



Project Title:
**Crash Risk for Low-Income and Minority Populations:
An Examination of At-risk Population Segments and
Underlying Risk Factors**

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Problem Statement and Project Focus

- Lower-income and minority populations are consistently found to be at a higher risk of being injured or killed in a traffic accident while walking or biking.
- Often treated as a single population regardless of age, gender, or trip purpose
- Community's underlying social and demographic characteristics are certainly important factors in understanding the disproportionate risk of pedestrian and bicycle crashes in low-income neighborhoods.
- Is the relative risk of being involved in a traffic accident similar for all age and gender cohorts within each of these at-risk subpopulations?
- While we know that crashes disproportionately occur in low-income and minority neighborhoods, we cannot simply assume that crashes exclusively involve persons residing in these neighborhoods.
- It is reasonable to expect that pedestrians or bicyclists involved in these collisions reside in nearby areas. Are the motorists who collide with these pedestrians also local residents? Are some of these collisions attributable to commuting patterns?

Key Project Goals and Objectives

- Identify at-risk subpopulations within the target population defined as “minority” or “lower-income”
 - Are the relative risk ratios for children, young adults, adults and the elderly similar across various age and gender groups?
 - Are these risk ratios comparable to those in more affluent neighborhoods for the same age/gender cohorts?
 - Are there any differences in terms of time-of-day or day of the week?
 - Are drugs and alcohol a major contributing factor in pedestrian or bicycle crashes?
- Understand the commuting patterns and other risk factors associated with adverse safety outcomes in lower-income and minority neighborhoods

Data Sources and Data Processing

- The study uses three years (2015 – 2017) of crash data on pedestrian and bicycle crashes for Broward, Palm Beach and Miami-Dade counties obtained from the Florida State Safety Office
- These data provide information about the non-motorist age, gender, injury severity, and drug and alcohol use.
- Data on crash time or crash location was extracted from the Signal Four Analytics web portal maintained by the Geoplan Center of the University of Florida.
- Based on crash locations, pedestrian-vehicle and bicyclist-vehicle collisions were mapped to low-income and high-income block groups.
- Issues:
 - Information on race was not available
 - Missing information on demographic characteristics

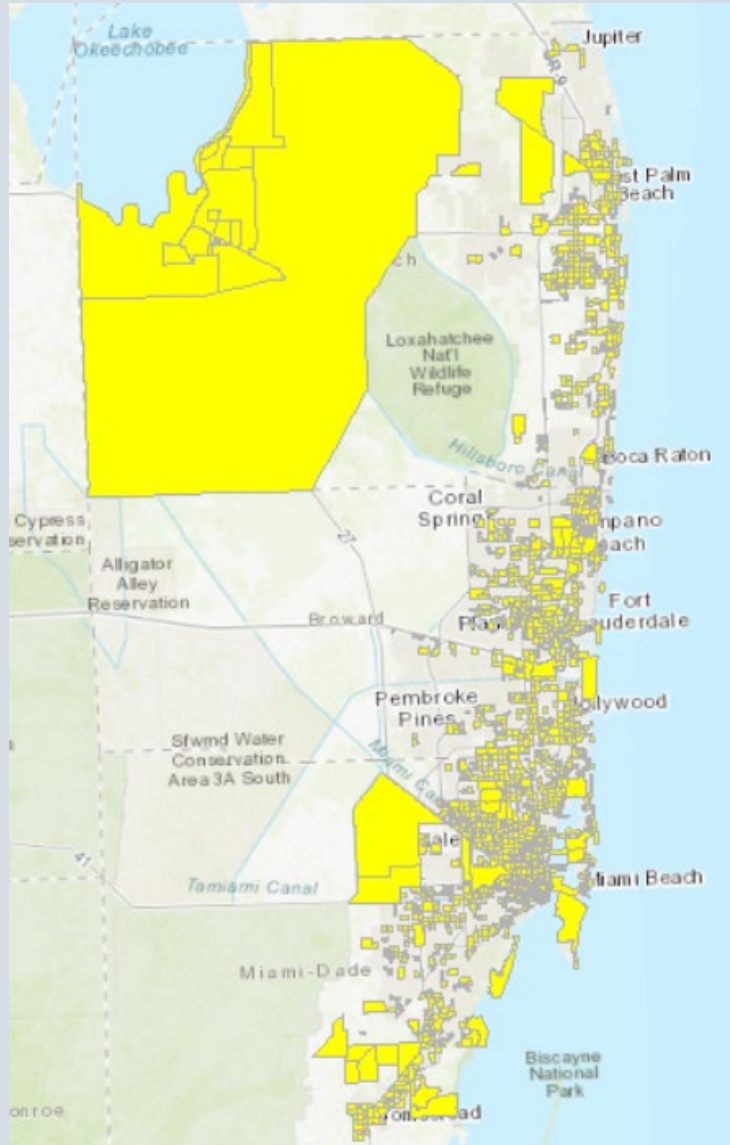
Defining “Lower-Income” and “Higher-Income” BGs

