Utilizing multiple data sources in the preparation of a Vision Zero Plan for the City of Alexandria

X. APPENDIX

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UTILIZING MULTIPLE DATA SOURCES IN THE PREPARATION OF A VISION ZERO PLAN FOR THE CITY OF ALEXANDRIA

INVESTIGATING THE RELATIONSHIP BETWEEN TRANSPORTATION INFRASTRUCTURE, SOCIO-ECONOMIC CHARACTERISTICS, AND CRASH OUTCOMES IN THE CITY

X. APPENDIX

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VirginiaTech National Capital Region

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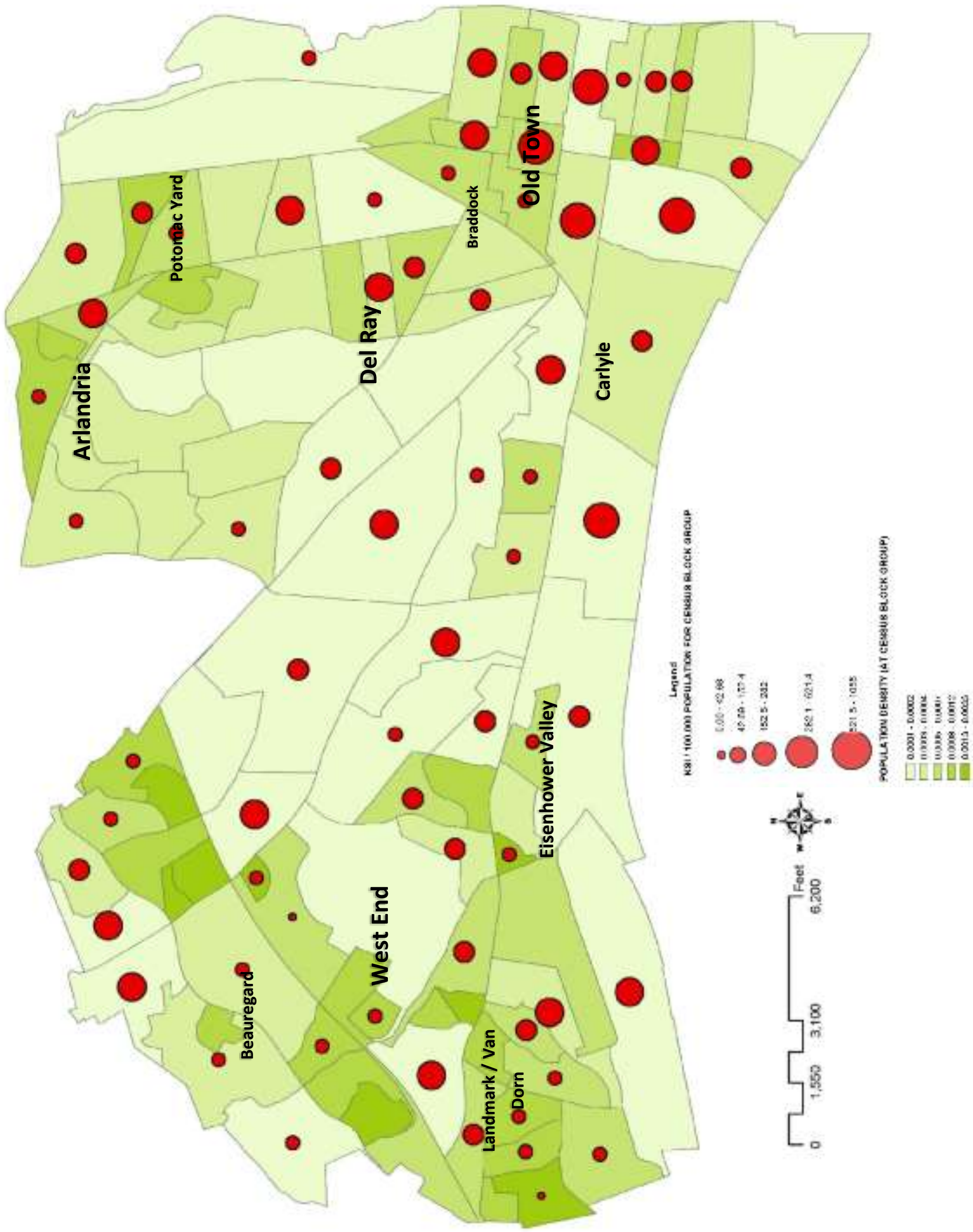
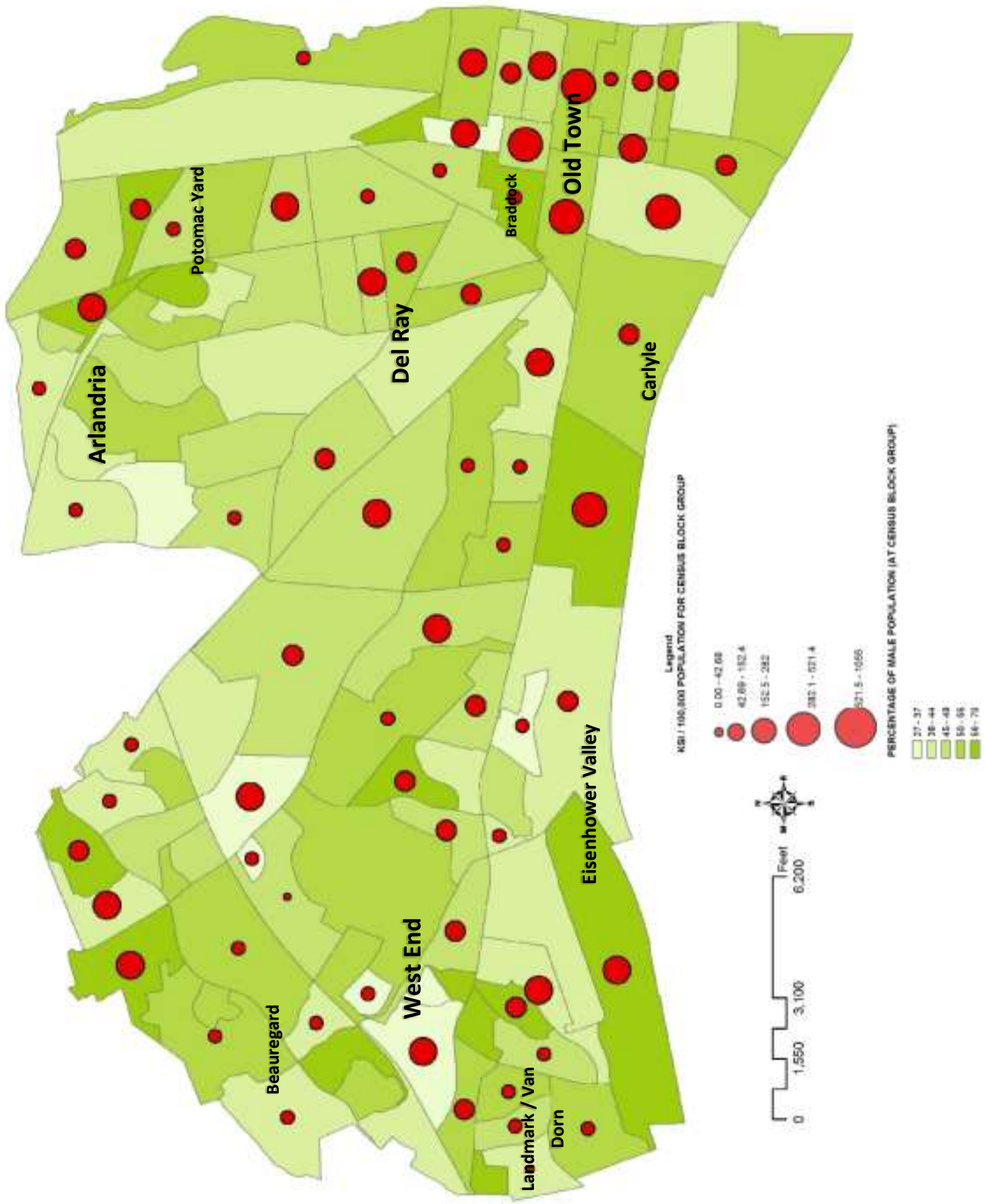
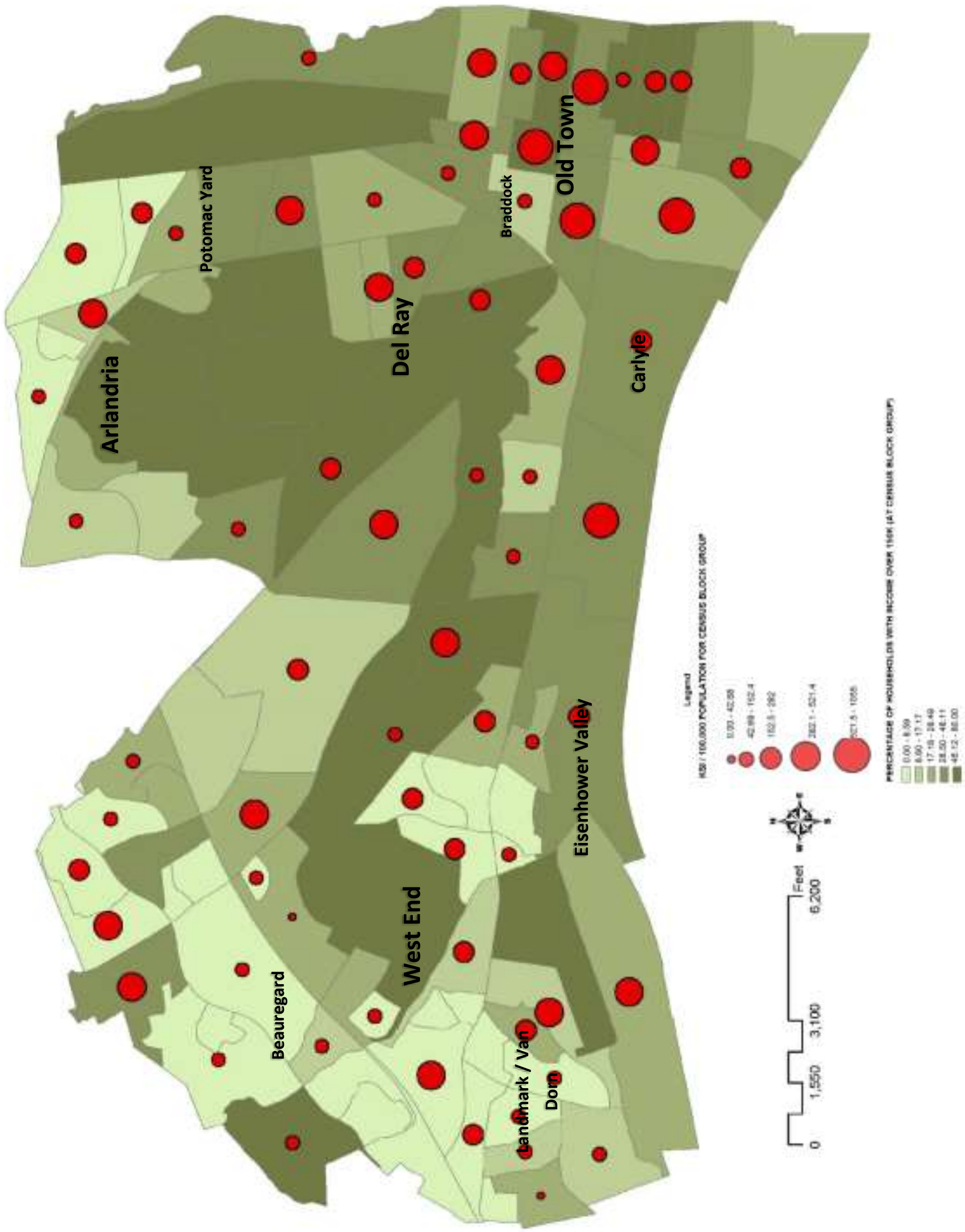


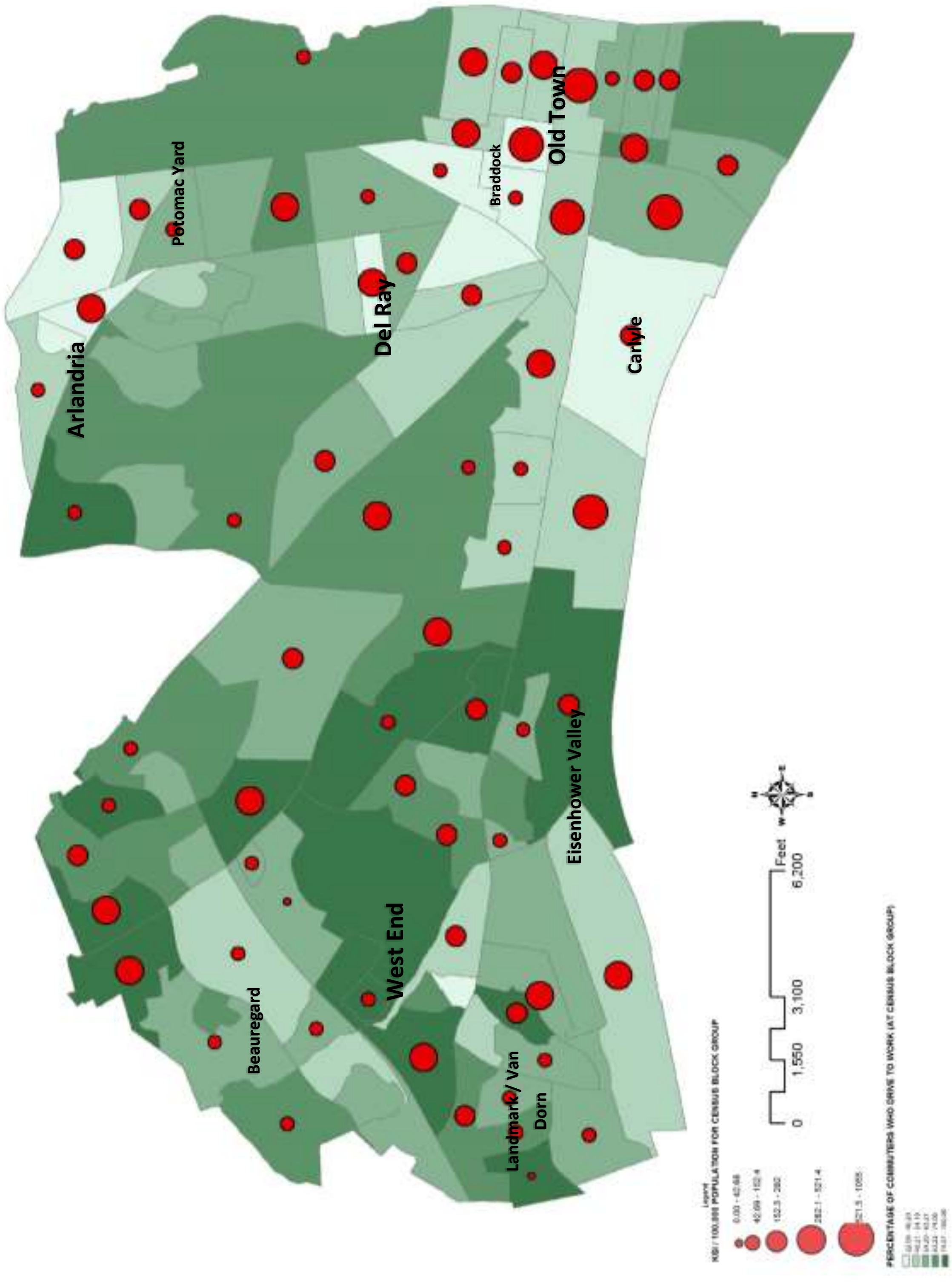
A. Map 1. KSI involving crashes per 100,000 population for each census block group level (2010-2014) with respect to the population density of census block groups (Source: APD, City of Alexandria, Virginia, Census ACS profile 2014).



