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OLDER PEDESTRIAN FATALITIES IN NEW JERSEY, 1999 - 2000

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Abstract
The population aged 65 years and older has the highest pedestrian mortality rates. We examined incidents (ICD-10 codes V03, 04, 09) in which older adults (65+) were fatally struck by a motor vehicle in New Jersey in 1999 and 2000. Our objective was to determine whether there are demographic or geographical characteristics associated with risk. Data on fatalities came from the Multiple Cause of Death files and New Jersey death certificates. Data on municipality characteristics were obtained from 2000 Census. Medical Examiner narratives provided additional information about the circumstances of the incidents. Decedents' residential address and location of incident were geocoded, and distance calculations were performed in ArcView 8.2. Results show significant association between risk of injury and age, gender, marital status, and population density of municipality. The GIS analysis suggest that older adults are at greatest risk of being struck by a motor vehicle when they are in close proximity to their home, especially within one mile. Older victims of pedestrian fatalities were disproportionately likely to be unmarried males aged 75 years old or older, living in municipalities with above average population density, and walking within one mile of their residence. These findings suggest that preventive programs target these at-risk populations and include all pedestrian trips.

Introduction

Children and the elderly are the two age groups with the highest rates of pedestrian injury and death (U.S Department of Transportation, 2002). In fact, pedestrian mortality rates are considerably higher among persons age 65 and over than their younger counterparts (Table 1; U.S. Department of Health & Human Services, WISQARS^{TM}). Nationally, death rates for older pedestrians have declined more slowly than have pediatric and adolescent fatality rates in recent years. For pedestrians under 21 years, mortality rates declined by 15% between 1996 and 2001, while older pedestrian mortality rates declined by only 10%. In New Jersey, there were 96 fatalities and an additional 465 nonfatal injuries to older pedestrians in 2000 and 2001. Like the nation as a whole, New Jersey's pedestrian fatality rates are highest among older adults (age 65+ years) (Table 2; U.S. Department of Health & Human Services, WISQARS^{TM}).

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Table 1. Pedestrian Mortality Rates, Children and Older Adults, United States, 1996-2001

	Age			
	0-20		65+	
Year	Total Deaths	Mortality Rates[a]	Total Deaths	Mortality Rates
1996-1997	2551	1.51	2833	4.05
1998-1999	2289	1.36	2685	3.84
2000-2001	2168	1.29	2549	3.64

[a] Rate per 100,000

Table 2. Pedestrian Mortality Rates, Children and Older Adults, New Jersey, 1996-2001

	Age			
	0-20		65+	
Year	Total Deaths	Mortality Rates[a]	Total Deaths	Mortality Rates
1996-1997	55	1.16	108	4.85
1998-1999	52	1.10	115	5.17
2000-2001	45	0.95	96	4.31

[a] Rate per 100,000

Additionally, New Jersey's older pedestrian fatality rates are higher than national rates. This was most notable during 1998-1999, however, reasons for this variance are unknown.

The number of elderly pedestrians will grow as the American population ages. Between 2010 and 2030, the total population of persons aged 65 and over is expected to increase by 75% to over 69 million (U.S. Census Bureau, 1996). Given the elevated pedestrian mortality rates among this age group, the number of older pedestrian deaths may increase considerably.

Because pedestrian-motor vehicle incidents can be so life threatening for older adults, researchers have investigated several factors that may increase risk. One may be the effects of aging on walking ability. When compared to younger persons, the walking or "gait" pattern of the elderly is typically more conservative, i.e., slower in speed, shorter paces, and inconsistent step timing (Menz et. al., 2003). In a study that compared traffic light timing to the gait speed of 1229 pedestrians who legally crossed an intersection, researchers found that 27% of those who appeared 65 years old or more were not able to walk across the entire width of the street—curb to curb—before the traffic light changed to red (Hoxie et. al., 1994). Of this selected group, 23% had at least one full traffic lane left to cross before reaching the curbside. All pedestrians who appeared under the age of 65, and who legally entered the intersection, successfully crossed the street in the time allotted by the traffic light.

