FIELD TEST OF A PEDESTRIAN SAFETY ZONE PROGRAM FOR OLDER PEDESTRIANS *

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ABSTRACT

The objectives of this study were to develop and apply procedures for defining pedestrian safety zones for the older (age 65+) adult and to develop, implement and evaluate a countermeasure program in the defined zones. Zone definition procedures were applied to two cities: Phoenix and Chicago. Extensive countermeasure programs were implemented in both cities. A complete crash-based evaluation was conducted only for the city of Phoenix where data showed significant reductions in zone crashes to 65+ pedestrians over a period in which the city's population and overall pedestrian crashes increased. It was concluded that the zone process resulted in an effective and efficient means of deploying pedestrian countermeasures for the older adult.

INTRODUCTION

This study represents a further step in the systematic efforts of both the National Highway Traffic Safety Administration (NHTSA) and the Federal Highway Administration (FHWA) to develop techniques to reduce pedestrian crashes. Past research has identified the frequency and types of crashes involving pedestrians of all ages (Snyder and Knoblauch, 1971; Knoblauch, 1977; Hunter, Stutts, Pein et al, 1996; Leaf and Preusser, 1997). Based on information about the behavioral errors committed by pedestrians and drivers and other information about the context in which these crashes occur, countermeasures have been developed targeting preschoolers (NHTSA, 1985) and school-age children (Blomberg, Preusser, Hale et al, 1983a; Dueker, 1981; Hale, Blomberg and Preusser, 1978; Cleven and Blomberg, 1994) as well as adult pedestrians (Blomberg, Preusser, Hale et al, 1983b; Blomberg, Hale and Preusser, 1984).

Recent NHTSA and FHWA efforts have focused greater attention on the crashes of older adult pedestrians. Data from NHTSA's Fatality Analysis Reporting System (1999) show that older adults account for almost one-quarter (22.1%) of all pedestrian fatalities, and have a fatality rate of 3.14 per 100,000 population, greater than that of other age groups. Others have supported this finding (Evans, Gerrish and Bahram, 1998). This is likely because older adults tend to die in crashes that are survivable by younger, more resilient pedestrians. Since America's population is aging, the magnitude of this problem is expected to increase.

To combat this problem, NHTSA and FHWA sponsored the present study with the primary objectives of creating and evaluating a technique for defining zones that would permit efficient targeting of pedestrian crash countermeasures for the older adult. The concept of employing "zones" or clusters of defined population groups as part of a countermeasures program has been used in targeting remedial efforts to children. For the young, school safety zones (Bowman, Fruin and Zegeer, 1989) and guidelines for safe routes to school (Shinder, Robertson and Reiss, 1975) have been available for years. Also, dissemination of pedestrian safety information through school systems has proved to be both efficient and effective (Blomberg et al, 1983a).

It was considered reasonable that zones could be created for similar targeting of countermeasures to other groups. Retting, Schwartz, Kulewicz et al (1989) reported that fatal pedestrian crashes declined sharply along a 2.5 mile stretch of Queens Boulevard (New York

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City) after engineering improvements (e.g., increases in signal timing and improved road markings), increased enforcement and public education safety presentations were targeted to older pedestrians. Also a set of countermeasures aimed at reducing errors committed by both drivers and older pedestrians was available for testing (Blomberg, Cleven and Edwards, 1993). Therefore, the older adult was selected as the target group for this effort.

The following objectives were established for the study:

- Develop procedures for defining older adult pedestrian safety zones within communities.

- Apply the procedures to the problem of older adult pedestrian crashes to validate the zone definition procedure and provide a basis for a field evaluation of the zone concept.

- Develop a set of countermeasures to reduce older adult pedestrian crashes in the defined zones to support the examination of the technique.

- Conduct a field evaluation of the countermeasure program.

- Prepare a manual that program implementers in other cities can use in defining zones and applying the zone process to their pedestrian safety problems.

