Spinal cord injuries in Arkansas due to violence: 1980–1989

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In some areas of the US the incidence of violence-related spinal cord injuries (SCIs) is double or triple that of 10 years ago. The purpose of this study was to determine if this trend is evident in Arkansas, a small rural state. For the study period 15.3% of traumatic SCIs identified in Arkansas were violence-related. The overall incidence rate of traumatic SCIs in Arkansas declined from 41.11 per million in 1980 to 33.18 per million in 1989. However, the rate of violence-related SCIs rose from 3.5 per million in 1980 to 5.14 in 1989. The incidence of violence-related SCIs in Arkansas did not increase dramatically during the 1980s. However, the incidence of women with violence-related SCIs nearly tripled. With the dramatic rise in violence-related SCIs in women and the decrease in violence-related SCIs in men, the gender gap has been virtually eliminated in violence-related SCIs.

Keywords: spinal cord; spinal cord injury; violence; gunshot wounds

Introduction

During the decade of the 1980s, violence became the number one cause of spinal cord injuries in most large urban areas. In some areas the incidence of spinal cord injuries due to violence is double or triple that of 10 years ago.¹ The purpose of this study is to determine whether such a trend is evident in Arkansas and who in Arkansas sustains spinal cord injuries from acts of violence.

In 1985 the National Spinal Cord Injury Center Database reported 14.6% of all spinal cord injuries were due to violence. Nationally, violence was responsible for 20.5% of spinal cord injuries in those between 0 and 15 years of age.³ However, by 1991 acts of violence were the number one cause of spinal cord injury at several major urban trauma centers and rehabilitation institutes, including the Rehabilitation Institute of Michigan in Detroit, 43% and Rancho Los Amigos in Downey, California, 35%.³

National studies of spinal cord injury show rates varying substantially between general trauma injuries and violence injuries. While over 71% of people with spinal cord injuries are white, whites account for less than one-third of all spinal cord injuries due to violence.⁴ According to a 1989 national study, a black male is six times more likely to be a homicide victim than a white male.⁵ This disparity in risk also carries over to spinal cord injuries.

The Southeastern Michigan Spinal Cord Injury System determined that the individual most likely to receive a spinal cord injury from violence is a black male between 15 and 17 years of age who has not

finished the eleventh grade. The injury is most likely to occur on a weekend in the fall, following an argument or fight with an acquaintance in the injured person's neighborhood.⁶ Rates of violence-related spinal cord injuries are highest in socioeconomically depressed areas.⁷

Nationally, spinal cord injuries due to violence most often result in complete paraplegia, 42.4%. This is quite different from traumatic spinal cord injuries as a whole. Only 28.4% of spinal cord injuries due to motor vehicle crashes result in complete paraplegia.⁸

This study attempts to answer several questions related to spinal cord injuries due to violence. The current national trend of increased incidence of spinal cord injuries due to violence is compared to the trend in incidence rates in Arkansas. A profile of the violence-related spinal cord injuries in Arkansas is developed by determining those groups at greatest risk. Identification of high-risk groups should assist in prevention of these injuries.

Methodology

Case ascertainment

The Arkansas Spinal Cord Commission (ASCC) has maintained active surveillance and case management of individuals with spinal cord disabilities in the state of Arkansas since 1977. State law requires the reporting of non-fatal spinal cord disabilities by every public and private health and social agency and attending physician.

To be listed on the ASCC registry, an individual must have sustained spinal cord disability and exhibit

three of the following four characteristics: (1) lack of normal motor control, (2) lack of normal sensation, (3) lack of normal bladder function, and (4) lack of normal bowel function. Both injury and disease etiology cases must meet these criteria for inclusion on the registry. If at any time an individual meets these criteria, that person is entered in the registry.

The registry contains individuals who are now, or once were, Arkansas residents. Cases are accepted regardless of the place or date of onset. In the event of death or complete recovery, the cases remain on the registry for statistical purposes.

