Ohio Department of Public Safety
Emergency Medical Services Division
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Special Study #4

The Impact of Trauma on Minority Children

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Acknowledgements

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Summary and Conclusions.

1. *Information for the report was obtained from regional pediatric trauma registries, the 2000 US Census, and the Ohio Bureau of Vital Statistics Death Certificate database. Children fifteen and younger were studied for this report.*
2. *The trauma registries have a single field for race and ethnicity while the US census and Bureau of vital statistics separate race from ethnicity (Hispanic). Combining race and ethnicity, the 2000 census reported about 12.3% of Ohio children 15 and under were African American, 0.1% were Native American, 0.3% were Asian, 1.1% were Hispanic (white-Hispanic), and 2.2% were other races/ethnic.*
3. *Of the 1900 injury deaths of children from 1996 through 2001, 510 (26.8%) of them were minorities. Of the 6084 direct from the scene admissions to regional pediatric trauma programs from 1998 through 2001, 2060 (33.9%) were minorities. Approximately two thirds of the injury admissions were in boys (65%) and there was no differential effect of gender and race (Chi Square = 3.35, p=0.647). Overall about 28% of the admissions were African American. Other minorities made up a very small portion of cases.*
4. Identify the causes and outcomes of trauma injuries in the minority populations of African Americans, Asians, Hispanic Americans, and Native Americans. Outcome is defined as death and length of stay in the hospital.
   African Americans have the highest rate of death and injury per 100,000 children (nearly 25 deaths per 100,000 and 130 admissions per 100,000) and Asians have the lowest. The relative risk of African Americans to injury death and trauma admissions is two to three times as great as to white. Hispanics are about the same, American Indians a little less, and Asians are at substantially less risk than whites.

   After controlling for injury severity, hospital length of stay for minorities was the same as for majority whites. The most frequent cause of minority admission was from falls (26 per 100,000 children 15 and under), followed by pedestrian (19 per 100,000), motor vehicle (17 per 100,000), and the other injury category (15 per 100,000). Risk of injury admission relative to the majority white population was led by burns (6.6 times as likely for all minorities as for whites) followed by pedestrian injuries, gunshot wounds, assaults, drowning, and crushes injuries.

   From death certificate data, homicides were greater for children under two than for children 15 and there was no difference in the pattern between minorities and whites across age (Chi Square = 17.9, p=0.265). The rise in suicide suggests prevention activities should begin as early as age 10. There was no difference in the pattern of suicide between minorities and whites across age (Chi Square = 9.0, p=0.176). The pattern of death by age was different for overall injury deaths and unintentional injuries (p<0.001 for both) with minorities having greater unintentional deaths at infancy and whites having more unintentional deaths in the early teenage years.

5. Identify the rate of injury by cause and outcome by location (zip code and county) for each of the minority groups. State maps identifying rates of injury by zip code and county will be produced. Location information will also be examined relative to the effects of education and income level in each zip code area.

Within the minority population, there was a small correlation between falls and the number of vacant housing units and a stronger correlation with population density. Numbers of assaults were associated with neighborhoods that had lower median income, increased population density, vacant housing units, adults with education below the 9th grade, and those out of the work force. The categories, Other Injury, and Burns were also correlated with all the socioeconomic factors. The correlations support the hypothesis that assaults, burns, and other injuries are a disease of poverty.

6. Compare the rates of missing data across minority group and location (county). This study reviews a subset of the information at the local level that is submitted to the State Trauma Registry. Complete data is essential for the successful use of the State Registry. The study will determine if there are any patterns of missing data related to minority populations. *While there was substantial missing data in some fields there was not a significant differential pattern of missing data between minorities and majority whites.*

7. Compare the rates of patients discharged to rehab for ISS > 16 across minority group. *About 3.4% of all minority admissions result in referral to rehabilitation compared to 2.2% of majority whites (Odds Ratio = 1.57, p=0.005). This difference was reduced to a non-statistically significant 11 percent increase when adjusted for seriousness of injury (OR = 1.11, p=0.59).*

8. Assess access to EMS services.
   The number of miles to the address of the nearest EMS agency and the center point (centroid) of each census block group in Ohio was calculated. There was no relationship between distance to an EMS agency and the proportion of minorities within a census block. In urban areas most residents are within three miles of an EMS agency regardless of minority status. In semi urban areas most residents are within 4 miles of an EMS agency.

Introduction

This study reports on *the causes and impact of trauma minority children.* Columbus Children's Hospital conducted this study by partnering with the other pediatric trauma centers in Ohio in order to provide a statewide review of the causes and outcomes of trauma across various populations.

Report Objectives

1. Identify the causes and outcomes of trauma injuries in the minority populations of African Americans, Asians, Hispanic Americans, and Native Americans. Outcome is defined as death and length of stay in the hospital.
2. Identify the rate of injury by cause and outcome by location (zip code and county) for each of the minority groups. State maps identifying rates of injury by zip code and county will be produced. Location information will also be examined relative to the effects of education and income level in each zip code area.
3. Compare the rates of missing data across minority group and location (county). This study reviews a subset of the information at the local level that is submitted to the State Trauma Registry. Complete data is essential for the successful use of the State Registry. The study will determine if there are any patterns of missing data related to minority populations.
4. Compare the rates of patients discharged to rehab for ISS > 16 across minority group.
5. Compare the time from 911 call logging to arrival in the ED across minority group. Caucasian times will represent the reference group while creating location matched pairs of other minority racial categories. The hypothesis tested will be no systematic differences of response time across racial groups.

Methods of data collection and analysis

Study sample
The study sample consisted of children who were listed in the trauma registries of the regional pediatric trauma in Ohio. These registries are maintained in the programs in Akron, Cincinnati, Cleveland, Columbus, Dayton, and Toledo.

Trauma Registry data characteristics
The sample characteristics and inclusion criteria were: patients admitted to the hospital for treatment of injury (or outcome died in the emergency department (ED)), age is less than or equal to 15 years, transported to reporting facility from scene by either ambulance service (AS), helicopter service (HS) or private vehicle PV), and injured in 1999, 2000 or 2001. The trauma registry data fields included patient's age, gender, E-Code, race, outcome (alive/died), residential zip code, residential city, residential state, type of trauma (blunt, penetrating, etc.), AIS to region, ISS, RTS[1], transportation method from scene, injury location (home, street, etc.), injury zip code, ED arrival time, ICU length of stay, hospital (initial trauma admission) length of stay, and discharge destination from hospital.

[1] AIS = Abbreviated Injury Score. ISS = Injury Severity Score. RTS = Revised Trauma Score. (See Appendix)

Zip code identification in the report used injury location. If the injury zip code was missing, then residential zip code was used. No further attempt was used to define zip code if neither injury or residential zip code were present. County was defined from the zip code information. If the zip code was missing then the city was used to define the county. If the city was missing then county was defined by the county of the trauma program.

Other sources. Other sources of information for the reported included the 2000 US census and Ohio Bureau of Vital Statistics Death Certificate data from 1996 through 2001.