METHOD

Two cities were selected to be test sites: Phoenix, Arizona and Chicago, Illinois. A crash-based approach was used for establishing zones in the two cities. Procedures were identical except that, for Phoenix, the zoning task was accomplished manually and, for Chicago, use was made of a computerized Geographic Information System (GIS) mapping tool.

Since over three-quarters of the older adult crashes occurred within one mile of the victim's residence, circles with a radius of one mile were established as zones. Three years of Phoenix data (153 pedestrian crashes involving victims 65+) were mapped manually, and an acetate with a one-mile radius circle was moved around the map until it contained 10 or more crashes. This defined a zone for countermeasure application. The map was also examined for linear strips of roadway that contained six crashes in a two-mile segment. The Chicago data for one year (436 crashes) were mapped using a commercially available GIS mapping tool. This system was used to create a circle with a one-mile radius that was moved over the computer map to identify circular areas containing a minimum of 10 crashes.

By this process, six circular zones and one linear zone were identified in Phoenix that accounted for 54.9% of the city's older adult pedestrian crashes in about 4.6% of the land area (see Figure 1 in Appendix 1). For Chicago, the process led to the identification of 14 circular zones and one linear zone that encompassed 52.5% of the older adult crashes in just over 19% of the total Chicago land area. The ratios of crash percentage to land area led to the conclusion that the process resulted in an efficient definition of study zones for the older adult in both cities.

Once established, the zones were monitored throughout the conduct of the study for any changes that might affect study design or program results. For example, the addition or removal of a senior residence, school, hospital, trailer park or other zone component could markedly change the zone composition and even require the deletion or revision of the zone. No such change in the zones was noted during the conduct of the study in either city.

A team made up of the project staff and city traffic safety representatives made a detailed examination of each of the zones for possible engineering countermeasures. A list was prepared for final consideration by city traffic engineering personnel. In addition, each city was provided with the same package of public information and education (PI&E) countermeasures. These included several materials developed specifically for the project, other NHTSA materials adapted for the study so that materials would have a common theme, and still other NHTSA and American Automobile Association education materials that were used intact. Developed as part of the study were a video entitled *Walking Through the Years* and five public service announcements (PSAs) all of which provided pedestrian safety advice for the older adult. In addition, a set of 13 flyers sized to fit in a business envelope were developed. These flyers provided advice to both pedestrians and motorists. Other materials provided to the two cities included brochures, posters, bus cards, bumper stickers, radio PSAs and slides.

From the materials provided, city representatives designed their own countermeasure programs. The resulting programs were quite different in the two cities. As examples, among other educational activities, Phoenix distributed all project flyers and brochures as door hangers to each residence in the zones in three separate distributions. Materials were distributed to senior centers and senior residences in and near the zones. In addition, educational activities were directed to the city at large through the use of television and radio PSAs, bus cards, and notices in newspapers and local water bill mailers. Motor vehicle offices and police precincts were also used as distribution points for printed materials. Chicago concentrated its efforts primarily on a community-based initiative that involved police presentations to the elderly. These presentations were made at senior centers, residences and other locations where older adults congregate. Television and radio PSAs were also used as were bus cards. Copies of the video were provided to each library in the Chicago zones.

In terms of engineering countermeasures, among other activities, Phoenix mounted pedestrian signal information signs near pedestrian push buttons at intersections in and near the zones. These signs explained the meaning of the "Walk," flashing "Don't Walk" and steady "Don't Walk" pedestrian signal legends. Impediments to sight distance in the zones were removed where possible, pavement in pedestrian crossing areas was repaired where needed, traffic signal timing errors were corrected and crosswalks were repainted and repaired where required. Planned engineering activities in Chicago were not accomplished due to cut-backs in engineering personnel.

