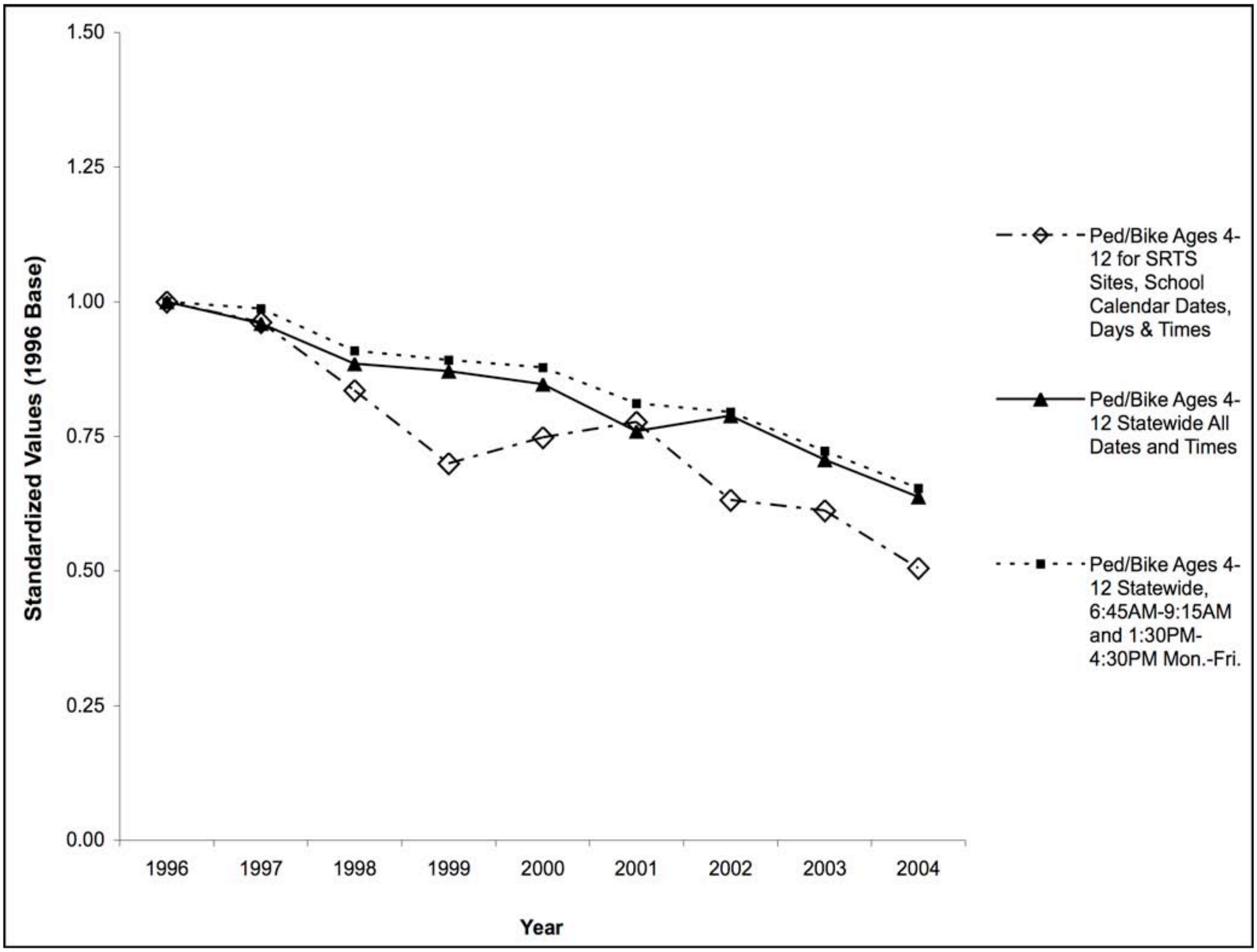

Figure 10. State 1 crash-involved 4- to 12-year-old pedestrians and bicyclists

Two data series were constructed for crash-involved pedestrians and bicyclists 0 to 3 years old and 13+ years old in order to examine crashes for non-elementary aged people. One series for this age grouping represents crash-involved pedestrians and bicyclists statewide for all dates and times. The other series represents crash-involved pedestrians and bicyclists for this age grouping at the SRTS focus sites during the elementary school calendar dates, days and times. These two series serve as comparisons for the 4- to 12-year-old series in order to determine if any changes in crashes were occurring for all other ages at the same time they were occurring for the 4- to 12-year-olds. Figure 11 reveals that the statewide series is essentially flat, showing only minor reductions in crashes over time. The series for this age group at the SRTS focus sites shows an inconsistent pattern with some increases in crashes as well as some minor reductions for some years. There is no notable downward trend in either series.

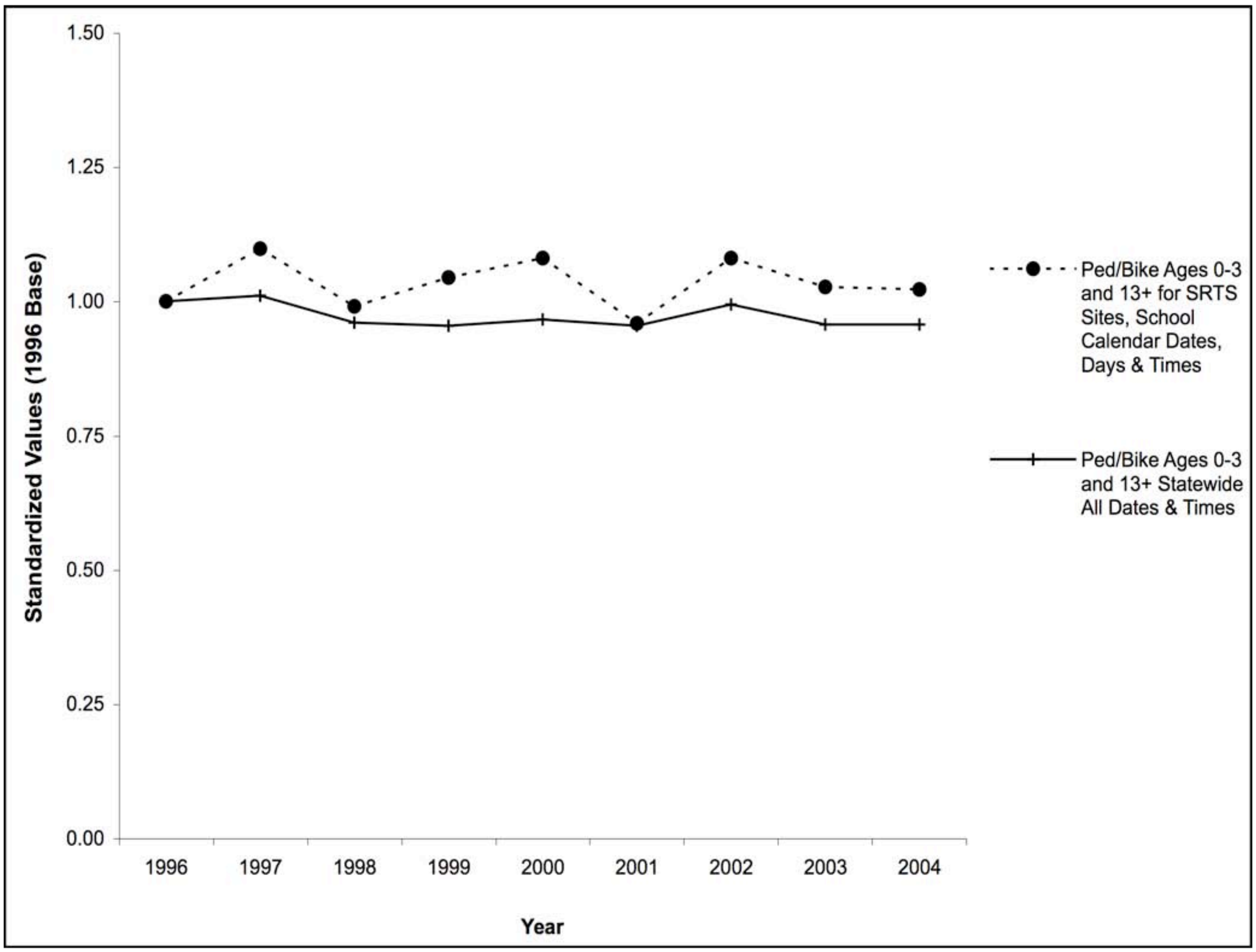

Figure 11. State 1 crash-involved non-elementary-school-age pedestrians and bicyclists

Two series were created to examine crash-involved passengers 4 to 12 years old in order to serve as a potential measure of mode shift. An increase in crash-involved passengers in this age group could be indicative of more children riding in automobiles to school. The statewide series in Figure 12 for crash-involved passengers 4 to 12 shows a trend of increasing crash-involved passengers that peaks in 2001 and then starts a slight decline over the next few years. The series for crash-involved passengers at the SRTS focus sites is inconsistent with some years showing an increase in crashes and others a decrease.