Definition of minority

For the purposes of this report minority will include races other than white. Separate races were reported in the context where sufficient numbers allowed. Because the trauma registries include Hispanic in their race field, a single variable was created from race and ethnicity variables in the U.S. census information and death statistics provided by the Ohio Bureau of Vital Statistics. The census bureau distinguishes between race and ethnicity and reports Hispanic ethnicity separately. In this report race counts were derived from the single race headings and the ethnic category of Hispanic whites. The number of whites was reduced by the number of Hispanic whites. This method resulted in a slight underestimation of the number of Hispanics. A similar strategy was used for Ohio death statistics provided by the Ohio Bureau of Vital Statistics by subtracting Hispanic from white. The resulting categories for all three primary sources of data were white, African-American, American-Indian, Asian, Hispanic, and other.

Results

Characterization of the sample. All regional pediatric trauma programs in the state provided trauma registry data for the years 1998-2001. Table 1 presents the race and gender distributions for trauma admissions to the regional pediatric trauma centers. Approximately two thirds of the injuries were in boys (65%) and there was no relationship between gender and race (Chi Square = 3.35, p=0.647). Overall about 28% of the cases were African American. Other minorities made up a very small portion of cases. The 2000 census reported about 12.3% of Ohio children 15 and under were African American, 0.1% were Native American, 0.3% were Asian, 1.1% were Hispanic (white-Hispanic), and 2.2% were other races/ethnic. Approximately 17% of Ohio children are non-white. Figure 1 illustrates the distribution of minorities across the State by block group from the US census. The towers represent the number of individuals within a block group who are minority. While Cuyahoga County has the most minorities, Hamilton County has a few census block groups that lead the State in number of minorities.

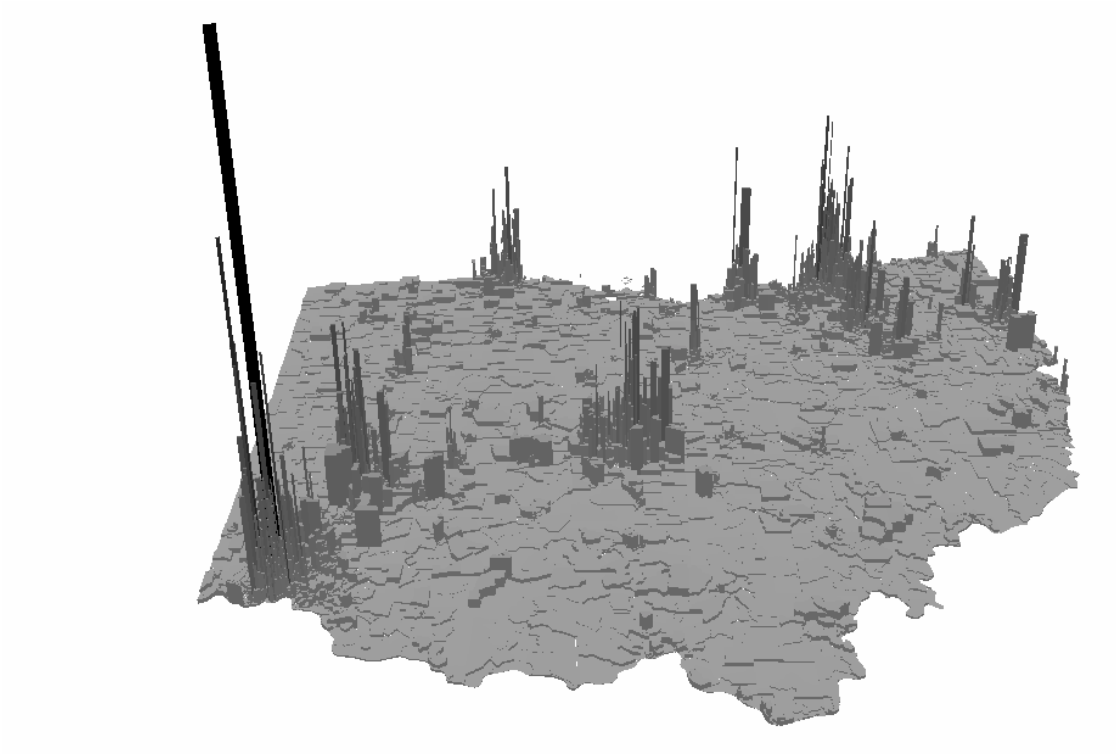

Figure 1. Distribution of minority children across Ohio. The height of the towers reflect the number of minority children 15 years and younger living in a US census block group.

Table 1. Percent of cases (Age <= 15 yrs) presenting to regional pediatric trauma centers 1998 - 2001.

		Race/Ethnicity						
	Gender	White	African American	Native American	Asian	Hispanic	Other Nonwhite	Number Cases
Akron	Male	55.1%	9.6		0.3		0.2	399
	Female	27.1%	7.4				0.3	213
	Total	82.2%	17.0		0.3		0.5	612
Cincinnati	Male	47.7	14.4	0.2		1.1	2.9	1197
	Female	24.6	7.1		0.1	0.6	1.5	611
	Total	72.2	21.5	0.2	0.1	1.7	4.4	1808
Cleveland	Male	31.4	31.7	0.2		0.9	0.1	833
	Female	17.8	17.1	0.1	0.1	0.6		462
	Total	49.3	48.7	0.3	0.1	1.5	0.1	1295
Columbus	Male	43.4	18.0		0.4	0.2	2.2	665
	Female	25.1	8.4		0.3	0.1	1.9	371
	Total	68.5	26.4		0.7	0.3	4.2	1036
Dayton	Male	50.6	11.6			0.3	1.1	450
	Female	28.7	7.1				0.6	257
	Total	79.3	18.7			0.3	1.7	707
Toledo	Male	42.9	16.7		0.8	0.8	0.6	318
	Female	25.8	10.5		0.8	1.0	0.2	197
	Total	68.7	27.2		1.6	1.7	0.8	515

All Children's Hospitals (Number of admissions)	4072	1668	7	19	65	142	5973
Percent	68.2%	27.9%	0.1%	0.3%	1.1%	2.4%	
Number Children <= 15 Ohio Census	2,134,133	314,185	5,600	28,539	24,724	57,466	2,564,646
Percent	83.2%	12.3%	0.2%	1.1%	1.0%	2.2%	

184 of 6157 total registry cases were missing race

Summary of the number of serious injuries. Figure 2 illustrates the rate of injury for each of the racial groups. **African Americans have the highest rate of death and injury per 100,000 children** (nearly 25 deaths per 100,000 and 130 admissions per 100,000) and Asians have the lowest. These points are further demonstrated in Figure 3 which presents the risk of the minority populations relative to the white population (i.e. the rates of the minority population are divided by the rates of the white population). **The relative risk of African Americans to injury death and trauma admissions is two to three times as great as to white**. Hispanics are about the same, American Indians a little less, and Asians are at substantially less risk than whites.