- 2017 ACS block group level data
- Lower-income communities
 - poverty rates of greater than 15% or
 - median household income of less than 50% of the *area median income* (AMI) for a family of 4
 - We used the 2018 income and rent limits defined by the Florida Housing and Finance Corporation (FHFC) for the State Housing Initiatives Partnership (SHIP) Program as the baseline
- Higher-income communities defined as those with
 - median household income greater than 120% AMI for a family of four

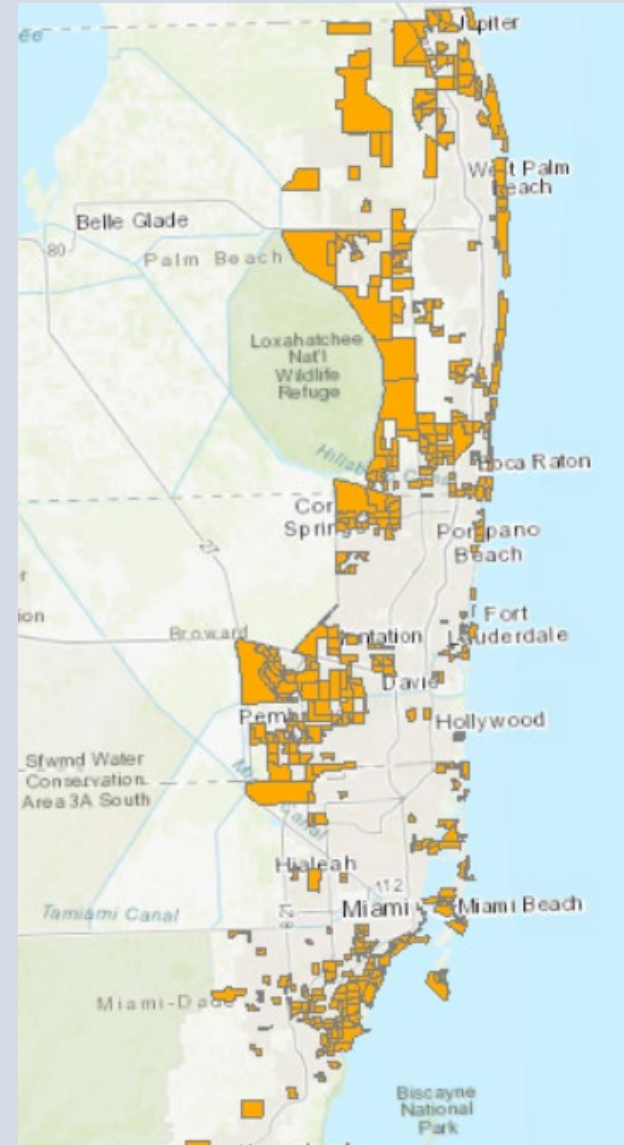
Criteria	County		
	Broward	Palm Beach	Miami-Dade
Median income	\$65,700	\$74,300	\$52,300
50% AMI limits for a family of 4 ^a	\$40,400	\$38,450	\$39,350
120% AMI limits for a family of 4 ^a	\$96,960	\$92,280	\$94,440
Number of block groups with a poverty rate greater than 15%	362	273	816
Number of block groups with a poverty rate greater than 15% and/or HH income less than 50% AMI	434	342	905

Comparative Risk: Low-income vs. High-income Block Groups

Low-income Block Groups: Percent population below the poverty level > 15% and/or median household income < the 50% limit for a family of four as defined by the FL Housing and Finance Corporation for Broward and Palm Beach counties



High-income Block Groups: Median household income > the 120% limit for a family of four as defined by the FL Housing and Finance Corporation for Broward and Palm Beach counties