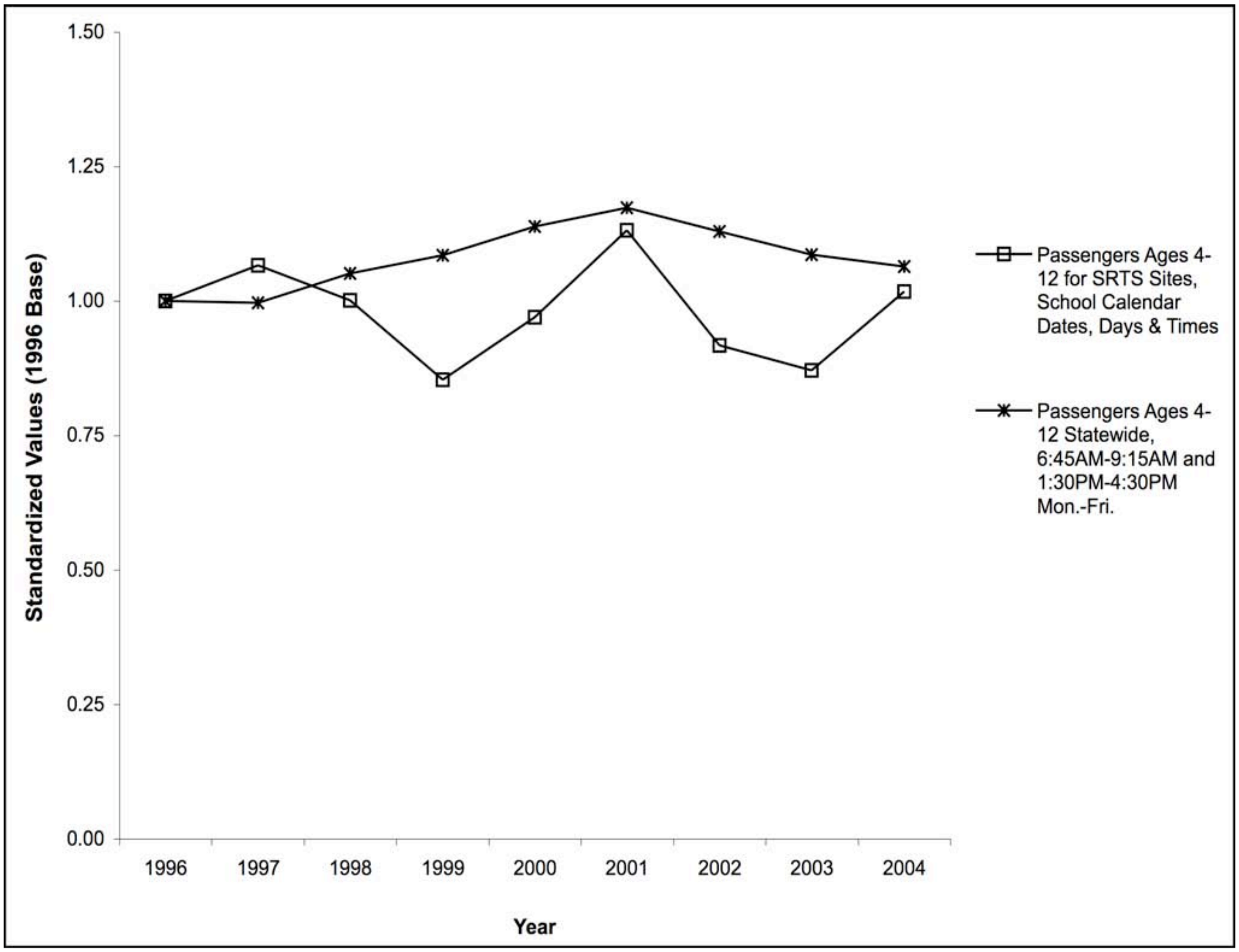

Figure 12. State 1 crash-involved passengers 4 to 12 years old

Figure 13 on the next page combines all seven data series in a single graph. This figure permits a visual comparison of the changes in crashes observed for the various data series. Statistical representations and comparisons of the data series are provided in Tables 10-13.

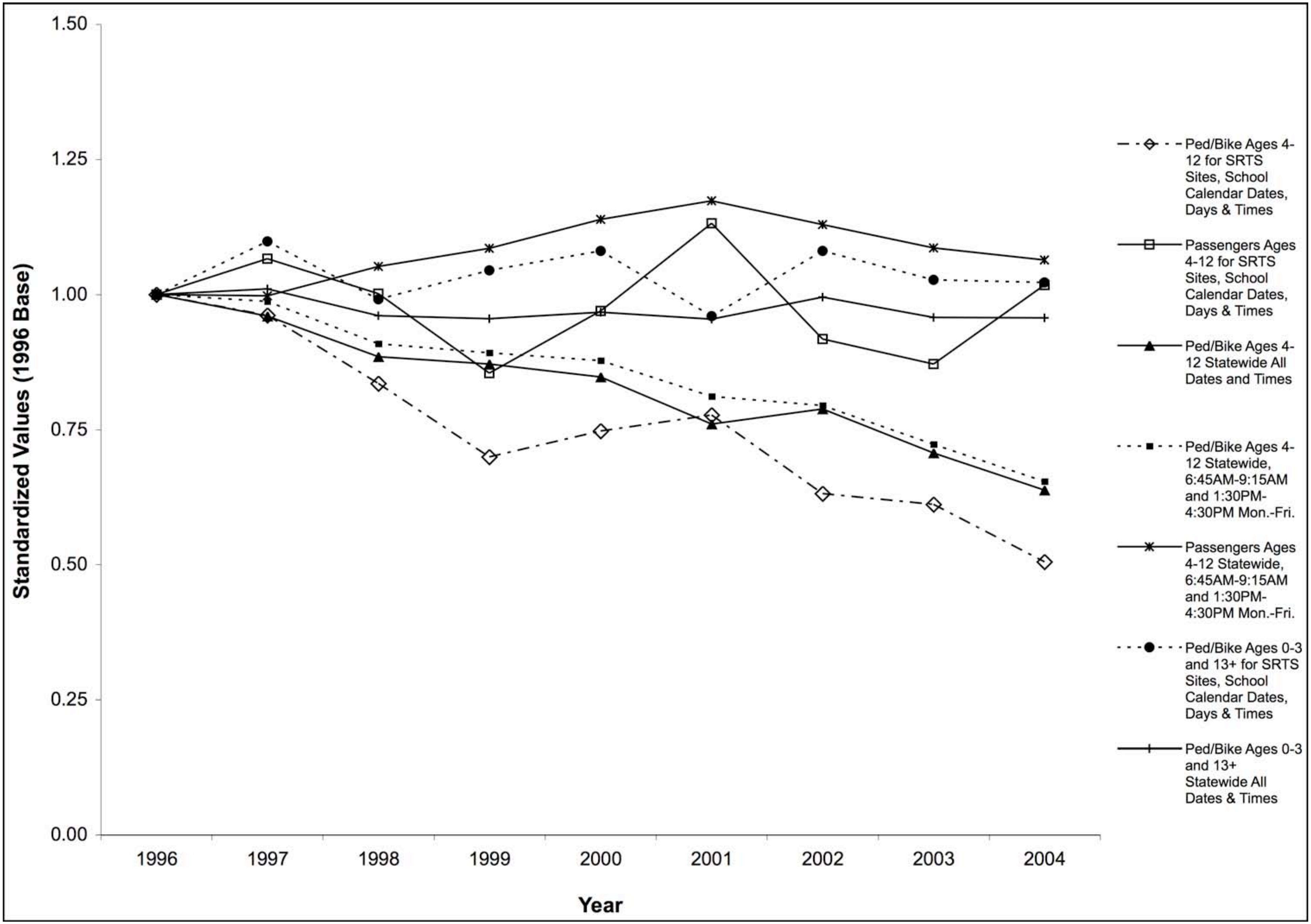

Figure 13. State 1 crash-involved people 1996 - 2004

Table 10 displays regression equation values for each data series for State 1. The shaded cells indicate significant values of R Square ($p < 0.050$) that indicate the regression line was a good least squares fit to the data. The table shows that the regression equation obtained for each of the three data series for 4- to 12-year-old pedestrians and bicyclists was highly significant, $p<0.001$. These values indicate that the reductions in crash-involved 4- to 12-year-old pedestrians and bicyclists over the studied years almost certainly did not occur by chance. None of the other series in this table showed statistically significant trends.

Table 10. Regression values for State 1 data series

Series Description	R	R Square	Unstandardized Coefficients	Standard Error	Sig. (p)
Ped/Bike Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	0.944	0.891	-0.056	0.007	0.000
Passengers Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	0.207	0.043	-0.007	0.012	0.593
Ped/Bike Ages 4 to 12 Statewide All Dates & Times	0.980	0.961	-0.042	0.003	0.000
Ped/Bike Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	0.984	0.968	-0.041	0.003	0.000
Passengers Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	0.579	0.335	0.013	0.007	0.102
Ped/Bike Ages 0-3 and 13+ for SRTS Sites, School Calendar Dates & Times	0.031	0.001	-0.001	0.006	0.937
Ped/Bike Ages 0-3 and 13+ Statewide All Dates & Times	0.538	0.290	-0.004	0.003	0.135

Table 11 provides the statistical comparison values for the regression line representing crash-involved pedestrians/bicyclists 4 to 12 years old at the SRTS focus sites during school calendar dates, days and school trip times versus each of the other data series. Four of the six comparisons were statistically significant ($p < 0.050$), which indicates that the decrease in 4- to 12-year-old pedestrians and bicyclists involved in crashes at the SRTS focus sites was significantly different from the trend for those four comparison data series. The two non-significant comparisons involved the data series concerning crash-involved pedestrians/bicyclists 4 to 12 years old at the statewide level. These nonsignificant findings indicate that the pattern of decreasing crash involvement for 4- to 12-year-olds at the SRTS focus sites was not statistically different from the decreases seen statewide for the same age group.

Table 11. Comparison of crash-involved pedestrians/bicyclists age 4- to 12 for SRTS sites, school calendar dates and times versus all other data series for State 1.