Increased reaction time may also threaten older pedestrians' safety. In a recent study, researchers measured the reaction times of active seniors and young adults to visual and/or auditory stimuli while traversing a prepared pathway in a laboratory setting (Sparrow et. al., 2002). During the assigned walking tasks, the older adults had significantly longer reaction times than the younger adults to the visual and visual/auditory events. These authors suggested that slower reaction times during certain dual task situations, such as crossing a road, may increase older adults' risk of injury. Another study found that older subjects performed less well in tests of vision, peripheral sensations, strength, balance than their younger counterparts (Menz et. al., 2003).

Older pedestrians are also more likely to be seriously injured when struck by a motor vehicle. Elderly pedestrian victims admitted to trauma centers have higher Injury Severity Scores (ISS) than do younger victims (Peng & Bongard, 1999; Kong et al., 1996). Older pedestrian victims are also more likely to be admitted to an intensive care unit, and have longer hospital stays (Kong et al., 1996).

Individual Risk Factors

While age is a significant predictor of older adult pedestrian risk and mortality (Hijar et. al., 2001; Kingma, J., 1994), other demographic factors are also important. Males have been found to be at higher risk for fatal pedestrian injuries (U.S. Department of Transportation, 2002; Hijar et. al., 2001; Kingma, J., 1994; Peng & Bongard, 1999). Less is known about the relation between marital status and older pedestrian injury. However, other studies of injury and marital status have shown that injury rates are highest among unmarried individuals (Hokby et. al., 2003; Kelly & Miles-Doan, 1997; Hawton & Fagg, 1990).

The relative risk of pedestrian fatality is greater for American Indians, Hispanics, and African-Americans than non-Hispanic whites (Campos-Outcalt et. al., 2002). In the southwestern US, American Indians are especially at risk when compared to other racial groups (Campos-Outcalt et. al., 1997; Schiff & Becker, 1996). In other parts of the country, African-Americans are found to be at higher risk for motor vehicle-related deaths and injuries than whites or Hispanics (Braver, E., 2003; Todem & Harding, 2003). While the older population is disproportionately non-Hispanic white, little is known about racial differences in risk of pedestrian mortality among elderly adults.

Socioeconomic status has been found to be negatively correlated with pedestrian and vehicle occupant injuries for both children and adults under 65 (Steenland et. al., 2003; Hasselberg et. al, 2001; Cubbin et. al., 2000; Laflemme & Diderischsen, 2000). In these studies, lower income and education attainment were most commonly associated with motor vehicle injury and mortality.

Alcohol use has been shown to significantly influence pedestrian injury (Zajac & Ivan, 2003). Even though younger males are more often involved in pedestrian incidents while intoxicated, (Blake et. al., 1997; Williams et. al, 1995; Vestrup & Reid, 1989), additional research into pedestrian intoxication among older adults is needed.

Location Characteristics

The relation between neighborhood socioeconomic status and pedestrian injury rates is also of interest. In a San Francisco study, LaScala et al. (2000) found that pedestrian injury rates were greater in census tracts with higher rates of unemployment. When analyzing hospital-based trauma mortality from all injury types, including pedestrian incidents, researchers found higher rates among young persons ($\leq$ 18 years) residing in poorer census blocks, i.e., areas with low median household income, a higher proportion of families below the poverty line, and a greater proportion of Medicaid recipients (Marcin et. al., 2003).

Population density has been shown to be positively associated with pedestrian injury rates (LaScala et. al, 2000; Joly et. al., 1991), but negatively related to severity (Zajac & Ivan, 2003). Pedestrian injuries sustained in downtown, compact residential, and medium- and low-density commercial areas were less severe than were those sustained in villages and low-density residential areas.

Risk of injury may also vary by proximity to residence. Several studies of pediatric populations found that pedestrian incidents involving children and adolescents frequently occur close to the victim's home (Lightstone et. al. 2001; Bass et. al., 1992). However, among the older adult population, very little is known about the relation between residence-to-incident distance and pedestrian injury risk.

Methods

From the 1999 and 2000 National Center for Health Statistics' (NCHS) Multiple Cause of Death files, we selected New Jersey incidents that listed an international classification of diseases code (ICD-10) of V03 (pedestrian injured in collision with car, pick-up, van), V04 (pedestrian injured in collision with heavy transport vehicle or bus), and V09 (pedestrian injured in unspecified accident or with unspecified motor vehicle). From the New Jersey death certificates, we obtained decedents' demographic characteristics and residential and incident location information. Data on municipality characteristics, including median household income and population density, came from the 2000 Census.