Subjects

In this study, violence is defined as 'assaults, either as a method of conflict resolution or as an incidental to the commission of some other crime'.⁹ The subjects of the study were taken from the ASCC registry. The two criteria for being included in the study were: first, the date of onset of the injury must have been between 1 January, 1980 and 31 December, 1989, and second, that the injury must have been intentional, whether self-inflicted or caused by another party.

Information was taken from both the registry and each client's case file. In addition to information on the registry, case manager narratives and medical records were used to obtain information.

Results

One hundred and thirty-eight individuals on the ASCC registry were identified as fitting the criteria for inclusion as violence-related spinal cord injuries. During the time period being studied, 902 individuals sustained traumatic spinal cord injuries. The incidence rate of traumatic spinal cord injuries in Arkansas over the period from 1980 to 1989 was 380 per million (see Table 1). The incidence rate of violence-related spinal cord injuries over that period was 50 injuries per million.

Violence is the third leading cause of traumatic spinal cord injuries in Arkansas over the study period, 15.3%. This rate is only slightly lower than that for falls, 15.9%. While the incidence rate for all traumatic spinal cord injuries in Arkansas fell from 41 per million population in 1980 to 33.18 spinal cord injuries

per million in 1989, the rate of violence-related spinal cord injuries rose. Violence-related spinal cord injuries increased from 3.5 per million in 1980 to 5.14 per million in 1989.

Gender

Eighty-two per cent of all traumatic spinal cord injuries were to males (Table 1). However, only 75% of violence-related spinal cord injuries were to males. This indicates a significant increase in the proportion of females with violence-related spinal cord injuries, 25% from 18% with traumatic spinal cord injuries in general, $P=0.001$.

Over the period of the study, 1 January, 1980 to 31 December, 1989 the incidence of trauma to males was 660 per million and the incidence of trauma to females was 130 per million population. This 5 to 1 ratio of men to women receiving spinal cord injuries is nearly halved when the spinal cord injury is violence-related. The incidence rate of violence-related spinal cord injuries during this study period in males was 80 per million and 30 per million in females. This is only a 2.7:1 ratio.

From 1980 to 1989 incidence rates of violence-related spinal cord injuries among males decreased from 5.43 per million in 1980 to 4.41 per million (Figure 1). Over the study period, violence-related SCI in males appears to have been somewhat cyclical. The rate for females, however, rose from 1.69 million in 1980 to 4.11 per million in 1989. While there is no prolonged upward trend of violence-related SCI in females, the rate of violence-related SCI in women was significantly higher the final 2 years of the decade and also appeared to have some cyclical components.

Race

Blacks were significantly more likely to incur a violence-related spinal cord injury than were whites, $P=0.0001$. Fifty-seven percent of violence-related spinal cord injuries were to blacks and 43% were to whites (Table 1). However, whites accounted for 75% of all traumatic

Table 1 Violence related spinal cord injured arkansans vs. All traumatic spinal cord injured arkansans: 1980–1989

	Trauma (1,000,000)		Violence (1,000,000)	
	%	Incidence	%	Incidence
Total	100	380	100	50
Gender				
Females	18	130	25	30
Males	82	660	75	80
Race				
Black	22	520	57	158
White	75	350	43	25

Incidence Rates of Violence-Related SCIs in Arkansas per Year by Sex: 1980–1989

Figure 1 Incidence rates of violence-related SCIs in Arkansas per year by sex: 1980–1989

spinal cord injuries. Twenty-two percent of traumatic spinal cord injuries were to black individuals and 3% were to individuals of other races.

The incidence rate for traumatic spinal cord injuries among the black population during the study period was 1.5 times greater than that for whites. Blacks sustained 520 traumatic spinal cord injuries per million population, *versus* 350 per million for whites.

The disparity in incidence rates was even greater for violence-related spinal cord injuries. Blacks were six times more likely to sustain a violence-related spinal cord injury than whites. Over the study period, the incidence rate for violence-related SCI among blacks was 158 per million as compared to 25 per million for whites. The incidence rate for violence-related spinal cord injuries among whites dropped from 2.65 per million in 1980 to 2.06 per million in 1988 (Figure 2) and showed no upward or downward trend over the study period. However, the rate for blacks tripled from 8.03 per million in 1980 to 24.05 per million in 1989 and showed a definite upward trend over the period.