Comparison Series	"T - value"	Df	Sig. (p)
Ped/Bike Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times			
Passengers Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	-3.527	14	0.003
Ped/Bike Ages 4 to 12 Statewide All Dates & Times	-1.838	14	0.087
Ped/Bike Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	-1.970	14	0.069
Passengers Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	-6.970	14	0.000
Ped/Bike Ages 0-3 and 13+ for SRTS Sites, School Calendar Dates & Times	-5.966	14	0.000
Ped/Bike Ages 0-3 and 13+ Statewide All Dates & Times	-6.828	14	0.000

Table 12 provides the statistical comparison values for statewide crash-involved pedestrians/bicyclists 4 to 12 years old for all dates and times versus each of the other data series. These comparisons show the same pattern as seen in Table 11 above. This is not surprising since the pattern of crash reduction at the State level was so similar to that seen at the SRTS focus sites. The same four comparisons yielded highly significant statistical differences ($p < 0.050$), indicating that the reduction in 4- to 12-year-old pedestrians and bicyclists involved in crashes statewide was significantly different than the crash involvement patterns observed for 4- to 12-year-old passengers and non-elementary-age pedestrians/bicyclists statewide and at the SRTS focus sites. As previously described, the value obtained for the comparison with pedestrian/bicycle crash-involved 4- to 12-year-olds at the SRTS focus sites is the same as that obtained in Table 11 with the exception that the sign is in the opposite direction. The small value obtained for the comparison with the series for statewide crash-involved pedestrians/bicyclists 4- to 12-year-olds for school trip times (6:45 a.m. – 9:15 a.m. and 1:30 p.m. – 4:30 p.m., Monday to Friday) suggests that these two series were essentially identical in their patterns of crash reduction.

Table 12. Comparison of crash-involved 4- to 12-year-old pedestrians/bicyclists statewide, all dates and times versus all other data series for State 1.

Comparison Series	"T - value"	Df	Sig. (p)
Ped/Bike Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	1.838	14	0.087
Passengers Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	-2.830	14	0.013
Ped/Bike Ages 4 to 12 Statewide All Dates & Times			
Ped/Bike Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	-0.236	14	0.817
Passengers Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	-7.222	14	0.000
Ped/Bike Ages 0-3 and 13+ for SRTS Sites, School Calendar Dates & Times	-6.112	14	0.000
Ped/Bike Ages 0-3 and 13+ Statewide All Dates & Times	-8.957	14	0.000

Table 13 provides the statistical comparison values for statewide crash-involved pedestrian/bicyclists 4 to 12 years old, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m., Monday through Friday, versus each of the other data series. Once again, the same four comparisons were statistically significant ($p < 0.050$) as in the previous two tables, indicating significant differences in the patterns of crashes for the legacy SRTS data series and those concerning passengers 4 to 12 and non-elementary-age crashes statewide and at the SRTS focus sites. The two non-significant comparisons are repeats of comparisons found in Table 11 and Table 12 except that the signs of the obtained values are opposite.

Table 13. Comparison of crash-involved 4- to 12-year-old pedestrians/bicyclists statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri., versus all other data series for State 1.

Comparison Series	"T - value"	df	Sig. (p)
Ped/Bike Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	1.970	14	0.069
Passengers Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	-2.749	14	0.016
Ped/Bike Ages 4 to 12 Statewide All Dates and Times	0.236	14	0.817
Ped/Bike Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.			
Passengers Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	-7.091	14	0.000
Ped/Bike Ages 0-3 and 13+ for SRTS Sites, School Calendar Dates & Times	-5.963	14	0.000
Ped/Bike Ages 0-3 and 13+ Statewide All Dates & Times	-8.721	14	0.000

4.8 Results for State 2

State 2 data were available for nine years, 1996-2004. They covered 14 SRTS programs in 7 separate cities. The focus series of 4- to 12-year-old crash involvements on the school trip represented 0.59% of all pedestrian and bicycle crash involvements statewide and 3.21% of all statewide 4- to 12-year-old pedestrians and bicyclists involved in crashes. A brief description of the pattern for each data series is provided below. The only difference between the construction of the data series for State 1 and that for State 2 is that for State 2 city level rather than county level data were used to create the crash series for the SRTS focus sites.

As seen in Figure 14, each of the data series for crash-involved pedestrians/bicyclists 4 to 12 shows a large decrease in crashes over time. Similar to State 1, the SRTS focus sites showed an apparently larger decrease in crashes over time than did the two statewide series for 4- to 12-year-old pedestrians/bicyclists.

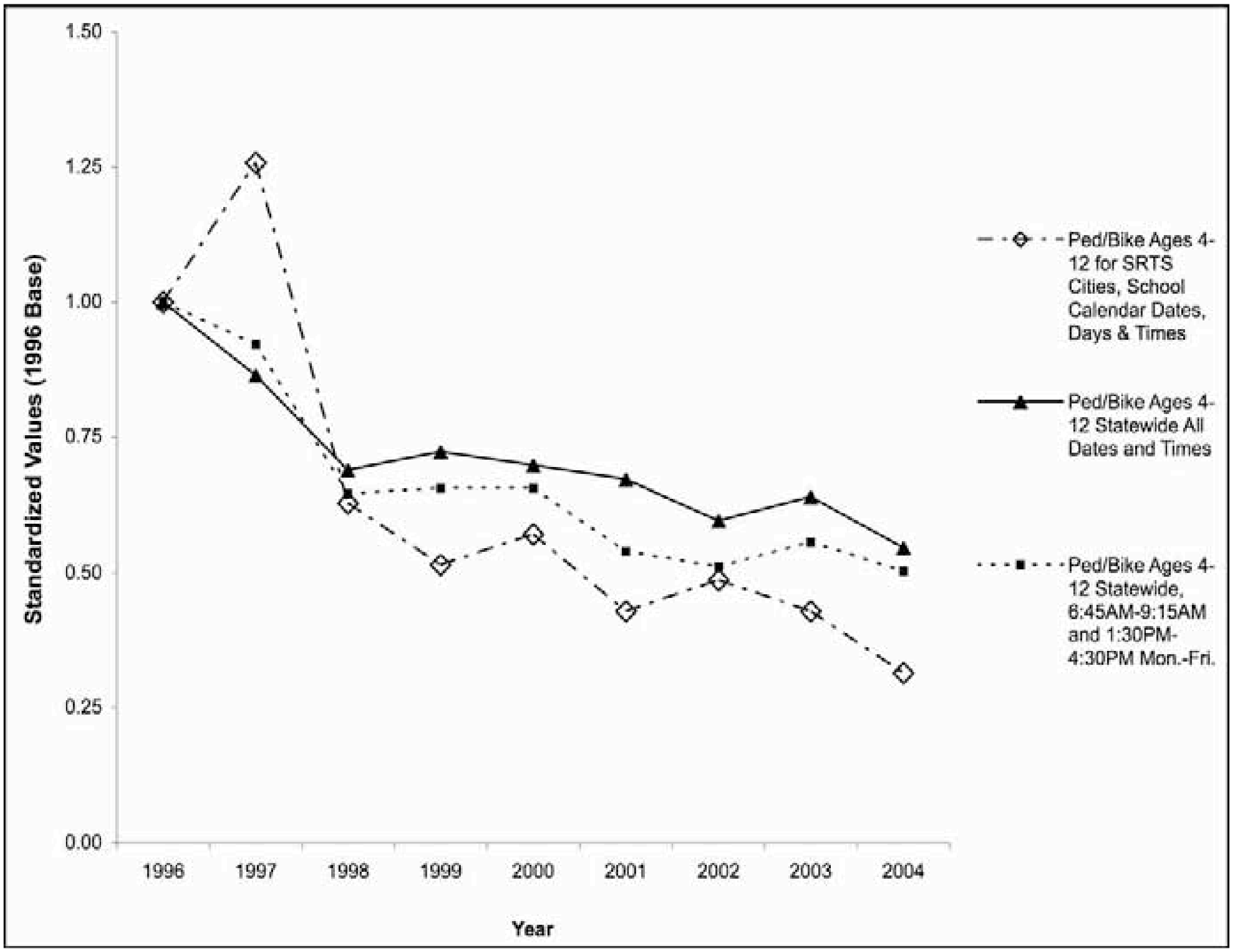

Figure 14. State 2 crash-involved 4- to 12-year-old pedestrians and bicyclists

Figure 15 shows that, for non-elementary-age pedestrians/bicyclists statewide, there was a drop in crashes in 1999, but crashes remained stable at the same level for subsequent years. For the same age group at the SRTS focus sites there was a large drop in crashes in 2000, and a steady decline for three more years. Crashes in 2004, however, returned to near the level seen for 2000. The small sample size may be contributing to this pattern of results.