Data Summary

Crash Type	Description	Low-Income Block Groups	High-Income Block Groups
Pedestrians	Number of crashes	5,757	701
	Number of pedestrians involved	6,157	753
	Number of pedestrian fatalities	367	36
	Number of pedestrian injuries ^a	3,116	407
	Number killed or severely-injured	3,483	443
Bicyclists	Number of crashes	4,131	694
	Number of bicyclists involved	4,174	708
	Number of bicyclist fatalities	72	14
	Number of bicyclist injuries ^a	1,888	337
	Number killed or severely-injured	1,960	351

^a Injuries = Incapacitating + Non-incapacitating injuries

Relative Risk Ratios

- Relative risk ratios for age and gender cohorts
 - the number of per capita pedestrian or bicyclist collisions in lower income block groups, divided by the per capita rate of such collisions in the block groups classified as being higher income.
- Relative risk ratios (RRRs) determine the extent to which pedestrians and bicyclists in lower-income areas may be at disproportionate risk, when compared against similar cohorts in more affluent areas.
- RRRs were examined in terms of
 - total number of pedestrian-vehicle and bicyclist-vehicle collisions
 - KSI (killed or severely injured) collisions involving pedestrians and bicyclists
 - the incidence of such crashes affecting specific cohorts, stratified by age and gender

Relative Risk Ratios: Pedestrians

	Total		KSI	
	50 AMI	120 AMI	50 AMI	120 AMI
Pedestrians	50 AMI	120 AMI	50 AMI	120 AMI
Pedestrian Collisions per Year	2052	251	653	117
Population (000s)	2,868	785	2,868	785
Rate per 1,000 Population	0.715	0.320	0.228	0.149
Relative Risk	2.237	0.447	2.148	0.466

	All Crashes			KSI		
	Male	Female	Total	Male	Female	Total
Pedestrians						
14 and Under	2.678	2.833	2.748	2.517	2.881	2.669
15-19	2.283	2.154	2.236	2.241	2.524	2.375
20-24	0.915	2.281	1.225	1.084	3.147	1.470
25-34	1.036	1.461	1.180	0.908	1.181	0.993
35-44	1.686	2.485	1.977	1.606	2.410	1.875
45-54	2.121	2.483	2.208	2.161	1.916	2.033
55-64	2.886	1.808	2.293	2.223	1.569	1.847
65-69	2.838	2.517	2.659	1.853	2.209	1.965
70 and Older	2.920	2.085	2.438	2.671	2.289	2.434
Total	1.956	2.132	2.237	1.778	1.992	2.148

Relative Risk Ratios: Bicyclists

	Total		KSI	
	50 AMI	120 AMI	50 AMI	120 AMI
Bicyclists				
Bicycle Collision per Year	1,391	236	653	117
Population (000s)	2,868	785	2,868	785
Rate per 1,000 Population	0.485	0.301	0.228	0.149
Relative Risk	1.613	0.620	1.528	0.654

Age Cohorts	All Crashes			KSI		
	Male	Female	Total	Male	Female	Total
Bicycle						
14 and Under	1.212	1.514	1.248	1.103	1.499	1.154
15-19	0.957	0.526	0.849	1.532	1.212	1.462
20-24	1.311	0.985	1.228	2.242	1.494	2.046
25-34	1.806	1.316	1.695	1.266	0.743	1.106
35-44	1.701	0.805	1.464	1.261	0.494	1.074
45-54	2.428	0.859	1.922	1.804	1.002	1.629
55-64	2.128	1.243	1.840	1.840	1.783	1.724
65-69	1.082	0.649	0.901	1.171	0.227	0.851
70 and Older	0.826	1.478	0.878	0.718	0.608	0.634
Total	1.572	0.998	1.613	1.466	0.968	1.528