Also included in the analysis was narrative text from the 1999 and 2000 New Jersey Office of the State Medical Examiner (ME), which supplied the details of each case, when known. The length and specificity of the narrative varied among the incidents. When possible, the ME information was used to confirm that each incident met the requirements of our study, which were identified as a pedestrian age 65 or older who was struck by a motor vehicle in New Jersey while walking in a roadway or a nontraffic location, such as a parking lot or driveway. After reviewing the ME narratives, it was determined that 10 incidents did not qualify for the study, resulting in a final sample of 95. Additionally, the ME narrative data was used to better understand the reasons for pedestrian trips. Available incident descriptions were compared to determine if circumstances surrounding close-to-home incidents were unlike those that occurred further away.

The New Jersey death certificate was the source of information on decedent address as well as the location of the injury. These two locations were geocoded using ArcView 8.2 and the US Census 2000 TIGER street file for New Jersey. Seventy-seven of the incident addresses (81%), and 88 of the residential addresses (93%) were successfully matched during geocoding. Straight-line distances between each victim's residence and incident were calculated in miles using the Multiple Minimum Distance script (Chasan, R., 2003) for only those decedents whose residence and incident addresses were successfully geocoded (71 records or 75%).

Results

When compared with the overall elderly population of New Jersey, fatally injured older pedestrians are significantly more likely to be male, unmarried, and over age 75 years (Table 3). Mortality rates were positively correlated with age. Among 65-74 year olds, fatality rates were 3.1 per 100,000, but increased to 5.5 among those 75 and older (Table 4). No significant differences were observed by race or ethnicity.

Figure 1 illustrates the incident locations that were successfully geocoded (n=77). To examine the location of elderly pedestrian-motor vehicle fatalities in relation to residence, we measured the distance between decedent's home and incident location for all cases where both residence and incident addresses were available (n=71). It should be noted that this measurement reflects the straight-line distance between the two locations, and not the actual distance

traveled. Our findings strongly suggest that pedestrian fatalities involving older adults occurred most often in relatively close proximity to the decedent's home. In fact, 77% of these cases were struck within one mile of their residence (Figure 2).

Table 3. Demographics of fatally injured older pedestrians[a] compared to older population, New Jersey, 1999-2000

Demographic Characteristics	Older Pedestrian Fatalities		Older Adult Population
	n	%	%
Gender			
Male	57	60.0**	40.1
Female	38	40.0**	59.9
Race/Ethnicity			
White	79	83.2	81.8
Black	7	7.4	8.5
Hispanic	7	7.4	5.0
Other	2	2.1	4.7
Marital Status			
Never married	10	10.5*	5.9
Married	30	31.6**	52.3
Separated	N/A	N/A	1.3
Divorced	11	11.6*	5.9
Widowed	43	45.3*	34.6
Age			
65-74	36	37.9**	51.6
75-84	42	44.2	36.2
85+	17	17.9	12.2

*P<.05;**P<.001. Results are two tailed.
[a] n=95

Table 4. Older Pedestrian Deaths by Age, New Jersey, 1999-2000

Pedestrian Age	Rates[a] (*n*)
65-74	3.1 (36)
75+	5.5 (59)
Total	(95)

[a] Rate per 100,000

We considered whether population density affected the risk of fatal pedestrian incidents by comparing the distribution of the senior population by density of municipality with the distribution of accident locations. Pedestrian fatalities among older adults were disproportionately likely to occur in higher density municipalities (Figure 3). This relationship was statistically significant at p=.05. Of the 95 total fatalities, half occurred in four, densely populated counties near New York City: Bergen (16), Hudson (12), Essex (10), and Union (9). See Figure 4.