Phoenix also sponsored a survey to measure knowledge gains and exposure to the project countermeasures. The survey was administered to older adults in face-to-face interviews conducted at small shopping malls, grocery stores and other locations in and near the zones where individuals of all demographics were expected to be plentiful. For most zones, there were two data collection sites. Surveys were conducted outdoors during daylight hours on all seven days of the week. Ten separate waves of survey data were collected. The first three waves provided baseline data. The remaining seven waves were spread throughout the time period in which program education countermeasures were introduced. The survey consisted of 10 questions that covered age, gender, zone residence and walking habits of the respondents as well as knowledge of important pedestrian safety issues and exposure to project activities. In the baseline waves (waves 1 through 3), 2,133 surveys were conducted. In the program waves (waves 4 through 10), 2,751 surveys were conducted. Approximately 50% of the sample reported that they were residents of the zone in which they were interviewed.

As the study progressed, it became apparent that full program implementation and evaluation in both Phoenix and Chicago would not be possible or practical within study time and funding constraints. Since Phoenix had completed its countermeasure program when this decision was made and Chicago had encountered a number of unforeseen setbacks in program implementation, it was agreed that full program evaluation would be based on the experience in Phoenix only. Chicago provided supporting data on the zone definition and countermeasure implementation processes. The information presented on Chicago has been included since it shows an efficient selection of zones using the GIS process (in contrast to the manual process used in Phoenix). In addition, it shows that the same countermeasure input materials can result in markedly different programs depending on the needs and resources of the community in which the program is conducted.

RESULTS

Phoenix pedestrian crash data were obtained from police crash reports collected over an eight-year period. There were four baseline years (1988 through 1991) and four program years (1992 through 1995). Complete data on older adult pedestrian crashes were available for all eight years. Data on *all* pedestrian crashes were not available for the first two baseline years.

Results showed that, while both the overall population and pedestrian crashes in the city *increased* over the study period, older adult crashes *decreased* by 13.7%. This decrease was greatest in the zones (46.3%), while an *increase* of 9.9% in older adult pedestrian crashes occurred outside the zones. These data, shown in Table 1 (Appendix 2), are statistically significant ($\chi^2 = 11.65$ with 1 d.f., $p < .001$).

While the reductions in the number of in-zone crashes are compelling, the simple numerical drops do not take possible seasonal or other time-dependent effects into account. Therefore, crashes for the entire period of study (from 1988 through 1995) that involved pedestrian victims 65 years of age and older were subjected to a time series analysis. The primary series of interest was the 65+ in-zone crashes by month. The techniques used were based on Box-Jenkins (1976) theory for discrete time series in the time domain for either the prediction of future events or for evaluation of known interventions. This analysis produced a multivariate model which estimated a significant decrease in older adult (65+) crashes in the zones coincident with the implementation of the countermeasure program (Omega parameter = -.648, statistically significant at t = 2.35).

The decreases in 65+ pedestrian crashes occurred in all of the older adult pedestrian safety zones although the decreases were remarkably larger in some of the zones than in others. The reductions ranged from 16.7% to 72.7%. These data, shown in Table 2 (Appendix 2), are statistically significant (χ^2 = 25.89 with 6 d.f., $p < .001$).

Of the crashes that were classifiable as occurring at an intersection or midblock, there was a 59.4% decrease from baseline to program period in the in-zone intersection crashes and a 7.0% decrease in the out-of-zone intersection crashes. These data are statistically significant (χ^2 = 7.70 with 1 d.f., $p < .01$). For the midblock data, in-zone crashes decreased by 36.8% and out-of-zone crashes increased by 40.0%. These data did not reach the minimum level of statistical significance adopted by this study (which was that p must be less than .05 to be considered significant). Thus the larger decrease and the only statistically significant decrease in crashes between baseline and program periods occurred at intersections, which was precisely where the maximum project effort was focused in Phoenix. Several of the project flyers addressed intersection issues. In addition, the pedestrian signal information signs as well as the vast majority of engineering improvements, such as increases in the available sight distance and corrections in signal timing, were focused at these intersections. These data are shown in Table 3 (Appendix 2).