Pedestrians involved in crashes in low-income areas by Age and Time-of-Day

Age Group	Time of Day								Total	Pct.
	Midnight to 3 am	3 am to 6 am	6 am to 9 am	9 am to noon	Noon to 3 pm	3 pm to 6 pm	6 pm to 9 pm	9 pm to midnight		
14 and under	5	1	51	23	48	97	89	14	328	8.30%
15-19	15	7	51	18	39	62	47	37	276	6.90%
20-24	25	21	29	31	43	54	60	41	304	7.70%
25-34	63	44	64	61	81	83	129	88	613	15.50%
35-44	28	22	51	58	75	81	104	70	489	12.30%
45-54	27	20	67	85	99	108	133	77	616	15.50%
55-64	21	17	59	81	103	113	155	75	624	15.70%
65-69	4	4	26	39	38	46	33	13	203	5.10%
70 and older	2	9	64	141	97	71	103	26	513	12.90%
Total	190	145	462	537	623	715	853	441	3966	
Pct.	4.80%	3.70%	11.70%	13.50%	15.70%	18.00%	21.50%	11.10%		
Unknown	93	76	278	268	302	393	477	304	2191	35.59%
Total	283	221	740	805	925	1108	1330	745	6157	
Pct.	4.60%	3.59%	12.02%	13.07%	15.02%	18.00%	21.60%	12.10%	100.00%	

Pedestrians Killed or Seriously Injured by Age and Time-of-Day

Age Group	Time of Day								Total	Pct.
	Midnight to 3 am	3 am to 6 am	6 am to 9 am	9 am to noon	Noon to 3 pm	3 pm to 6 pm	6 pm to 9 pm	9 pm to midnight		
14 and under	3	1	23	10	28	46	47	11	169	5.1%
15-19	10	4	26	7	18	34	24	30	153	4.6%
20-24	17	17	11	17	23	32	36	30	183	5.5%
25-34	44	31	35	23	43	33	64	53	326	9.8%
35-44	18	9	26	19	35	41	64	40	252	7.6%
45-54	16	10	35	40	48	50	77	41	317	9.5%
55-64	13	12	31	45	48	53	92	43	337	10.1%
65-69	3	4	13	21	15	24	17	7	104	3.1%
70 and older	1	6	39	86	43	45	72	15	307	9.2%
Total	185	145	370	399	438	539	778	468	3322	100.0%
Pct.	5.6%	4.4%	11.1%	12.0%	13.2%	16.2%	23.4%	14.1%	100.0%	

Pedestrians 14 and Under involved in Crashes in Low-Income Areas by Time-of-Day and Day-of-Week

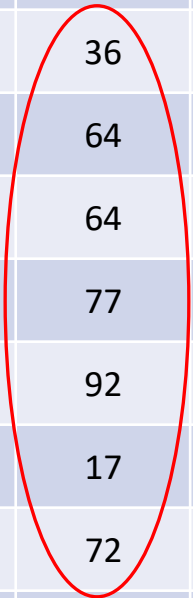
	Time of Day								Total	Pct.
	Midnight to 3 am	3 am to 6 am	6 am to 9 am	9 am to noon	Noon to 3 pm	3 pm to 6 pm	6 pm to 9 pm	9 pm to midnight		
Monday	0	1	1	0	7	10	6	3	28	8.5%
Tuesday	0	0	3	6	2	15	12	3	41	12.5%
Wednesday	2	0	14	5	4	7	12	2	46	14.0%
Thursday	0	0	13	3	12	14	12	0	54	16.5%
Friday	0	0	11	1	8	20	16	1	57	17.4%
Saturday	0	0	8	2	7	20	17	3	57	17.4%
Sunday	3	0	1	6	8	11	14	2	45	13.7%
Total	5	1	51	23	48	97	89	14	328	100.0%
Pct.	1.5%	0.3%	15.5%	7.0%	14.6%	29.6%	27.1%	4.3%	100.0%	

Pedestrians 14 and Under involved in Crashes in Low-Income Areas by Gender and Time-of-Day

Time of Day	Male	Female	Total	Pct.
Midnight to 3 am	4	1	5	1.5%
3 am to 6 am	0	1	1	0.3%
6 am to 9 am	31	20	51	15.5%
9 am to noon	13	10	23	7.0%
Noon to 3 pm	26	21	48	14.6%
3 pm to 6 pm	57	39	97	29.6%
6 pm to 9 pm	56	33	89	27.1%
9 pm to midnight	8	6	14	4.3%
Total	195	131	328	100.0%
Pct.	59.5%	39.9%	100.0%	