Figure 1. Geocoded locations of fatal older pedestrian incidents, New Jersey, 1999-2000, (n=77)

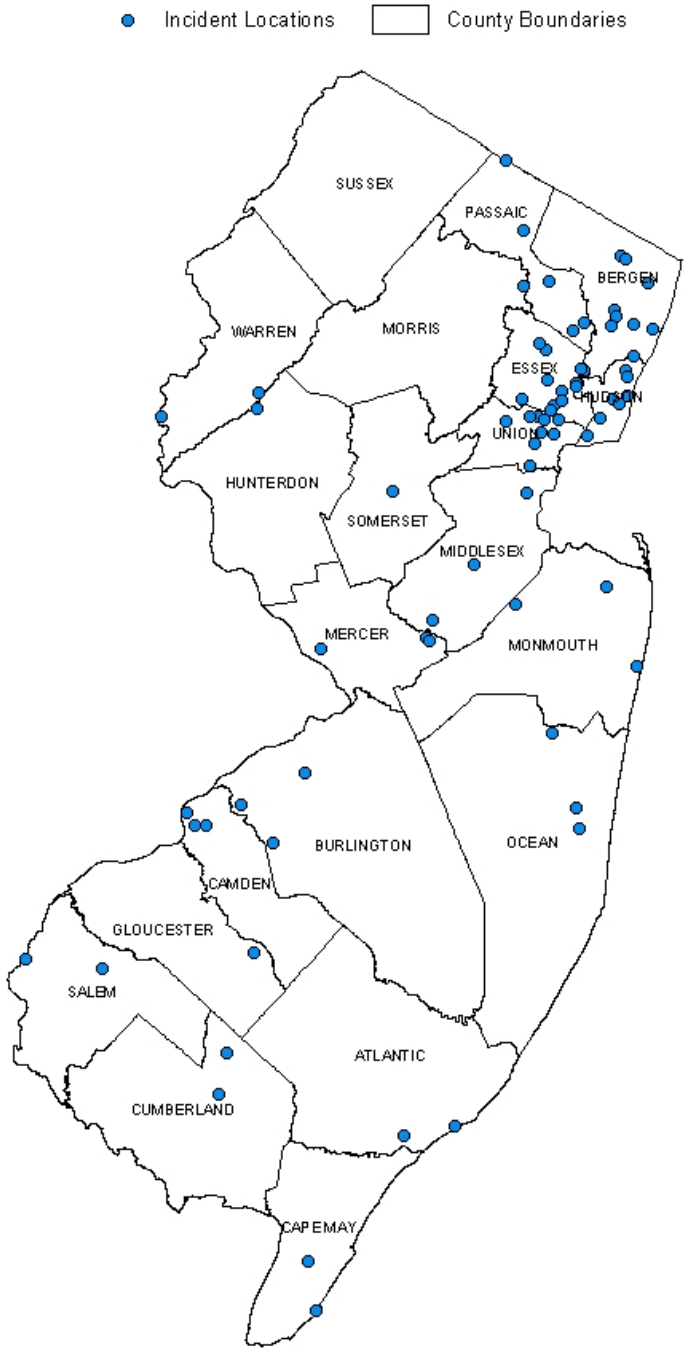


Figure 2. Older Pedestrian Fatalities, by Distance from Residence, New Jersey, 1999-2000, (n=71)

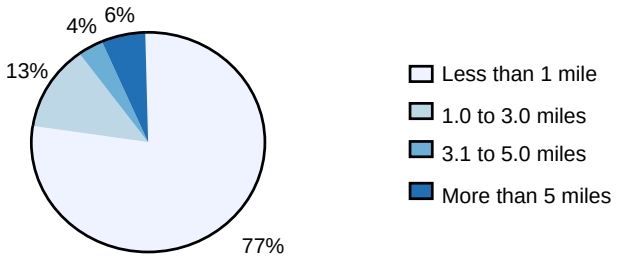
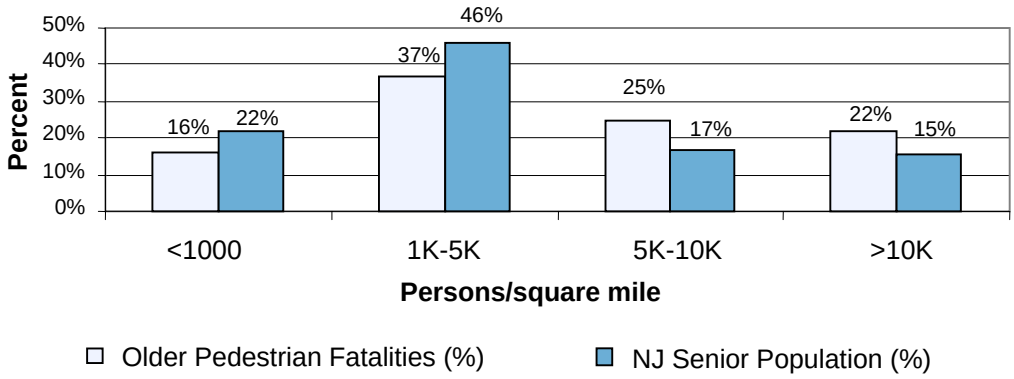