General Cause of Injury (E-codes). Part of the International Classification of Diseases (ICD version 9 and 10) is a system of codes that identifies the general cause of injury. Table 2 presents rates of injuries per 100,000 children by the major causes of injury. The most frequent cause of minority admission was from falls (26 per 100,000 children 15 and under), followed by pedestrian (19 per 100,000), motor vehicle (17 per 100,000), and the other injury category (15 per 100,000). Risk of injury admission relative to the majority white population was led by burns (6.6 times as likely for all minorities as for whites) followed by pedestrian injuries, gunshot wounds, assaults, drowning, and crushes injuries.

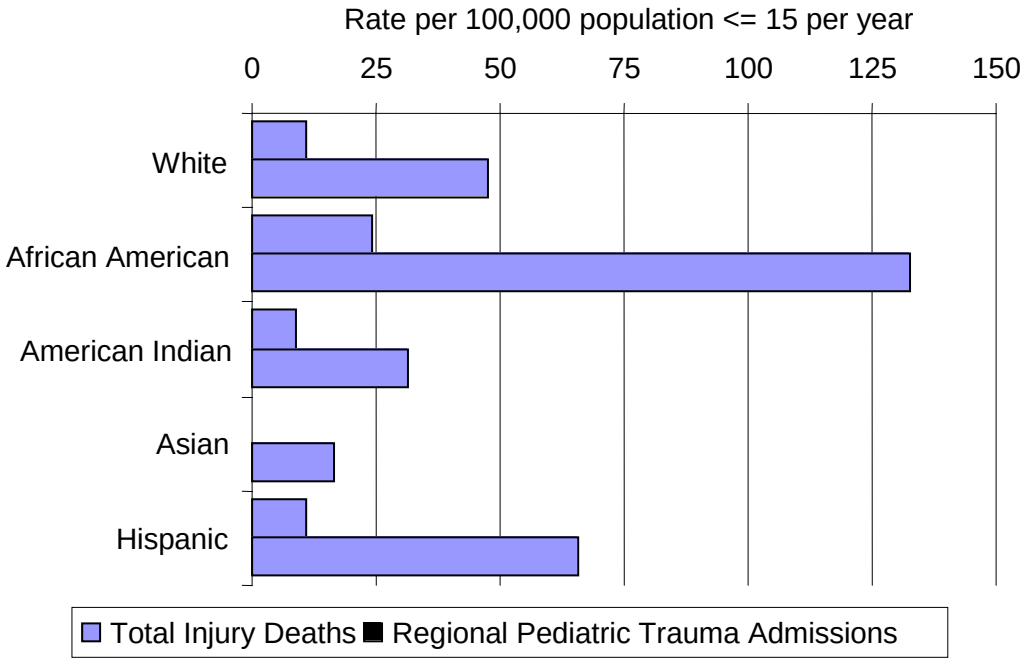

Figure 2. Rate of injury death and trauma admissions.

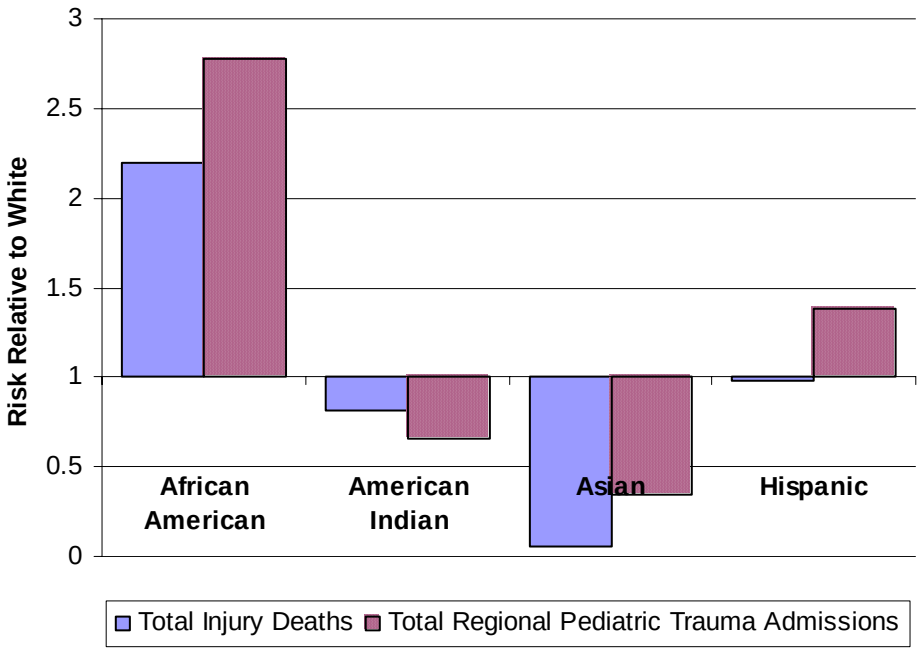

Figure 3. Risk of minority populations relative to the white population

Table 2. Rate of trauma center admissions per 100,000 children by major cause of injury.

Major Cause Category (E-Code)	White	African American	Native American	Asian	Hispanic	All Minority
Fall	13.3	27.8	8.9	4.4	18.2	26.0
Pedestrian	3.1	21.6	4.5	1.8	2.0	18.9
Motor Vehicle	8.9	16.0	13.4	2.6	11.1	17.2
Other	6.1	16.8	0.0	0.9	12.1	14.7
Bike	4.8	10.7	0.0	0.9	4.0	9.6
Burn	1.3	10.1	4.5	1.8	1.0	8.7
Assault	1.5	8.8	0.0	0.9	8.1	7.4
Sport	2.8	4.7	0.0	0.0	3.0	4.2
Stab	1.8	4.7	0.0	0.0	2.0	3.8
Gunshot	0.4	2.8	0.0	0.0	0.0	2.1
Crush	0.5	2.1	0.0	0.0	1.0	2.1
Animal	1.2	1.8	0.0	0.0	1.0	1.8
Drown	0.4	1.9	0.0	3.5	0.0	1.7
Foreign Body	0.4	0.6	0.0	0.0	1.0	0.6
Motorcycle	0.4	0.2	0.0	0.0	1.0	0.3
Hang	0.0	0.2	0.0	0.0	0.0	0.1
Dive	0.1	0.0	0.0	0.0	0.0	0.0

Table 3. Risk of pediatric trauma center admission relative to whites by major cause of injury. Calculated by dividing the rate of the minority group by the rate of whites.