Pedestrians Killed or Severely-Injured: 6 pm to 9 pm

Age Group	Time of Day								Total	Pct.
	Midnight to 3 am	3 am to 6 am	6 am to 9 am	9 am to noon	Noon to 3 pm	3 pm to 6 pm	6 pm to 9 pm	9 pm to midnight		
14 and under	3	1	23	10	28	46	47	11	169	5.1%
15-19	10	4	26	7	18	34	24	30	153	4.6%
20-24	17	17	11	17	23	32	36	30	183	5.5%
25-34	44	31	35	23	43	33	64	53	326	9.8%
35-44	18	9	26	19	35	41	64	40	252	7.6%
45-54	16	10	35	40	48	50	77	41	317	9.5%
55-64	13	12	31	45	48	53	92	43	337	10.1%
65-69	3	4	13	21	15	24	17	7	104	3.1%
70 and older	1	6	39	86	43	45	72	15	307	9.2%
Total	185	145	370	399	438	539	778	468	3322	100.0%
Pct.	5.6%	4.4%	11.1%	12.0%	13.2%	16.2%	23.4%	14.1%	100.0%	



Older Adults Killed or Severely-Injured: Midday and Early Evening

Age Group	Time of Day								Total	Pct.
	Midnight to 3 am	3 am to 6 am	6 am to 9 am	9 am to noon	Noon to 3 pm	3 pm to 6 pm	6 pm to 9 pm	9 pm to midnight		
14 and under	3	1	23	10	28	46	47	11	169	5.1%
15-19	10	4	26	7	18	34	24	30	153	4.6%
20-24	17	17	11	17	23	32	36	30	183	5.5%
25-34	44	31	35	23	43	33	64	53	326	9.8%
35-44	18	9	26	19	35	41	64	40	252	7.6%
45-54	16	10	35	40	48	50	77	41	317	9.5%
55-64	13	12	31	45	48	53	92	43	337	10.1%
65-69	3	4	13	21	15	24	17	7	104	3.1%
70 and older	1	6	39	86	43	45	72	15	307	9.2%
Total	185	145	370	399	438	539	778	468	3322	100.0%
Pct.	5.6%	4.4%	11.1%	12.0%	13.2%	16.2%	23.4%	14.1%	100.0%	

Pedestrians Killed or Severely-Injured, Age 25 - 34

Age Group	Time of Day								Total	Pct.
	Midnight to 3 am	3 am to 6 am	6 am to 9 am	9 am to noon	Noon to 3 pm	3 pm to 6 pm	6 pm to 9 pm	9 pm to midnight		
14 and under	3	1	23	10	28	46	47	11	169	5.1%
15-19	10	4	26	7	18	34	24	30	153	4.6%
20-24	17	17	11	17	23	32	36	30	183	5.5%
25-34	44	31	35	23	43	33	64	53	326	9.8%
35-44	18	9	26	19	35	41	64	40	252	7.6%
45-54	16	10	35	40	48	50	77	41	317	9.5%
55-64	13	12	31	45	48	53	92	43	337	10.1%
65-69	3	4	13	21	15	24	17	7	104	3.1%
70 and older	1	6	39	86	43	45	72	15	307	9.2%
Total	185	145	370	399	438	539	778	468	3322	100.0%
Pct.	5.6%	4.4%	11.1%	12.0%	13.2%	16.2%	23.4%	14.1%	100.0%	

Pedestrians involved in Crashes, Age 25 – 34, by Gender

Time of Day	Male	Female	Total	Pct.
Midnight to 3 am	46	17	63	10.3%
3 am to 6 am	36	8	44	7.2%
6 am to 9 am	33	31	64	10.4%
9 am to noon	35	26	61	10.0%
Noon to 3 pm	39	41	81	13.2%
3 pm to 6 pm	46	37	83	13.5%
6 pm to 9 pm	62	67	129	21.0%
9 pm to midnight	60	28	88	14.4%
Total	357	255	613	100.0%
Pct.	58.2%	41.6%	100.0%	

Pedestrians Involved in Crashes, Suspected Drug and Alcohol Use by Age and Time-of-Day

Age Group	Time of Day								Total	Pct.
	Midnight to 3 am	3 am to 6 am	6 am to 9 am	9 am to noon	Noon to 3 pm	3 pm to 6 pm	6 pm to 9 pm	9 pm to midnight		
15-19	4	0	0	0	0	0	0	3	7	2.1%
20-24	5	5	1	1	0	0	3	5	20	5.9%
25-34	14	9	4	0	1	0	5	10	43	12.6%
35-44	2	4	2	3	2	3	8	9	33	9.7%
45-54	4	1	2	3	4	4	10	13	41	12.0%
55-64	4	3	0	2	4	5	7	16	41	12.0%
65-69	0	0	1	0	0	1	3	2	7	2.1%
70 and older	1	0	1	1	0	1	7	3	14	4.1%
Total	47	32	18	13	19	22	80	110	341	100.0%
Pct.	13.8%	9.4%	5.3%	3.8%	5.6%	6.5%	23.5%	32.3%	100.0%	

