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Pediatric Pedestrian Trauma Study: A Pilot Project

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Objective: To evaluate the implementation of the WalkSafe *Program, a school based educational injury prevention program for children grades Kindergarten through 5.*

Methods: A randomized comparative design was used for this study. The study was conducted in two high-risk urban school districts, which were chosen based on the geographic areas with the highest pedestrian injury and fatality rates. Four elementary schools (two in each district) were identified as potential study sites. Two intervention schools, one in each school district, were randomly chosen to receive the WalkSafe *program; the other two schools served as controls, and received no intervention. The data was collected within the classroom setting for both the intervention and control schools. All elementary school children were administered the same pedestrian safety questionnaire as a pre-test, post-test and at three months following the intervention.*

Results: A total of 2300 children participated in the WalkSafe *program. The intervention (I) schools showed significant improvement in post-test scores then the control (C) schools ($p = 0.012$), and the (I) schools were able to maintain their test scores as reflected in a three-month follow-up evaluation ($p = 0.47$). Grades 3–5 of the (I) schools showed significant improvement in their test scores over grades K–2 ($p < 0.0001$).*

Conclusion: The WalkSafe *program was shown to improve the pedestrian safety knowledge of elementary school children. Future research will include implementing the* WalkSafe *program at each elementary school within a single high-risk district.*

Keywords Pediatric; Pedestrian; Safety; Education; Injury Prevention; Intervention

Pedestrians involved in motor vehicle crashes are the second leading cause of unintentional-injury related to death among children 5–14 years old in motorized countries (Mayr et al., 2003). Each year in the United States approximately 25,000 children 0–15 years of age are struck by motor vehicles. This accounts for 22% of total injury by this population (NSC, 2000). According to the U.S. Department of Transportation for 2000, the age groups with the highest percentages of pedestrian injury are the elderly population older than 59 years (10%) and the children less than 16 years (30%); this accounts for 24,000 pedestrians injured. The age group 5–9 accounted for 50% of the total children pedestrians injured in this population and 30% of the fatalities. Most school-age pedestrians are killed in the afternoon rather than the morning, with 42% of the fatalities occurring in crashes between 3:00 and 7:00 P.M. (Stuffts & Hunter, 2000; NHTSA, 2001).

Florida is currently facing an epidemic of pedestrian trauma (HSMV, 2001). Four of the five most dangerous cities for pedestrians in the United States are located in Florida. Miami—Dade County is the third most dangerous city with respect to pedestrian safety in this country (Crider, 1992). The mortality rate after pedestrian trauma (3.9 per 100,000) is higher than the national average (2.3 per 100,000) (McCann & DeLille, 2000).

The incidence of pedestrian crashes in Miami-Dade has continued to raise over the past three years, leading to an urgent need for prevention-aimed programs. In preliminary studies (Phase I, II) investigating the epidemiology of pediatric pedestrian traffic injuries in South Florida (Jackson Memorial Medical Center/University of Miami—Ryder Trauma Center) we found that (53%) of the pediatric pedestrian accidents occurred in children ages 5–13. The majority of cases were males with 60% of all

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cases being African American. A significant proportion of these pedestrian crashes (71%) took place in the vicinity of elementary schools between 1 and 7 P.M. and 46% were attributed to "dart out" behavior (Hameed, 2004). Of the 29 pediatric pedestrian cases the mean hospital charges were $24,478 ± $43,939. In Miami-Dade county in 2002, there were 297 injuries and 3 fatalities for children (<14 years) hit by motor vehicles (Henderson, 2002).

These studies allowed us to compile a comprehensive characterization of the problem in our community and the basis of the implementation of a multidisciplinary, community-oriented approach that included primarily education, enforcement, and engineering in an injury prevention program targeting elementary school age children.

Pedestrian safety education has been recommended in many countries. Educational measures used to teach pedestrians how to deal with traffic environment are an essential component of any injury prevention strategy. However, the lack of information exists pertaining to the implementation and evaluation of these pedestrian injury prevention programs. The primary aim of this study (Phase III) was to evaluate the implementation of the *WalkSafe* program in order to increase the pedestrian safety knowledge of elementary school children.

METHODS

Subjects

The study was conducted in two high-risk urban school districts in Miami—Dade County, Florida. These districts were chosen based on the highest pediatric pedestrian injury and fatality rates per population reported from data available from the Metro Planning Office (MPO) (Henderson, 2002). A randomized comparative design was used for this study, the school and grade being the unit of assignment.

Four elementary schools (two in each district) were identified as study sites based on the proximity to these high-risk pedestrian accident areas. In each school district one school was randomly chosen to receive the *WalkSafe* intervention program; the remaining two schools served as controls, and received no intervention. A random coin-flip indicated which schools would receive the intervention and which would serve as controls. The (I) and (C) groups were similar on demographic profile with respect to age, gender, and race/ethnicity (See Table I). The University of Miami Institutional Review Board and the Miami-Dade School Board approved this study protocol.