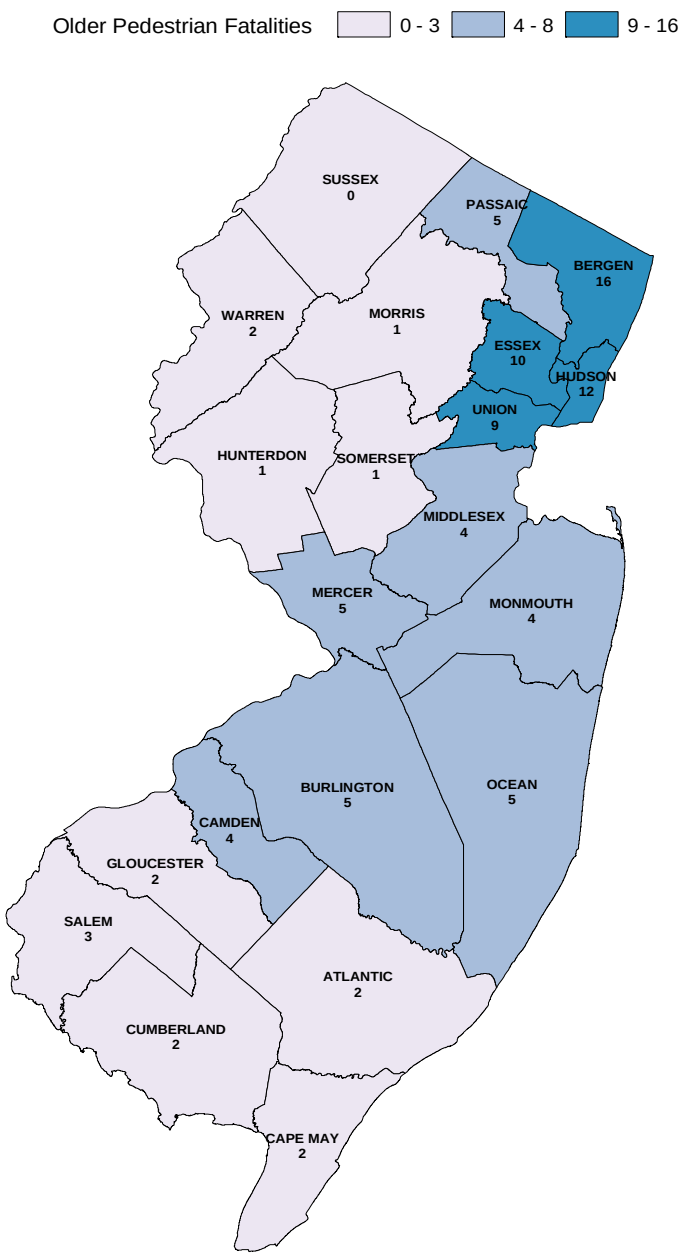
Figure 3. Pedestrian Fatalities and Senior Population, by Municipality Population Density, New Jersey, 1999-2000



Since a very high proportion of pedestrian fatalities involving seniors occur close to the victim's residence, this implies pedestrian fatalities are disproportionately likely to affect seniors residing in high-density municipalities. This may be because seniors in densely populated municipalities walk more than seniors in lower density areas, and therefore have more exposure to the risk of being struck by a motor vehicle. Alternatively, it may be the case that densely populated municipalities have traffic characteristics that put seniors at greater risk, or that seniors living in these municipalities have other characteristics which make them more vulnerable as pedestrians. In any case, it would appear that seniors living in high-density municipalities are at above average risk for pedestrian fatalities.

We also considered whether age distribution affected relative risk. Municipalities with relatively older populations may have enhanced safety features on roadways for the purpose of reducing elderly pedestrian injury. While the relationship between age distribution of municipalities and that of accident location was not statistically significant, senior pedestrian fatalities were slightly more likely to occur in “young” municipalities (i.e. < 10% of population above age 65 years), as compared with “old” municipalities (i.e. > 20% of population above age 65 years). However, since “younger” municipalities also tend to be the most densely populated, the effects of these two factors cannot be separated.