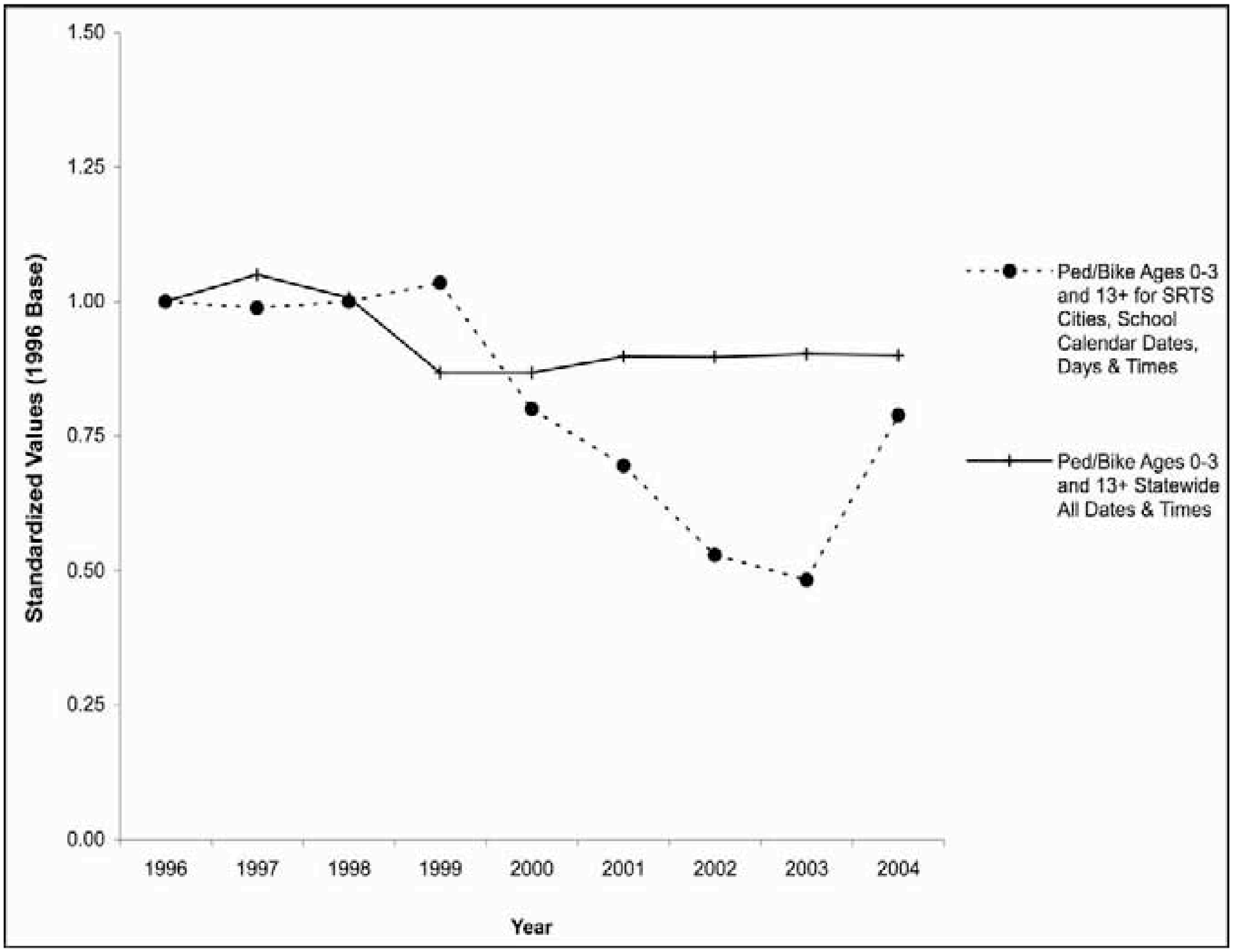

Figure 15. State 2 crash-involved non-elementary-school-age pedestrians and bicyclists

There was a steady decline over time in crash-involved passengers 4 to 12 at the SRTS focus sites. At the State level, however, the same age group of passengers showed a steady increase in crash involvement over time (see Figure 16).

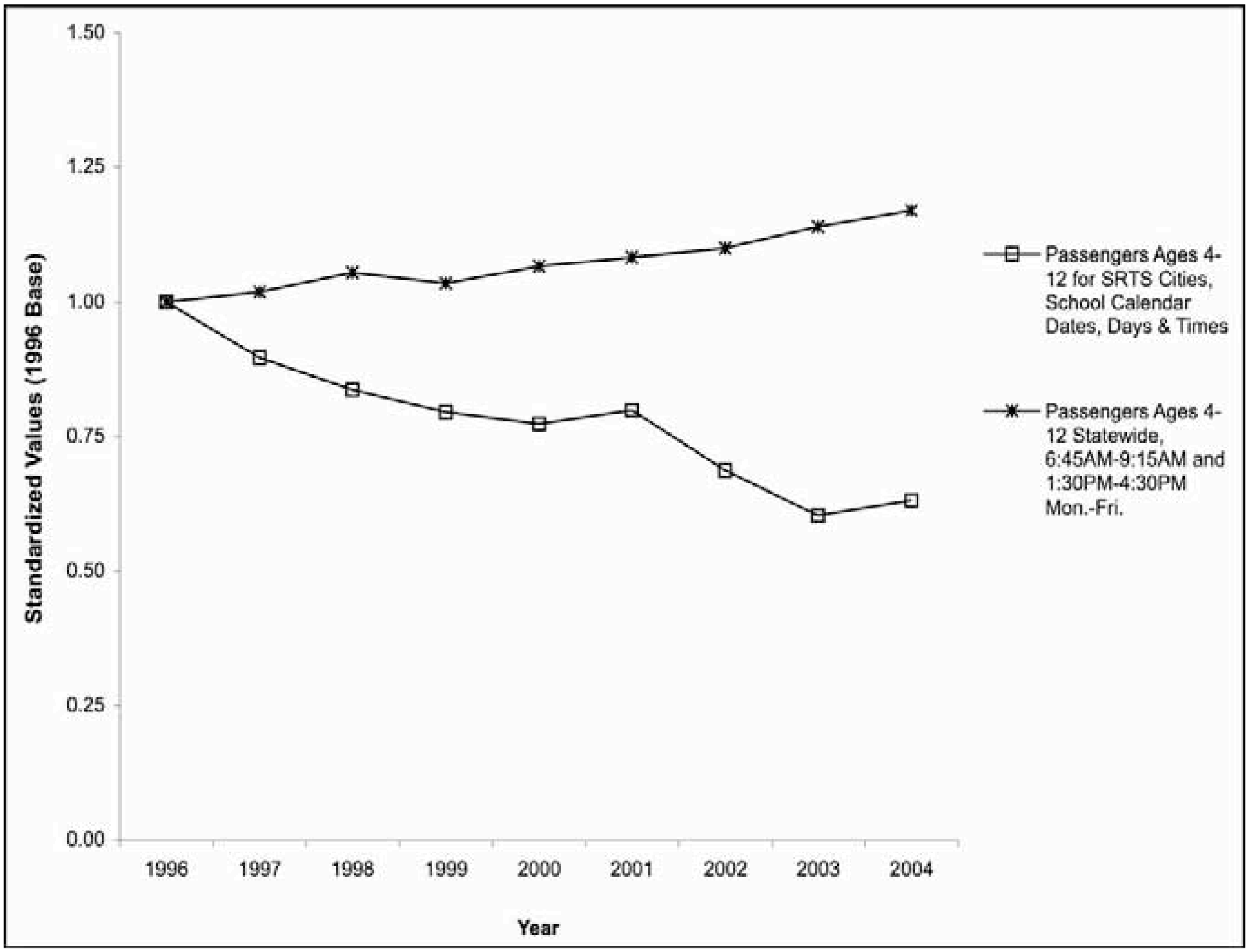

Figure 16. State 2 crash-involved passengers 4 to 12 years old

Figure 17 combines all seven data series in a single graph for State 2. This figure permits a visual comparison of the changes in crashes observed for the various data series. Statistical representations and comparisons of the data series are provided in Tables 14–17.