A. Map 2. KSI involving crashes per 100,000 population for each census block group level (2010-2014) with respect to the percentage male population for census block groups (Source: APD, City of Alexandria, Virginia, Census ACS profile 2014). High KSI involving crashes show correlation with the higher percentage of males in the census block groups.



A. Map 3. KSI involving crashes per 100,000 population for each census block group level (2010-2014) with respect to the percentage households with high-income (minimum income of 150K) population for census block groups (Source: APD, City of Alexandria, Virginia, Census ACS profile 2014). KSI involving crashes are low in most of the high-income areas and concentrated towards Old Town area.



A. Map 4. KSI involving crashes per 100,000 population for each census block group level (2010-2014) with respect to the percentage population commuting by driving to work for census block groups (Source: APD, City of Alexandria, Virginia, Census ACS profile 2014). High KSI involving crashes do not show correlation with the higher percentage commuters driving to work in census block groups.

B. Charts

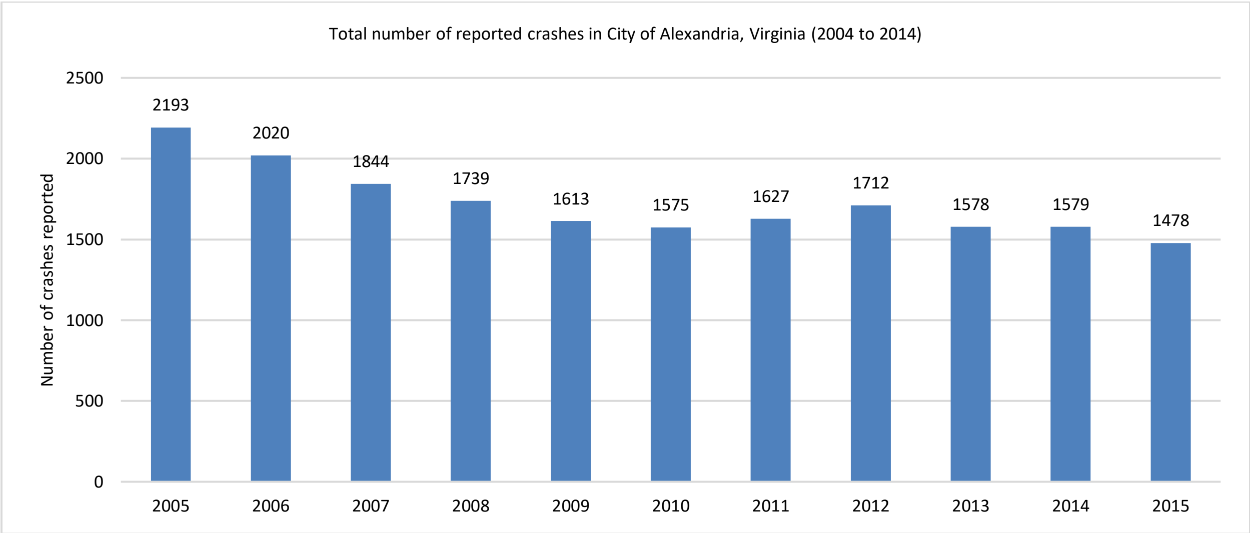


Chart 1. Total number of reported crashes in City of Alexandria, Virginia by year (2005 to 2015) (Source: APD, City of Alexandria, Virginia)

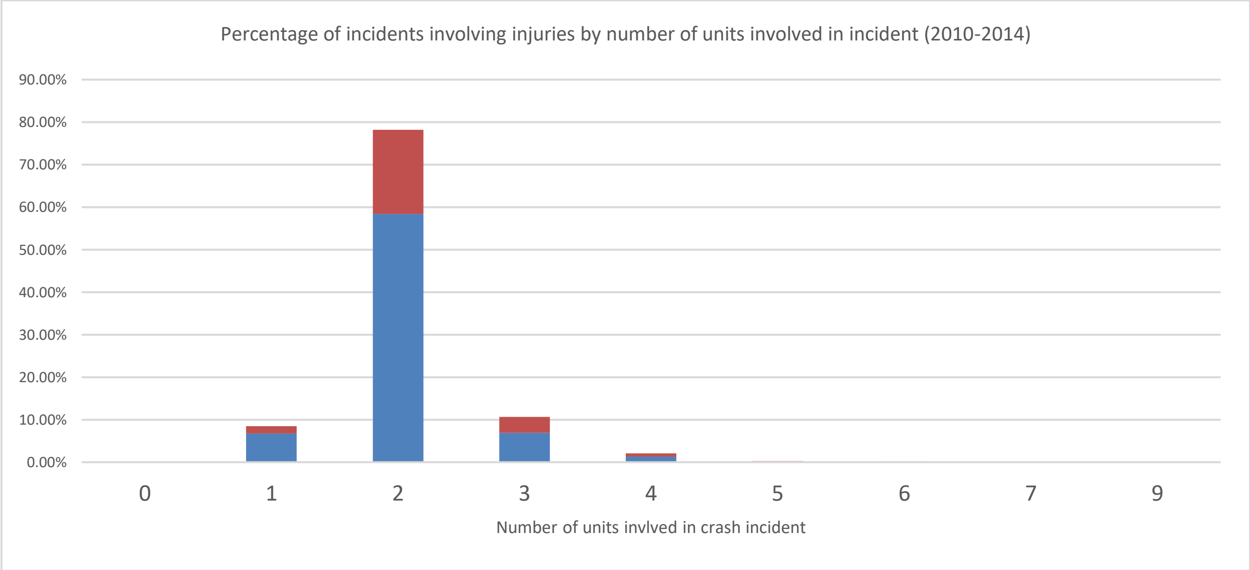
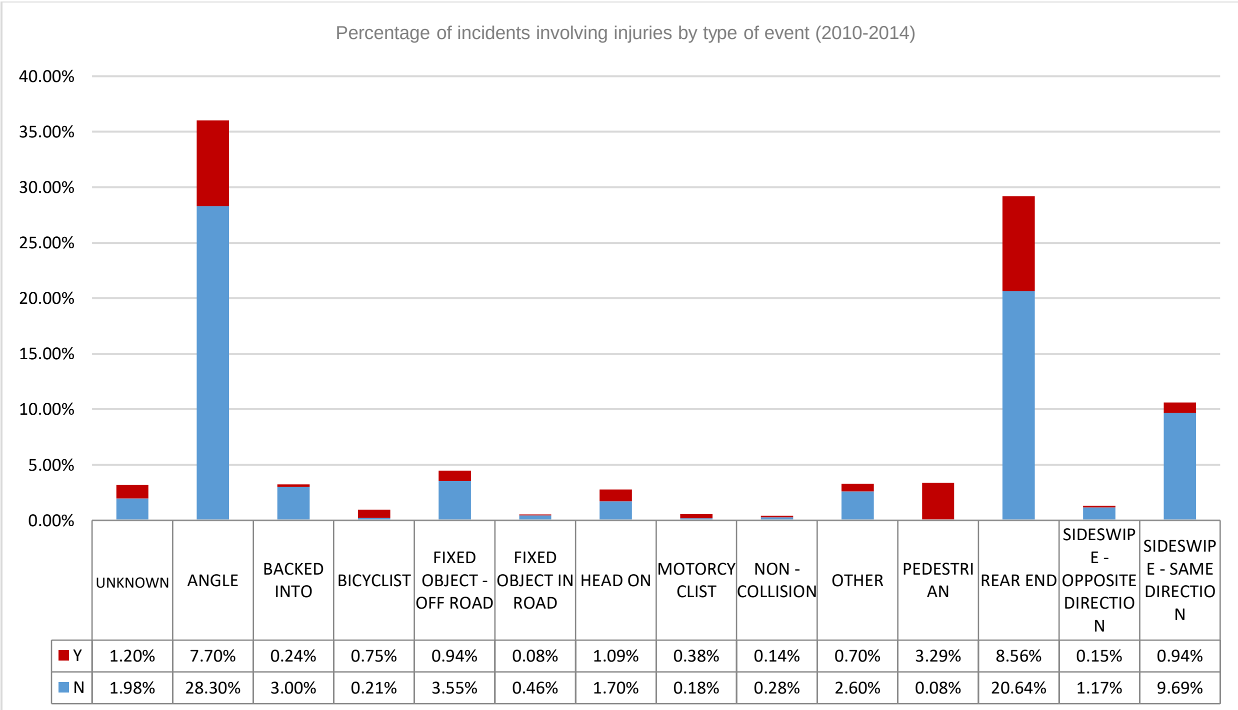


Chart 2. Percentage of crash incidents and incidents involving injuries (red color = incidents involving injuries, blue color = incidents with no injuries) by number of units (vehicle/pedestrian/bicyclist/motorcyclist) involved in incident (2010-2014) (Source: APD, City of Alexandria, Virginia)



	UNKNOWN	ANGLE	BACKED INTO	BICYCLIST	FIXED OBJECT - OFF ROAD	FIXED OBJECT IN ROAD	HEAD ON	MOTORCYCLIST	NON - COLLISION	OTHER	PEDESTRIAN	REAR END	SIDESWIPE - OPPOSITE DIRECTION	SIDESWIPE - SAME DIRECTION
Y	1.20%	7.70%	0.24%	0.75%	0.94%	0.08%	1.09%	0.38%	0.14%	0.70%	3.29%	8.56%	0.15%	0.94%
N	1.98%	28.30%	3.00%	0.21%	3.55%	0.46%	1.70%	0.18%	0.28%	2.60%	0.08%	20.64%	1.17%	9.69%

Chart 3. Percentage of crash incidents and incidents involving injuries (red color = incidents involving injuries, blue color = incidents with no injuries) by type of event (2010-2014) (Source: APD, City of Alexandria, Virginia)

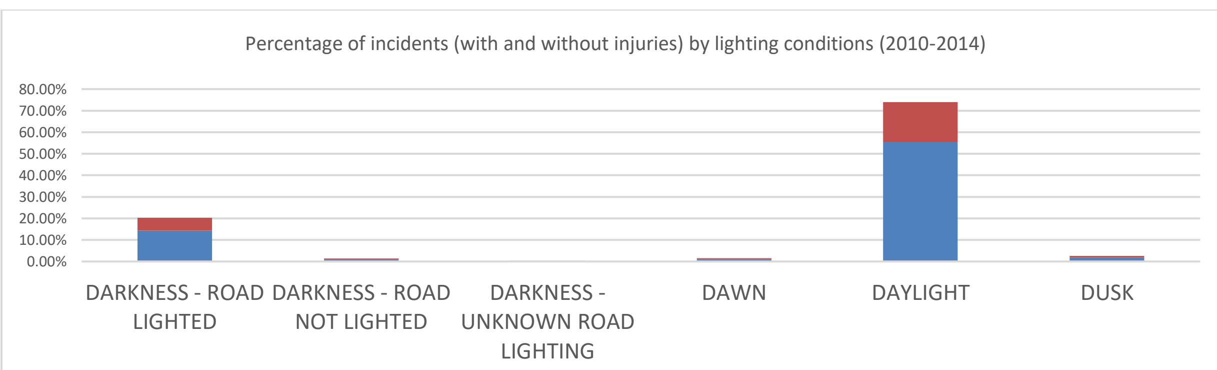


Chart 4. Percentage of crash incidents and incidents involving injuries (red color = incidents involving injuries, blue color = incidents with no injuries) by lighting conditions (2010-2014) (Source: APD, City of Alexandria, Virginia)

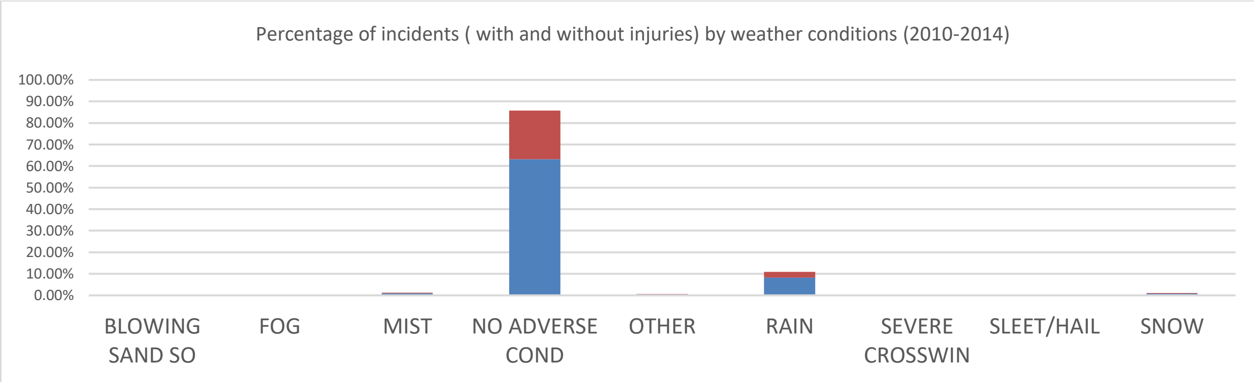
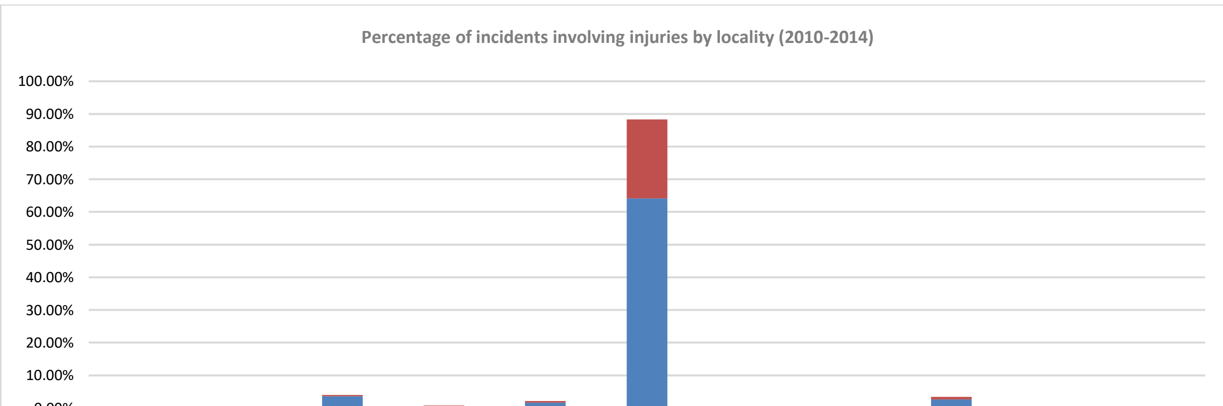
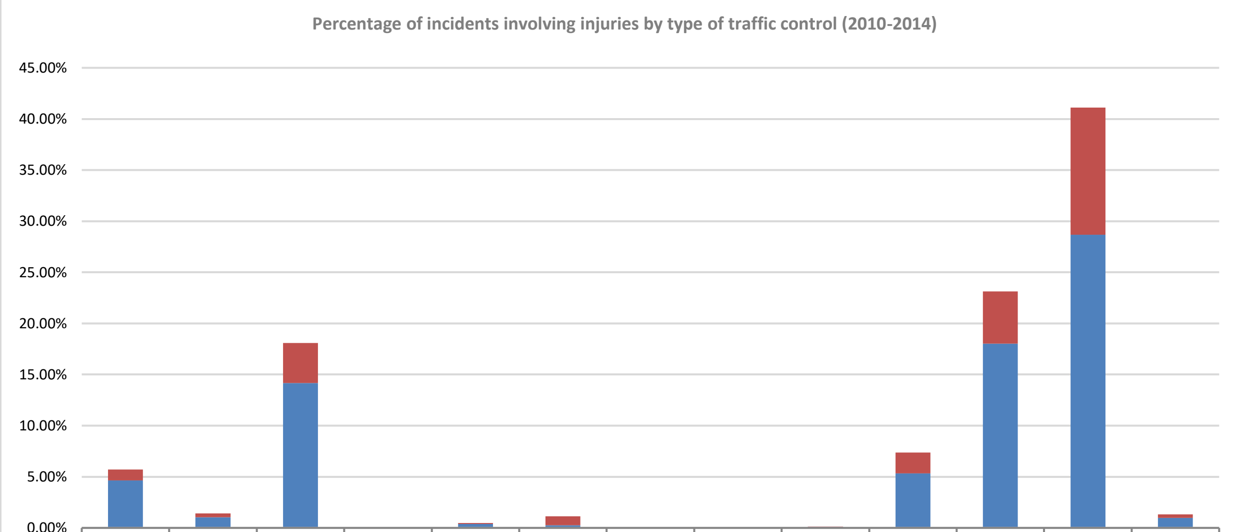