All students were including in each school from Kindergarten through Grade 5, the number of classes and students in each grade varied between schools. In District 1: the (I) schools A and C, had 12 classes with approximately 420 students, and the (C) schools B and D had 24 classes with approximately 650 students. In District 2: the (I) school had 42 classes with approximately 1,200 students, and the (C) school had 21 classes with approximately 700 students. (Table II)

Table I Demographic characteristics of elementary schools

Characteristics	School A	School B	School C	School D	Total
Grades K–3					
Gender:					
Male	356	208	99	197	860
Female	377	211	125	186	899
Ethnicity:					
White	2	2	0	0	4
Black	675	379	220	380	1654
Hispanic	51	32	2	2	87
Multiracial	5	6	2	1	14
Grades 4–5					
Gender:					
Male	190	98	59	101	448
Female	181	122	73	105	481
Ethnicity:					
White	4	0	0	1	5
Black	348	205	131	199	883
Hispanic	17	15	1	6	39
Multiracial	2	0	0	0	2

Educational Intervention

The *WalkSafe* Program is a school based educational injury prevention program targeting students in kindergarten through Grade 5. This pedestrian safety program was developed by a group of pedestrian specialists at UM/JMMC based on the literature review of pre existing programs and the support of different community agencies. This program utilized two grade-specific educational curriculum, Kindergarten through Grade 3 and for Grade 4 through 5.

Test questions were designed based on information from the videos and other educational programs. The tests were reviewed by classroom teachers that felt the level of education and language was appropriate for Grades K–3 and 4–5. The tests were presented in a one-page written format with the questions presented orally and in multiple choice format to the students in the younger grades. In the older grades, the students were required to read and write answers to the questions. The format of the questions included multiple choice and open-ended type questions. There were a total of 10 questions presented at each grade level.

The program included videos, workbook, and outside simulation activities using a fictitious road located on school grounds. The intervention was conducted over a period of four weeks, with one half-hour session per week; or a total of two hours of

Table II Student test scores for I schools (% correct ± S.E.) by grade and time

Grade	# of Classes	Pre-test	Post-test	Delta
Kindergarten	8	57.62 ± 3.1	67.61 ± 2.5	9.98
First	9	69.55 ± 2.3	77.57 ± 2.5	8.02
Second	10	77.48 ± 1.9	86.23 ± 1.6	8.75
Third	9	52.17 ± 1.6	71.14 ± 2.4	18.96*
Fourth	9	54.00 ± 1.7	72.55 ± 2.3	18.54*
Fifth	9	57.40 ± 1.7	74.20 ± 3.3	16.80*

Test scores ± standard error. *$p < .001$.

Table III *WalkSafe* program curriculum

	Session 1	Session 2	Session 3	Session 4
Kindergarten Grade 1 Grade 2 Grade 3	*Objectives*: Tell left from right. Demo. Stop, look Left Right Left. *Video*: Stop and Look w/ Willy Whistle	*Objectives*: Rules for getting ready for school and for walking to the bus stop. *Video*: A Surprise of Otto	*Simulation*: Students demonstrate skills learned in the classroom outside. Crossing guards assist.	*Poster Contest*: Themes must correspond to classroom education; children win prizes
Grade 4 Grade 5	*Objectives*: Demo. Stop, look Left Right Left. Encountering intersections and parking lots. *Video*: Walking w/ your eyes	*Objectives*: Rules for getting ready for school and for walking to the bus stop. *Video*: Getting To School The Safe Way	*Simulation*: Students demonstrate skills learned in the classroom outside. Crossing guards assist.	*Poster Contest*: Themes must correspond to classroom education; children win prizes

educational training for each student that participated. The sessions were taught in a specific order with one session each week. Each session objectives are shown in Table III. Twenty volunteer instructors from the RTC were trained by a safety specialist to teach the pedestrian safety curriculum at the two intervention schools. Each student received parental consent to participate in the educational program.

The data were collected within the classroom setting for both the (I) and (C) schools. Students that participated in the program were required to take a 10-item test that objectively assessed their knowledge of pedestrian safety. The pre-test was given one week prior to the start of the *WalkSafe* program; the same test was administered at the end of the *WalkSafe* program and then only the (I) schools received the test three months later. The test for K–3 was read aloud by trained instructors in a classroom setting. The research team in conjunction with the safety specialist developed a standard scoring system for each exam. Each exam was based on a 100-point scale (10 points for each correct answer).