	African American	Native American	Asian	Hispanic	All Minority
Burn	7.70	3.40	1.34	0.77	6.64

Pedestrian	7.05	1.45	0.57	0.66	6.17
Gunshot	7.67	0.00	0.00	0.00	5.92
Assault	5.98	0.00	0.60	5.52	5.08
Drown	4.66	0.00	8.55	0.00	4.25
Crush	4.17	0.00	0.00	1.96	4.06
Hang	4.53	0.00	0.00	0.00	3.30
Other	2.74	0.00	0.14	1.98	2.41
Stab	2.67	0.00	0.00	1.15	2.15
Bike	2.23	0.00	0.18	0.84	1.99
Fall	2.10	0.67	0.33	1.37	1.95
Motor Vehicle	1.80	1.51	0.30	1.25	1.94
Foreign Body	1.44	0.00	0.00	2.62	1.65
Sport	1.71	0.00	0.00	1.10	1.52
Animal	1.50	0.00	0.00	0.83	1.48
Motorcycle	0.57	0.00	0.00	2.40	0.83
Dive	0.00	0.00	0.00	0.00	0.00

Death outcome. Table 4 identifies children who were either dead upon arrival to the hospital or died in the hospital after admission to the trauma program. **Overall the odds of a minority child dying was 2.4 times greater than a white child** (Chi Square 32.4, $p<0.001$). However, adjusting for severity of injury using TRISS (TRISS Odds ratio = 0.324, Wald=248, $p<0.001$), the adjusted odds ratio for minorities was reduced to a non-statistically significant 1.60 ($p=0.167$). Length of stay was not significantly different between minorities and the majority white children (Odds ratio=1.033, $p=0.23$). After controlling for TRISS (Wald = 663, $p<0.001$) length of stay for minorities was the same as for majority whites (Odds ratio = 0.999, $p=0.97$). The TRISS is a standardized injury severity measure composed of the ISS and the RTS. The means and standard deviations for the ISS, RTS, and hospital length of stay are found in Table 4. **Statewide statistics from the Ohio Bureau of Vital Statistics confirm the 2 to 1 ratio of injury deaths for African-American children relative to Whites and the other racial categories**. The rather high death rate for Asian children in the Trauma program database was not borne out in the data from death statistics, and was most likely due to the very low number of Asian patients in the trauma program.

Table 4. Death outcome by race/ethnicity, mean (SD) ISS, RTS, and hospital length of stay

	Regional pediatric Trauma Programs					Ohio Bureau of Vital Statistics
	Alive	Dead	ISS	RTS	LOS	Deaths per 100,000 children <= 15
White	98.1%	1.9%	7.79 (7.9)	7.53 (1.05)	3.18	11
African American	95.6%	4.4%	6.52 (8.5)	7.30 (1.51)	3.17	24
Native American	100.0%	0.0%	3.14 (1.8)	7.67 (0.16)	2.14	9
Asian	84.2%	15.8%	7.13 (7.1)	6.77 (2.49)	2.16	1
Hispanic	100.0%	0.0%	6.41 (6.4)	7.71 (0.24)	3.97	11
Total	97.4%	2.6%				
Number of Admissions	5746	156				

Outcome data is summarized for only the counties in which the trauma programs are located.

Table 5 explores the question of whether there was an increase or decrease in injury deaths. There was no statistically significant relationship between race and year of injury death. A review of Table 5 suggests a possible decrease but then deaths in 2001 increased.

Table 5. Bureau of Vital Statistics injury related deaths from death certificates.

	White	African American	Native American	Asian	Hispanic	All minorities
1996	266	81	1	0	3	91
1997	233	90	0	0	2	97
1998	252	74	1	0	3	89
1999	219	52	1	1	5	66
2000	245	73	0	0	3	79
2001	192	85	0	0	0	88
	1407	455	3	1	16	510

In Figure 4 the cause of injury death as reported on the death certificate is presented. The main causes were motor vehicle crashes, drowning, fire, unspecified non-transport events, and homicide. Figure 5 shows the statewide distribution of deaths as recorded on Ohio Bureau of Vital Statistics death certificates. There were rather striking large black slices indicating homicides of children 15 years old and under in the major cities. Figure 6 illustrates the similarity in pattern of injury death over age across both minorities and majority whites. Homicides were greater for children under two than for children 15 and there was no difference in the pattern between minorities and whites across age (Chi Square = 17.9, $p=0.265$). The rise in suicide suggests prevention activities should begin as early as age 10. There was no difference in the pattern of suicide between minorities and whites across age (Chi Square = 9.0, $p=0.176$). The pattern of death by age was different for overall injury deaths and unintentional injuries ($p<0.001$ for both) with minorities having greater unintentional deaths at infancy and whites having more unintentional deaths in the early teenage years.

The frequency of trauma program admissions varies over age depending on the type of injury. Falls were the most frequent cause of injury and fairly constant across age (see Figure 7). Motor vehicle injuries increased with age peaking at year six and then decreasing through year 15. This may be due to children growing out of their initial car seats. As in the death certificate pattern, assaults are highest at very early ages and quickly declined only to rise again with the early teenage years. Injuries due to burns at early age suggest prevention efforts should be directed toward new mothers. Table 6 presents more detailed causes of injuries that present to the trauma programs. Figure 8 is a map of the major causes of injury to minorities in the various communities across Ohio. All major areas see many children with falls. Assaults were greater in Cincinnati, Columbus had more motor vehicle accidents than would be expected, and Cleveland led in burns. Many counties were not represented by any admissions. The study only considered admissions directly from the scene. A much wider representation would have been seen had transfers from other hospitals been considered.