Chart 5. Percentage of crash incidents and incidents involving injuries (red color = incidents involving injuries, blue color = incidents with no injuries) by weather condition (2010-2014) (Source: APD, City of Alexandria, Virginia)



	BUSINESS/INDUSTRIAL	GORE	IN PARKING LANE OR Z	MEDIAN	OFF ROADWAY, LOCATIO	ON ROADWAY	OUTSIDE RIGHT-OF-WAY	RESIDENTIAL	ROADSIDE	SEPARATOR	SHOULDER
Y	0.00%	0.03%	0.41%	0.21%	0.42%	24.17%	0.13%	0.01%	0.79%	0.00%	0.08%
N	0.03%	0.06%	3.63%	0.61%	1.68%	64.16%	0.37%	0.04%	2.65%	0.06%	0.46%

Chart 6. Percentage of crash incidents and incidents involving injuries (red color = incidents involving injuries, blue color = incidents with no injuries) by locality (2010-2014) (Source: APD, City of Alexandria, Virginia)



		NO PASSING LINES	NO TRAFFIC CONTROL	OFFICER OR FLAGGER	ONE WAY ROAD OR STREET	PEDESTRIAN CROSSWALK	REDUCED SPEED-SCHOOL ZONE	REDUCED SPEED-WORK ZONE	SLOW OR WARNING SIGN	STOP SIGN	TRAFFIC LANES MARKED	TRAFFIC SIGNAL	YIELD SIGN
Y	1.06%	0.37%	3.91%	0.03%	0.07%	0.89%	0.00%	0.01%	0.01%	2.03%	5.11%	12.45%	0.34%
N	4.65%	1.05%	14.17%	0.04%	0.40%	0.25%	0.01%	0.04%	0.10%	5.33%	18.01%	28.67%	0.99%

Chart 7. Percentage of crash incidents and incidents involving injuries (red color = incidents involving injuries, blue color = incidents with no injuries) by type of traffic control (2010-2014) (Source: APD, City of Alexandria, Virginia)

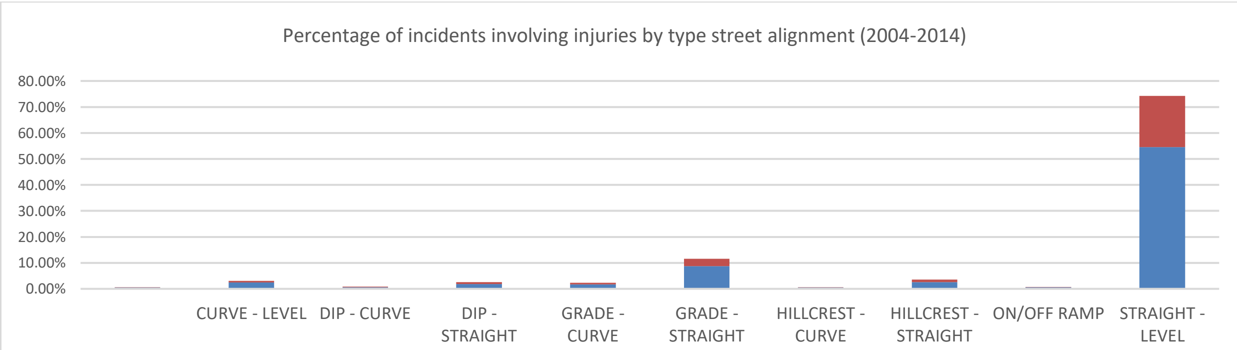


Chart 8. Percentage of crash incidents and incidents involving injuries (red color = incidents involving injuries, blue color = incidents with no injuries) by type of street alignment (2004-2014) (Source: APD, City of Alexandria, Virginia)

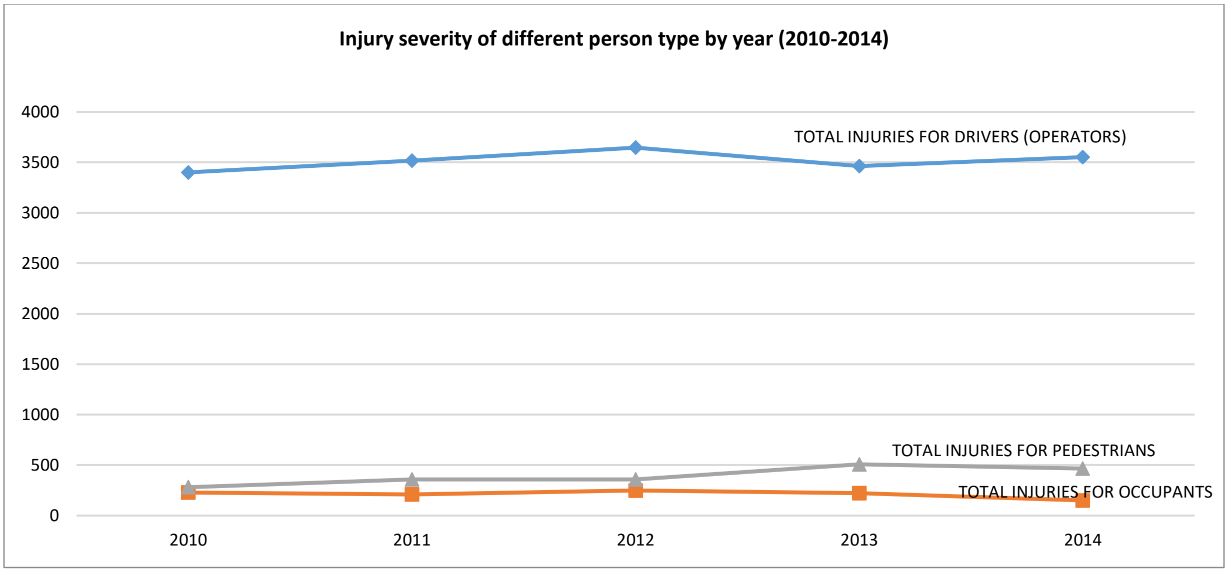


Chart 9. Number of incidents and injuries of person type by year (2010-2014) (Source: APD, City of Alexandria, Virginia)

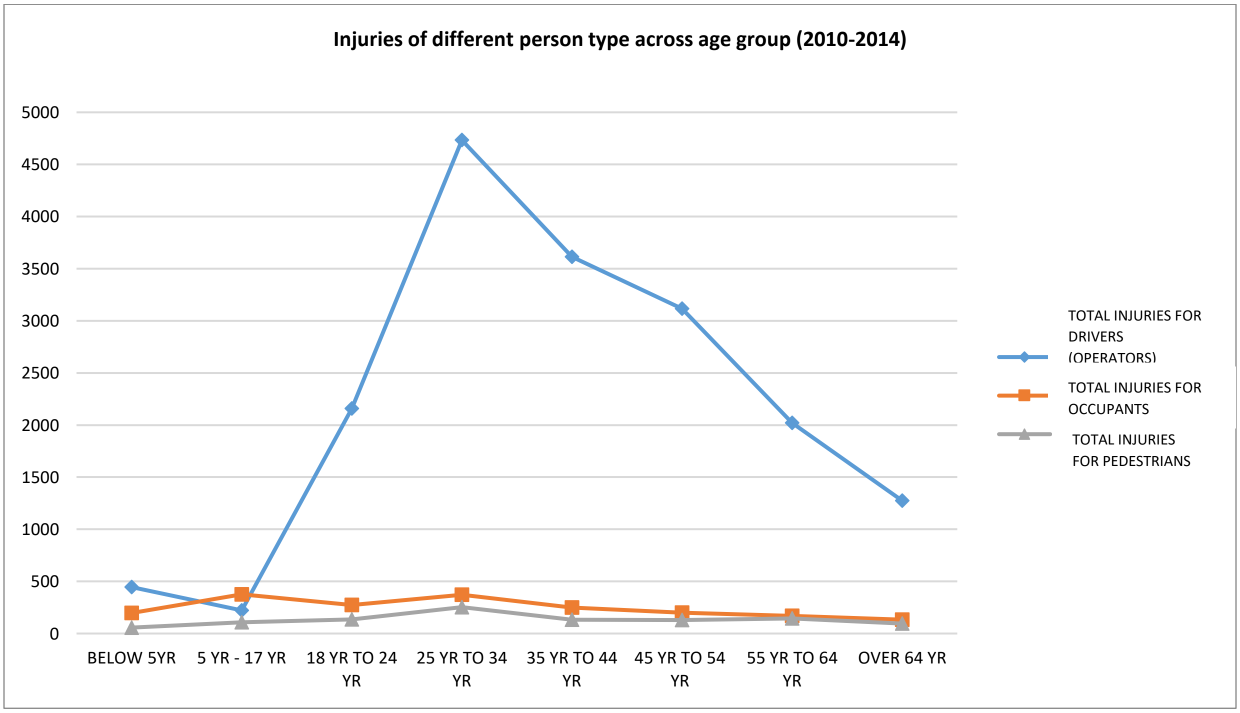


Chart 10. Injury severity of person types across age group (2010-2014) (Source: APD, City of Alexandria, Virginia)

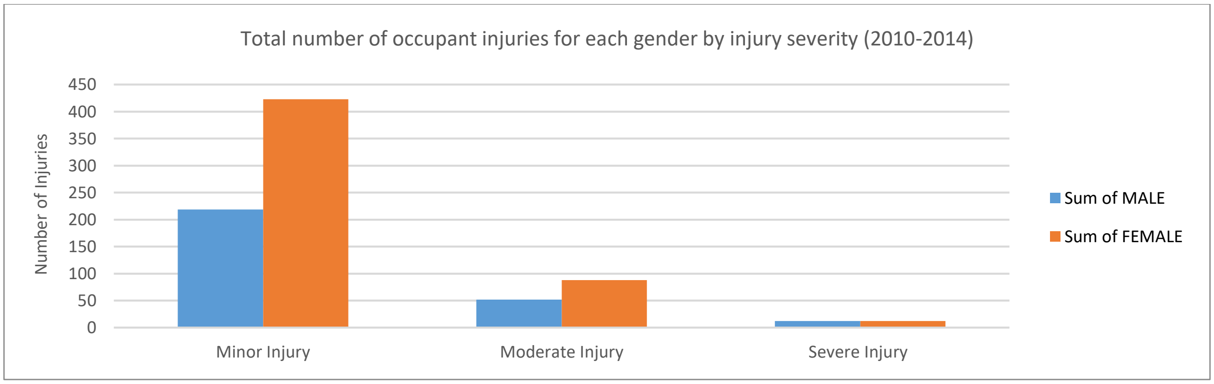


Chart 11. Injury severity of occupants across gender (2010-2014) (Source: APD, City of Alexandria, Virginia)

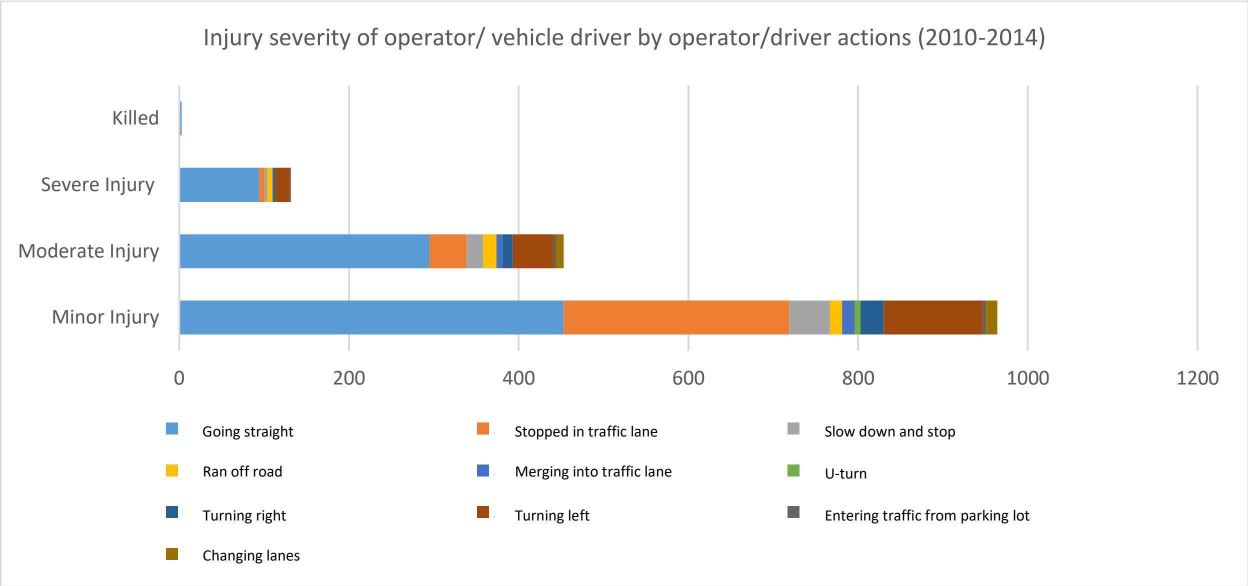


Chart 12. Injury severity of operators across the type of actions (2010-2014) (Source: APD, City of Alexandria, Virginia)

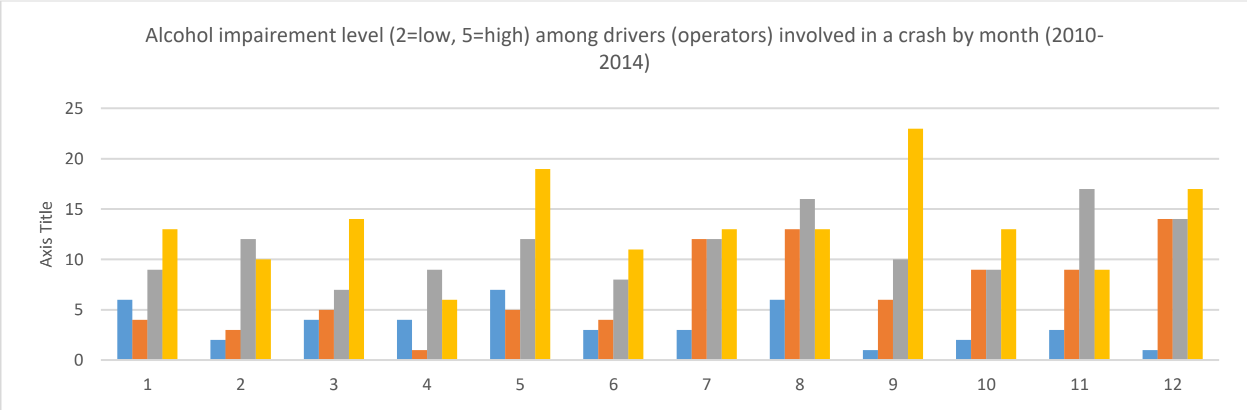


Chart 13. Alcohol impairment level (2=low, 5=high) among drivers (operators) involved in a crash by month (1 = January, 12 = December) (2010-2014) (Source: APD, City of Alexandria, Virginia)