Statistical Analysis

The instructors assigned to each school were responsible for collecting all student evaluation tests. Two research assistants were responsible for grading and entering all test scores into an Access database. Statistical analyses were performed using a Statistical Analysis System (SAS Institute, Inc., Release 8.02. Cary, NC). The data were analyzed in a repeated measures analysis of variance with two grouping factors and one repeated factor. The grouping factors were Intervention (education) versus Control (no education) and Grades K–5. The repeated factor was time (pre, post, and 3 months post). Following the analysis of variance schools and grades were compared using pair-wise t-tests among schools, grades, and times and Bonferoni adjustment for multiple comparisons. Test scores are presented as means ± standard errors.

RESULTS

A total of 4,423 pedestrian safety tests were administered to the (I) and (C) schools, 2,231 pre-tests and 2,192 post-tests. The four schools in the study were similar across demographic characteristics with respect to age, gender, and ethnicity seen in Table I. In addition, a three-month follow-up test was administered to 1,277 students at the two (I) schools. In District 1, the (I) school had a total of 850 tests across all 3 testing times (pre post, and 3 month follow-up), the (C) school had a total of 654 tests (pre, and post). In District 2, the (I) school had a total of 3,074 tests and the (C) school had a total of 1,123 tests. (Table II)

When comparing the difference in the pre- and post-test scores of the (I) schools to the (C) schools, significant test score improvement was shown at the two (I) schools. The mean change of scoring improvement was 13.5 ± 1.2 for the (I) schools compared to 7.8 ± 2.0 for the (C) schools, ($p = 0.012$) (Figure 1).

Grades 3–5 of the (I) schools showed significant improvement in their test scores then grades K–2. Grades 3–5 improved by 18.1 ± 1.4 percentage points compared to 8.9 ± 1.4 for Grades K–2 ($p < .0001$). The individual grade level pre- and post-test scores for the intervention schools are reported in Table II.

The (I) schools were able to maintain their test score improvement over a three-month period as indicated by no statistical significance when comparing post- and follow-up test scores. The mean post-test score was 75.2 ±1.3 compared to 74.4 ± 1.4 for the three-month follow-up test ($p = 0.47$) (Figure 2).

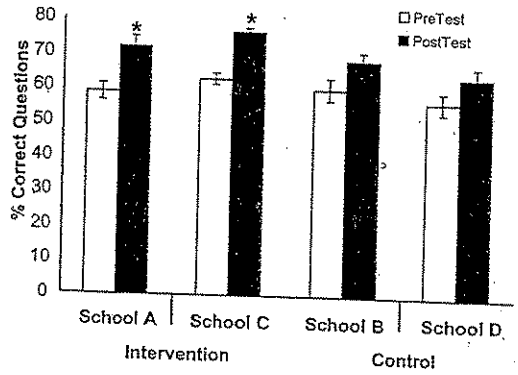

Figure 1 Student test scores (% correct) by school, condition and time. Test scores ± standard error * $p < .05$.

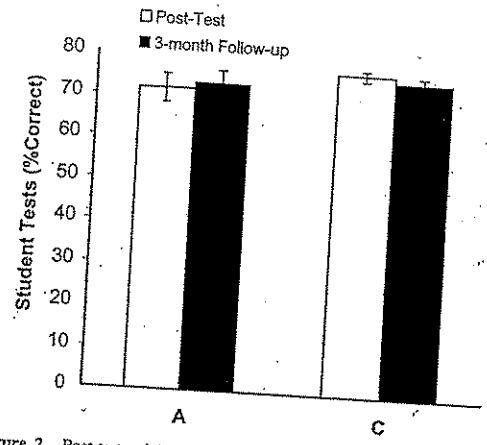

Figure 2 Post-test and three-month follow-up among intervention schools.

DISCUSSION

The primary objective of this study was to evaluate the implementation of the *WalkSafe* program, a school-based educational injury prevention program for children Grades K–5. The analysis indicated that a *WalkSafe* program implemented at elementary schools provided an increase in pedestrian safety knowledge.

Our center's previous research on pediatric pedestrian trauma (Phase I and II) was valuable in defining this problem within our community, and further enabled us to take an active approach toward prevention (Hameed et al., 2002). In order to create an intervention program that would be implemented into our high-risk districts, we first reviewed the existing literature on previous pediatric injury prevention programs.

Past attempts to lower the incidence of pediatric pedestrian injury have had limited success. These programs failed to provide prospective data confirming their benefits, and had difficulties being sustained once grants were terminated. A validated model that would include a pedestrian injury prevention program that can be used in all demographic, socioeconomic, and geographic areas had not been created. However, we did identify some programs that appeared to be beneficial in creating our own.