Bicyclists Involved in a Collision in Lower-Income Areas, by Age and Time-of-Day

Age Group	Time of Day								Total	Pct.
	Midnight to 3 am	3 am to 6 am	6 am to 9 am	9 am to noon	Noon to 3 pm	3 pm to 6 pm	6 pm to 9 pm	9 pm to midnight		
14 and under	1	0	14	17	17	65	38	2	154	6.3%
15-19	6	0	21	22	45	77	55	14	240	9.9%
20-24	9	3	29	33	47	71	47	22	261	10.8%
25-34	14	12	48	50	83	96	96	52	451	18.6%
35-44	7	8	63	44	54	77	69	23	345	14.2%
45-54	7	12	62	49	57	109	76	26	398	16.4%
55-64	15	6	47	68	75	91	73	24	399	16.4%
65-69	2	1	10	15	18	22	12	5	85	3.5%
70 and older	2	2	17	27	12	20	10	3	93	3.8%
Total	63	44	311	325	408	628	476	171	2426	100.0%
Pct.	2.6%	1.8%	12.8%	13.4%	16.8%	25.9%	19.6%	7.0%	100.0%	

Bicyclists Killed or Seriously Injured in Lower-Income Areas, by Time-of-Day and Age

Age Group	Time of Day								Total	Pct.
	Midnight to 3 am	3 am to 6 am	6 am to 9 am	9 am to noon	Noon to 3 pm	3 pm to 6 pm	6 pm to 9 pm	9 pm to midnight		
14 and under	1	0	12	11	16	58	34	0	132	6.6%
15-19	5	0	17	22	35	70	50	14	213	10.6%
20-24	8	3	27	29	39	59	42	17	224	11.1%
25-34	11	11	39	41	67	75	76	45	365	18.1%
35-44	6	7	49	35	49	57	59	18	280	13.9%
45-54	5	10	49	44	43	84	66	20	321	15.9%
55-64	12	5	42	57	55	73	65	16	325	16.1%
65-69	2	1	9	12	15	20	10	5	74	3.7%
70 and older	2	2	17	22	10	15	8	3	79	3.9%
Total	52	39	261	273	329	511	410	138	2013	100.0%
Pct.	2.6%	1.9%	13.0%	13.6%	16.3%	25.4%	20.4%	6.9%	100.0%	

Bicyclists Aged 25-34 Involved in a Collision, by Time-of-Day and Gender

Time of Day	Male	Female	Total	Pct.
Midnight to 3 am	13	1	14	3.1%
3 am to 6 am	12	0	12	2.7%
6 am to 9 am	35	13	48	10.6%
9 am to noon	38	12	50	11.1%
Noon to 3 pm	61	21	83	18.4%
3 pm to 6 pm	77	19	96	21.3%
6 pm to 9 pm	68	27	96	21.3%
9 pm to midnight	47	5	52	11.5%
Total	351	98	451	100.0%
Pct.	77.8%	21.7%	100.0%	

Bicyclists Involved in a Collision Suspected of Being under the Influence of Drugs or Alcohol, by Age and Time-of-Day

Age Group	Time of Day								Total	Pct.
	Midnight to 3 am	3 am to 6 am	6 am to 9 am	9 am to noon	Noon to 3 pm	3 pm to 6 pm	6 pm to 9 pm	9 pm to midnight		
14 and under	0	0	0	0	0	2	1	0	3	1.0%
15-19	1	0	1	3	4	8	5	2	24	8.2%
20-24	2	1	3	3	2	6	6	7	30	10.3%
25-34	5	1	2	7	14	10	16	9	64	22.0%
35-44	0	0	5	6	6	7	7	8	39	13.4%
45-54	1	1	6	4	11	10	13	9	55	18.9%
55-64	3	1	5	3	11	10	8	8	49	16.8%
65-69	0	0	0	1	3	5	3	1	13	4.5%
70 and older	0	2	0	3	4	2	1	2	14	4.8%
Total	12	6	22	30	55	60	60	46	291	100.0%
Pct.	4.1%	2.1%	7.6%	10.3%	18.9%	20.6%	20.6%	15.8%	100.0%	