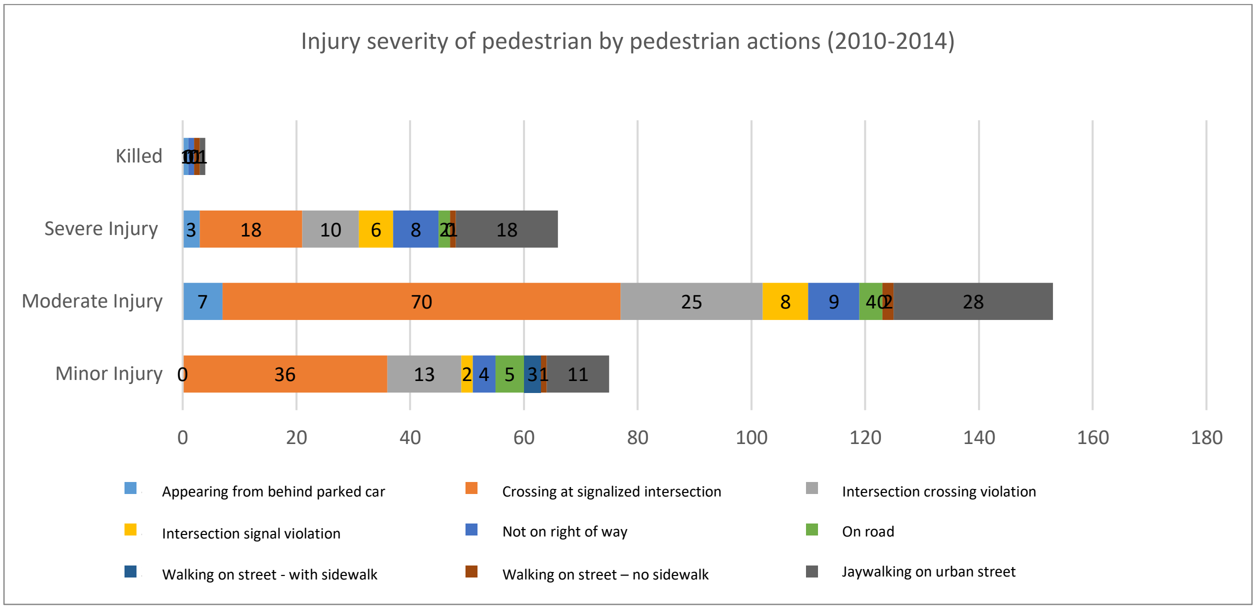


Chart 14. Injury severity of pedestrians with the individual's actions (2010-2014) (Source: APD, City of Alexandria, Virginia)

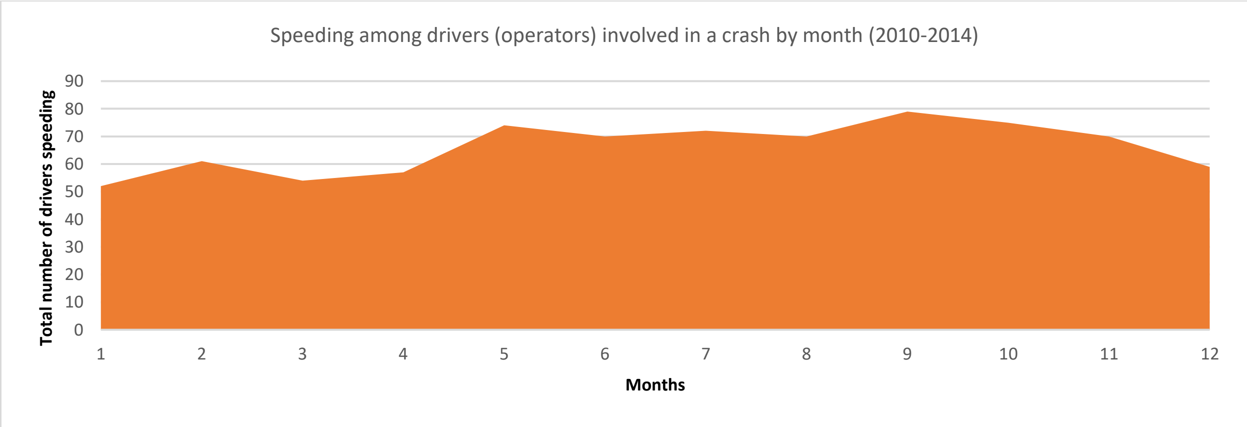


Chart 15. Total number of drivers (operators) reported speeding before a crash incident by month (1 = January, 12 = December) (2010-2014) (Source: APD, City of Alexandria, Virginia)

Chart 16. Safety equipment usage by drivers (operators) in a crash incident by year (red color = no safety equipment use, blue color = safety equipment use) (2010-2014) (Source: APD, City of Alexandria, Virginia)

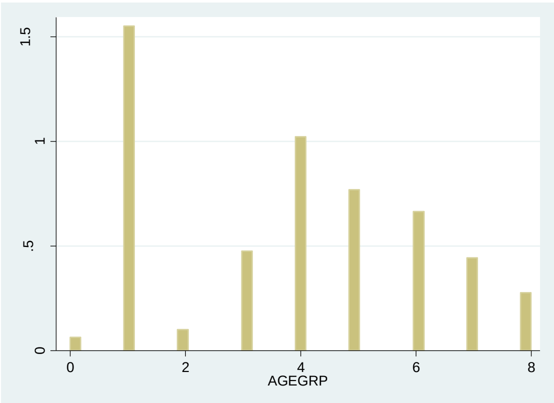


Chart 17. Number of individuals from each age group involved in crash incidents (2010-2014).(0=unknown, 1 = <5yr, 2=5to17yr, 3=18to24yr, 4=25to34yr, 5=35to44yr, 6=45to54yr, 7=55to64yr, 8=>64yr)

C. ***Tables***

Table 1. Yearly rate of injuries per crash incident and KSI per crash incident (2010-2014) (Source: APD, City of Alexandria, Virginia)

Year	Injuries / crash incident	Severe injuries /crash incident	Killed /crash incident	KSI / crash incident
2010	0.338	0.026	0.0006	0.027
2011	0.336	0.033	0.0018	0.035
2012	0.300	0.026	0.0012	0.027
2013	0.372	0.023	0.0006	0.032
2014	0.382	0.025	0.0006	0.026

Table 2. Data cleanup and details of individual crash reports (2010-2014) (Source: APD, City of Alexandria, Virginia)

CATEGORY	THEME	NEW VARIABLE	RECODING	SOURCE VARIABLE	ATTRIBUTES
DEPENDENT VARIABLES					
	Crash severity	INJURY_SEV	5 = Dead (V_KILLED) 4 = Sever Injury (V_SEVERE) 3 = Minor/Possible Injury (V_MINOR) 2 = No Apparent Injury (V_MODERATE) 1 = No Injury (driver only) (V_NOINJURY)	N_INJURY	Severity – Dead / Fatality Serious / sever Injury Minor/Possible Injury No Apparent Injury No Injury (driver only)
	Killed and/or Severe Injury (KSI)	V_KSI	Dead + Sever Injury Where Dead Y = 1 N = 0 Severe injury Y = 1 N = 0	V_KILLED V_SEVERE	
	Killed and/or Severe Injury (KSI) occurrence	KSI_OC	(Dead * 2) + (Sever Injury * 1) Where, Dead Y = 1 N = 0 Severe injury Y = 1 N = 0	V_KILLED V_SEVERE	
INDEPENDENT VARIABLES					
Gender	***Individual's gender - male***	MALE	Y = 1 N = 0	N_SEX	Male Female

CATEGORY	THEME	NEW VARIABLE	RECODING	SOURCE VARIABLE	ATTRIBUTES
	Individual's gender - female	FEMALE	Y = 1 N = 0		
Age	***Individual's Age*** <5yr	AGE_B5	Y = 1 N = 0	N_age	
	Individual 5yr-17yr old	AGE_5TO17	Y = 1 N = 0		
	Individual 18yr-24yr old	AGE_18TO24	Y = 1 N = 0		
	Individual 25yr-34yr old	AGE_25TO34	Y = 1 N = 0		
	Individual 35yr-44yr old	AGE_35TO44	Y = 1 N = 0		
	Individual 45yr-54yr old	AGE_45TO54	Y = 1 N = 0		
	Individual 55yr-64yr old	AGE_55TO64	Y = 1 N = 0		
	Individual 18yr-64yr old	AGE_18TO64	Y = 1 N = 0		
	Individual > 64yr old	AGE_O64	Y = 1 N = 0		
CONTROL VARIABLES					
Crash characteristics					
Crash type (collision type)	***Pedestrian collision***	PED	Y = 1 N = 0	A_EVENT1	PEDESTRIAN BICYCLIST MOTORCYCLIST ANGLE HEAD ON REAR END BACKED INTO SIDESWIPE - SAME DIRECTION SIDESWIPE - OPPOSITE DIRECTION FIXED OBJECT - OFF ROAD FIXED OBJECT - ON ROAD
	Bicyclist	BICYCLIST	Y = 1 N = 0		
	Motorcyclist	MOTORCYCLIST	Y = 1 N = 0		
	Angle	ANGLE	Y = 1 N = 0		
	Head on	HEADON	Y = 1 N = 0		

CATEGORY	THEME	NEW VARIABLE	RECODING	SOURCE VARIABLE	ATTRIBUTES
	Rear end	REAREND	Y = 1 N = 0		
	Backed into	BACKEDINTO	Y = 1 N = 0		
	Sideswipe - same direction	SIDESWIPESAME	Y = 1 N = 0		
	Sideswipe - opposite direction	SIDESWIPEOPPO	Y = 1 N = 0		
	Fixed object - off road	FIXEDOB_OFFRD	Y = 1 N = 0		
	Fixed object - on road	FIXEDOB_ONRD	Y = 1 N = 0		
Vehicle characteristics					
	Vehicle with no defects	V_NODEFECTS	No defects = 1 All other = 0	V_CONDITION	1. Brakes defective 2. Chains in use 3. Exhaust system 4. Lights defective 5. Mirrors defective 6. Motor trouble 7. No defects 8. Other defects 9. Power train defective 10. Puncture/ Blowout 11. Steering defective 12. Suspension defective 13. Wheels defective 14. Windows/ windshield defective 15. Worn/ slick tires
	Vehicle with no visual obstruction defects	V_NOOBSCURED	Not obscured = 1 All other = 0		
Environment characteristics					
	Light condition	LIGHTCOND	DAYLIGHT = 1 DAWN = 2 DUSK = 3 DARKNESS - ROAD LIGHTED = 4 DARKNESS - UNKNOWN ROAD = 5 DARKNESS - ROAD NOT LIGHTED = 6	A_LIGHTING	1. DARKNESS - ROAD LIGHTED 2. DARKNESS - ROAD NOT LIGHTED 3. LIGHTING 4. DAWN 5. DAYLIGHT 6. DUSK 7. UNKNOWN
	Weather severity	WEATHER_SEV	1. CLEAR 2. NO ADVERSE CONDITION (CLEAR/CLOUDY)	A_WEATHER	1. BLOWING SAND SOIL DIRT OR SNOW

CATEGORY	THEME	NEW VARIABLE	RECODING	SOURCE VARIABLE	ATTRIBUTES
			3. MIST 4. RAIN 5. FOG 6. SEVERE CROSSWINDS 7. SNOW 8. BLOWING SAND SOIL DIRT OR SNOW 9. SLEET/HAIL		2. CLEAR 3. FOG 4. MIST 5. NO ADVERSE CONDITION (CLEAR/CLOUDY) 6. OTHER 7. RAIN 8. SEVERE CROSSWINDS 9. SLEET/HAIL 10. SNOW
Day	***Day of the week***	A_ACCIDDY_N	Monday = 1 to Sunday = 7	A_ACCIDDY	Monday Tuesday Wednesday Thursday Friday Saturday Sunday
	Accident day - Weekday	A_ACCIDWKDY	A_ACCIDDY_N = 1 to 5 Y = 1 N = 0	A_ACCIDDY	
	Accident day - Weekend	A_ACCIDWKND	A_ACCIDDY_N = 6 & 7 Y = 1 N = 0	A_ACCIDDY	
Part of year					
	Year	YEAR	2010-2014	a_acciddt	mm/dd/yr
	Month	MONTH	January - December	a_acciddt	mm/dd/yr
	Season - Winter	WINTER WINTER_L	MONTH = December-February Y = 1 N = 0 Y = 2 N = 1	MONTH	January; February; March; April; May; June; July; August; September; October; November; December
	Season - Spring	SPRING SPRING_L	MONTH = March-May Y = 1 N = 0 Y = 2 N = 1	MONTH	January; February; March; April; May; June; July; August; September; October; November; December
	Season - Summer	SUMMER SUMMER_L	MONTH = June-August Y = 1 N = 0 Y = 2 N = 1	MONTH	January; February; March; April; May; June; July; August; September; October; November; December
	Season - Fall	FALL FALL_L	September-November Y = 1 N = 0 Y = 2 N = 1	MONTH	January; February; March; April; May; June; July; August; September; October; November; December

CATEGORY	THEME	NEW VARIABLE	RECODING	SOURCE VARIABLE	ATTRIBUTES
Part of day	***Parts of day (three hour zones)***	TIMEPD	1 = (12am-3am) 2 = (3am-6am) 3 = (6am-9am) 4 = (9am-12pm) 5 = (12pm-3pm) 6 = (3pm-6pm) 7 = (6pm-9pm) 8 = (9pm-12am)	a_accidtm	HR:MIN
	Morning peak (6am-12pm)	MPEAK MPEAK_L	TIMEPD = 3 (6am-9am) Y = 1 N = 0 Y = 2 N = 1	TIMEPD	
	Evening peak (3pm-6pm)	EPEAK EPEAK_L	TIMEPD = 6 (3pm-6pm) Y = 1 N = 0 Y = 2 N = 1	TIMEPD	
INDIVIDUAL'S CHARACTERISTICS					
Alcohol influence /impairment	Level of impairment / alcohol influence	ALCUSE_LVL	0 = No alcohol use to 5 = alcohol use and impairment 5 - DRINKING - ABILITY IMPAIRED 4 - DRINKING - OBVIOUSLY DRUNK 3 - DRINKING - ABILITY NOT IMPAIRED 2 - DRINKING - UNKNOWN WHETHER IMPAIRED 1 - HAD NOT BEEN DRINKING 0 - UNKNOWN/NULL	N_ALCOHOLUSE	DRINKING - ABILITY IMPAIRED DRINKING - OBVIOUSLY DRUNK DRINKING - ABILITY NOT IMPAIRED DRINKING - UNKNOWN WHETHER IMPAIRED HAD NOT BEEN DRINKING UNKNOWN/NULL
	No alcohol usage	ALCUSE_N	HAD NOT BEEN DRINKING = 1 Others = 0	N_ALCOHOLUSE	
Speeding	***Speeding***	SPEEDING	v_speedtravelling (Travelling speed) > v_speedlimit (Posted speed) Y = 1 N = 0	v_speedtravelling v_speedlimit	
Safety equipment usage	*Safety equipment usage*	SAFETY_Y	Y (Safety equipment used) = 1 N (No safety equipment was used) = 0	N_SAFETY	N_SAFETY_AIRBAG_N N_SAFETY_BOOSTERSEAT_N

CATEGORY	THEME	NEW VARIABLE	RECODING	SOURCE VARIABLE	ATTRIBUTES
			Where, Y = N_SAFETY_AIRBAG_N Y=N_SAFETY_BOOSTERSEAT_N Y=N_SAFETY_CHILDRESTRAINT_N Y=N_SAFETY_HELMET_N Y=N_SAFETY_LAPANDSHOULDERBELTS_N Y=N_SAFETY_LAPBELTONLY_N N=N_SAFETY_NORESTRAINTUSED_N Y=N_SAFETY_SHOULDERBELTONLY_N		N_SAFETY_CHILDRESTRAINT_N N_SAFETY_HELMET_N N_SAFETY_LAPANDSHOULDERBELTS_N N_SAFETY_LAPBELTONLY_N N_SAFETY_NORESTRAINTUSED_N N_SAFETY_SHOULDERBELTONLY_N
Individual's defects	***Person no defect***	PER_NODEF	NO DEFECTS = 1 All other = 0	n_perscondition	
TRANSPORTATION INFRASTRUCTURE					
	Presence of traffic control	TRAFFCONT_Y	Y (NO TRAFFIC CONTROL) = 1 N (all other) = 0	A_TRAFFICCONTROL	1. NO PASSING LINES 2. NO TRAFFIC CONTROL 3. OFFICER OR FLAGGER 4. ONE WAY ROAD OR STREET 5. OTHER 6. PEDESTRIAN CROSSWALK 7. REDUCED SPEED-SCHOOL ZONE 8. REDUCED SPEED-WORK ZONE 9. SLOW OR WARNING SIGN 10. STOP SIGN 11. TRAFFIC LANES MARKED 12. TRAFFIC SIGNAL 13. YIELD SIGN
	Presence of no traffic control	NOTRAFCONT	Y = 1 N = 0	A_TRAFFICCONTROL	