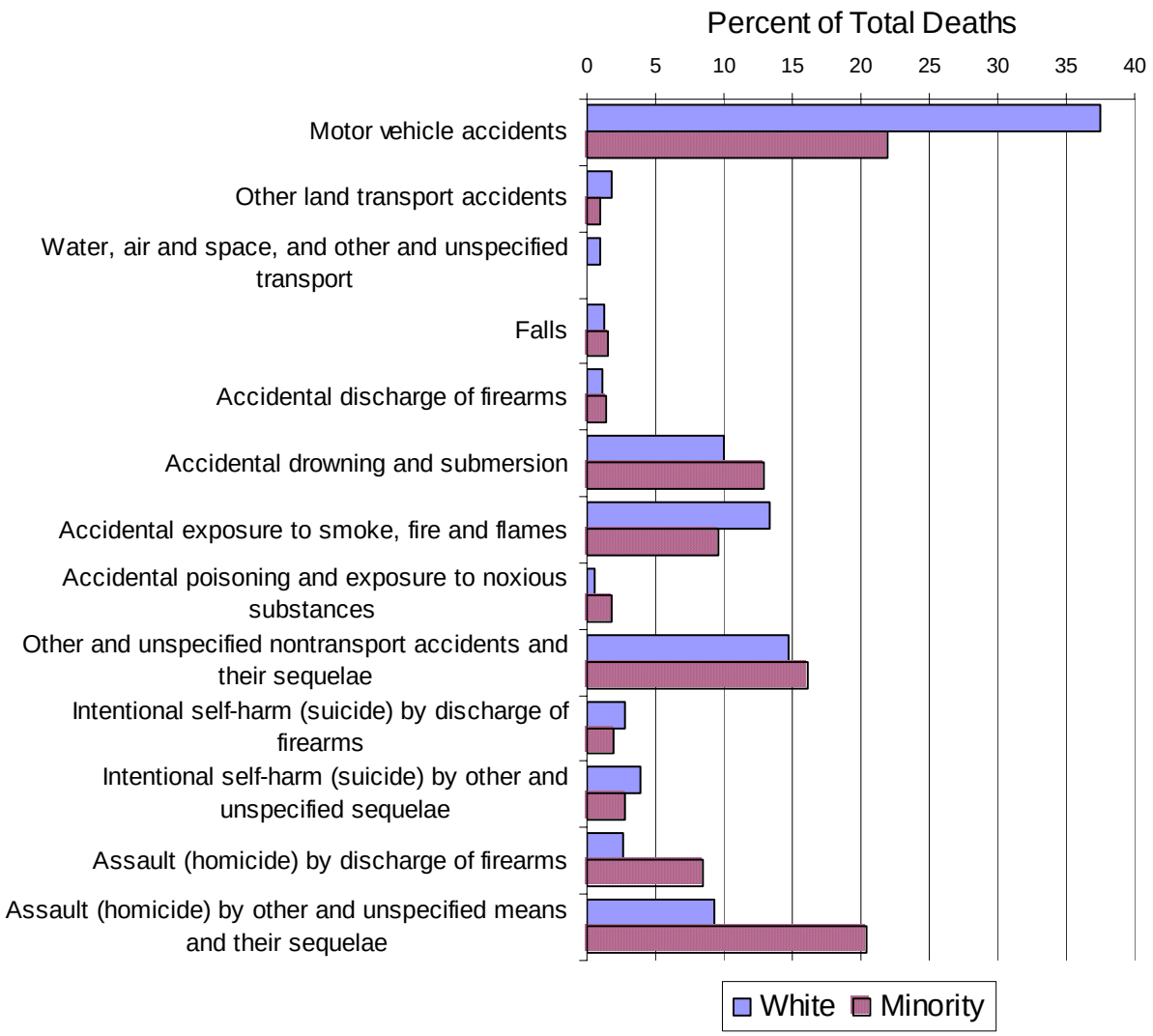

Figure 4. Death certificate cause of death by race/ethnicity

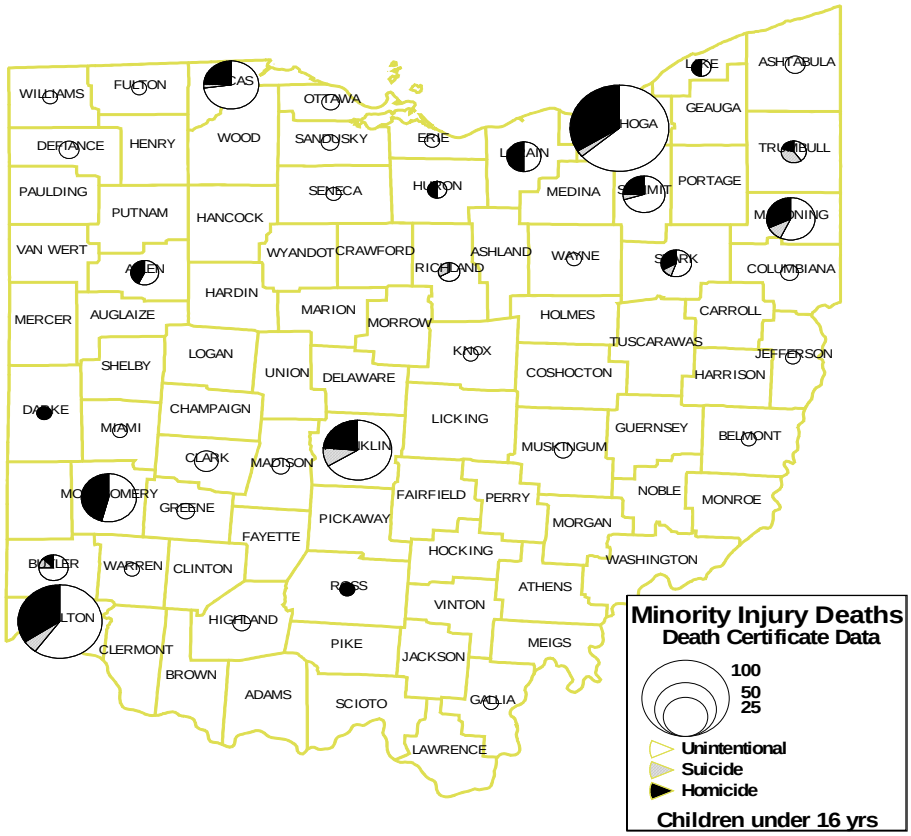

Figure 5. Pediatric injury deaths as recorded by the Ohio Bureau of Vital Statistics from 1996 through 2001. Size of the pie reflects the number of deaths and the slices represent unintentional, suicides, and homicides.

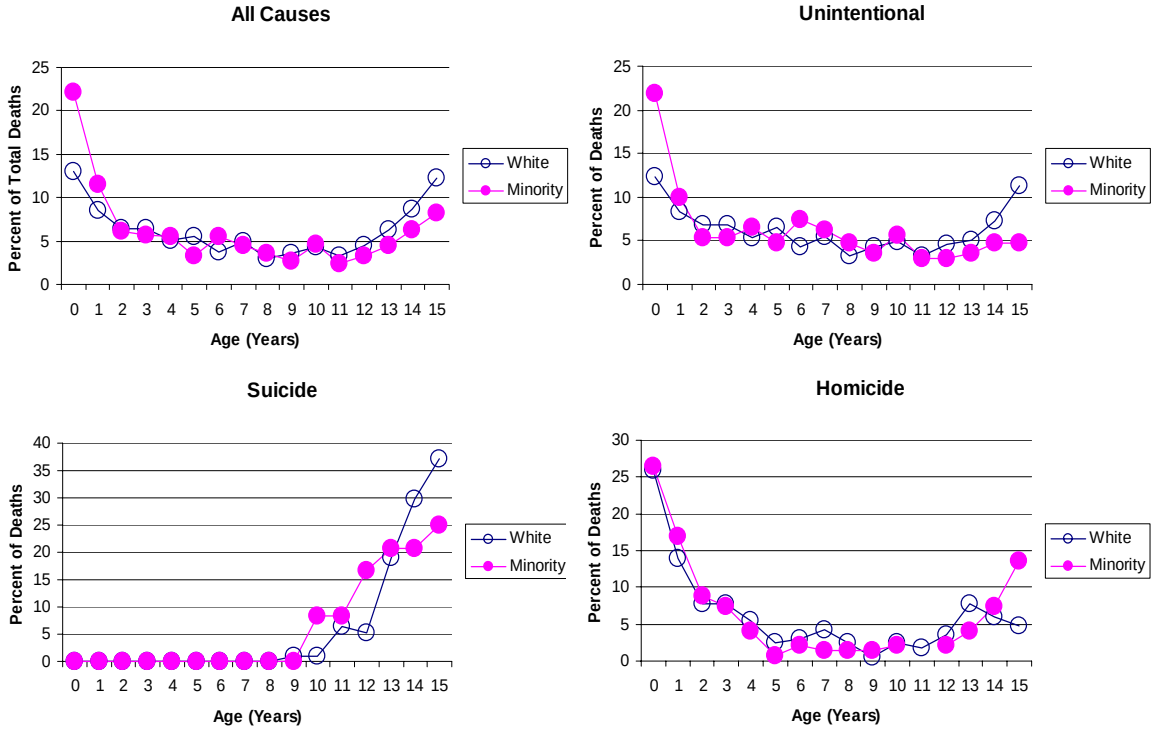

Figure 6. Pediatric deaths by age as reported on death certificates.

