Close or Far from Home? An Investigation on Location of Older Pedestrian Crashes

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Introduction

- Walking campaigns will not be successful if pedestrians do not perceive the roadway network to be safe for walking, they might decide to use other modes of transportation

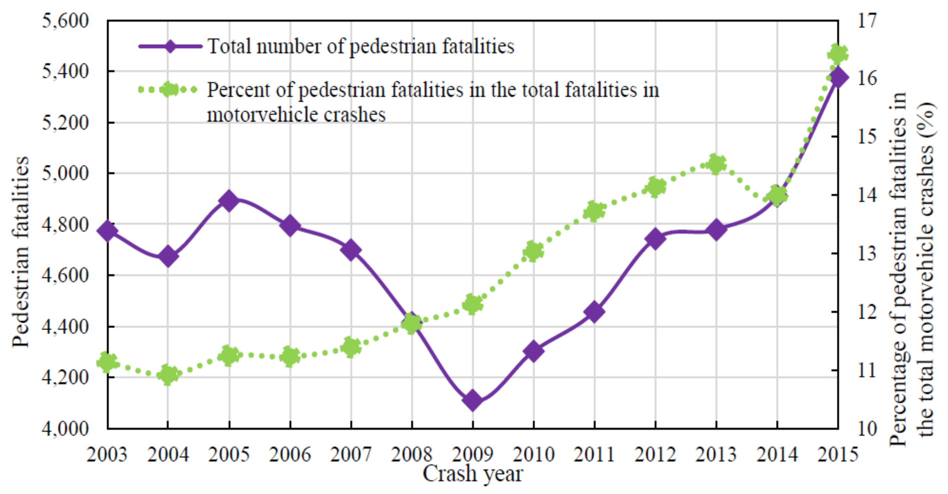

Figure 1: Pedestrian fatalities due to traffic crashes in the U.S., 2003-2015 Source;(NHTSA)

- The 2014 U.S. data indicated that 20% of all pedestrian fatalities and 11% of injured pedestrians were 65 years and older (NHTSA, 2014)
- 65+ olds walk shorter distances than younger pedestrians, yet being overrepresented in fatalities
- Life expectancy in the US rose in the year 2012 to a record high of 78.8 years (USA Today, October 9, 2014)
- In 2011, none of the Florida's county had an aging population of more than 36% but in year 2030, it is projected that the population of 65+ would be higher than 36% in four Florida counties (Ortman, J.M. and Velkoff, V.A. ,2014)
- Literature on the influence of the distance between crash occurrence locations and pedestrians' residences is scarce
- Objective is to investigate the proximity of crash locations to older pedestrians' residences and its relationship with socioeconomic attributes

Figure 2: Older pedestrians using the roadway

- Findings will assist state and local safety officials in developing appropriate intervention and prevention programs for various roadway conditions in order to improve safety and enhance mobility for aging road users

Methodology

Data Description

- 1068 crashes involving 65+ old pedestrians from year 2008 to 2013 (The State of Florida)
- Residential addresses from Police reports
- Socio-economic data from GIS shapefiles

Data preparation

- Estimating distance between crash locations and residential addresses
- Shortest path distances estimated using the Google map API services integrated in GIS
- Distances estimated considering walking and driving as modes of travel
- Associating crash locations, residential addresses to socio-economic characteristics