Figure 4. Older Pedestrian Fatalities by County of Occurrence, New Jersey, 1999-2000, (n=95)



We assessed whether risk of pedestrian injury was related to socioeconomic status, which we proxied using municipality median income. Although area-based SES measures have been found to be predictive of pedestrian injury risks for pediatric populations (Braddock et. al, 1991; Dougherty et al., 1990), municipality median income was not significant in the case of older adults.

We examined medical examiner data for alcohol-related pedestrian incidents. The use of alcohol was not reported among any of the pedestrian victims. However, it should be noted that results from autopsy reports, which indicate if alcohol was present in the decedent's blood, were not included in the medical examiner narratives, and consequently, not reviewed for this study.

Discussion

Age, Gender, and Marital Status

Nationally, pedestrian mortality rates are higher for older adults (65+) than for any other age group, and increase with age among older adults (U.S. Department of Transportation, 2002). In New Jersey, pedestrian fatality rates were lowest among persons in their late sixties, and highest among the oldest adults (85+). This finding supports previous studies, which have found increasing age to be one of the most significant factors associated with pedestrian mortality among the older population. Increased frailty, slower walking speeds, and increased reaction time put older adults at greater risk of pedestrian injury. Hearing and vision impairments may also increase older pedestrians' vulnerability, as these impairments do in younger pedestrians (Lundalv, J., 2004; Roberts & Norton, 1995).

Other risk factors include gender and martial status. Sixty percent of all older pedestrians fatally injured in New Jersey between 1999 and 2000 were male. This is slightly higher than the proportion of older men (70+) who died nationally in pedestrian incidents in 2002 (U.S. Department of Transportation, 2002). Unmarried older pedestrians are also at greater risk for being fatally injured by a motor vehicle. This is consistent with the overall findings on marital status and risk of traffic injury in younger adults. For example, one study involving adults aged 18-64, found that divorced, widowed, and never married persons are more likely to be fatally injured in any type of motor vehicle traffic or nontraffic incident than are married persons (Cubbin et. al., 2000).

Population Density

A positive association was found between older pedestrian mortality and municipality population density. Half of all older pedestrian incidents occurred in four, densely populated counties in northern New Jersey. Within these counties, 76% of the incidents occurred in dense (5,000-10,000 persons/sq. mile) or very dense (>10,000 persons/sq. mile) municipalities. This is consistent with findings of pediatric pedestrian incidents, in which population density has been identified as an important risk factor for injury (Lightstone, 2001; Joly, 1991). Since pedestrians are more common in urban cities and town centers, it is not surprising that these areas have higher rates of pedestrian-related injuries. Additionally, since the great majority of incidents occurred within a mile of the decedent's residence, this suggests that residents of high-density municipalities are at especially high risk. The relationship between density and severity of pedestrian injuries was not examined for this study, although they have been found to be negatively related in other studies (Zajac & Ivan, 2003).

Distance

It is not clear why pedestrian deaths among older adults are disproportionately likely to occur near the home. A review of incident descriptions from New Jersey Medical Examiner data revealed no systematic differences in circumstances of incidents occurring near and far from decedent's residence. Since many pedestrian trips would be expected to start near the home,

this may be the location of maximum exposure for all older adults. However, it is possible that high-risk older adults are even more likely to be in close proximity of their home when walking. This may be because they are more likely to be non-drivers, or because they cannot walk long distances. However, in the absence of data on pedestrian patterns of older adults, we can only speculate on this finding. It has been found that the frequency and duration of pedestrian trips has an effect on risk of injury (Hoxie et. al, 1994).

Conclusion and Prevention Implications

Our results suggest that unmarried men who are 75 years old or more are at increased risk of being fatally struck by a motor vehicle. The effect of marital status is consistent with a more generally found protective effect of marriage on health (Miniño et. al., 2002). Seniors living in high density municipalities were more likely to be fatally struck than were other seniors. More than three-quarters of decedents for whom data are available were struck within one mile of their home, suggesting that elderly adults are at risk as soon as they leave their home or as they are about to return. This also suggests that very short or routine trips, which are more commonly undertaken by older persons, may not be safe, especially for those who are frail or have limited physical abilities. When an older person admits to needing help with one or more activities of daily living, he or she is 10 times as likely to report difficulty crossing the street (Langlois et. al., 1997). Consequently, the effects of aging can increase the amount of time an older pedestrian is in the roadway as well as their exposure to vehicular traffic.