Age

Eighty-one percent of violence-related spinal cord injuries occurred in the age groups from 15 to 39 on the date of onset (Figure 3). Thirty-six percent were 15 to 24 years old and 45% were 25 to 39 years old on the date of onset. The mean age of onset for violence-related spinal cord injuries was 29. This was younger than the mean age at onset of the overall traumatic spinal cord injury population, which was 32.

Individuals in the age groups of 15 to 24 years old and 25 to 39 years old also had the greatest incidence of violence-related spinal cord injuries, with 129 and 104 per million population, respectively. The age group with the next highest incidence rates of violence-related spinal cord injuries was that from 40 to 59 years of age. The two lowest incidence rates during the study period were in the age groups 1 to 14 and over 60, 14 per million and 15 per million, respectively.

Figure 2 Incidence rates of violence-related SCIs by race in Arkansas: 1980–1989

High-risk groups

The incidence rate of violence-related spinal cord injuries among black males during the study period was 430 per million population. This was 11 times greater than the incidence rate for white males, which was 49 per million (Figure 4). Among black males, those between the ages of 15 and 24 were at greatest risk for violence-related spinal cord injuries with an incidence rate of 656 per million (Table 2). At 430 violence-related spinal cord injuries per million population, black males ranging in age from 25 to 39 had the second highest incidence rate.

After black males, black females were the next highest-risk group (Figure 4). Over the study period, the incidence rate of 85 violence-related spinal cord injuries per million was more than 4.5 times greater than that of white females, 18 per million. The incidence rate of violence-related spinal cord injuries

Age at Onset of Violence-Related SCI versus Overall Traumatic SCI in Arkansas: 1980-1989

Figure 3 Age at onset of violence-related SCI *versus* overall traumatic SCI in Arkansas: 1980–1989

Incidence Rate of Violence-Related SCIs in Arkansas by Race and Sex: 1980-1989

Figure 4 Incidence rate of violence-related SCIs in Arkansas by race and sex: 1980–1989

in black males more than doubled from 11.45 per million in 1980 to 23.05 per million in 1989. For black females, the incidence rate nearly doubled from 5.02 per million in 1980 to 9.98 in 1989. Sixty-three percent of black females with traumatic spinal cord injuries sustained their injuries in a violent manner. The age group 25 to 39 had the highest incidence of violence-related spinal cord injuries for black females, 170 per million over the study period (Table 2). Only black males were more at risk for violence-related spinal cord injuries than black females.

Violence-related spinal cord injured

Age

The age groups with the highest incidence of violence-related spinal cord injuries were the age groups of 15 to 24 years old, 129 per million, and 25 to 39 years old, 104 per million (Table 3). This incidence rate was six to seven times greater than the rate for the age group with the next highest incidence rate, the 40 to 59 year old age group.

Among males, the incidence rate of violence-related spinal cord injuries was greatest for those between 15 and 24 years old, 260 violence-related spinal cord injuries per million population. This was considerably greater than the incidence rate among 25 to 39 year old males whose incidence rate was 140 per million.

The age group with the highest incidence of violence-related spinal cord injuries among females was the 25 to 39 year old age group, 84 violence-related spinal cord injuries per million. The age group from 15 to 24 years old had the second highest incidence, 41 per million. Females tended to be somewhat older than males at the time of their injury. The mean age of onset for females was 34 and the mean age at the time of onset for males was 27 years old.

The age groups with the highest incidence rate differed between races. The 15 to 24 year old age group had an incidence rate of 363 per million among blacks (Table 4). The second highest incidence rate

among blacks was the 25 to 39 year old age group, 262 violence-related spinal cord injuries per million. The greatest incidence of violence-related spinal cord injuries among whites was in the 25 to 39 year old age group, 57 per million. The 15 to 24 year old age group had a very similar incidence rate of 52 per million. The mean age of black and white violence-related spinal cord injured differed also. The mean age at the time of onset for blacks was 31 and the mean age at onset for whites was 27.