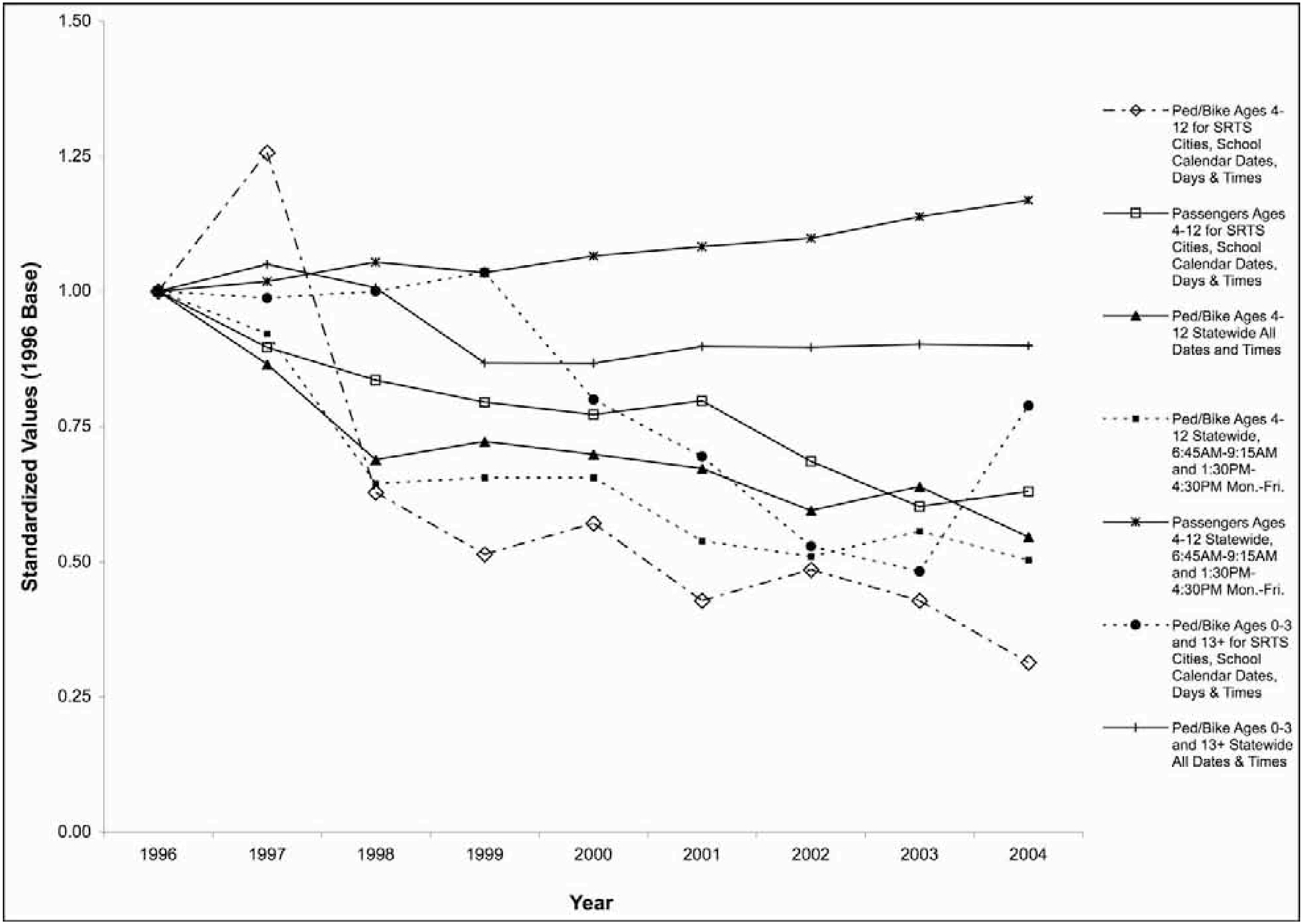

Figure 17. State 2 crash-involved people 1996 – 2004

Table 14 displays regression equation values for each data series for State 2. The shaded cells indicate significant effects ($p < 0.050$). All of the regression equations were significant. Six of the seven equations had negative coefficients that indicate significant decreases in crashes over time. Only statewide crashes involving passengers age 4 to 12 had a positive coefficient which indicates a significant increase in crash involvement over time.

Table 14. Regression values for State 2 data series

Series Description	R	R Square	Unstandardized Coefficients	Standard Error	Sig. (p)
Ped/Bike Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	0.836	0.698	-0.093	0.023	0.005
Passengers Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	0.957	0.917	-0.044	0.005	0.000
Ped/Bike Ages 4 to 12 Statewide All Dates & Times	0.894	0.800	-0.045	0.009	0.001
Ped/Bike Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	0.884	0.782	-0.058	0.012	0.002
Passengers Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	0.969	0.938	0.02	0.002	0.000
Ped/Bike Ages 0-3 and 13+ for SRTS Sites, School Calendar Dates & Times	0.791	0.625	-0.061	0.018	0.011
Ped/Bike Ages 0-3 and 13+ Statewide All Dates & Times	0.696	0.485	-0.017	0.007	0.037

Table 15 provides the statistical comparison values for crash-involved pedestrians/bicyclists 4 to 12 years old at the SRTS focus sites in State 2 during school calendar dates, days, and school trip times versus each of the other data series. Two of the six comparisons were statistically significant ($p < 0.050$), which indicates that the decrease in pedestrian/bicycle crashes involvements for 4- to 12-year-olds at the SRTS focus sites was significantly different from the patterns of crash victims for those two particular data series. The comparison with the statewide 4- to 12-year-old passengers was highly significant since this series showed an increase while pedestrians/bicyclists 4 to 12 years old involved in crashes at the SRTS focus sites were going down. The other significant comparison involved non-elementary-age pedestrians/bicyclists statewide for all dates and times. Although the data series for non-elementary-age pedestrians/bicyclists statewide demonstrated a drop in crashes over time, the decrease observed at the SRTS focus sites for 4- to 12-year-old pedestrians/bicyclists was significantly greater. The non-significant findings for the comparisons with 4- to 12-year-old pedestrians/bicyclists statewide indicate that the pattern of decreasing crash-involved 4- to 12-year-olds at the SRTS focus sites was not statistically different from the decreases seen statewide.

Table 15. Comparison of crash-involved pedestrians/bicyclists age 4 to 12 for SRTS sites, school calendar dates, and times versus all other data series for State 2.

Comparison Series	"T - value"	df	Sig. (p)
Ped/Bike Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times			
Passengers Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	-2.082	14	0.056
Ped/Bike Ages 4 to 12 Statewide All Dates & Times	-1.943	14	0.072
Ped/Bike Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	-1.349	14	0.199
Passengers Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	-4.895	14	0.000
Ped/Bike Ages 0-3 and 13+ for SRTS Sites, School Calendar Dates & Times	-1.096	14	0.292
Ped/Bike Ages 0-3 and 13+ Statewide All Dates & Times	-3.161	14	0.007

Table 16 provides the statistical comparison values for statewide crash-involved pedestrians/bicyclists 4 to 12 years old for all dates and times versus each of the other data series. These comparisons show the same pattern seen in Table 15 above with only two statistically significant (p <0.050) comparisons. The same two comparison series yielded significant statistical differences indicating that the reduction in crash-involved 4- to 12-year-old pedestrians and bicyclists statewide was significantly different than the crash patterns observed for 4- to 12-year-old crash-involved passengers statewide and for non-elementary-age crash-involved pedestrians/bicyclists statewide for all dates and times.

Table 16. Comparison of crash-involved pedestrians/bicyclists age 4 to 12 statewide, all dates and times, versus all other data series for State 2.

Comparison Series	"T - value"	df	Sig. (p)
Ped/Bike Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	1.943	14	0.072
Passengers Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	-0.097	14	0.924
Ped/Bike Ages 4 to 12 Statewide All Dates & Times			
Ped/Bike Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	0.867	14	0.401
Passengers Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	-7.050	14	0.000
Ped/Bike Ages 0-3 and 13+ for SRTS Sites, School Calendar Dates & Times	0.795	14	0.440
Ped/Bike Ages 0-3 and 13+ Statewide All Dates & Times	-2.456	14	0.028

Table 17 provides the statistical comparison values for statewide crash-involved pedestrians/bicyclists 4 to 12 years old, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m., Monday–Friday versus each of the other data series. Not surprisingly, the same two series comparisons as in Table 15 and Table 16 were statistically significant (p < 0.050) here. These significant comparisons indicate that the reduction in pedestrian/bicycle crash victims statewide for 4- to 12-year-olds during school trip times is significantly different than the crash patterns observed for 4- to 12-year-old crash-involved passengers statewide and for non-elementary age crash-involved pedestrians/bicyclists statewide for all dates and times.

Table 17. Comparison of crash-involved pedestrians/bicyclists ages 4 to 12 statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri. versus all other data series for State 2.

Comparison Series	"T - value"	df	Sig. (p)
Ped/Bike Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	1.349	14	0.199
Passengers Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	-1.077	14	0.299
Ped/Bike Ages 4 to 12 Statewide All Dates & Times	-0.867	14	0.401
Ped/Bike Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.			
Passengers Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	-6.412	14	0.000
Ped/Bike Ages 0-3 and 13+ for SRTS Sites, School Calendar Dates & Times	0.139	14	0.891
Ped/Bike Ages 0-3 and 13+ Statewide All Dates & Times	-2.951	14	0.011

4.9 Results for State 3

For State 3, data were available for 8 years, 1996 – 2003. The State 3 focus series of crashes involving 4- to 12-year-olds on the school trip represented 0.88% of all pedestrians and bicyclists involved in crashes statewide and 3.42% of all statewide crash-involved 4- to 12-year-old pedestrians and bicyclists. Two cities in State 3 contained the 10 programs that are included. A brief description of the pattern for each series is provided below. City-level data were used to create the crash involvement series for the SRTS focus sites.

As seen in Figure 18, the two statewide data series for crash-involved pedestrians/bicyclists age 4 to 12 show a steady and large decrease over time. The series for crash-involved pedestrians/bicyclists age 4 to 12 at the SRTS focus sites was volatile until 1999. After 1999, there was a consistent downward trend in crashes for the SRTS focus sites. In 2003 the SRTS focus sites standardized crash value was lower than the statewide values for crash-involved 4- to 12-year-olds.