CATEGORY	THEME	NEW VARIABLE	RECODING	SOURCE VARIABLE	ATTRIBUTES
	Presence of traffic signal	TRAFFSIGNAL	Y = 1 N = 0	A_TRAFFICCON TROL	
	Presence of stop sign	STOPSIGN	Y = 1 N = 0	A_TRAFFICCON TROL	
	Presence of marked lanes	LANESMARKE D	Y = 1 N = 0	A_TRAFFICCON TROL	
	Presence of no passing lanes	NOPASSLN	Y = 1 N = 0	A_TRAFFICCON TROL	
	Presence of one way street	ONEWAYRD	Y = 1 N = 0	A_TRAFFICCON TROL	
	Presence of pedestrian crosswalk	PEDCRSWK	Y = 1 N = 0	A_TRAFFICCON TROL	
	Presence of reduced speed school zone	RSPEED_SZN	Y = 1 N = 0	A_TRAFFICCON TROL	
	Presence of reduced speed work zone	RSPEED_WZN	Y = 1 N = 0	A_TRAFFICCON TROL	
	Presence of slow sign	SLOWSIGN	Y = 1 N = 0	A_TRAFFICCON TROL	
	Presence of yield sign	YLDSIGN	Y = 1 N = 0	A_TRAFFICCON TROL	
	Traffic control type	TRAFFCONT_G RP	1 = HIGHWAY SAFETY CORRIDOR 2 = NO PASSING LINES 3 = NO TRAFFIC CONTROL 4 = OFFICER OR FLAGGER 5 = ONE WAY ROAD OR STREET 6 = PEDESTRIAN CROSSWALK 7 = REDUCED SPEED-SCHOOL ZONE 8 = REDUCED SPEED-WORK ZONE 9 = SLOW OR WARNING SIGN 10 = STOP SIGN 11 = TRAFFIC LANES MARKED 0 = UNKNOWN/NULL	A_TRAFFICCON TROL	-HIGHWAY SAFETY CORRIDOR -NO PASSING LINES -NO TRAFFIC CONTROL -OFFICER OR FLAGGER -ONE WAY ROAD OR STREET -PEDESTRIAN CROSSWALK -REDUCED SPEED-SCHOOL ZONE -REDUCED SPEED-WORK

CATEGORY	THEME	NEW VARIABLE	RECODING	SOURCE VARIABLE	ATTRIBUTES
					ZONE -SLOW OR WARNING SIGN -STOP SIGN -TRAFFIC LANES MARKED
INDIVIDUAL'S ACTIONS					
VEHICLE OPERATORS' ACTIONS	***Vehicle operators' actions***	MANEUVER_GRP	1 = BACKING 2 = CHANGING LANES 3 = ENTERING STREET FROM PARKING LOT 4 = GOING STRAIGHT AHEAD 5 = MAKING LEFT TURN 6 = MAKING RIGHT TURN 7 = MAKING U-TURN 8 = MERGING INTO TRAFFIC LANE 9 = PARKED 10 = PASSING 11 = RAN OFF ROAD - LEFT 12 = RAN OFF ROAD - RIGHT 13 = SLOWING OR STOPPING 14 = STARTING FROM PARKED POSITION 15 = STARTING IN TRAFFIC LANE 16 = STOPPED IN TRAFFIC LANE 0 = UNKNOWN/NULL	V_MANEUVER	- BACKING -CHANGING LANES -ENTERING STREET FROM PARKING LOT -GOING STRAIGHT AHEAD -MAKING LEFT TURN -MAKING RIGHT TURN -MAKING U-TURN -MERGING INTO TRAFFIC LANE -PARKED -PASSING -RAN OFF ROAD - LEFT -RAN OFF ROAD - RIGHT -SLOWING OR STOPPING -STARTING FROM PARKED POSITION -STARTING IN TRAFFIC LANE -STOPPED IN TRAFFIC LANE
PEDESTRIANS' ACTIONS	***Pedestrians' actions***	PEDACTION_GRP	1 = COMING FROM BEHIND PARKED CARS 2 = CROSSING AT INTERSECTION DIAGONALLY 3 = CROSSING AT INTERSECTION -NO SIGNAL 4 = CROSSING AT INTERSECTION W/ SIGNAL 5 = CROSSING NOT AT INTERSECTION URBAN 6 = GETTING ON OR OFF OTHER VEHICLE 7 = LYING IN ROADWAY 8 = NOT IN ROADWAY 9 = PLAYING IN ROADWAY 10 = STANDING IN ROADWAY 11 = WALK RD AGAINST TRAFFIC NO SIDEWALK 12 = WALK RD AGAINST	P_PEDACTION	-COMING FROM BEHIND PARKED CARS -CROSSING AT INTERSECTION DIAGONALLY -CROSSING AT INTERSECTION - NO SIGNAL -CROSSING AT INTERSECTION W/ SIGNAL -CROSSING NOT AT INTERSECTION URBAN -GETTING ON OR OFF OTHER VEHICLE

CATEGORY	THEME	NEW VARIABLE	RECODING	SOURCE VARIABLE	ATTRIBUTES
			TRAFFIC SIDEWALK 13 = WALKING IN RD W/TRAFFIC NO SIDEWALK 14 = WALKING IN RD W/TRAFFIC SIDEWALKS 15 = X-ING @ INTERSECTION AGAINST SIGNAL 0 = UNKNOWN/NULL		-LYING IN ROADWAY -NOT IN ROADWAY -PLAYING IN ROADWAY -STANDING IN ROADWAY -WALK RD AGAINST TRAFFIC NO SIDEWALK -WALK RD AGAINST TRAFFIC SIDEWALK -WALKING IN RD W/TRAFFIC NO SIDEWALK -WALKING IN RD W/TRAFFIC SIDEWALKS -X-ING @ INTERSECTION AGAINST SIGNAL

Table 3. Data cleanup and details of census block group level data (Census ACS 2014 Profiles) (Source: City of Alexandria, GIS Division)

VARIABLE DESCRIPTION	INDEPENDENT VARIABLE	RECODING	SOURCE VARIABLE	THEME
INDEPENDENT VARIABLES (census block group)				
RACE				
Percentage of individuals – White **Percentage of individuals – White** **Percentage of individuals – White**	PER_P_WHITE PER_P_BLACK PER_P_HISP	(P_NHISP_WHITE/P_TOT) * 100 (P_BLACK/P_TOT) * 100 (P_HISP/P_TOT) * 100	P_TOT = total population P_NHISP_WHITE = total population non-Hispanic white P_BLACK = total population African American P_HISP = total population hispanic	Population non-Hispanic White, African American, and Hispanic races
ALTERNATE MODES OF TRANSPORTATION				
Percentage of commuters – drive to work **Percentage of commuters – bus to work** **Percentage of commuters – light rail to work** **Percentage of commuters – walk/bike to work**	PER_DR PER_BUS PER_RAIL PER_BIKEWALK	(COM_A160_DRIVE/COM_A160_TOT) * 100 (COM_A160_BUS/COM_A160_TOT) * 100 (COM_A160_SUBWAY/COM_A160_TOT) * 100 (COM_A160_WALKBIKE/COM_A160_TOT) * 100	COM_A160_TOT = total workers 16 over COM_A160_DRIVE = total workers 16 over who drive to work COM_A160_BUS = total workers 16 over who use bus to work COM_A160_SUBWAY = total workers 16 over who use subway to work COM_A160_BIKEWALK = total workers 16 over who bike or walk to work	Means of transportation to work for workers 16yrs and over

VARIABLE DESCRIPTION	INDEPENDENT VARIABLE	RECODING	SOURCE VARIABLE	THEME
INDEPENDENT VARIABLE (census block group)				
INCOME				
Percentage of households with income–under 50K	PER_HH_U50K	{(INC_HH_U10000+ INC_HH_10000O_U25000+ INC_HH_25000O_U50000) / INC_HH_TOT} * 100	INC_HH_TOT = total households INC_HH_U10000 = total households less than $10K income	Households with the level of income
Percentage of households with income–min 150K	PER_HH_O150K	(INC_HH_MIN150000 / INC_HH_TOT) * 100	INC_HH_10000O_U25000 = total households $10,000-$24,999 income INC_HH_25000O_U50000 = total households $25,000-$49,999 income INC_HH_MIN150000 = total households over $150,000 income	
Percentage of poor households with families and children	PER_FAMCHILD_POV	(HH_FAMCHILD_POV/HH_TOT) * 100	HH_FAMCHILD_POV = poor households with family and children HH_TOT = total households	Households with poverty
CONTROL VARIABLES				
Street segments per sq. mile area	STSEG_PERSQM	(Count of road segments in a census block group)/ (shape_area of the block group)	Road segment counts for a census block group (spatial join of transport_cl counts with census block group)	
Job density	OFF_PERSQM	(Total offices in a census block group) / (shape_area of block group in sq. mile)	Shape_area (census block group area in sq. miles.)	
Housing density	RES_PERSQM	(Total residential units in a census block group) / (shape_area of block group in sq. mile)	GIS_USE = Office (spatial join of office premises with census block group shapefile)	
Bus stop density	BUSSTOP_PERSQM	(Total busstop count in a census block group) / (shape_area of block group in sq. mile)	GIS_USE = Residential (spatial join of residential premises with census block group shapefile)	

VARIABLE DESCRIPTION	INDEPENDENT VARIABLE	RECODING	SOURCE VARIABLE	THEME
Crashes close to bus stop	BUSSTOP_PERCRASH	(Crash counts within 100 ft. of bus stops) / (total crashes in census block group)	Busstop count (for each census block group) (spatial join of busstop with census block group shapefile)	
Density	DENSITY	(Census block group population) / (shape_area of block group in sq. mile)	Total crashes within 100 ft. of bus stops (spatial join of crashes with busstop layer data)	
No alcohol use per crash	ALCUSE_N_PERCRASH	(Sum of ALCUSE_N of all crashes at census block group) / (Total crashes census block group)	TOT_POP ALCUSE_N	
Speeding per crash	SPEEDING_PERCRASH	(Sum of SPEEDING of all crashes at census block group) / (Total crashes census block group)	SPEEDING	
Safety use per crash	SAFETY_Y_PERCRASH	(Sum of SAFETY_Y of all crashes at census block group) / (Total crashes census block group)	SAFETY_Y	

Table 4. Definition table

Term	Definition	Source
KSI	Killed and/or severely injured	
Arterial road	"An arterial road or arterial thoroughfare is a high-capacity urban road. The primary function of an arterial road is to deliver traffic from collector roads to freeways or expressways, and between urban centers at the highest level of service possible".	Wikipedia
Communities of concern	"Communities of concern" is the term used to define the traditionally disadvantaged communities that are found to be disproportionately impacted by traffic crash outcomes in some of the cities where vision zero plans have been implemented.	Vision Zero San Francisco 2024; City of Portland - Vision Zero Action Plan, 2016
Community level	Census block group level	Ouyang & Bejleri, 2014
Census block group (CBG)	"It is a geographical unit used by the United States Census Bureau which is between the Census Tract and the Census Block. It is the smallest geographical unit for which the bureau publishes sample data, i.e. data which is only collected from a fraction of all households".	Wikipedia

D. Equity analysis using regression

i. Investigating the risk of KSI among non-whites, low-income population, and alternate transportation users in Alexandria

A negative binomial regression model (incident rate ratio) was used to investigate the risk of KSI associated with the vulnerable communities/groups in Alexandria. Here the demographic characteristics of the neighborhood (for race, income, and alternate transportation users) are the predictor variables (independent variables) and the response variable (dependent variable) is the total number of KSI in the neighborhoods. The unit of analysis is the census block group. Killed or severely injury (KSI_OC) is the dependent or outcome variable for this model. The independent variables used to answer the research question of equity in Alexandria are: percent white (PER_P_WHITE); percentage households with income under 50K (PER_HH_U50K); percentage households with income over 150K (PER_HH_O150K); percentage commuters who drive to work (PER_DRIVE); percentage commuters who take bus to work (PER_BUS); percentage commuters take metro/subway to work (PER_RAIL); and percentage commuters who walk/bike to work (PER_BIKEWALK). Other variables from previous research that were statistically significant in influencing KSI are used as control variables in this model. This method is used to understand the statistical significance of each demographic characteristic in question (whites/low-income/drive-to-work commuters) with the increased risk of KSI in census block groups when all other factors remain constant. Any statistical significance shown by these demographic groups (variables) in predicting KSI (KSI_OC=killed or severely injured in a crash) would represent an existing relationship between the two at the census block group level in Alexandria. The magnitude of variance in KSI (KSI_OC) predicted by them will represent the risk of KSI associated with each group at the census block group level.

Summary of variables

The traffic related crash data for Alexandria during the 2010-2014 duration shows an average of 1.98 KSI (killed or severely injured) for a census block group (Table 5). However, high variance in the values across block groups is prominent with the high SD (2.56). For independent variables, on an average the Alexandria neighborhoods have a predominantly higher percentage of whites (56.80 percent). In addition, census block groups on an average show higher percentage of commuters driving to work (60.04 percent) than on light-rail (12.62 percent), bus (7.17 percent), or by walking/biking (5.20 percent). Again, these also show high variance from average values across census block groups. On an average the census block groups have 24.67 percent of all households with income under 50K and a 26.78 percent of all households with minimum 150K income. Both are again highly varying across the census block groups. The control variables included in the model are provided in Table 5.

Table 5. Summary of variables for census block group level equity analysis

INDIVIDUAL DEMOGRAPHICS	**FIELD NAME**	**MEAN**	**ST. DEV.**	**MIN**	**MAX**
DEPENDENT VARIABLE					
Total killed and sever injuries (KSI)	KSI_OC	1.980769	2.561783	0	11
INDEPENDENT VARIABLES EQUITY ANALYSIS					
RACE					
Percentage population – White	PER_P_WHITE	56.80769	25.98322	9	98
Percentage population – African American	PER_P_BLACK	19.20192	17.34872	0	78
Percentage population – Hispanic	PER_P_HISP	15.11538	15.75375	0	74
ALTERNATE MODES OF TRANSPORTATION					
Percentage of commuters – drive to work	PER_DRIVE	60.04254	13.599	22.5974	100
Percentage of commuters – use bus to work	PER_BUS	7.176549	7.031692	0	33.4471
Percentage of commuters – use light rail to work	PER_RAIL	12.62255	10.20128	0	51.74825
Percentage of commuters – walk/bike to work	PER_BIKEWALK	5.201372	4.954975	0	21.21212
INCOME					
Percentage of households with income–under 50K	PER_HH_U50K	24.67782	17.65161	1.678657	70.3827
Percentage of households with income – over 150K	PER_HH_O150K	26.78513	21.18654	0	80

Percentage of poor households – poor family with child	PER_FAMCHILD_POV	3.288173	5.574384	0	28.33724
CONTROL VARIABLES					
AGE					
Percentage of individuals - over 64 yr old	PER_P_O64	11.30808	12.10433	0	91.41631
Percentage of individuals - 18 to 64 yr old	PER_P_A18TO64	71.17308	12.27393	9	93
LAND USE					
Job density (per sq. mile area of census block group)	OFF_PERSQM	252.7384	505.4994	0	3393.528
Housing density (per sq. mile area of census block group)	RES_PERSQM	8244.131	7691.842	1025.792	50759.93
STREET CHARACTERISTICS					
Road segment per sq. mile area (for census block group)	STSEG_PERSQM	483.6583	213.6292	109.3821	1239.068
Bus stops per sq. mile area (for census block group)	BUSSTP_PERSQM	64.08915	43.806	0	212.1892
Crashes close to bus stops (within 100 ft.)	BUSSTP_PERCRASH	1.334632	.2955119	1	2
RISKY BEHAVIOR					
No alcohol influence (individuals without alcohol influence per crash incident)	ALCUSE_N_PERCRASH	3.610902	.4501277	0	5
Use of safety equipment (individuals with safety harness per crash incident)	SAFETY_Y_PERCRASH	3.740209	.5876608	0	6
Speeding (drivers per crash incident)	SPEEDING_Y_PERCRASH	.221265	.1207293	0	1

Hypothesis

H1a. KSI is higher in neighborhoods with lower percentage of whites.