One of the programs that have been nationally accepted is the U.S. Department of Transportation/National Highway Traffic Safety Administration program called *Walk—Ride—Walk* (NSC, 2000). This program utilizes video and formal education to promote pedestrian safety among children in Grades K–6. Another program we utilized was sponsored by the Utah Department of Transportation. This agency sponsors an annual statewide *Green Ribbon Week* (Berman, 1998). Green ribbons are distributed to members in cities throughout the community to remind drivers to slow down near school zones and to be more aware of the pedestrians that surround them. In addition, each school participated in a traffic safety education program throughout the week.

Another resource we found beneficial toward the creation of our program was from the United Kingdom Department of Transportation. This agency has spent many years studying child development and the aims of road safety education. They have performed a detailed analysis of pedestrian behavior and the skill components required in practicing traffic safety. These include: detecting the presence of traffic, visual timing judgments, and coordinating information from different directions. Developmental theorists agree that practical training methods are more successful then knowledge-based approaches, and that the best way for young children to develop traffic safety skills is to undergo training exercises which would result in changing actual behavior in the traffic setting (Zeedyk et al., 2001, 2002; Young & Lee, 1987).

The Cochrane Review (2002) is a systematic review of 15 randomized controlled trials of safety education programs for pedestrians of all ages (Duperrex et al., 2002). Of these trials none assessed the effect of safety education on the occurrence of pedestrian injury but six assessed the effect on observed behavior. Only some of these trials demonstrated behavioral changes following pedestrian safety education but it was difficult to predict what effect this may have on risk of pedestrian injury. There is also evidence that changes in safety knowledge and observed behavior decline with time suggesting that it may be beneficial that safety education should be repeated at regular intervals. Our study demonstrated that a significant change was seen in safety education knowledge however we did not evaluate changes in pedestrian behavior.

The *WalkSafe* intervention program was unique in that pre- and post-educational testing was performed. Schools that received the *WalkSafe* educational program scored significantly higher on post-tests than schools that did not receive formal pedestrian safety education. The three-month follow-up tests demonstrated that children retained the knowledge gained from the educational curriculum. Since our primary interest was studying the change in the intervention group after receiving the *WalkSafe* program, a three-month post-test was only administered to the intervention group so that retention of the safety information could also be studied.

In addition, children in Grades 3–5 scored significantly higher then those children in Grades K–2. Our educational program included class discussion, videos, and simulation exercises. By incorporating a verbal, visual, and interactive component into the program, we were attempting to communicate our message to the students through multiple modalities. Repetition of the message in different mediums is an important teaching technique used with school-age children. Therefore, the *WalkSafe* program provided pedestrian safety knowledge in those students who participated. Our study was not designed to assess what parts of the curriculum were most beneficial.

Limitations of the Study

The primary limitation of this study is the difficulty level of the pre and post tests. Test questions may not have been worded

in such a way as to maximize the students understanding of what they were being asked. Many of the students that we tested in Grades K–2 were not yet able to read and write, making it necessary for instructors to read questions aloud followed by the corresponding answer choices. For the purposes of this study we performed grade-specific comparisons with the assumption that the areas are reasonably homogeneous within grade. The item of analysis was not an individual child but a classroom and stated in the methods section the appropriate ANOVA was performed. We believe that converting the answer choices from words to picture choices may increase the post-test scores of the younger children. Also the pre and post tests administered in our study may not have been a true indicator of the information that students retained from the *WalkSafe* Program.

Future Research

Our future research will include evaluating pediatric pedestrian injuries within a single high-risk district. We intend to implement the *WalkSafe* program at each elementary school within this county and also make the appropriate engineering modifications and enforcement recommendations as needed. Elementary school teachers will assist us in our plan to improve the quality of our testing techniques, and our *WalkSafe* task force has committed to further investigate how to decrease the incidence of prediatric pedestrian injuries in these areas. In addition, is critical to the success of the program that it be easily implemented and sustainable in any school district. We plan to make the *WalkSafe* intervention materials part of the required curriculum in these elementary schools. Therefore, educators will be responsible for ensuring that each student participates in the program. Elementary school teachers will be trained to administer the program. The next phase of the study will be to intervene within a larger population, which will allow us to observe any changes in that district in pediatric pedestrian injury and fatality.

Also a greater emphasis will be placed on observing and measuring pedestrian behavior. Although a traffic simulation (lesson 3) is part of the *WalkSafe* program, a more structured roadside traffic component needs to be incorporated along with a way to evaluate behaviors.

CONCLUSION

Our study evaluated the implementation of a school based pedestrian injury prevention program with the primary component being education. However, in order to decrease the number of injuries and fatalities for young pedestrians, a combination of efforts by a number of agencies is clearly needed. Future research, needs to study the implementation of this school-based pedestrian injury prevention model in an entire high-risk district, and then expand the program statewide.

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