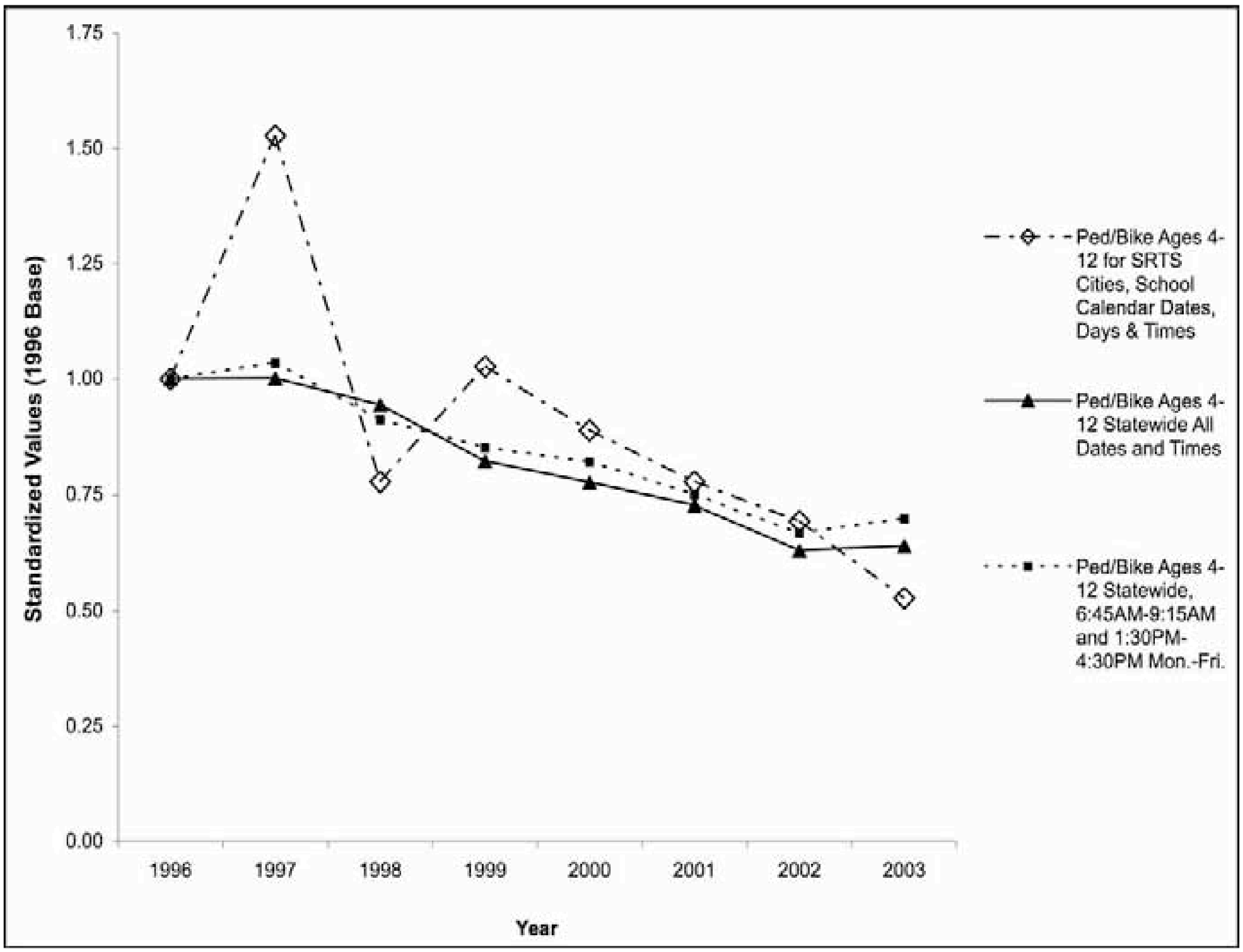

Figure 18. State 3 crash-involved 4- to 12-year-old pedestrians and bicyclists

For non-elementary-age pedestrians/bicyclists statewide there was a small drop in crash involvement over time as shown in Figure 19. For the same age group of pedestrians/bicyclists at the SRTS focus sites there was an up and down pattern over time that ultimately ended with fewer crashes by 2003. This saw-tooth pattern of involvement in pedestrian and bicycle crashes at the focus sites could be the result of small sample sizes.

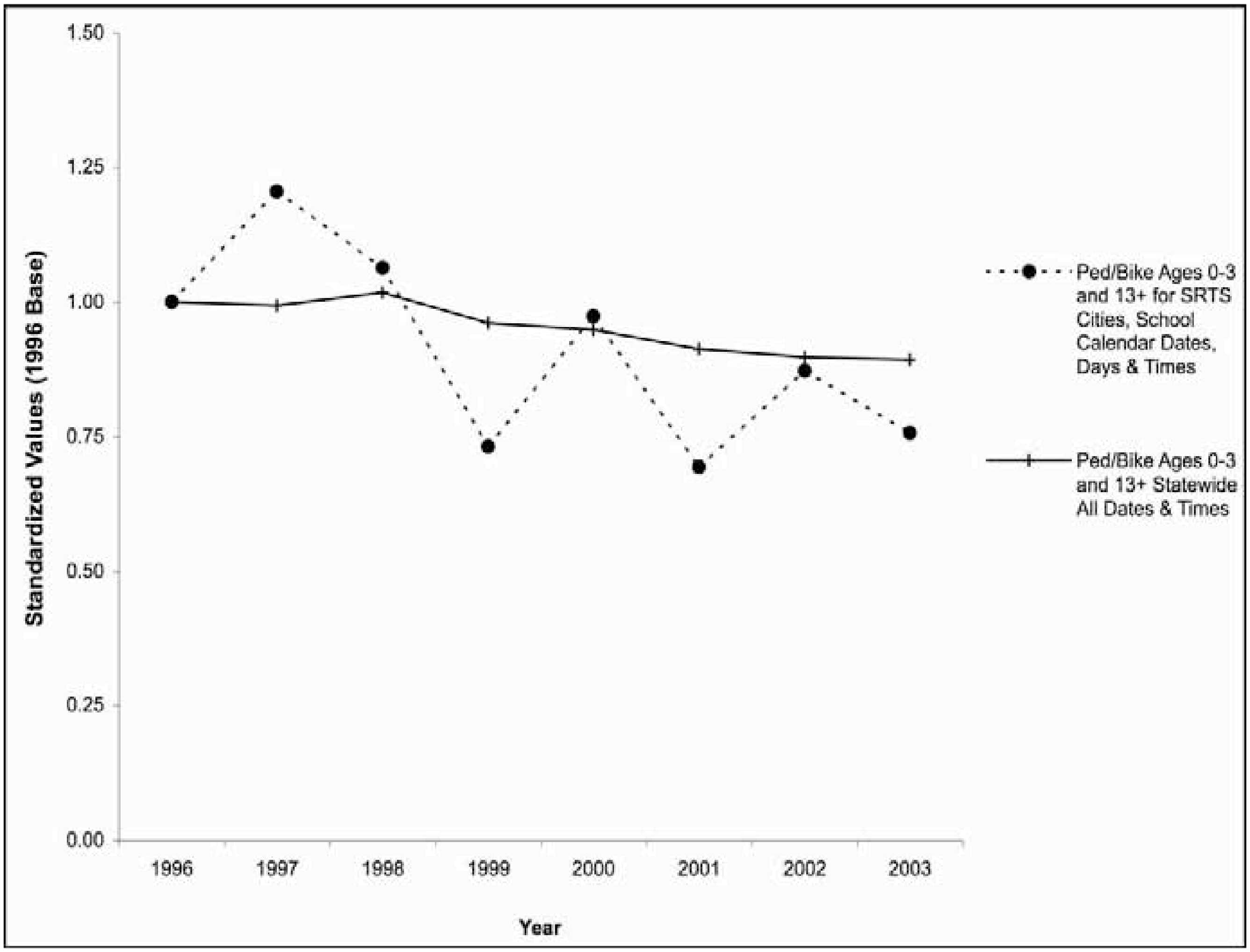

Figure 19. State 3 crash-involved non-elementary-school-age pedestrians and bicyclists

Figure 20 shows that there was an increase until 2001 in the number of crash-involved passengers age 4 to 12 at the SRTS focus sites. The increase was followed by an abrupt return to near the baseline level during 2002 and another rise in 2003. At the State level, however, crash-involved passengers age 4 to 12 showed some decrease over time.

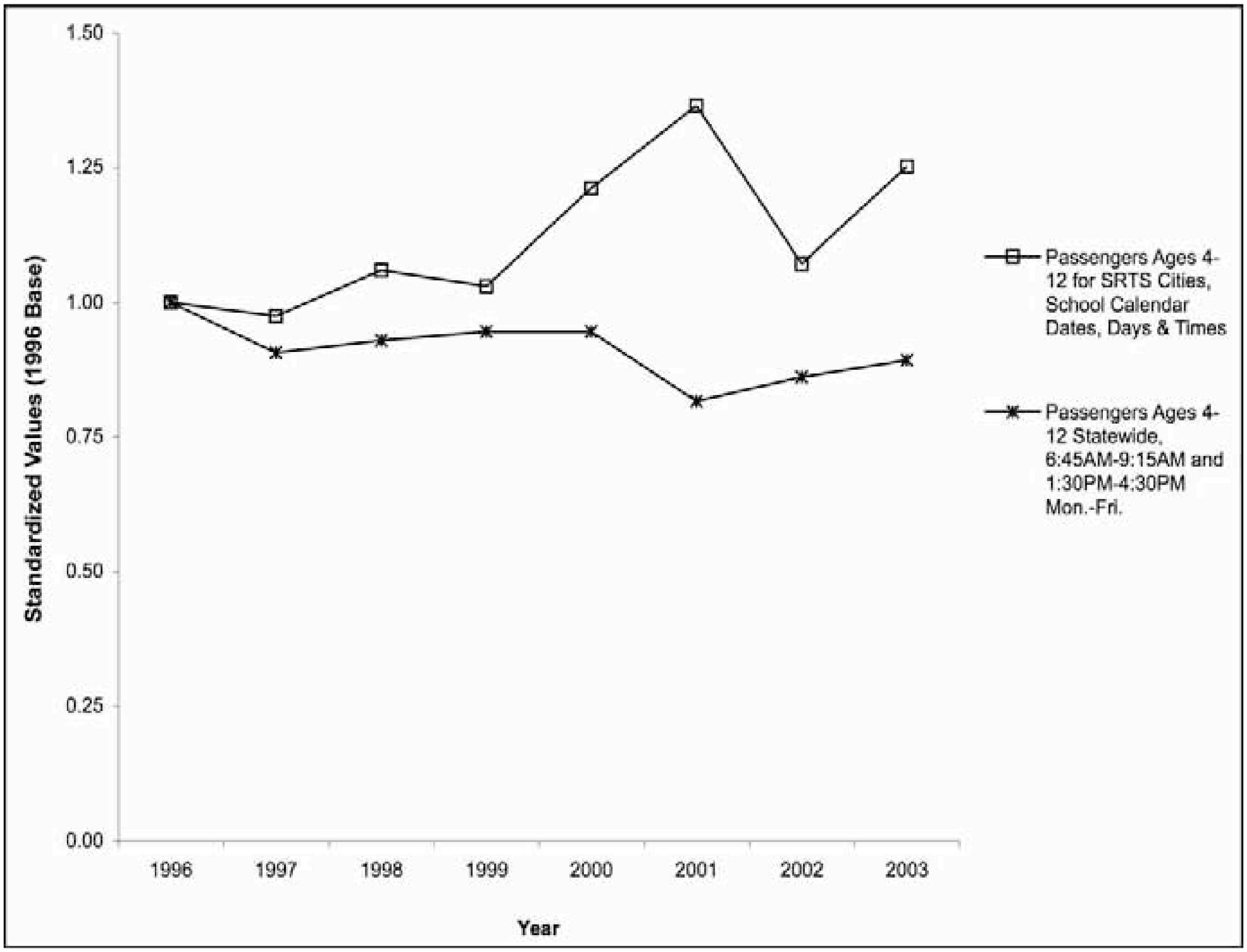

Figure 20. State 3 crash-involved passengers 4 to 12 years old

Figure 21 combines all seven data series in a single graph for State 3. This figure permits a visual comparison of the changes observed for the various data series. Statistical representations and comparisons of the data series are provided in Tables 18-21.