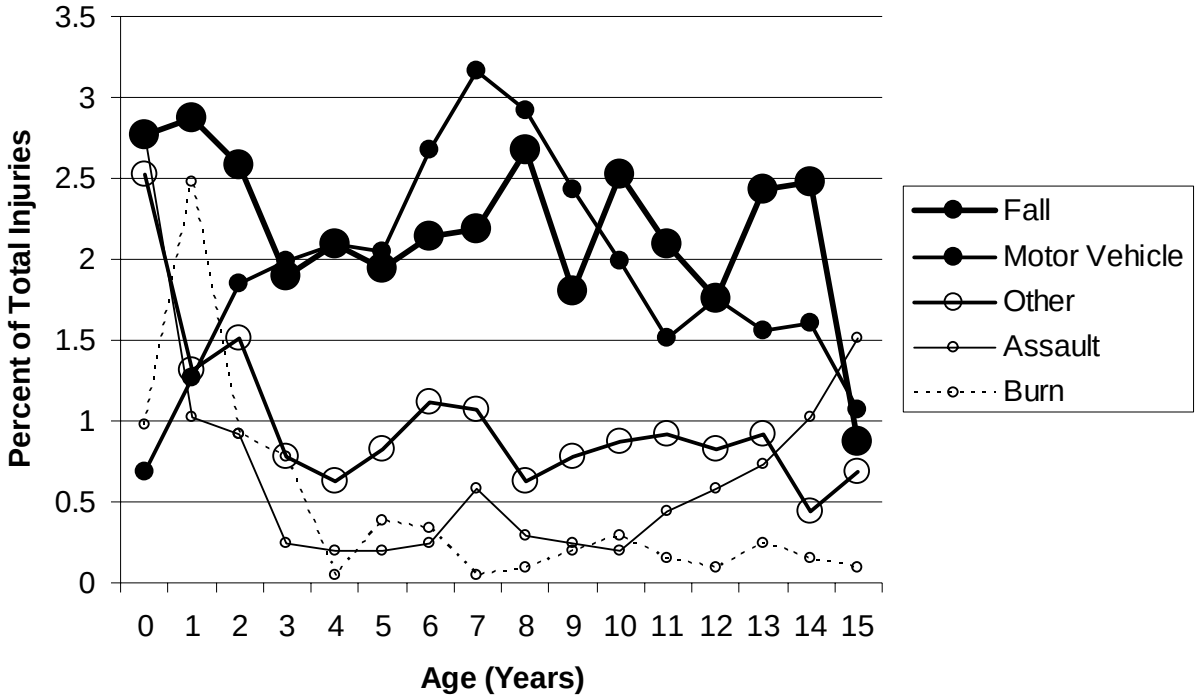

Figure 7. Major cause of trauma program admissions for minority children. Size and boldness of line represent number of injuries.

Table 6. Cause of minority child trauma program admissions by age. Values are percents of the total admissions pool in the six Ohio Regional pediatric trauma programs (n=2057)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Fall	2.58	2.72	2.43	1.60	1.51	1.31	1.41	1.36	1.22	0.92	1.12	0.92	0.68	0.73	0.92	0.29	21.73
Pedestrian	0.05	0.19	1.07	0.92	0.68	1.22	1.90	2.04	1.85	1.51	0.97	0.97	0.78	0.83	0.68	0.19	15.85
MotorVehicle	0.63	1.07	0.78	1.07	1.36	0.83	0.73	1.12	1.02	0.92	0.97	0.53	0.97	0.73	0.83	0.88	14.44
Other	2.43	0.88	1.12	0.63	0.53	0.49	0.78	0.88	0.39	0.53	0.53	0.78	0.68	0.68	0.39	0.63	12.35
Bike	0.00	0.00	0.00	0.10	0.24	0.58	0.44	0.63	1.07	0.53	0.97	0.78	0.78	1.02	0.63	0.24	8.02
Burn	0.97	2.48	0.92	0.78	0.05	0.39	0.34	0.05	0.10	0.19	0.29	0.15	0.10	0.24	0.15	0.10	7.29
Assault	2.58	0.88	0.53	0.15	0.05	0.05	0.00	0.10	0.15	0.05	0.10	0.24	0.24	0.24	0.34	0.53	6.22
Sport	0.10	0.00	0.00	0.05	0.05	0.00	0.15	0.10	0.24	0.24	0.34	0.24	0.29	0.58	0.78	0.34	3.50
Stab	0.10	0.10	0.29	0.10	0.15	0.15	0.10	0.44	0.15	0.15	0.05	0.19	0.19	0.10	0.49	0.44	3.16
Gunshot	0.10	0.05	0.10	0.00	0.00	0.00	0.15	0.05	0.00	0.05	0.05	0.00	0.15	0.39	0.19	0.53	1.80
Crush	0.10	0.15	0.15	0.15	0.29	0.05	0.15	0.10	0.10	0.10	0.10	0.15	0.00	0.05	0.15	0.00	1.75
Animal	0.00	0.15	0.19	0.00	0.05	0.19	0.19	0.00	0.19	0.10	0.19	0.10	0.05	0.05	0.05	0.00	1.51
Drown	0.10	0.19	0.05	0.10	0.05	0.15	0.10	0.15	0.05	0.15	0.15	0.00	0.05	0.19	0.00	0.00	1.46
Foreign Body	0.00	0.10	0.15	0.05	0.00	0.00	0.05	0.05	0.00	0.00	0.00	0.05	0.05	0.00	0.00	0.05	0.53
Motorcycle	0.00	0.00	0.00	0.00	0.05	0.00	0.05	0.00	0.05	0.00	0.05	0.00	0.00	0.00	0.10	0.00	0.29
Hang	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.10
Total	9.72	8.95	7.78	5.69	5.06	5.40	6.51	7.05	6.61	5.44	5.88	5.10	5.01	5.88	5.69	4.23	100.0