The Phoenix survey showed knowledge gains in daytime conspicuity, an area believed important to achieving a reduction in age 65+ pedestrian crashes. When asked if they felt that drivers have a problem seeing walkers in the daytime, 13.9% of the total number of baseline individuals (N = 2,104) responding to this question reported that drivers *do* have a problem. In the last program study wave, this number increased to 21.5% of the total number of individuals responding (N = 418). This represented a statistically significant increase of 54.7% (χ^2 = 15.89 with 1 d.f., $p < .001$).

The survey also showed that Phoenix residents were aware of the countermeasure program, and this awareness increased as the study progressed. These data are shown in Table 4 (Appendix 2). The table shows that, in the survey baseline, 9.4% of the respondents reported having seen, heard or read something recently in Phoenix on safe walking. This value increased to 34.1% for the final study survey. The increase was most marked for the last three study waves. Distributions of different program flyers were made to each zone residence prior to each of the last three study waves.

Project flyers that were distributed as door hangers were reported to be the primary source of the education information received by the respondents. Table 5 (Appendix 2) shows the major information sources and the percentage of respondents who reported receiving information from each source in the final three survey waves. Of the 298 individuals reporting awareness of education activities during the last three survey waves, 45.3% reported door hangers as the major source of the pedestrian education information.

When asked if they had seen signs in Phoenix giving information or advice to walkers, the project pedestrian signal information signs were the most frequently mentioned by the respondents. Of the 2,144 individuals who reported seeing signs, 66.6% indicated that the pedestrian signal information signs were the ones they had seen. As indicated previously, these signs explained the meaning of the various phases of the "Walk"/"Don't Walk" signal.

DISCUSSION

There was clearly an "efficiency factor" in being able to deploy countermeasures in a small area in both cities and reach a relatively large proportion of the target population. This factor was especially prevalent in Phoenix where the door hanger campaign and the deployment of pedestrian signal information signs near the push buttons in the zones both proved to be successful in prompting recall and, presumably, positive behavioral change. It was economically feasible to use these approaches because the area of the city to be treated in order to reach the target population had been reduced to a small fraction of the total. In Phoenix, for example, the cost for three waves of door hanger deliveries was about $24,000. It is estimated that, had these deliveries been made over the entire city, the cost would have been more than $250,000. Based on the Phoenix crash data results, therefore, it can be concluded that the zoning process worked and that it was cost-effective. However, confidence in the precise estimate of the magnitude of the change in the problem is somewhat limited by the small number of older adult crashes in Phoenix.

Representatives in both cities had favorable opinions on the zone process and the method in which it was applied. Neither city had previously used zoning for pedestrian studies, and both found it a valuable means for helping to focus limited resources in areas where they are most needed. Although there were no problems in defining zones for the current study, city representatives recommended that, in future studies, zones be examined to see if they need fine tuning. For example, they suggested that it might be advisable to add a block or two to a zone to keep a neighborhood intact. As was done in the current study, city representatives noted the importance of subjecting the selected zones to a periodic review to determine if redefinition is needed, especially for long-term studies. In addition, zones may need changes for implementation of specific countermeasures. For example, in the current study, it was necessary to make squares of the circular zones in Phoenix in order to deliver flyers to each residence in the zones.

Representatives from both cities found the engineering review of the zones useful in identifying where scarce funds for engineering countermeasures can best be used. Opinions on the package of PI&E countermeasures were positive in both cities, although city representatives noted that materials that are customized for local use are much more favorably received by the population.

CONCLUSION

The successful application of the zone process together with evidence that the zone-based countermeasure program in Phoenix successfully reduced crashes lead to a conclusion that “zoning” is an approach that should be considered as part of pedestrian crash countermeasure programs. The two documents prepared for the study can assist other communities in adapting the zone process to their pedestrian safety needs. The final technical report (Blomberg and Cleven, 1998) provides details on study design and conduct. The zone guide (NHTSA/FHWA, 1998) provides step-by-step procedures for conducting a zone study and was specifically prepared to aid representatives in other communities in applying the zoning process to their pedestrian safety problems.