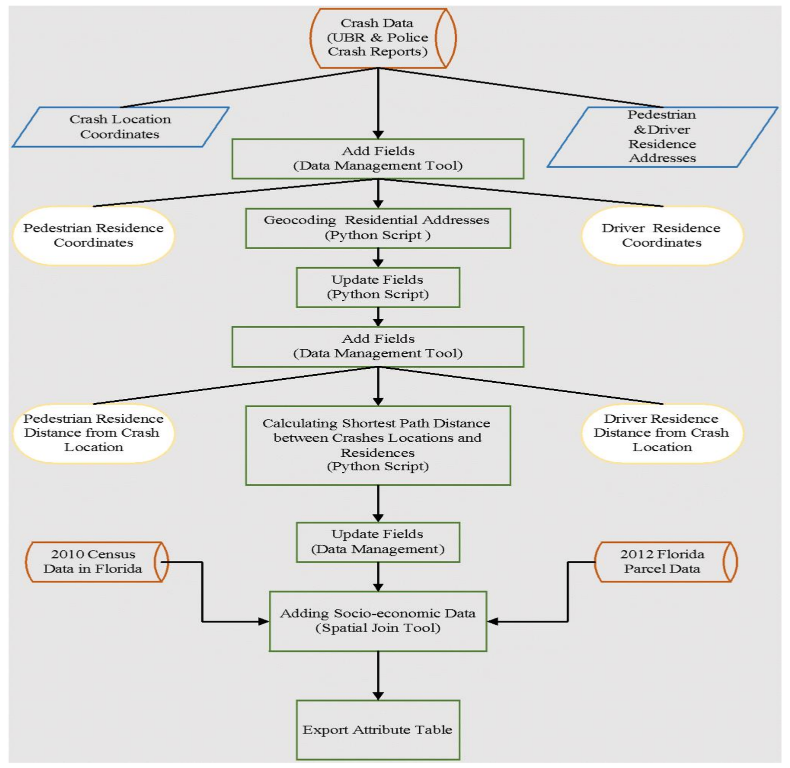

Figure 3: GIS model flowchart

Data analysis

- Generalized linear mixed model

$$S_{ij} = \beta_o + \beta X_{ij} + \varepsilon_{ij} + \eta_j$$

$$P_{ij} = \frac{exp(\beta_o + \beta X_{ij} + \varepsilon_{ij} + \eta_j)}{1+[exp(\beta_o + \beta X_{ij} + \varepsilon_{ij} + \eta_j)]}$$

S_{ij}: Logit function for the outcome of a crash involving pedestrian *i* at crash location *j*
β: Vector of coefficient estimates
β_o:Constant term
X_{ij}: Vector of variables affecting proximity
η_j : Random term
ε_{ij} :An IID error term

Results

Descriptive statistics

- 50% of crashes occur more than 2 miles of pedestrians residences in Orlando-Kissimmee (Figure 5)

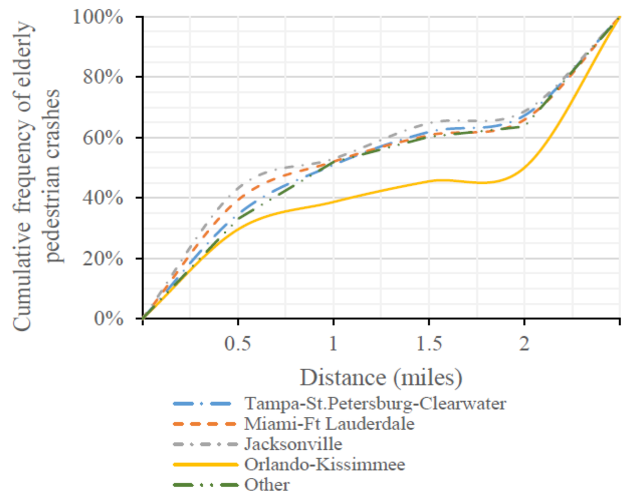

Figure 4: Distribution of 65+ pedestrian crashes according to the proximity to pedestrians' residences in Florida metropolitan areas