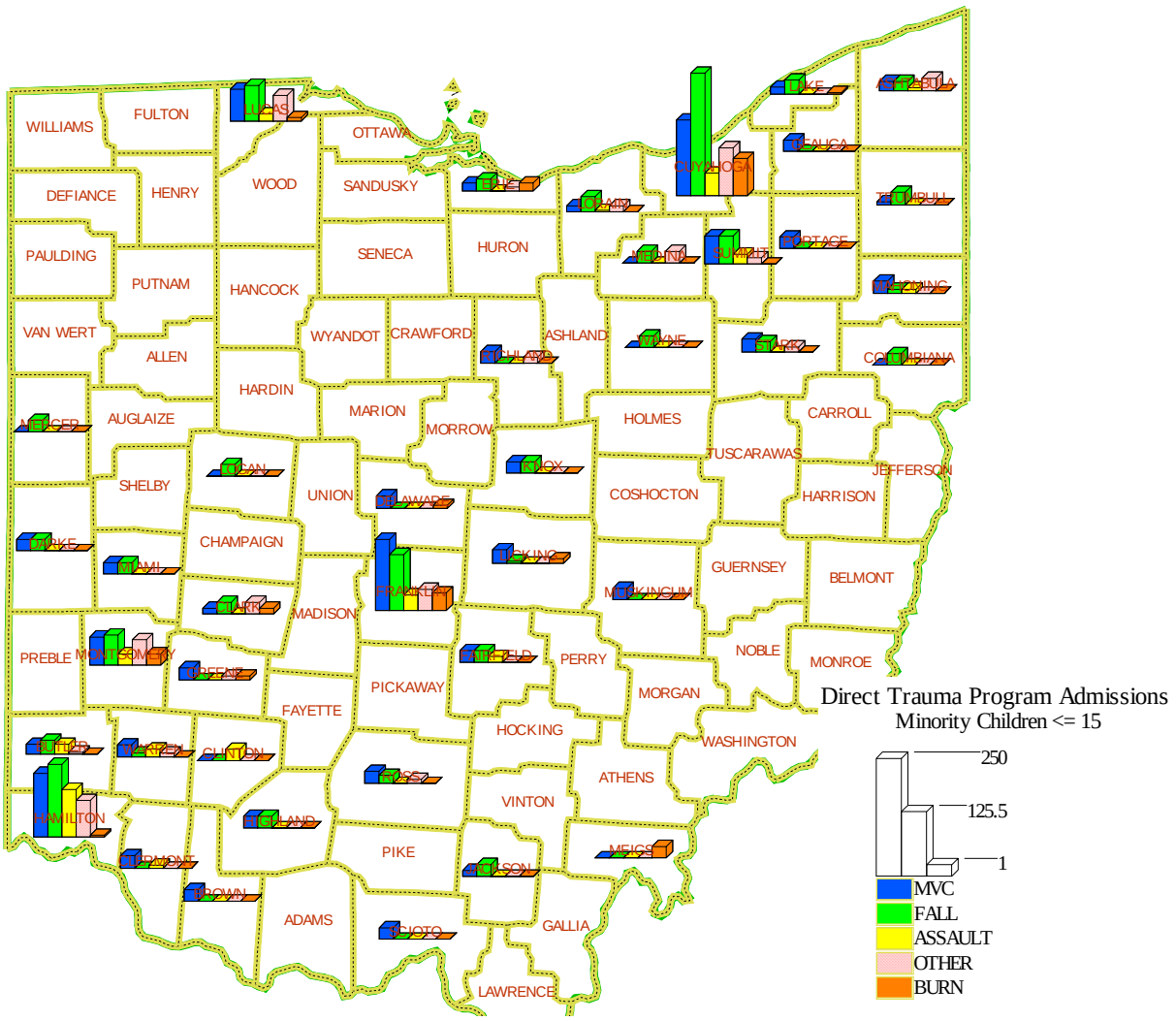

Figure 8. Minority children trauma program admissions.

Socioeconomic factors. Socioeconomic factors were analyzed from census data aggregated by zip code areas. Correlations are presented between the population adjusted rate of injuries within a zip code and the number of vacant housing units, number of people with an education below 9th grade, number of adults out of the work force, median income, and population density of the zip code (Table 7). The socioeconomic variables were assessed across the general population within the zip code without regard to race/ethnicity. Zip code areas with increased adults out of the work force were associated with fewer motor vehicle crashes. There was a small correlation between falls and the number of vacant housing units and a stronger correlation with population density. Numbers of assaults were associated with neighborhoods that had lower median income, increased population density, vacant housing units, adults with education below the 9th grade, and those out of the work force. The categories, Other Injury, and Burns were also correlated with all the socioeconomic factors. The correlations support the hypothesis that assaults, burns, and other injuries are a disease of poverty.

Table 7. Non-parametric correlation of rate of minority injuries with various socioeconomic factors. Data aggregated over zip codes.

	MVC	Fall	Assault	Other	Burn
Number of Vacant Housing Units	-0.09	0.12*	0.38**	0.31**	0.26**
Education below 9th grade	-0.08	0.10	0.32**	0.18**	0.17**
Unemployed	-0.15**	0.11	0.15*	0.15*	0.16**
Median Income	-0.04	-0.06	-0.38**	-0.24**	-0.20**
Population Density People/Sq Mile	-0.02	0.20**	0.39**	0.36**	0.23**

* $p<0.05$; ** $p<0.01$

Missing Data. Complete data is important for the epidemiological study of any population. Table 8 provides information on the percent of missing data and any differential effects between minorities and the majority whites. While there was substantial missing data in some fields there was not a significant differential pattern of missing data between minorities and majority whites. In this study residential zip code was used as a proxy for injury zip code in about half the cases because of the extensive missing data. Absence of injury severity data weakens studies that attempt to adjust for severity by reducing the available sample size. Nearly ten percent of the sample had to be discarded because race information was not available.

Table 8. Missing Data

	White	Minority
Injury Zip Code	59.6%	41.9%
RTS	24.2%	25.4%
Location of injury	14.5%	21.2%
Mode of transport	12.5%	5.5%
Injury type	10.3%	18.0%
Zip code	2.6%	1.7%
ISS	1.9%	2.3%
E-Code	0.6%	0.1%
Hospital length of stay	0.3%	0.1%
Age	0.0%	0.0%
Sex	0.0%	0.0%
Race	8.8%	
Outcome	0.0%	0.0%
Total Sample	4024	2060

Rehabilitation Services. About 3.4% of all minority admissions result in referral to rehabilitation compared to 2.2% of majority whites (Odds Ratio = 1.57, p=0.005). This difference was reduced to a non-statistically significant 11 percent increase when adjusted for seriousness of injury by TRISS (OR = 1.11, p=0.59). These results suggest essentially equal access to rehabilitation services for minorities.

Access to EMS. The number of miles to the address of the nearest EMS agency and the center point (centroid) of each census block group in Ohio was calculated. Each point in the scatter diagrams in Figure 9 represents the EMS distance and the proportion of the population that is

minority, p(Minority), within the census block group. Of the 1428 EMS agencies (including volunteer fire departments), 260 were not located. Those not located were primarily rural volunteer departments. The figures show the lack of relationship between distance to an EMS agency and the proportion of minorities within a census block. Further the figures illustrate that in urban areas most residents are within three miles of an EMS agency regardless of minority status. In semi urban areas most residents are within 4 miles of an EMS agency. Data was most complete for urban areas and a bit less for semi urban and rural areas. The clustering of points at each end of the p(Minority) demonstrates a tendency for the races to live separately particularly in some urban areas. The locations are based on fire departments as a proxy for EMS.