Education

Individuals with violence-related spinal cord injuries, on average, were less educated than the overall traumatic spinal cord injured population. With a frequency of 31% a high school diploma was the modal education level for the traumatic spinal cord injured population (Figure 5). The mode, 38%, for those with violence-related spinal cord injuries was some high school but no diploma. Education levels for individuals beyond school age with violence-related SCIs were relatively comparable to the overall traumatic SCI population.

Income

Due to the 10 year time span of the study, income figures were standardized to base year 1984–1985 using the Consumer Price index as provided by the Bureau of Labor Statistics. Individuals with violence-

Table 3 Age at onset of violence-related spinal cord injuries in Arkansas: 1980–1989

Age group	Trauma (1,000,000)			Violence (1,000,000)		
	n	%	Incidence	n	%	Incidence
1–14	28	4	543	7	6	14
15–24	243	36	710	44	36	129
25–39	239	361	452	55	45	104
40–59	101	15	200	9	7	18
60+	59	9	129	7	6	15

Table 2 Age by race and gender

	Incidence (1,000,000) Female	Incidence (1,000,000) Male
<i>Black</i>		
1–14	0	52
15–24	88	656
25–39	170	430
40–59	96	198
60+	0	47
<i>White</i>		
1–14	5	10
15–24	30	73
25–39	36	78
40–59	9	5
60+	4	0

Table 4 Age by race

	%	(1,000,000) Incidence
<i>Black</i>		
1–14	7	8
15–24	43	363
25–39	39	262
40–59	11	106
60+	2	19
<i>White</i>		
1–14	7	8
15–24	30	52
25–39	54	57
40–59	7	7
60+	2	2

related spinal cord injuries tended to have a lower level of income than the overall traumatic spinal cord injury population (Figure 6). Thirty-one percent of individuals with violence-related spinal cord injuries earned less than \$5000. Only 17% of all traumatic spinal cord injuries earned less than \$5000 at the time of their injury.

A disproportionately large portion of low-income violence-related spinal cord injuries were women. Forty-seven percent of females with violence-related spinal cord injuries earned less than \$5000 (Figure 7). Only 20% of males with violence-related spinal cord injuries earned less than \$5000.

Black individuals with violence-related spinal cord injuries tended to have incomes concentrated in the three lowest income ranges (Figure 8). The mode for both black and whites was less than \$5000 annual income. However, the weighted average income of

blacks fell between \$5000 and \$9999 and the weighted average income for whites was between \$10,000 and \$14,999.

Urban versus rural

Over the study period, 52.6% of the population in Arkansas lived in urban areas and 47.4% lived in rural areas. For this study those individuals living within a Standard Metropolitan Statistical Area were considered to be living in an urban area.

Significantly more violence-related spinal cord injuries occurred in urban areas, 54%, than occurred in rural areas, 46%, $P = 0.0001$ (Table 5). However, this was not significantly different from the distribution of the population in general. Population distribution between rural and urban areas of males and females with violence-related spinal cord injuries was the same as the distribution of the general population in Arkansas. However, the distribution of the races between rural and urban areas was not the same.

Seventy-one percent of blacks in Arkansas with violence-related spinal cord injuries lived in urban

Figure 5 Education levels of those beyond school age with general traumatic and violence-related SCIs in Arkansas: 1980–1989

Standardized to 1984-1985 = Base 100, Consumer Price Index, Bureau of Labor Statistics

Figure 7 Income level of violence-related SCIs in males and females in Arkansas: 1980–1989

Standardized to 1984-1985 = Base 100, Consumer Price Index, Bureau of Labor Statistics

Figure 6 Income level of general trauma and violence-related SCIs in Arkansas: 1980–1989

Standardized to 1984-1985 = Base 100, Consumer Price Index, Bureau of Labor Statistics

Figure 8 Income level of violence-related SCIs by race: Arkansas 1980–1989

areas. Only 29% of blacks with violence-related spinal cord injuries lived in rural areas. Conversely, 68% of whites with violence-related spinal cord injuries lived in rural areas and only 32% lived in urban areas. The incidence rate of blacks with violence-related spinal cord injuries living in urban areas was 130 per million population. The incidence of whites with violence-related spinal cord injuries living in urban areas was 9 per million. Conversely, the incidence rate of whites living in rural areas with violence-related spinal cord injuries was 19 per million. Still, at 60 per million, the incidence rate of blacks with violence-related spinal cord injuries in rural areas was three times that for whites in rural areas.