GLMM results

Variable	Category	D = 0.5 mile		D = 1 mile		D= 1.5 mile		D = 2 miles	
		Coef.	Pval.	Coef.	Pval.	Coef.	Pval.	Coef.	Pval.
Constant		-0.640	0.276	-0.020	0.972	-0.041	0.943	-0.271	0.646
Pedestrian and driver attributes									
Pedestrian age(years)	76 - 85	-0.306	0.057	-0.587	0.000	-0.574	0.000	-0.623	0.000
Pedestrian gender	Male	0.254	0.116	0.312	0.045	0.242	0.129	0.269	0.102
Pedestrian injury severity	Fatal	-0.266	0.174	-0.112	0.550	-0.173	0.371	-0.234	0.243
Driver proximity(miles)	Above 2	0.366	0.032	0.159	0.343	0.382	0.029	0.439	0.017
Socioeconomic attributes									
PR[1] population	Continuous	0.098	0.177	0.189	0.007	0.151	0.021	0.209	0.003
PR[1] property value(USD)	Above 100,000	-0.203	0.216	-0.290	0.064	-0.156	0.329	-0.194	0.238
PR[1] population density(pop/acres)	6-10	-0.006	0.978	-0.154	0.495	-0.199	0.377	-0.112	0.625
PR[1] population density(pop/acres)	Above 10	0.117	0.665	0.017	0.951	-0.101	0.712	-0.038	0.887
PR[1] median household income(USD)	Above 50,000	0.519	0.006	0.485	0.005	0.489	0.005	0.443	0.013
CA[2] land-use	Other	0.175	0.286	0.05	0.732	-0.032	0.845	-0.126	0.448
PR[1] elderly population(%)	Above 50%	0.812	0.034	0.717	0.033	0.537	0.106	0.691	0.040
Roadway attributes									
Crash location	Not Intersection	0.161	0.332	-0.032	0.841	-0.066	0.685	0.055	0.744
Average daily traffic	Continuous	0.226	0.000	0.164	0.000	0.135	0.003	0.134	0.003
Environmental attributes									
Season	Summer/Fall	0.283	0.084	0.187	0.240	0.141	0.389	0.139	0.411
Weather condition	Other	0.098	0.616	0.049	0.793	0.129	0.494	0.186	0.337
Crash day	Weekend	-0.173	0.364	-0.224	0.229	-0.280	0.146	-0.148	0.453
Traffic condition	Peak	-0.047	0.770	-0.090	0.562	-0.246	0.119	-0.251	0.124
$R^2_{GLMM(m)}$		0.11		0.11		0.11		0.13	
$R^2_{GLMM(c)}$		0.13		0.12		0.12		0.14	

Figure 5: GLMM model results

Pedestrian Age

- 76+ olds are involved in crashes closer to residences than 65 to 75 years elderly pedestrians

Gender

- Male elderly pedestrians have higher likelihood being in crashes closer to their residences

Drivers' residence proximity

- Drivers who live far from crash locations involved in crashes with pedestrians who live close to crash locations

Traffic volume

- Residences close to high traffic volume roadways are more involved pedestrian crashes
- Vehicles moving at high speeds

Results

Census track population

- High populated areas have pedestrian crashes occurring close to pedestrians residences
- Pedestrian-vehicle conflicts are more likely close to home because of being an origin and destination for many vehicle and pedestrian trips

Residence value

- Higher residential property values areas have fewer pedestrian crashes close to home
- Environment not comfortable for older pedestrians activities e.g. Commercialized localities

Pedestrian income

- Pedestrians from locations with high household median income have higher likelihood of pedestrian crashes occurring close to residences
- 52% and 37% walking trips longer than 0.5 miles for groups with lowest and highest household income respectively (Yang, 2012)

Elderly population

- Elderly population greater than 50% increase likelihood of pedestrian crashes occurring close to residences

Seasons of the year

- Pedestrian crashes are more likely to occur close to pedestrians' residences in summer and fall compared to spring

Conclusions

- The study adds knowledge to be used in improving safety of aged population in the transportation network
- 64% of crashes occurred within 2 miles of pedestrians' residences
- Many factors affect the location of pedestrian crashes in relation to pedestrians residences e.g. age, driver proximity, population, income

Recommendations

- Limitation in differentiating crashes that a pedestrian walked from home to those involving an individual driving before walking near the crash location
- Study did not analyze hit and run crashes due to lack of drivers' addresses
- Further research involving other age cohorts
- Research to associate aging pedestrian crashes with type residence such as own versus rent or private property versus senior living facilities