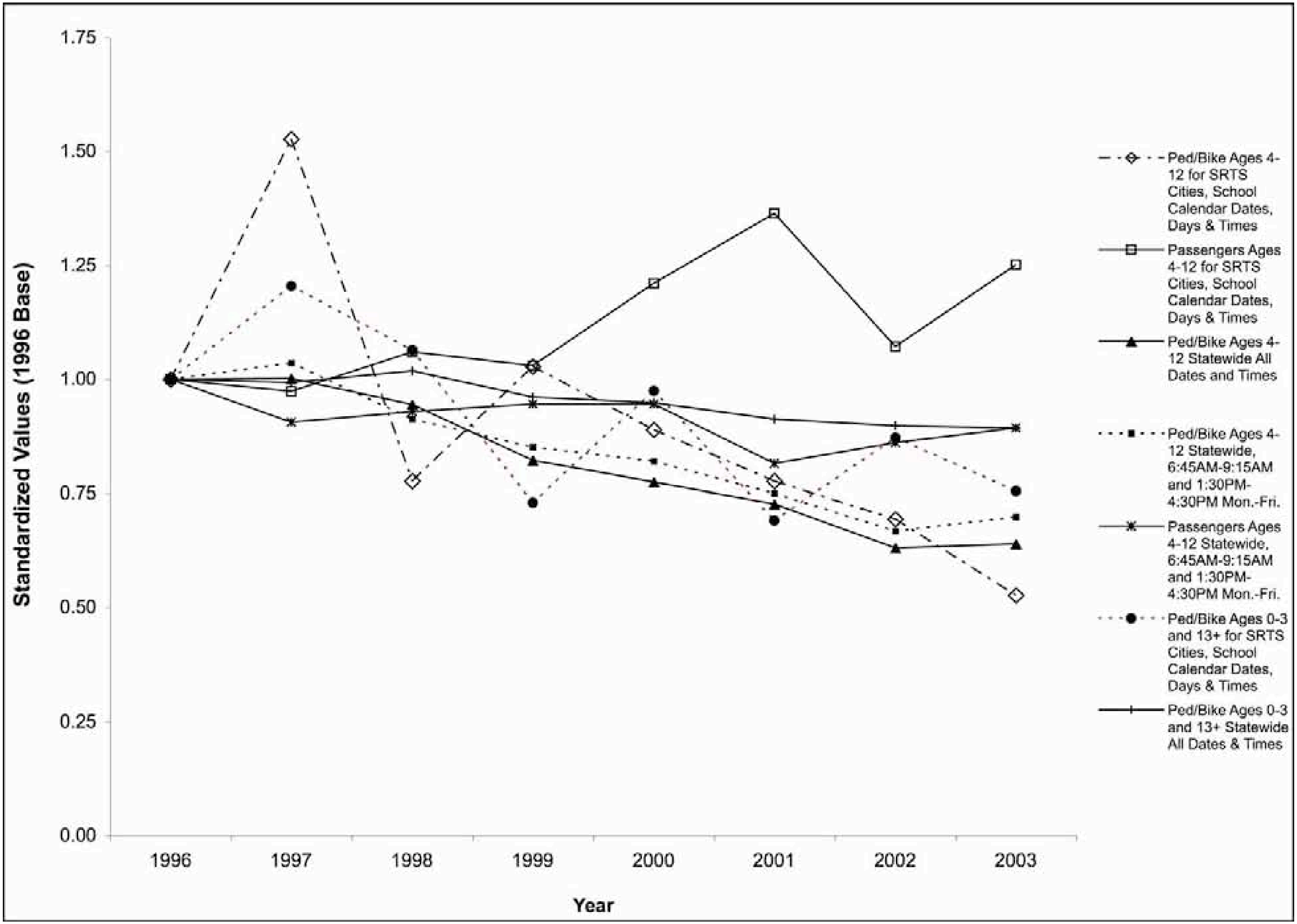

Figure 21. State 3 crash-involved people 1996 – 2003

Table 18 displays regression equation values for each data series for State 3. The shaded cells indicate significant linear fits ($p < 0.050$). Four of the seven regression equations were statistically significant, and the other three neared significance. All of the pedestrian/bicycle victim data series, with the exception of the non-elementary age group at the SRTS focus sites ($p = 0.060$), showed statistically significant reductions ($p < 0.050$). The increase in crash-involved passengers age 4 to 12 at the SRTS focus sites neared significance ($p = 0.052$).

Table 18. Regression values for State 3 data series

Series Description	R	R Square	Unstandardized Coefficients	Standard Error	Sig. (p)
Ped/Bike Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	0.739	0.546	-0.091	0.034	0.036
Passengers Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	0.702	0.493	0.04	0.017	0.052
Ped/Bike Ages 4 to 12 Statewide All Dates & Times	0.980	0.960	-0.06	0.005	0.000
Ped/Bike Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	0.966	0.932	-0.053	0.006	0.000
Passengers Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	0.674	0.454	-0.016	0.007	0.067
Ped/Bike Ages 0-3 and 13+ for SRTS Sites, School Calendar Dates & Times	0.686	0.471	-0.051	0.022	0.060
Ped/Bike Ages 0-3 and 13+ Statewide All Dates & Times	0.935	0.875	-0.018	0.003	0.001

Table 19 provides the statistical comparison values for crash-involved pedestrian/bicyclists 4 to 12 years old at the SRTS focus sites during school calendar dates, days and school trip times versus each of the other data series. Two of the six comparisons were statistically significant ($p < 0.050$). One of these significant comparisons indicates that the decrease in pedestrian/bicycle involvements for 4- to 12-year-olds at the SRTS focus sites was significantly different than the pattern for 4- to 12-year-old passengers at the SRTS focus sites during school travel times. This significant difference is not surprising since the crash involvements for 4- to 12-year-old passengers were increasing at the SRTS focus sites while those for pedestrians and bicyclists in the same age group were decreasing at the same sites. A significant effect was also obtained for the comparison with crash-involved 4- to 12-year-old passengers statewide, although the effect is not as pronounced. The comparison with non-elementary aged pedestrians/bicyclists statewide neared significance ($p = 0.051$). The lack of significance for the comparisons with the other 4- to 12-year-old pedestrian/bicycle crash involvement series indicates that the crash pattern at the SRTS focus sites was not significantly different than the patterns of decreasing crashes seen statewide. The non-significant effect for the comparison with non-elementary age crash-involved pedestrians/bicyclists at the SRTS focus sites indicates that the crash reductions were occurring for all age groups at the SRTS focus sites, not just children walking/biking to elementary schools.

Table 19. Comparison of crash-involved pedestrians/bicyclists age 4 to 12 for SRTS sites, school calendar dates, and times versus all other data series for State 3.

Comparison Series	"T - value"	df	Sig. (p)
Ped/Bike Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times			
Passengers Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	-3.446	14	0.004
Ped/Bike Ages 4 to 12 Statewide All Dates & Times	-0.902	14	0.382
Ped/Bike Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	-1.101	14	0.290
Passengers Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	-2.161	14	0.049
Ped/Bike Ages 0-3 and 13+ for SRTS Sites, School Calendar Dates & Times	-0.988	14	0.340
Ped/Bike Ages 0-3 and 13+ Statewide All Dates & Times	-2.139	14	0.051

Table 20 provides the statistical comparison values for statewide crash-involved pedestrians/bicyclists 4 to 12 years old for all dates and times versus each of the other data series for State 3. The pattern of significant ($p < 0.050$) comparisons is similar to that seen in Table 19 with the exception that the comparison with non-elementary age crash-involved pedestrians/bicyclists is highly significant here whereas it was only near-significant in Table 19.

Table 20. Comparison of crash-involved pedestrians/bicyclists age 4 to 12 statewide, all dates and times, versus all other data series for State 3.