Time of injury

Approximately 44% of violence-related spinal cord injuries occurred between 5 pm and 11 pm (Figure 9). Fifty-two percent of blacks were injured at this time and 36% of whites sustained violence-related spinal cord injuries during this time period (Figure 10).

Fifty-three percent of males sustained violence-related spinal cord injuries between 5 pm and 11 pm (Figure 11). Only 17% of the females were injured at that time. Twenty-five percent of the males with violence-related spinal cord injuries were injured between 5 pm and 7 pm, as opposed to about 7% of

the females injured. Females were more likely to be injured in the early and mid-morning hours than were males.

Assailant

Thirty-six percent of violence-related spinal cord injured individuals reported they did not know their assailant (Table 6). Males and blacks were most likely to be unable to identify the person who injured them, 40% and 38% respectively.

Twenty-five percent of violence-related spinal cord injuries were caused by an acquaintance, though this was much more likely to be the case with males than females. Twenty-nine percent of males with violence-related spinal cord injuries were injured by an acquaintance. In contrast, only 12% of females who were injured were injured by an acquaintance.

Eighteen percent of all violence-related spinal cord injuries were caused by relatives. However, 32% of violence-related spinal cord injuries in females were caused by a relative. Only 13% of the injuries in males were caused by a relative. Eighty-nine percent of the females injured by a relative were injured by their spouse. Only 13% of males were injured by a spouse. Fifty-three percent of males injured by a relative were injured by some relative other than a spouse, parent or sibling.

Table 5 Place of residence by race

	%	(1,000,000)	Incidence
<i>Total</i>			
Urban	54		67
Rural	46		62
<i>Black</i>			
Urban	71		130
Rural	29		60
<i>White</i>			
Urban	32		9
Rural	68		19

Figure 9 Time of violence-related spinal cord injuries in Arkansas: 1980–1989

Figure 10 Time of violence-related spinal cord injuries in Arkansas by race: 1980–1989

Figure 11 Time of violence-related spinal cord injuries by sex in Arkansas: 1980–1989

Method of injury

Seventy-seven percent of violence-related spinal cord injuries were caused by gunshot wounds. Nine percent were caused by a fall/push, 7% were due to stabbings and 6% were due to beatings. Males were more likely to have been injured by a gunshot than were females. Eighty-two percent of injuries to males were due to gunshot wounds but only 61% of females' injuries were a result of a gunshot wound.

Females were more likely than males to have been injured due to being beaten or pushed. Fourteen percent of injuries to females were caused by beatings, as compared to 3% of injuries to males. Fourteen percent of injuries to females were caused by a fall or push but only 8% of the injuries to males were due to a fall or push.

Level and extent of lesion

Fifty-two percent of all traumatic spinal cord injuries resulted in paraplegia and 44% resulted in tetraplegia. However, violence-related spinal cord injuries resulted in paraplegia significantly more often than did traumatic spinal cord injuries in general, $P=0.0001$. Violence-related spinal cord injuries resulted in paraplegia 64% of the time and tetraplegia only 36% of the time.

The level of injury from violence varied considerably between the races and the sexes. Seventy-four percent of violence-related spinal cord injuries to whites resulted in paraplegia (Table 7). However, paraplegia was the result in only 57% of blacks with violence-related spinal cord injuries, and tetraplegia occurred 43% of the time. Violence-related spinal cord injuries resulted in paraplegia 64% of the time in men, but only 57% of the time in females. Females became tetraplegic 43% of the time, but males became tetraplegic 36% of the time.