Despite its threat to pedestrian safety, walking undoubtedly provides numerous personal health benefits. For older adults, routine walking has been linked to improved physical performance, which can lower the risk of disability (Wong et. al., 2003). Aerobic activity has even been shown to provide selective benefits for cognition among sedentary older adults (Colcombe & Kramer, 2003). For older adults without significant health problems, walking can help them develop and maintain strength and dexterity, thereby reducing their risk of pedestrian injury. However, seniors with health conditions that can not be improved by walking may want to limit their risk of pedestrian injury by considering transportation alternatives, such as driving or utilizing delivery, taxi, or companionship services.

A frequently-cited reason for the increase in older pedestrian deaths in New Jersey and in the rest of the country is the growing number of persons aged 65 and older. The growth of the older adult population in the US has been increasing steadily throughout the last century, but will increase even more significantly over the next three decades as the baby-boomer generation ages. In New Jersey, the proportion of older adults is estimated to be 16% of the state population by 2020 (New Jersey Department of Labor, n.d.), which is similar to the projected percentage for the nation (U.S. Census Bureau, 2004). However, in certain New Jersey counties, such as Cape May and Ocean, the 65+ cohort is expected to exceed 25% of the total county resident population in 2020 (New Jersey Department of Labor, n.d.).

According to Healthy New Jersey 2010—a public health agenda for the state—reducing the motor vehicle traffic-related death rate among high risk groups, including persons 65 and older, is a fundamental objective for the New Jersey Department of Health & Senior Services (State of New Jersey, 2001). For the years 2000-2001, New Jersey's older pedestrian mortality rate was 4.3 per 100,000 population, which is already below the state's 2010 target death rate of 4.9 for this population group, but exceeds the preferred 2010 endpoint rate of 3.9. Among the state's older Black population, the 2000-2001 pedestrian mortality rate was 3.5 (U.S. Department of Health & Human Services, WISQARS™)—lower than both the state's 2010 target (4.9) and preferred (3.9) rates.

Educating older pedestrians about ways to improve their own roadway safety is an important public health objective. Despite research showing that older adults are more likely than younger adults to adopt cautious street crossing behavior (Harrell, W., 1991), others have reported a reduction in safe traffic judgment among the older population, especially on two-way undivided roads (Oxley et. al., 1997). The National Highway Transportation Safety Administration (NHTSA) developed a booklet, Stepping Out – Mature Adults Be Healthy, Walk Safely, to inform older adults of the health benefits of walking and to encourage them to adopt safe walking strategies (U.S. Department of Transportation, n.d.). In 1997, The Federal Highway Administration (FHWA) in conjunction with NHTSA developed the Pedestrian Safety Roadshow program, which was a 4-hour train-the-trainer workshop designed to "assist communities in developing their own approach to identifying and solving the problems that affect pedestrian safety and walkability" for citizens of all ages (U.S. Department of Transportation, Overview section, para. 1). During its nearly five-year existence, the Pedestrian Roadshow instructed over 300 people in various states, and continues to be modeled by other pedestrian advocacy groups (Leverson Boodlal, personal communication, September 25, 2003). Other transportation safety agencies have encouraged older pedestrians to take an active role in protecting themselves from motor vehicle collisions by stopping at the curb before stepping into a roadway, allowing ample time to check for oncoming and turning vehicles so that proper street crossing decisions can be made, and making eye contact with drivers, if possible (Loyola Univ. Health System of Chicago, n.d.).

The New Jersey Division of Highway Traffic Safety (NJDHTS) and the Bergen County Office of Highway Safety implemented the 'Walk Safely Seniors' program in 2002 (Robert Gaydosh, personal communication, October 30, 2003). This program consisted of self-contained kits, which included brochures, a video, talking points, and small give-away items, that were designed so that any layperson could present a pedestrian safety educational program to an older adult audience. Initially, the kits were distributed to 75 local police departments in Bergen County, NJ. Following this implementation phase, NJDHTS distributed an additional 400 kits to other local police stations and senior citizens centers in all of New Jersey's remaining counties. Also in New Jersey, several counties, including Ocean and Camden, have implemented the Older Adult Traffic Safety (OATS) program, which offers pedestrian safety education information and other transportation-related services, seminars, and assistance to its older citizens (Robert Gaydosh, personal communication, October 30, 2003).