The zone concept is now being applied in a comprehensive pedestrian safety demonstration project in Miami, FL. It will also be described in a Pedestrian Resource Guide which will be distributed on CD-Rom.

The same basic zoning approach might also be beneficial in other crash and operational contexts such as drunk driving crashes or tracking and repairing roadway problems such as potholes. It is likely that maximizing the effectiveness of the concept for these uses will require refinements in some of the procedures that were developed for older adult pedestrian crashes. However, since the development process used in this study is not particularly difficult, refinements based on other problem-specific data should be relatively easy to make.

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APPENDIX 1: FIGURES

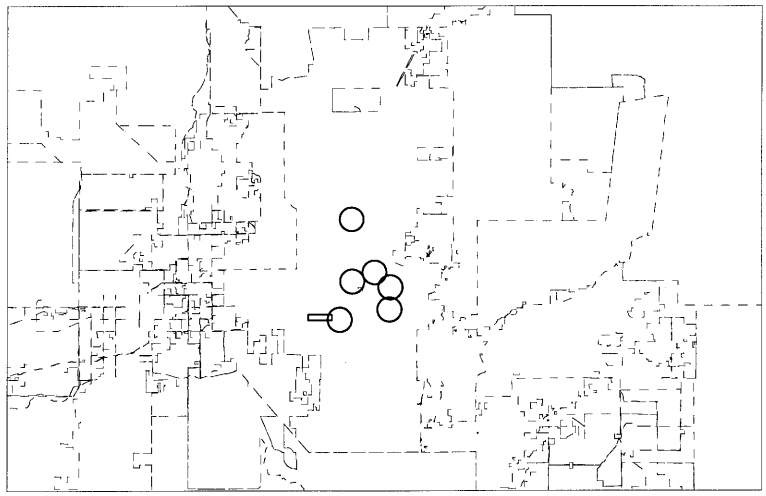

Figure 1. **Phoenix Zones**.

APPENDIX 2: TABLES

Table 1: Phoenix 65+ In-Zone and Out-of-Zone Pedestrian Crashes

Zone Status	No. of Crashes Baseline	Program	% Change
In-zone	95	51	- 46.3
Out-of-zone	131	144	+9.9
Total	226	195	-13.7

Table 2: Phoenix 65+ Pedestrian Crashes by Zone

Zone	No. of Crashes Baseline	Program	% Change
1	11	3	-72.7%
2	18	12	-33.3
3	16	5	-68.8
4	18	15	-16.7
5	15	5	-66.7
6	10.5**	6	-42.9
7	6.5**	5	-23.1
Total	95	51	-46.3%

** One crash occurred where zones 6 and 7 overlap.

Table 3: Intersection and Midblock In-Zone and Out-of-Zone Pedestrian Crashes (Phoenix, ages 65+)

Zone Status	No. of Crashes: Baseline	No. of Crashes: Program	% Change
Intersection			
In-zone	64	26	- 59.4%
Out-of-zone	57	53	- 7.0%
Midblock			
In-zone	19	12	- 36.8
Out-of-zone	35	49	+ 40.0

Table 4: Respondent Awareness of Education Activities by Survey Wave (Phoenix)

Survey Wave	Sample Size	% Reporting Awareness
1-3 (baseline)	2104	9.4%
4	413	9.2
5	422	2.6
6	370	10.3
7	406	12.1
8	367	19.6
9	334	25.1
10	417	34.1

Table 5 - Major Sources of Education Information During Last Three Survey Waves

Source	% Reporting Source (N = 298)
Door hanger	45.3%
Newspaper	19.8
Television	19.1
Pamphlet	7.4
Radio	4.0