The aim of this analysis is to investigate if census block groups with a higher share of vulnerable ethnic groups like Hispanics or African Americans have a higher probability of a KSI than other groups. This hypothesis uses percent white (PER_P_WHITE) as the proxy indicator (independent) variable to represent the percentage of other racial/ethnic groups. This means a higher percentage of whites would represent a lower percentage of other racial demographics in a census block group. A statistically significant relationship between the predictor variable (PER_P_WHITE) and the response variable (KSI_OC), that's negative, would mean the hypothesis is correct.

H1b. KSI occurrence is higher in census block groups containing higher transit and alternative modes of transportation users.

The aim of this analysis is to investigate if vulnerable groups -- like pedestrians, bicyclists or transit users -- have a higher risk of KSI at the census block group level. The relationship between higher concentrations of alternative transportation users for commuting and higher KSI occurrence is used to test this hypothesis at the census block group level. A statistically significant relationship between any one of these predictor variables (PER_BUS, PER_RAIL, PER_BIKEWALK) and the response variable (KSI_OC), that's positive, would mean the hypothesis is correct. Also, a statistically significant relationship between KSI_OC and the predictor variable PER_DRIVE, that's negative, would also mean the hypothesis is correct.

H1c. KSI occurrence is higher in census block groups containing higher percentage of low-income households.

The aim of this analysis is to investigate if areas (census block groups) with low-income households are at higher risk of KSI. It uses the percentage of low-income households at census block groups as predictor variables for KSI occurrence. A statistically significant relationship between the percent low-income variable (PER_HH_U50) and dependent variable of KSI occurrence (KSI_OC), that's positive, would mean the hypothesis is correct.

Table 6. Summary of dependent variable for census block group level equity analysis

VARIABLE DESCRIPTION	***FIELD NAME***	***MEAN***	***ST. DEV.***	***MIN***	***MAX***
DEPENDENT VARIABLE					
KSI OCCURENCE					
Total killed and sever injuries (KSI)	KSI_OC	1.980769	2.561783	0	11

Methodology

The dependent variable (KSI_OC) used to address the research question in this analysis is a count of number of killed and severely injured individuals at the census block group level during the period of 2010-2014. The conventional linear regression model is not suitable for analyzing count data (Negative binomial regression, ND) due to the discrete nature of data points and non-normalized distribution of crash data (Table 5). A Poisson regression method is usually applied for traffic crash analysis and modeling of count data. However, this method assumes that the variance is equal to the mean which is clearly absent in the crash data for this analysis. The variance is seen much higher than the mean in the variables for this analysis (as shown in Table 4) which is indicative over-dispersion. To resolve this issue, a negative binomial regression[1] is applied in many previous studies (Ouyang & Bejleri, 2014; Kim et al., 2006; Lord, 2005; Hadayeghi et al., 2003; Ivan, 2000; Miaou, 1994). Thus, this method is used for the analysis of crash data in this section.

The results from the regression show that the likelihood ratio chi-square for the NCR Model [LR chi2 (14) of 123.40] is significantly better than an empty model (i.e., a model with no predictors) using alpha of 0.05 because p-value is smaller than 0.05 (p=0.000). But, to understand the models' fitness at predicting the outcomes, it was also checked for fitness of model, correlation, and collinearity. The proxy indicator for percentage low-income (PER_HH_U50K = percentage of households with income under 50K) and the percentage high-income (PER_HH_150K = percentage of households with income over 150K) in a census block group was found to be highly correlated with the percentage white (PER_P_WHITE) independent variable in the model (Scatter 1 & 2). Since the proxy indicator of the vulnerable group of poor households families with children (PER_FAMCHILD_POV = percentage of poor household families with children) did not show such correlation with other independent variables, it was used in the model to represent the low-income group (Table 7). Due to collinearity found between "percent-White population" (PER_P_WHITE) and other variables in the model, PER_P_WHITE was also replaced by the "percentage-Hispanic population" (PER_P_HISP) and the "percentage-African American population" (PER_P_BLACK) variables as racial indicator variables. Lastly, "percentage commuters driving to work" (PER_DRIVE) was also found collinear with other variables and was removed from the model. Some control variables that were found collinear with other variables were also removed from the model (Table 7).

After testing with collinearity diagnostics, the final model showed low VIF (variance inflation factor = an indicator of high collinearity) for the independent variables, implying low collinearity. Thus, the next

[1] Negative binomial regression can be used for over-dispersed count data, that is when the conditional variance exceeds the conditional mean.

section summarizes this NBR model results. This model also uses an exposure variable "population density" (POP_DENSITY) in the model.

In a negative binomial regression (NBR), log of the outcome KSI_OC is predicted with a linear combination of the predictors:

log(KSI_OC) = Intercept + b1(PER_HISP) + b2(PER_BLACK) +

b3(PER_HH_U50K) ………………………………… bn(SAFETY_Y_PERCRASH)

This implies:

KSI_OC = exp(b1(PER_HISP) + b2(PER_BLACK) +

b3(PER_HH_U50K) ………………………………… bn(SAFETY_Y_PERCRASH))

= exp(Intercept) * exp(b1(PER_HISP)) * exp(b2(PER_BLACK)) *

exp(b3(PER_HH_U50K)) ………………………………. *exp(bn(SAFETY_Y_PERCRASH))

where,

KSI_OC = variance in dependent variable

PER_HISP, PER_BLACK, …. SAFETY_Y_PERCRASH = variance in each independent variable

b1, b2…bn = coefficient of variance predicted by each point change in respective independent variable in the NBR model

Results

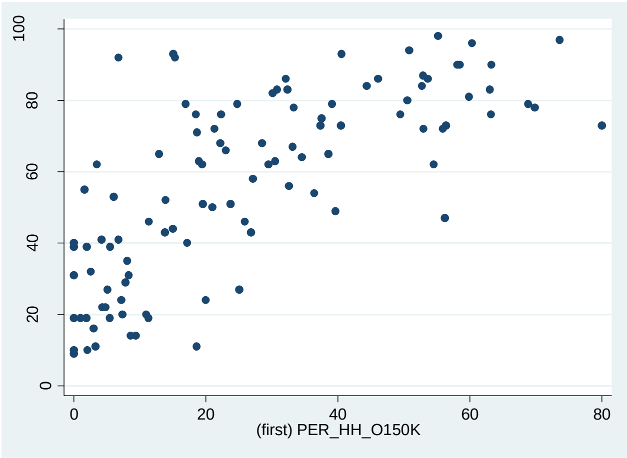
The NBR model shows that the percent-Hispanic (PER_P_HISP) and percent-African American (PER_P_BLACK) demographic profiles of a census block group are not statistically significant ($p>0.05$) in predicting the number of killed or severly injured individuals (KSI_OC) for the census block groups in Alexandria. Hence, we reject the hypothesis that KSI shows a negative relationship with the percent-white at census block group level in Alexandria.

On the other hand, among the alternate transportation mode to work in census block groups (PER_BUS, PER_RAIL, and PER_BIKEWALK), only higher percentage of commuters using metro to work (PER_RAIL) shows statistically significanct relationship with the KSI_OC. A one point increase in the percent of commuters using rail/subway to work in a census block group (PER_RAIL) would mean a higher KSI by a factor of 1.03, while holding all other variables in the model constant. Hence, the hypothesis is not rejected because the KSI shows a positive relationship with the 'percent-commuters using rail/subway to work' (PER_RAIL) at the census block group level in Alexandria.

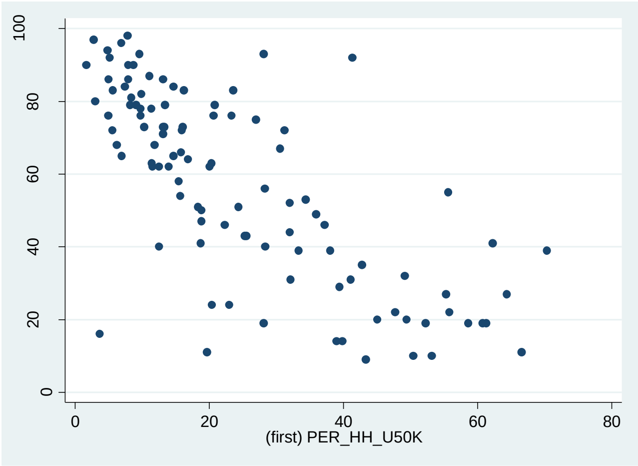
The proxy indicator for percentage low-income (PER_HH_U50K = percentage of households with income under 50K) and the percentage high-income (PER_HH_150K = percentage of households with income over 150K) in a census block group was found to be highly correlated with the percentage white (PER_P_WHITE) independent variable in the model (Scatter 1 & 2). Since the proxy indicator of the vulnerable group of poor households families with children (PER_FAMCHILD_POV = percentage of poor household families with children) did not show such correlation with other independent variables, it was used in the model to represent the low-income group. The PER_FAMCHILD_ POV variable shows no statistical significance (p-value=0.019, $p<0.05$) in the model. Hence, we reject the hypothesis that the areas of higher concentration of low-income group are at higher risk of fatal and severe injuries (KSI) in Alexandria.

In addition, some other predictor variables in the model also show significance in predicting the KSI_OC (as $p<0.05$). The indicator variables for the percentage of young adult population (PER_P_18TO64) and the percentage of elderly population (PER_P_O64) also show statistical significance in the model. Increase in the percentage of young population (PER_P_18TO64) and the percentage of elderly (PER_P_O64) by one point each would mean an increase in the KSI by a factor of 1.036 and 1.0405, respectively, while holding all other variables in the model constant.

Among the built environment variables, road segment density (STSEG_PERSQM) shows statistical significance in the model. Increase in the number of road segments per square mile area (STSEG_PERSQM) (of census block group) by one point would reduce the KSI by a factor of 0.9981, while holding all other variables in the model constant. For the land use variables, both the proxy indicator for job density (OFF_PERSQM) and residence density (RES_PERSQM) show statistical significance in the model. Increase in job density (OFF_PERSQM) by one point would mean an increase in KSI by a factor of 1.0014, whereas, decrease in residential density (RES_PERSQM) by one point would mean decrease in KSI by a factor of 0.9997, while holding all other variables in the model constant.



Scatter 1. High correlation is seen between the percent white independent variable (PER_P_WHITE) and the percent households with income over 150K (PER_HH_O150K) independent variable



Scatter 2. High correlation is seen between the percent white (PER_P_WHITE) independent variable and the percent households with income under 50K (PER_HH_U50K) independent variable

Table 7. Control variables used in NBR analysis with respect to previous research

FACTORS	CRASH SEVERITY	RELATIONSHIP	INDICATOR PICKED FOR ANALYSIS	INDICATOR USED IN FINAL MODEL
DEMOGRAPHIC / SOCIO-ECONOMIC				
DENSITY	Low population density	Higher ratio of crashes with severe injuries; lower fatal and pedestrian crashes.	POP_DENSITY	Y (exposure)
AGE	Higher ratio of population aged 75 years or older	Increase in casualties	PER_P_O64	Y
	Young adult population density	Higher frequency of pedestrian crashes	PER_P_A18TO64	Y
Income	Regions with high income levels	Lower frequency of pedestrian crashes	PER_HH_O150K	N (correlated with PER_P_WHITE)
	Regions with lower income levels	Lower risk of pedestrian crashes	PER_HH_O50K (other– PER_FAMCHI_POV)	N (correlated with PER_P_WHITE) PER_FAMCHI_POV used as proxy variable
PHYSICAL				
LAND USE	Increase in proportion of land use mix (at census block group)	Increases all types of crashes and pedestrian crashes	LANDUSEMIX_1	N (due to high collinearity with residential density and job density)
	Increase in housing density	Reduces severe, fatal, and pedestrian crashes	RES_PERSQM	Y
	Increase in job density	Reduces severe and fatal crashes, and increases	OFF_PERSQM	Y

FACTORS	CRASH SEVERITY	RELATIONSHIP	INDICATOR PICKED FOR ANALYSIS	INDICATOR USED IN FINAL MODEL
		pedestrian crashes		
TRAFFIC CONGESTION	Higher degree of urbanization	Reduces crash severity	DENSITY	N (due to high collinearity with residential density and job density)
	Higher street volume to capacity ratio	Reduces crash severity	N/A	N/A
TRANSPORTATION INFRASTRUCTURE & FACILITIES	Increase in the number of road segments (at census block group)	Increases all types of crashes	STSEG_PERSQM	Y
	Pedestrian exposure	Higher crash frequency in dense urban areas	POP_DENSITY	Y (exposure)
	Higher number of bus stops at a census block group	Increases all types of crashes	BUSSTP_PERSQM	Y
	Crashes that were closer to bus stops (at census block group level)	Decreased all types of crash injuries	BUSSTP_PERCRASH	Y
	Increase in number of intersections at census block group	Decreased all types of crashes	N/A	N (correlated with number of street segments)
INDIVIDUAL's CHARACTERISTICS				
INDIVIDUAL's BEHAVIOUR	Speeding	Increases crash severity	SPEEDING_Y_PERCRASH	Y
	Alcohol use	Increases crash severity	ALCUSE_N_PERINJ	Y
	Not using safety equip ment (seat belt, helmet, etc.)	Increases crash severity	SAFETY_Y_PERINJ	Y

Table 8. NBR model result for total KSI at census block group

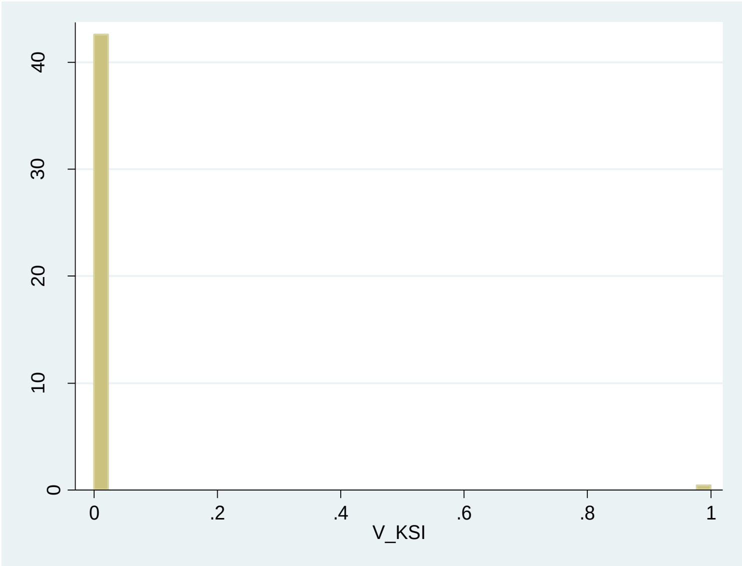
DEPENDENT VARIABLE	INDICATOR FIELD	MODEL RESULTS	
Total KSI in a census block group	**TOTAL KSI (KSI_OC)**	Number of observations: Log-likelihood - Model: Intercept-only: LR chi2(16): Prob > chi2: Pseudo R2: AIC: BIC (df=18):	104 -180.542 -224.405 87.72 0.0000 0.1955 397.084 444.683