Forty-four percent of blacks sustained incomplete injuries and 38% sustained complete injuries (Table 8). In contrast, whites were more likely to sustain a complete injury. Fifty-one percent of violence-related spinal cord injuries to whites were complete and 37% were incomplete.

Women tended to be more likely to sustain a complete injury than men. Females sustained a complete injury 50% of the time and 32% sustained an incomplete injury. Males, however, sustained

complete injury in 42% of the cases and an incomplete injury in 44% of the cases. Those sustaining neither complete nor incomplete injuries either had minimal deficit, recovered fully, or the extent of lesion was unknown.

Table 7 Level of injury by race and gender

	%	(1,000,000) Incidence
<i>Black</i>		
Paraplegia	57	131
Tetraplegia	43	78
<i>White</i>		
Paraplegia	74	23
Tetraplegia	26	7
<i>Female</i>		
Paraplegia	57	16
Tetraplegia	43	11
<i>Male</i>		
Paraplegia	64	65
Tetraplegia	36	26

Table 8 Extent of injury by race and gender

	%	(1,000,000) Incidence
<i>Black</i>		
Complete	38	80
Incomplete	44	91
Minimal	8	16
Unknown	10	21
<i>White</i>		
Complete	51	15
Incomplete	37	11
Minimal	7	2
Unknown	5	2
<i>Female</i>		
Complete	50	14
Incomplete	32	9
Minimal	12	3
Unknown	6	2
<i>Male</i>		
Complete	42	38
Incomplete	44	40
Minimal	6	5
Unknown	9	8

Table 6 Assailant

	<i>Self</i>		<i>Relative</i>		<i>Acquaintance</i>		<i>Friend</i>		<i>Unknown</i>	
	n	%	n	%	n	%	n	%	n	%
Female	4	12	11	32	4	12	7	21	8	24
Male	6	6	13	13	30	29	13	13	41	40
Black	2	3	14	18	22	28	10	13	30	38
White	8	14	10	17	12	20	10	17	19	32
Total	10	7	24	18	34	25	20	15	49	36

Conclusion and discussion

The incidence of traumatic spinal cord injury in Arkansas actually decreased between 1980 and 1989. However, as the incidence of violence-related spinal cord injuries increased on a nationwide basis, the incidence rate in Arkansas also increased during the 1980s. The incidence of violence-related spinal cord injuries in whites decreased over the study period. However, the incidence of violence-related spinal cord injuries in the black population in Arkansas doubled.

The groups most at risk for violence-related spinal cord injuries are, first, black males and, then, black females. Violence is the most common cause of spinal cord injuries among black females.

The age groups at most risk to sustain a violence-related spinal cord injury are 15 to 24 year olds and 25 to 39 year olds. Those with violence-related spinal cord injuries were generally of a lower income level. Women with violence-related spinal cord injuries tended to account for a disproportionately large number of the low income group.

Females were usually injured at home, especially those who were white. One-third of the injuries to females were caused by relatives; nine times out of ten that relative was the woman's husband. This incidence of wife battering may account for the higher rate of beatings and falls/pushes among females.

Violence-related spinal cord injuries plague an easily defined and highly visible group. Violence-related spinal cord injuries are a major health problem among young, black, low-income males in urban areas. Identification of this group does not mean that prevention of violence-related SCIs will be easy, but it does make targeted intervention possible. Gunshot wounds are responsible for the vast majority of violence-related SCIs; thus, the elimination of easy access to these weapons should contribute greatly to the control of violence-related SCIs.

Another group at risk for violence-related spinal cord injuries is that segment of the female population suffering from spousal abuse. A large proportion of violence-related spinal cord injuries to females can be directly traced to wife battering; however, the rate may be even larger than this study indicates. Reports of spouse abuse are consistently low due to the stigma and fear attached to wife beating. Those suffering

from spousal abuse are not as easily identified as young, black males in an urban environment, but might be more receptive to a prevention message.

This study does not presume to answer the problem of prevention of violence-related spinal cord injuries. However, those individuals at greatest risk have been identified and characterized. These findings should be helpful in determining a prevention strategy to slow down the worsening of this health crisis of the young, black male population.

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