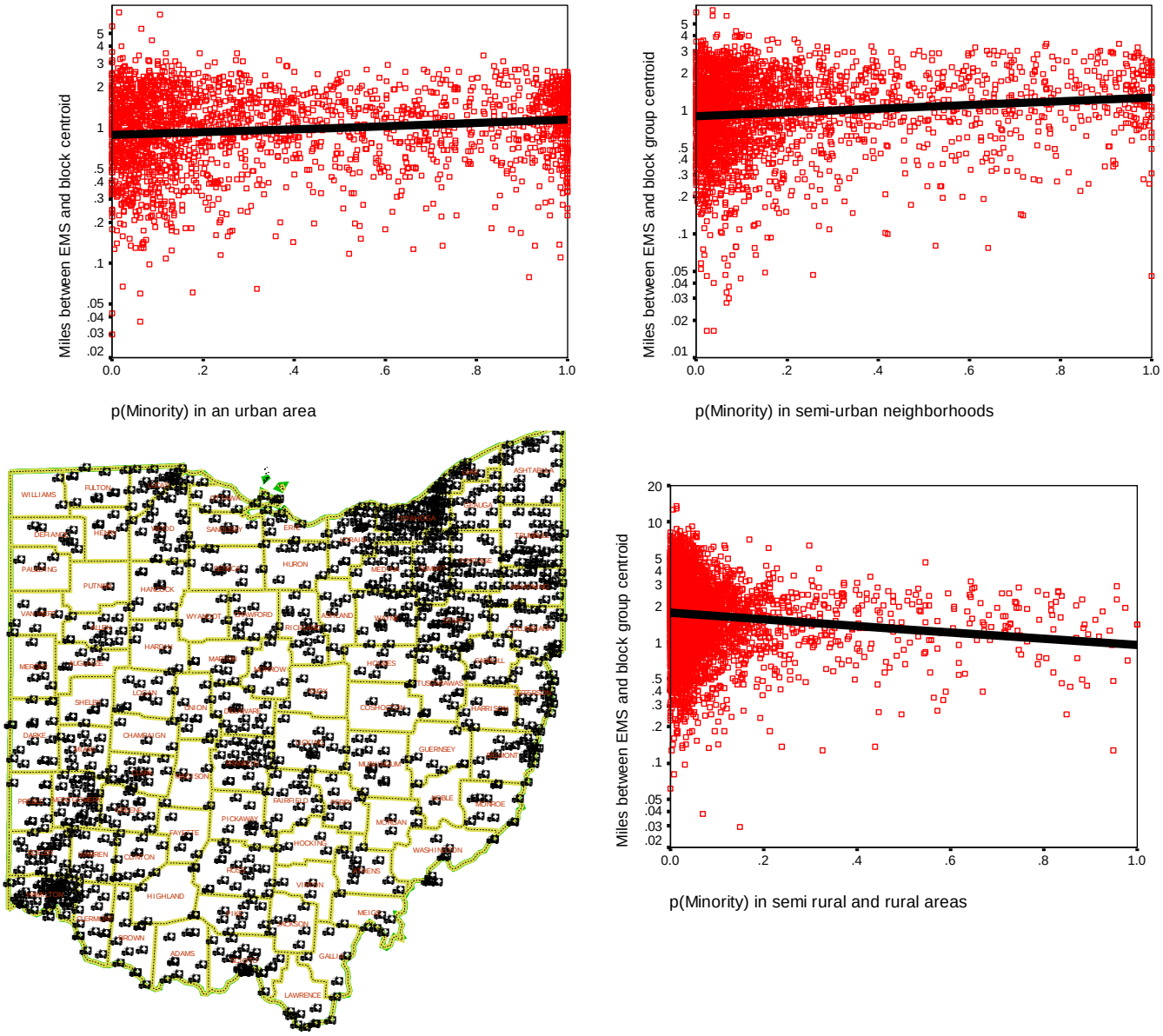

Figure 9. Distance between the centroids of census block groups and the EMS agencies located on the map and the proportion of minorities living within a particular census block group.

Appendix: Injury Scoring Systems

What is Injury Severity Score (ISS)?
Injury Severity Score is an objective method of comparing injury severity in different patients or patient groups. The information used to calculate ISS can come from physical examination (lacerations, bruising), radiologic reports (such as a CT scan showing a liver laceration) or even autopsy data (example: a patient is found to have spinal cord transaction at autopsy)

The ISS is the sum of the squares of the three highest Abbreviated Injury Scores (AIS) (see below). The lowest possible ISS is 3 and the highest possible is 75. Any ISS score greater than 15 is consider severe. In other words, a patient with an ISS of 16 or above is more likely to need intensive care and more likely to die of his injuries.

What is AIS?
Every conceivable injury has a 7 digit numerical injury identifier (injury code). The last digit (after the decimal point) is the AIS code. AIS is a 1- 6 scale of injury for a specific organ in a body region.

- 1 minor
- 2 moderate
- 3 serious
- 4 severe
- 5 critical
- 6 maximum

There are 9 body regions.

- Head
- Face
- Neck
- Thorax
- Abdomen and Pelvic Contents
- Spine
- Upper Extremity
- Lower Extremity
- External, Burns, Other

When calculating ISS, the highest AIS from each region is considered, and the sum of the squares of the three highest regions is the ISS. Exception: if there is an AIS of 6 in any region, the ISS is automatically 75.

For example:
Case 1: patient with abrasion (AIS 1) and deep laceration to the face into subcutaneous tissue greater than 20 cm long (AIS 2). No other injuries

This patient has an ISS of 4, because the highest AIS for the region (face) is 2

Case 2:

ATV rider with

- Subarachnoid hemorrhage (region head, AIS=3)
- Mild, diffuse brain edema (region head, AIS=3)
- Laceration to face (face, 1)
- Laceration to ear (face,1)
- Abrasions to Chest (chest, 1)
- Extradural Hematoma (head, 4)
- Cervical Spine, C2 fracture (neck, 2)
- Right Mandible fracture (face 2)

ISS =16 (head) + 4 (neck) + 1 (face) = 21

What is revised trauma score (RTS)?
A score that uses 3 physiologic parameters to quantify injury severity:

- Glascow Coma Score
- Systolic Blood Pressure
- Respiratory Rate

Specific ranges of each parameter are assigned coded values. The coded value for each variable is then multiplied by an assigned weight derived from regression analysis of over 25,000 patients in the Major Trauma Outcome Study. The sum of these three products is the RTS.

What is TRISS?
TRISS combines RTS and ISS with age to predict probability of mortality.