INDEPENDENT VARIABLES	INDICATOR FIELDS	Incident Rate Ratio (IRR)	P > | z |	RESULT SIGNIFICANT (Y / N)	DESCRIPTION
RACE					
Percent white population	PER_P_WHITE	N/A	N/A	N/A	(removed from model due to high correlation and collinearity)
Percent African American population	PER_P_BLACK	1.010	0.228	N	
Percent Hispanic population	PER_P_HISP	0.995	0.676	N	
INCOME					
Percentage low-income (households with income - under $50K)	PER_HH_U50K	N/A	N/A	N/A	(removed from model due to high correlation and collinearity)
Percentage high-income (households with income - over $150K)	PER_HH_O150K	N/A	N/A	N/A	(removed from model due to high correlation and collinearity)
Percentage low-income (proxy for low income households)	PER_FAMCHILD_POV	1.032	0.170	N	
ALTERNATE MODES OF TRANSPORTATION USERS					
Percentage population – drive to work	PER_DRIVE	N/A	N/A	N/A	(removed from model due to high correlation and collinearity)
Percentage population – take bus to work	PER_BUS	1.005	0.822	N	
Percentage population – take light rail to work	PER_RAIL	1.029 (+ve)	0.027	Significant	Increase in the percentage commuters taking metro/subway to work (at a census block group) by one point shows an increase in KSI by a factor of 1.029, while holding all other variables in the model constant.
Percentage population – walk/bike to work	PER_BIKEWALK	0.983	0.454	N	
CONTROL					

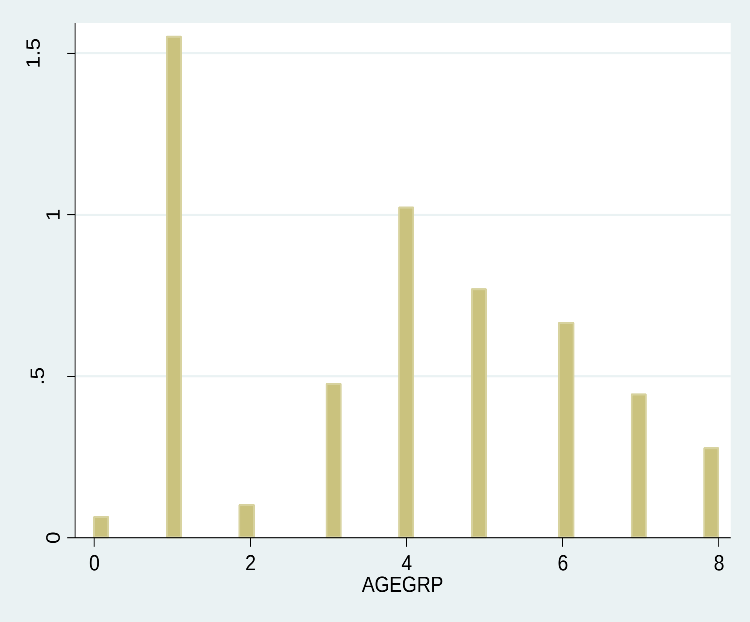
VARIABLES					
AGE					
Percentage young adult (percentage population – 18yr to 64yr old	PER_P_A18TO64	1.040 (+ve)	0.030	Significant	Increase in the percentage young adults (at census block group) by one point shows an increase in KSI by a factor of 1.040, while holding all other variables in the model constant.
Percentage elderly – (percentage of population 65yr old and over)	PER_P_O64	1.042 (+ve)	0.025	Significant	Increase in the percentage elderly (at census block group) by one point shows an increase in KSI by a factor of 1.001, while holding all other variables in the model constant.
LAND USE					
Job density (offices per sq. of census block group)	OFF_PERSQM	1.001 (+ve)	0.000	Significant	Increase in the job density (at census block group) by one point shows an increase in KSI by a factor of 1.001, while holding all other variables in the model constant.
Housing density (residential units per sq. mile area of census block group)	RES_PERSQM	0.9997 (-ve)	0.000	Significant	Increase in the housing density (at census block group) by one point shows a decrease in KSI by a factor of 0.9997, while holding all other variables in the model constant.
TRANSPORTATION FACILITY					
Crashes close to bus stops (within 100 ft)	BUSSTP_PERCRASH	1.067	0.894	N	
Bus stops per sq. mile (census block group) area	BUSSTP_PERSQM	1.0004	0.912	N	
STREET NETWORK					
Street segments per sq. mile (census block group) area	STSEG_PERSQM	0.9981 (-ve)	0.012	Significant	Increase in the number of road segments per sq. mile area (at census block group) by one point shows a decrease in KSI by a factor of 0.9981, while holding all other variables in the model constant.
INDIVIDUAL'S BEHAVIOR					
No alcohol impairment	ALCUSE_N_PERCRASH	1.853	0.255	N	
Speeding	SPEEDING_Y_PERCRASH	0.247	0.339	N	
Safety equipment usage	SAFETY_Y_PERCRASH	0.991	0.981	N	
EXPOSURE					
Population density	POP_DENSITY				
CONSTANT					
Intercept	_cons	3.60e-06	0.001		

ii. Investigating the impact of KSI occurrence on males and elderly in Alexandria

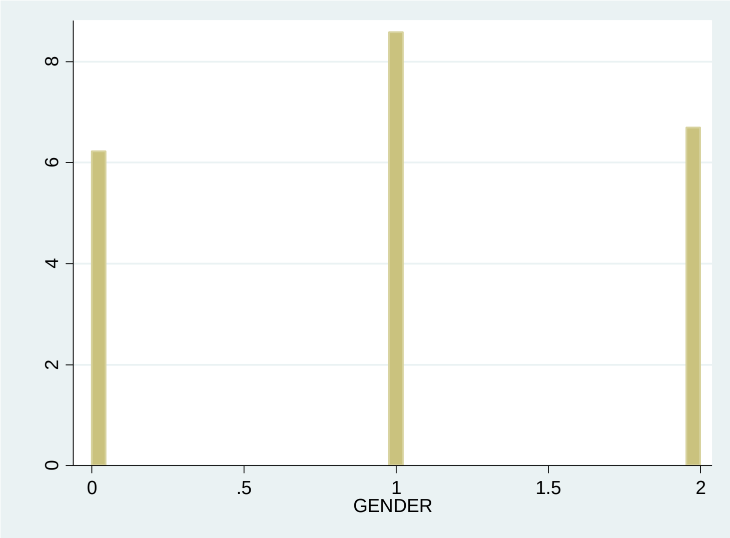
A binomial logistic regression (BLR) (odds ratio) is used to investigate the risk of KSI on the individuals (of the vulnerable groups – males and seniors) involved in a crash incident. The unit of analysis is the individual involved in a crash incident. Killed or severe injury occurrence (V_KSI) in an individual involved in a crash incident is the dependent or outcome variable for this model. The gender (1.GENDER=male; 2.GENDER=female) and the elderly age group (8.AGEGRP=age-over-64yr) are independent variables for this analysis. Any significance shown by the males/females/elderly individuals in predicting KSI (V_KSI=killed or severe injury in an individual during a crash) would represent that there is a relationship between an individual's gender and elderly person with KSI occurrence in a crash. The magnitude variance in KSI (V_KSI) predicted by them will represent the risk of KSI associated with each group.



Histogram 1. Histogram of dependent variable V_KSI



Histogram 2. Histogram of independent variable AGEGRP



Histogram 3. Histogram of independent variable GENDER

Summary of variables

The traffic related crash data for Alexandria during the 2010-2014 duration shows an average of 0.01 KSI occurrence per individual involved in a crash incident (Table 6). However, high variance in the values is prominent with the high SD (0.1), and as well as in the histogram (Hist. 1). For the independent variables GENDER, on an average there was a higher probability of an individual to be male (0.4) than a female (0.31) in a crash incident. In addition, on an average an individual involved in a crash shows the highest probability to be below5yr-old age group (0.29). On an average an individual involved in a car incident had the lowest probability of being in a 5to17yrold age group (0.01). An elderly individual also had a lower probability of being in a crash incident (0.05). The control variables included in the model are provided in Table 9.

Hypothesis

H2a. KSI occurrence in a crash incident is higher in males than in females.

The aim of this analysis is to investigate if one of the genders has a higher probability of KSI in a crash incident. This uses an individual's gender (1.GENDER=male, 2.GENDER=female) as the predictor variable for the KSI occurrence (V_KSI) in an individual involved in a crash. A statistically significant relationship between the male gender predictor variable (1.GENDER) and the response variable (V_KSI), and a higher V_KSI variance predicted by it (compared to the variance predicted by the female gender variable = 2.GENDER), would mean the hypothesis is correct.

H3b. KSI occurrence in a crash incident is higher in elderly from other age groups.

The aim of this analysis is to investigate if the elderly age group (over 64-year-old) has a higher probability of KSI in a crash incident than other age groups. It uses the variable of individual's age group of over64yr-old (8.AGEGRP) as the predictor variable for the KSI occurrence (V_KSI) in an individual involved in a crash. A statistically significant relationship between the elderly age group variable (8.AGEGRP= over64yr-old) and the response variable (V_KSI), and a higher V_KSI variance predicted by it (compared to the variance predicted by all other age groups), would mean the hypothesis is correct.

Table 9. Summary of dependent and independent variables for individual level equity analysis

VARIABLE DESCRIPTION	FIELD NAME	MEAN	ST. DEV.	MIN	MAX
DEPENDENT VARIABLE					
KSI OCCURENCE					
Indicator for KSI occurrence (killed or severely injured)	V_KSI	.0102544	.1007457	0	1
INDEPENDENT VARIABLES FOR EQUITY ANALYSIS	**FIELD NAME**	**MEAN**	**ST. DEV.**	**MIN**	**MAX**
GENDER (categorical variable)	GENDER	1.02172	.7749456	0	2
Male	1.GENDER	.3990135	.4897061	0	1
Female	2.GENDER	.3113534	.463057	0	1
AGE (categorical variable)	AGEGRP	3.805253	2.264444	0	8
Below 5 yr old	1.AGEGRP	.2885514	.4530986	0	1
5 to 17 yr old	2. AGEGRP	.0189512	.1363556	0	1
18 to 24 yr old	3. AGEGRP	.0886985	.2843142	0	1
25 to 34 yr old	4. AGEGRP	.1904206	.3926414	0	1
35 to 44 yr old	5. AGEGRP	.1430858	.3501679	0	1
45 to 54 yr old	6. AGEGRP	.123702	.3292484	0	1
55 to 64 yr old	7. AGEGRP	.0827709	.2755415	0	1
Over 64 yr old	8. AGEGRP	.051748	.2215226	0	1
OTHER PREDICTOR INDEPENDENT VARIABLES	**FIELD NAME**	**MEAN**	**ST. DEV.**	**MIN**	**MAX**
ENVIRONMENTAL FACTORS					
Light condition (Daylight=1, Dark without lighting = 6)	LIGHTCOND	1.721357	1.321097	0	6
TRANSPORTATION FACLITY					
TRAFFIC CONTROL (categorical variable)	TRAFFCONT_GRP	9.023797	4.184595	0	13
Highway safety corridor	1.TRAFFCONT_GRP	.0000865	.0093022	0	1
No passing lines	2.TRAFFCONT_GRP	.0139754	.1173913	0	1
No traffic control	3.TRAFFCONT_GRP	.1750173	.3799901	0	1
Officer or flagger	4.TRAFFCONT_GRP	.0009519	.0308386	0	1
One way road or street	5.TRAFFCONT_GRP	.0047162	.0685137	0	1
Pedestrian crosswalk	6.TRAFFCONT_GRP	.0094756	.0968825	0	1
Reduced speed-school zone	7.TRAFFCONT_GRP	.0001731	.0131548	0	1
Reduced speed-work zone	8.TRAFFCONT_GRP	.0005192	.0227808	0	1
Slow or warning sign	9.TRAFFCONT_GRP	.0009519	.0308386	0	1
Stop sign	10.TRAFFCONT_GRP	.07018	.2554556	0	1
Traffic lanes marked	11.TRAFFCONT_GRP	.228496	.4198729	0	1
	12.TRAFFCONT_GRP	.4163205	.4929587	0	1
	13.TRAFFCONT_GRP	.0124178	.1107435	0	1
VEHICLE OPERATOR ACTIONS (categorical variable)	MANEUVER_GRP	6.435791	4.600207	0	16
Backing	1.MANEUVER_GRP	.0243596	.1541664	0	1
Changing lanes	2.MANEUVER_GRP	.0344843	.1824734	0	1
Entering street from parking lot	3.MANEUVER_GRP	.009865	.0988337	0	1
Going straight ahead	4.MANEUVER_GRP	.4476895	.4972668	0	1
Making left turn	5.MANEUVER_GRP	.1156542	.3198167	0	1
Making right turn	6.MANEUVER_GRP	.0450848	.2074946	0	1
Making u-turn	7.MANEUVER_GRP	.0075718	.086688	0	1
Merging into traffic lane	8.MANEUVER_GRP	.017956	.1327945	0	1

Parked	9.MANEUVER_GRP	.0566805	.2312361	0	1
Passing	10.MANEUVER_GRP	.0046729	.0682002	0	1
Ran off road - left	11.MANEUVER_GRP	.0047162	.0685137	0	1
Ran off road - right	12.MANEUVER_GRP	.0071391	.0841932	0	1
Slowing or stopping	13.MANEUVER_GRP	.0462963	.2101306	0	1
Starting from parked position	14.MANEUVER_GRP	.0083939	.0912349	0	1
Starting in traffic lane	15.MANEUVER_GRP	.0000865	.0093022	0	1
Stopped in traffic lane	16.MANEUVER_GRP	.1288508	.335042	0	1
INDIVIDUAL'S RISKY BEHAVIOUR					
Level of alcohol among individual involved	ALCUSE_LVL	.7027518	.6708189	0	5
Safety harness / equipment use in a crash incident	SAFETY_Y	1.310748	.9390174	0	2
Speeding by individual before a crash incident	SPEEDING	.0512721	.2205569	0	1
PEDESTRIAN ACTIONS (categorical variable)	PEDACTION	.0711319	.703904	0	15
Coming from behind parked cars	1. PEDACTION	.0005192	.0227808	0	1
Crossing at intersection diagonally	2. PEDACTION	.0002596	.0161105	0	1
Crossing at intersection no signal	3. PEDACTION	.0019038	.0435916	0	1
Crossing at intersection w/ signal	4. PEDACTION	.0057546	.075642	0	1
Crossing not at intersection urban	5. PEDACTION	.0025961	.0508864	0	1
Getting on or off other vehicle	6. PEDACTION	.0000865	.0093022	0	1
Lying in roadway	7. PEDACTION	.0000865	.0093022	0	1
Not in roadway	8. PEDACTION	.0009952	.031531	0	1
Playing in roadway	9. PEDACTION	.0000433	.0065778	0	1
Standing in roadway	10. PEDACTION	.0004327	.0207968	0	1
Walk rd against traffic no sidewalk	11. PEDACTION	.0001298	.0113926	0	1
Walk rd against traffic sidewalk	12. PEDACTION	.0000865	.0093022	0	1
Walking in rd w/traffic no sidewalk	13. PEDACTION	.0000865	.0093022	0	1
Walking in rd w/traffic sidewalks	14. PEDACTION	.0000433	.0065778	0	1
x-ing @ intersection against signal	15. PEDACTION	.0006923	.0263027	0	1

Methodology

The dependent variable (V_KSI) used to address the research question in this analysis is a dichotomous binary variable (1 = KSI occurrence, 0 = no KSI occurrence) representing KSI occurrence in individuals involved in a crash incident during the period of 2010-2014. The conventional linear regression model is not suitable for analyzing a binary variable due to the discrete nature of data points and non-normalized distribution of V_KSI (Logistic Regression, ND) (Table 9). For that reason, a binomial logistic regression (BLR) (odds ratio) is used for this analysis.