Comparison Series	"T - value"	df	Sig. (p)
Ped/Bike Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	0.902	14	0.382
Passengers Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	-5.643	14	0.000
Ped/Bike Ages 4 to 12 Statewide All Dates & Times			
Ped/Bike Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	-0.896	14	0.385
Passengers Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	-5.115	14	0.000
Ped/Bike Ages 0-3 and 13+ for SRTS Sites, School Calendar Dates & Times	-0.399	14	0.696
Ped/Bike Ages 0-3 and 13+ Statewide All Dates & Times	-7.203	14	0.000

Table 21 provides the statistical comparison values for statewide crash-involved pedestrians/bicyclists 4 to 12 years old, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m., Monday through Friday, versus each of the other data series for State 3. The same three series comparisons that were highly significant in Table 20 are also statistically significant ($p < 0.050$) here. This is not surprising since the two data series showed virtually identical decreases in crashes over time.

Table 21. Comparison of crash-involved pedestrians/bicyclists age 4 to 12 statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m., Mon.-Fri., versus all other data series for State 3.

Comparison Series	"T - value"	Df	Sig. (p)
Ped/Bike Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	1.101	14	0.290
Passengers Ages 4 to 12 for SRTS Sites, School Calendar Dates & Times	-5.159	14	0.000
Ped/Bike Ages 4 to 12 Statewide All Dates & Times	0.896	14	0.385
Ped/Bike Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.			
Passengers Ages 4 to 12 Statewide, 6:45 a.m.-9:15 a.m. and 1:30 p.m.-4:30 p.m. Mon.-Fri.	-4.013	14	0.001
Ped/Bike Ages 0-3 and 13+ for SRTS Sites, School Calendar Dates & Times	-0.088	14	0.931
Ped/Bike Ages 0-3 and 13+ Statewide All Dates & Times	-5.217	14	0.000

5. DISCUSSION

The data presented in Sections 3 and 4 provide a picture of a sample of legacy SRTS programs and a view of crash trends with which they were associated. As discussed earlier, this study was designed to shed light on the nature and possible safety effects of these programs rather than to produce a specific measure of their impact on crashes. This section discusses the implications of the findings herein with respect to the objectives of the present study.

5.1 Nature of the Legacy Programs

It is not known to what extent the programs examined by this study are representative of the totality of legacy SRTS programs. No attempt was made to develop a random or probability sample of the programs in existence before the passage of SAFETEA-LU. In spite of these limitations, however, it is believed that the sample of 130 legacy SRTS programs that provided the data for this study are not an unreasonable cross section of the universe of programs. Thus, observations based on the information in this report are likely generalizable.

It is apparent from the programs studied and from the literature reviewed that legacy SRTS programs were quite heterogeneous. There appear to be wide disparities in program size, duration and primary focus. For example, some programs aimed at infrastructure improvement were high value, one-time undertakings while smaller-dollar-value education and encouragement efforts may be ongoing and essentially institutionalized within their elementary schools. In spite of the safety focus implied by the generic program name—Safe Routes to School—a large proportion of the programs studied did not have crash reduction as their primary objective.

While many programs were motivated by the desire to achieve a specific end, such as preventing the recurrence of a type of crash, reducing congestion on or near the school property or promoting exercise, it appears as if the primary reason for starting most of the studied programs was the availability of funds from State or other sources. The situation will likely be similar under SAFETEA-LU funding where the availability of grants for SRTS programs will generate local interest in their development. This appears to be a "natural" and reasonable stimulus/response pattern for programs of this type.

The legacy SRTS programs studied herein had little externally applied structure. Most State-funded engineering programs had to comply with State standards and guidelines, and a few private sponsors and State funding agencies required reports of activities. There was, however, no widely used standard for reporting either the process or outcome of conducting these programs. This should change for the programs funded by SAFETEA-LU which will have uniform reporting standards and operational guidelines developed by FHWA and its contractors.

One other aspect of SRTS programs that should change for the SAFETEA-LU funded activities relates to evaluation. The studied legacy programs involved little formal evaluation, and much of the evaluation that was done focused on changes in the travel mode selected for the school trip. SAFETEA-LU programs are encouraged to encompass all 5 E's and will be provided with detailed evaluation guidance through the National Center for Safe Routes to School.

Overall, it appears as if the structure being imposed by the SAFETEA-LU funding of new SRTS programs may reduce many of the methodological shortcomings of the legacy programs while simultaneously promoting uniformity in reporting and evaluation. These changes should greatly facilitate any future examination of SRTS programs similar to the one conducted by the present study.

5.2 Safety Effects of Legacy SRTS Programs

As discussed earlier, SRTS programs can potentially reduce pedestrian and bicycle crashes through safety interventions or possibly increase crashes because they generate additional exposure to traffic risks on the school trip for children as pedestrians and bicyclists. The pattern of crash results presented herein from three separate States provides no support for a conclusion that legacy SRTS programs increased pedestrian and bicycle crash involvements and, by implication, pedestrian and bicycle crashes themselves. On the contrary, the consistent pattern of declining crash involvements of elementary school children on the school trip over the years during which these programs were implemented provides support for a conclusion that legacy SRTS programs were at least benign with respect to crashes.

The remaining safety-related question is whether legacy SRTS programs can be associated with a decrease in crash involvements. Clearly, the data reported here are not sufficient to answer this question with precision because of the assumptions that had to be made to conduct the analyses, particularly the classification of a city or county as an SRTS focus site when only a minority of its elementary schools was involved in the studied programs. Also, the assumption that each of the studied programs accomplished a mode shift to increase walking and bicycling cannot be verified. Finally, the possibility exists that the crash reductions seen both for the focus locations and statewide in the three studied States are the result of reduced pedestrian and bicycle exposure rather than improved safety. While this possibility cannot be disproved with the available data, it is considered unlikely. First, there are no apparent reasons for a significant reduction in bicycling and walking. On the contrary, most efforts were attempting to increase the use of nonmotorized transportation modes. Second, it is considered likely that a drop in walking and bicycling sufficient to account for the crash reductions noted herein would have been noticed and reported at least anecdotally in one or more of the studied States.

In spite of these limitations, the pattern of results is certainly favorable to legacy SRTS programs for at least the following reasons. First, a marked decrease in pedestrian and bicycle crash involvements of 4- to 12-year-olds was noted at the SRTS focus sites in all three States. Thus, the safety of elementary school children on the school trip was clearly improving over the time studied. Second, although statewide data for the three studied States suggest a general decrease in the crash involvements of interest, there appears to be some tendency for the focus sites to show lower crash involvements even though the difference from the statewide values is not statistically significant. For example, in Figure 13 the series for pedestrian and bicycle crash involvements on the school trip at the focus sites is at or below the value of the similar statewide series for all of the sampled years.

A third consideration when interpreting these findings is that SRTS programs may contribute to improved safety community-wide even if they are only housed in a subset of the elementary schools. For example, enforcement activities around one school might be generalized by motorists to all schools in the jurisdiction. It must also be noted that the three studied States are known to have a significant number of legacy SRTS programs in addition to the ones that were identified, contacted and willing or able to provide the depth of data required by this study. Thus, the observed statewide results themselves may be attributable at least in part to the presence of active SRTS efforts within the studied States.

5.3 Implications

The findings of the present study certainly generate no cause for safety concerns arising from the implementation of legacy SRTS programs. Since the much broader SRTS programs funded under SAFETEA-LU are based in part on the lessons learned from these legacy programs, there should also be little concern that they will be detrimental to safety. Obviously, if the new programs are significantly more successful than the legacy efforts in shifting school trip travel modes to walking and bicycling, the possibility of a negative safety consequence due to increased exposure must again be considered. With the larger number of SRTS programs generated by SAFETEA-LU and the better data they plan to collect, a future replication of the current study should be facilitated. Moreover, if NHTSA continues to maintain and expand the SDS, a future replication of this type of study will be greatly facilitated.

6. REFERENCES

Boarnet, M. G., Anderson, C. I., Day, K., McMillan, T., & Alfonzo, M. (2005). Evaluation of the California safe routes to school legislation. *American Journal of Preventive Medicine, (2005:28),* 134-140.

Boarnet, M. G., Day, K., Anderson, C., McMillan, T., & Alfonzo, M. (June 22, 2005). California's Safe Routes to School Program: Impacts on Walking, bBking and Pedestrian Safety. *Journal of the American Planning Association, 71*, 301-317.

Hubsmith, D. A. (2006). Safe routes to school in the United States. *Children, Youths and Environments, 16*, 168-190.

McMillan, T. E. (May 2005). Urban form and a child's trip to school: The current literature and framework for future research. *Journal of Planning Literature, 19*, 440-456.

NHTSA. (July 2004). *Safe Routes to School: Practice and Promise.* DOT HS 809 742. Washington, DC: National Highway Traffic Safety Administration.

NHTSA. (2002). *Safe Routes to School.* DOT HS 809 497. Washington, DC: National Highway Traffic Safety Administration.

Nelson\Nygaard Consulting Associates. (2005). Marin County, CA: Author.

Robert Wood Johnson Foundation. (2007). *Safe Routes to School: 2007 State of the States Report.* Princeton, NJ: Author.

Snedecor, G., & Cochran, W. (1967). *Statistical Methods*. Ames, Iowa: Iowa University Press.

WalkBoston. (2003). *How to Start Your Own Walk-to-School-Bike-to-School-Traffic-Reduction-and-Safety-Program*. Boston, MA: Author.

Transportation Alternatives. (2002). *The 2002 Summary of Safe Routes to School Programs in the United States.* New York, NY: Author.

Transportation Alternatives. (2001). *The 2001 Summary of Safe Routes to School Programs in the United States.* New York, NY: Author.

Transportation Research Board. (2002). *The Relative Risks of School Travel.* Special Report 269. Washington, DC: Transportation Research Board.

University of Florida Department of Urban and Regional Planning. (n.d.). S*afe Ways to School "Tool Kit."* Gainesville, FL: University of Florida.

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