Summary of Findings

- Pedestrian-vehicle collisions in low-income areas
 - Subpopulations at disproportionately high risk
 - Children aged 14 and under – out of 328 > 169 killed or injured
 - Male 60%
 - 6 am to 9 am; Noon to 9 pm
 - 20 and older:
 - 6 pm to 9 pm > 778 killed or seriously injured
 - 3 pm to 6 pm > 539 killed or seriously injured
 - Drug and alcohol use > ~5.5%
 - Emerging adulthood (persons aged 25-34)
 - 6 pm to midnight and midnight to 3 am
 - Out of 613 > 328 killed or seriously injured
 - Only 43 suspected of drug or alcohol use
 - Older adults (55-64 and 70 and older)
 - Midday and early evening
 - For those 70 and older – most collisions occur midday (9 am to 3 pm), KSI in the evening hours

Summary of Findings (cont.)

- Bicyclist-vehicle collisions in low-income areas
 - Subpopulations at disproportionately high risk
 - Children 14 and under and bicyclists aged 15-19
 - After school activities > 3 pm to 9 pm
 - Working-age subpopulations
 - Persons aged 25-34 > higher incidence of collisions from 6 am to midnight
 - Male bicyclists twice as likely to be killed or injured from noon to 9 pm
 - Persons aged 45-64 > higher incidence of collisions from 6 am to 9 pm
 - Most likely short distance commute associated with various service-sector jobs
 - Drug and alcohol use > ~6.9%

Analysis of the commuting patterns

- Signal 4 database provides home zip code information for both drivers and non-motorists
- The driver and non-motorist database were merged using the crash ID
- Additionally, the data were intersected with the census ZCTA files in ArcGIS, which added to the database the zip code of the crash location
- Purpose of the analysis:
 - Find out whether the home zip code of the driver and the non-motorist involved in a collision are the same
 - Find out whether the home zip code of the driver and the non-motorist involved in a collision are the different
 - Do they match the zip code where the accident occurred?
 - How many non-motorists involved in a collision reside outside the tri-county area? This would suggest they are either tourists or visitors
 - How many of the drivers resided outside the area where the accident occurred

Residential Locations of Pedestrians and Motorists Involved in a Vehicle-Pedestrian Collision

	Pedestrian lives in crash location?		
Motorist lives in crash location?	Yes	No	Total
Yes	675 (16.6%)	485 (12.0%)	1160 (28.7%)
No	989 (24.5%)	1896 (46.9%)	2885 (71.3%)
Total	1664 (41.1%)	2381 (58.9%)	4045 (100.0%)

Residential Locations of Bicyclists and Motorists Involved in a Vehicle-Bicyclist Collision

	Bicyclist lives in crash location?		
Motorist lives in crash location?	Yes	No	Total
Yes	535 (17.1%)	463 (14.8%)	998 (32.0%)
No	840 (26.9%)	1285 (41.2%)	2125 (68.0%)
Total	1375 (44.0%)	1748 (56.0%)	3123 (100.0%)

Developing Targeted Interventions

- Safety education at schools with a particular focus on after-school activities
 - School-aged pedestrians and bicyclists were identified as being disproportionately at-risk, particularly during the afterschool period.
 - Identify areas where school crossing guards and traffic enforcement near school locations are not available
 - Focus on safety measures when school crossing guards are not present
- Educational and information programs focusing on crossing behavior
 - Around bus stops
 - Through local transit operators
 - Local health clinics

Developing Targeted Interventions

- Partnerships between local community leaders and law enforcement
 - During the late afternoon and early evening periods (3:00 PM to 9:00 PM) when the largest share of pedestrian and bicyclist crashes occurs
 - Culturally sensitive, taking into account the diverse background and experiences of the targeted populations
- Developing a targeted campaign for multiple at-risk cohorts in selected communities
 - Identify communities with a high number of pedestrian-vehicle and bicyclist-vehicle collisions
 - Identify the underlying causes, including environmental risk factors, that contribute to the disproportionately high risk
 - Develop interventions that address these risk factors holistically

Questions!