This analysis uses two parallel binomial logistic regression models (BLR Model 1 and BLR Model 2) for the study. The major difference between the two is the addition of few more variables in BLR Model 2 guided by literature and data. To compare the two models' fitness at predicting the outcomes, both models were diagnosed for fitness of model, correlation, and collinearity. The results show that the likelihood ratio chi-square for both BLR Model 1 [LR chi2 (19) of 476.32] and BLR Model 2 [LR chi2 (28) of 483.74] had a p-value of 0.0000. This shows that both models fit significantly better than an empty model (i.e., a model with no predictors) using alpha of 0.05, because p-value is smaller than 0.05. Also, after testing with the collinearity diagnostics the variables for both models show low VIF (variance inflation factor = an indicator of high collinearity). But, in the fitness to model test the AIC (Akaike Information Criterion) and BIC (Bayesian Information Criterion) -- the measures of model fitness -- for BLR Model 1 are slightly better than the BLR Model 2. Hence, the BLR Model 1 results are summarized in the next section.

The values for the binomial logistic regression equation for predicting the dependent variable from the independent variable are in log-odds units. The prediction equation is:

log(p/1-p) = b0 + b1*(GENDER) + b2*(AGEGRP) ………… + b3*(PEDACTION)

where p/1-p is odds ratio of sustaining a KSI by an individual from the odds of not sustaining it, and p is the probability of sustaining a KSI by the individual.

The odds ratio output the equation is:

p/1-p = exp((b0) + b1*(GENDER) + b2*(AGEGRP) ………… + b3*(PEDACTION))

= exp(b0) * (b1*(GENDER)) * (b2*(AGEGRP)) ………… * (b3*(PEDACTION))

GENDER, AGEGRP, ………… PEDACTION = variance in each independent variable

b1, b2…bn = coefficient of variance predicted by each point change in respective independent variable in the BLR model

Summary of results

The BLR Model 1 shows that the odds for females is not-significantly different from 0 using alpha of 0.05, because p-value is 0.390, which is greater than 0.05. In addition, after testing for the overall effect of GENDER for statistical significance (with test), the result shows that it is not-significantly different from 0 because its p-value is 0.390, which is greater than 0.05. Hence, the hypothesis that the odds of gender in predicting KSI is significantly greater than 0 is rejected. This also rejects the hypothesis that the odds of KSI predicted by the male gender is higher than the odds of KSI predicted by the female gender in a similar crash incident (when all other predictor variables are at a fixed value).

On the other hand, the odds for elderly is significantly different from 0 using alpha of 0.05 because its p-value is 0.0000, which is smaller than 0.05. Holding all other predictor variables at a fixed value, the odds of getting killed or sustaining severe injury (KSI) for elderly (age group over 64yr) (AGEGRP = 8) over its odds of the reference age group (age group below5year-old) (AGEGRP = 1) is 6219% higher. However, the school aged children of 5to17year-old (AGEGRP = 2) show the highest odds of KSI (70.41) compared to all other age groups, 821% higher than the elderly. Thus, we reject the hypothesis that elderly have the highest risk of sustaining KSI. But this also highlights that the school aged children (5to17year-old), another vulnerable group found in literature, are at the highest risk of KSI in crash occurrence in Alexandria.

In addition, other control variables are also seen significant in predicting KSI in the model (using alpha of 0.05) because their p-values are smaller than 0.05. Holding all other predictor variables at a fixed value, we will see 18% increase in the odds of sustaining a KSI for a one-unit increase in LIGHTING predictor variable (one-unit worsening of light conditions) (odds ratio=1.18). This means there is a higher risk of KSI for individuals at night and where traffic lighting is missing or not working. In addition, we will see 23% increase in the odds of sustaining a KSI for a one-unit increase in alcohol level (odds ratio=1.23)

(ALCUSE_LVL: no alcohol=1, high alcohol use causing impairment=5) in an individual during a crash occurrence. Also, we will see a 293% increase in the odds of sustaining a KSI if an individual is speeding before a crash incident (odds ratio=3.93) (SPEEDING: not-speeding=0, speeding before crash=1) from an individual not speeding. This shows risky behavior can cause higher risk of KSI in individuals. Whereas, we will see 56% decrease in the odds of sustaining a KSI for an individual using safety equipment in a crash incident (odds ratio=0.4404) (SAFETY_Y: not-using safety equipment=0, using safety equipment=1) from the individual not using one. This shows that the use of safety equipment by an individual involved in crash incident can save his/her from sustaining a KSI in a crash.

Further, the traffic control predictor variable "no traffic control" at a crash incident (3.TRAFFCONT_GRP) is significantly different from 0 because its p-value is 0.029, which is smaller than 0.05. Also, the maneuvering action predictor variable of "going straight" (4.MANEUVER_GRP) is significantly different from 0 because its p-value is 0.001, which is smaller than 0.05. Lastly, most of the pedestrian action predictors (PEDACTION) of KSI in the model are significantly different from 0 as well. However, there is a possibility of high collinearity between some categories of traffic control predictor variable (TRAFFCONT_GRP)[2] and some categories of the pedestrian action predictor variable (PEDACTION)[3]. This might result in a low/no significance of the predictors when added together in a binomial logistic model (as seen in BLR Model 2). Although out of scope of this study, further analysis may be carried out to resolve this issue. In addition, due to excess zeroes in the data another method may be more appropriate for this analysis. One method suggested in previous research and statisticians is the Zero-Inflated Poisson regression.

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[2] 6.TRAFFCONT_GRP= "PEDESTRIAN CROSSWALK," 10.TRAFFCONT_GRP= "STOP SIGN," 11.TRAFFCONT_GRP= "TRAFFIC LANES MARKED," 12.TRAFFCONT_GRP= "TRAFFIC SIGNAL," 13.TRAFFCONT_GRP= "YIELD SIGN"

[3] 2.PEDACTION= "CROSSING AT INTERSECTION DIAGONALLY," 4.PEDACTION= "CROSSING AT INTERSECTION W/ SIGNAL," 5.PEDACTION = "CROSSING NOT AT INTERSECTION URBAN," 11.PEDACTION = " WALK RD AGAINST TRAFFIC NO SIDEWALK," 12.PEDACTION = "WALK RD AGAINST TRAFFIC SIDEWALK," 13.PEDACTION = "WALKING IN RD W/TRAFFIC NO SIDEWALK," 14.PEDACTION = "WALKING IN RD W/TRAFFIC SIDEWALKS," 15.PEDACTION = "X-ING @ INTERSECTION AGAINST SIGNAL")

Table 10. BLR Model 1. KSI occurrence in individuals involved in a crash incident

DEPENDENT VARIABLE	MODEL RESULTS				
KSI in an individual involved in a crash incident	V_KSI			Number of observations Likelihood Ratio(LR) Chi2(19) Prob > Chi2 Pseudo R2 AIC*n BIC'	23,112 476.32 0.0000 0.1803 2216.186 -285.404
INDEPENDENT VARIABLES FOR HYPOTHESIS	**INDICATOR FIELDS**	**ODDS RATIO**	**P > | z | (+/- z)**	**PREDICTOR VARIABLE IN MODEL - SIGNIFICANTLY > 0 (Y / N)**	**DESCRIPTION**
GENDER	GENDER				
Female gender	2.GENDER	0.8851 (-ve)	0.390	N	
Male gender	1.GENDER	Reference			
AGE	AGEGRP				
Below 5yr old	1.AGEGRP	Reference			
5yr to 17yr old	2.AGEGRP	70.41 (+ve)	0.000	Significant	Holding all other predictor variables at a fixed value, the odds of KSI for elderly (2.AGEGRP) is 6941% higher than the odds of KSI for children below kindergarten (1.AGEGRP).
18yr to 24yr old	3.AGEGRP	44.55 (+ve)	0.000	Significant	Holding all other predictor variables at a fixed value, the odds of KSI for 18to24yr-old is 4455% higher than the odds of KSI for children below kindergarten (1.AGEGRP).
25yr to 34yr old	4.AGEGRP	41.37 (+ve)	0.000	Significant	Holding all other predictor variables at a fixed value, the odds of KSI for 25to34yr-old is 4137% higher than the odds of KSI for children below kindergarten (1.AGEGRP).
35yr to 44yr old	5.AGEGRP	39.14 (+ve)	0.000	Significant	Holding all other predictor variables at a fixed value, the odds of KSI for 35to44yr-old is 3914% higher than the odds of KSI for children below kindergarten (1.AGEGRP).
45yr to 54yr old	6.AGEGRP	42.78 (+ve)	0.000	Significant	Holding all other predictor variables at a fixed value, the odds of KSI for 45to54yr-old is 4278% higher than the odds of KSI for children below kindergarten (1.AGEGRP).
54yr to 64yr old	7.AGEGRP	46.38 (+ve)	0.000	Significant	Holding all other predictor variables at a fixed value, the odds of KSI for 55to64yr-old is 4638% higher than the odds of KSI for children below kindergarten (1.AGEGRP).
Over64year	8.AGEGRP	62.195 (+ve)	0.000	Significant	Holding all other predictor variables at a fixed value, the odds of KSI for elderly (8.AGEGRP) is 6119% higher than the odds of KSI for children below

					kindergarten (1.AGEGRP).
OTHER PREDICTOR VARIABLES					
ENVIRONMENTAL FACTORS					
Decrease in lighting condition	LIGHTCOND	1.18 (+ve)	0.000	Significant	Holding all other predictor variables at a fixed value, we will see 18% increase in the odds of sustaining a KSI for a one-unit increase in LIGHTING value, since it is = 1.18.
TRAFFIC CONTROLS	TRAFFCONT_GRP				
No passing lines	2.TRAFFCONT_GRP	Reference			
No traffic control	3.TRAFFCONT_GRP	0.64 (-ve)	0.029		Holding all other predictor variables at a fixed value, the odds of KSI for a street with no traffic controls is 64% lower than the odds of KSI for street without passing lines in a crash incident.
VEHICLE ACTIONS (MANEUVER)	MANEUVER				
Vehicle changing lanes	2.MANEUVER	Reference			
Vehicle going straight	4.MANEUVER	1.63 (+ve)	0.001	Significant	Holding all other predictor variables at a fixed value, the odds of KSI for individuals going straight is 163% higher than the odds of KSI for vehicle changing lanes in a crash incident.
INDIVIDUAL'S BEHAVIOR					
Increase in alcohol level	ALCUSE_LVL	1.23 (+ve)	0.004	Significant	Holding all other predictor variables at a fixed value, we will see 23% increase in the odds of sustaining a KSI for a one-unit increase in alcohol level.
Speeding	SPEEDING	3.93 (+ve)	0.000	Significant	Holding all other predictor variables at a fixed value, speeding will increase the odds of KSI by 293% as compared to the individual not speeding.
Safety harness/equipment use	SAFETY_Y	0.44 (-ve)	0.000	Significant	Holding all other predictor variables at a fixed value, using a safety harness/equipment will decrease the odds of KSI by 56% as compared to the individual not using one.
PEDESTRIAN ACTIONS	PEDACTION				
Pedestrian appearing from behind a car	1.PEDACTION	Reference			
Pedestrian crossing intersection – no signal	3.PEDACTION	7.12 (+ve)	0.000	Significant	Holding all other predictor variables at a fixed value, the odds of KSI for individual pedestrian action of crossing intersection with no signal is 612% higher than the odds of KSI for pedestrian action of appearing from behind a car in a crash incident.
Pedestrian crossing intersection – with signal	4.PEDACTION	4.7 (+ve)	0.000	Significant	Holding all other predictor variables at a fixed value, the odds of KSI for individual pedestrian action of crossing intersection with signal is 470% higher than the odds of KSI for pedestrian action of appearing from behind a car in a crash incident.

Pedestrian jaywalking in urban road	5.PEDACTION	13.8 (+ve)	0.882	N	
Pedestrian lying on road	7.PEDACTION	197.74 (+ve)	0.002	Significant	Holding all other predictor variables at a fixed value, the odds of KSI for individual pedestrian action of lying on road is 19774% higher than the odds of KSI for pedestrian action of appearing from behind a car in a crash incident.
Pedestrian walking on street opposite to traffic - no sidewalk	11.PEDACTION	14.20 (+ve)	0.000	Significant	Holding all other predictor variables at a fixed value, the odds of KSI for individual pedestrian action of walking on road opposite to traffic-without sidewalk is 1420% higher than the odds of KSI for pedestrian action of appearing from behind a car in a crash incident.

Table 11. BLR Model 2. KSI occurrence in individuals involved in a crash incident

DEPENDENT VARIABLE	**MODEL RESULTS**				
KSI in an individual involved in a crash incident	**V_KSI**			Number of observations Likelihood Ratio(LR) Chi2(19) Prob > Chi2 Pseudo R2 AIC*n BIC'	23,112 483.74 0.0000 0.1831 2226.764 -202.393
INDEPENDENT VARIABLES FOR HYPOTHESIS	**INDICATOR FIELDS**	**ODDS RATIO**	**P > | z |** **(+/- z)**	**PREDICTOR VARIABLE IN MODEL - SIGNIFICANTLY > 0 (Y / N)**	
GENDER	GENDER				
Female gender	2.GENDER	0.88	0.363 (-ve)	N	
Male gender	1.GENDER	Reference			
AGE	AGEGRP				
Below 5yr old	1.AGEGRP	Reference			
5yr to 17yr old	2.AGEGRP	71.94	0.000	Significant	
18yr to 24yr old	3.AGEGRP	44.57	0.000	Significant	
25yr to 34yr old	4.AGEGRP	42.15	0.000	Significant	
35yr to 44yr old	5.AGEGRP	39.59	0.000	Significant	
45yr to 54yr old	6.AGEGRP	43.66	0.000	Significant	
54yr to 64yr old	7.AGEGRP	46.72	0.000	Significant	
Over64year	8.AGEGRP	62.59	0.000	Significant	
OTHER PREDICTOR VARIABLES					
ENVIRONMENTAL FACTORS					
Decrease in lighting condition	LIGHTCOND	1.18	0.000	Significant	
TRAFFIC CONTROLS	TRAFFCONT_GRP				
No passing lines	2.TRAFFCONT_GRP	Reference			
No traffic control	3.TRAFFCONT_GRP	0.48 (-ve)	0.008	Significant	
Officer or flagger	4.TRAFFCONT_GRP	2.34	0.463	N	
One way road or street	5.TRAFFCONT_GRP	0.66 (-ve)	0.682	N	
Pedestrian crosswalk	6.TRAFFCONT_GRP	0.62 (-ve)	0.301	N	
Stop sign	10.TRAFFCONT_GRP	0.65 (-ve)	0.185	N	
Traffic lanes marked	11.TRAFFCONT_GRP	0.82 (-ve)	0.410	N	
Traffic signal	12.TRAFFCONT_GRP	0.65 (-ve)	0.064	N	
Yield sign	13.TRAFFCONT_GRP	0.78 (-ve)	0.736	N	
VEHICLE ACTIONS (MANEUVER)	MANEUVER				
Vehicle changing lanes	2.MANEUVER	Reference			
Vehicle going straight	4.MANEUVER	1.75	0.002	Significant	
Making left turn	5.MANEUVER	1.44	0.178	N	

Making right turn	6.MANEUVER	0.65 (-ve)	0.419	N	
INDIVIDUAL'S BEHAVIOR					
Increase in alcohol level	ALCUSE_LVL	1.22	0.005	Significant	
Speeding	SPEEDING	3.93	0.000	Significant	
Safety harness/equipment use	SAFETY_Y	0.44 (-ve)	0.000	Significant	
PEDESTRIAN ACTIONS	PEDACTION				
Pedestrian appearing from behind a car	1.PEDACTION	Reference			
Pedestrian crossing intersection – no signal	3.PEDACTION	7.82	0.000	Significant	
Pedestrian crossing intersection – with signal	4.PEDACTION	5.81	0.000	Significant	
Pedestrian jaywalking in urban road	5.PEDACTION	13.99	0.882	Significant	
Pedestrian lying on road	7.PEDACTION	214.61	0.002	Significant	
Pedestrian walking on street opposite to traffic - no sidewalk	11.PEDACTION	12.22	0.000	Significant	