Understandably, older pedestrians should not be the only ones responsible for their safety. Government and private agencies must also take responsibility for improving the accessibility of roadways and pedestrian walkways for older users. In 2001, the FHWA published "Guidelines and Recommendations to Accommodate Older Drivers and Pedestrians" to aid highway designers and engineers in developing roadway features that are sensitive to the needs and functioning levels of older motorists and pedestrians (Staplin et. al., 2001). The Insurance Institute for Highway Safety recently reviewed the effectiveness of numerous roadway and pedestrian safety improvements designed to manage vehicle speed, separate pedestrians and vehicles by time and space, and increase visibility of pedestrians (Retting et. al., 2003). This review identifies a study by Koepsell et. al. (2002), who found that crosswalk markings may increase the risk of pedestrian injury for persons aged 65 or older in locations where traffic signals are not used to stop motor vehicles.

In New Jersey, the Department of Transportation (NJDOT) began conducting the 2003 Senior Safety study, which was prompted by the rise in the older adult population and the increased rate of fatal and non-fatal injuries among this age group (Kathy Diringer, personal

correspondence, November 3, 2003). The goal of the NJDOT study is to assess the need for highway improvements, and propose new transportation policy initiatives and strategies that will help accommodate the special needs of older adults, while improving the overall level of highway safety. NJDOT officials expect the selected strategies will include a combination of improvements in engineering, design, operations, and motorist communication and education. At present, the first two phases of the study are complete: 1) needs-assessment and 2) review and amendment of existing policies and practices. The third and final phase—devising an implementation program—is currently underway and involves a statewide pilot project of three intersection improvements.

Other state and county governments have established progressive task forces that are responsible for devising regional or statewide transportation guidelines that will protect the lives of older adults. In 2002, the California Task Force on Older Adults and Traffic Safety released a formal report of recommendations for reducing traffic related mortality and injury as part of a statewide effort (Yanochko, P., 2002). Local governments in southeastern Michigan (Bruff & Evans, 1999) and the greater Phoenix, AZ area (Maricopa Association of Governments, n.d.) have also assembled task forces to identify the transit and mobility needs of older adults and propose regional strategies to guide state policy.

Government agencies are also addressing language barriers that may prevent those with limited English proficiency from understanding pedestrian safety information. The NHTSA's Multicultural Outreach program develops motor vehicle and pedestrian projects and publications for diverse audiences (National Highway Traffic Safety Administration, n.d.). In recent years, multicultural highway traffic safety education programs have been designed at the state (National Highway Traffic Safety Administration, 2001) and local levels (Montgomery County, MD, 2002; San Francisco Department of Public Health, 2002). Despite the increased awareness in the U.S. that multilingual traffic safety programs would prevent a larger number of injuries and fatalities than English-only instruction, it remains difficult to locate motor vehicle and pedestrian safety education materials in a variety of languages.

Historically, young children have been the primary target audience for pedestrian safety education. However, older adults are another special population group who are at high risk—particularly for fatal injury. A more concerted effort among government and private agencies is needed to increase the frequency with which older pedestrian education programs are delivered, and to determine more effective means of communicating pedestrian safety messages to an increasingly diverse senior population.

Limitations of the Study

The authors acknowledge several limitations regarding the present study. First, our study's small sample size may have confounded any statistically significant findings by overstating a difference that is not true, or by not detecting a true difference. Moreover, the effects of a small sample size may be greater with regard to our distance finding, since the number of records included in the distance calculations was reduced by 25% due to unmatched or missing home and/or incident addresses. Also, the accuracy of the distance calculation between the geocoded addresses of the pedestrian's home and accident location may be compromised due to the deficiencies in the Census TIGER file. If the TIGER file contains street lines that do not reflect the exact layout of the road, the geocoding accuracy of any address to these roads can be reduced (Ratcliffe, J., 2001). Consequently, any measurements taken that involve such points may be exaggerated or understated.

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