Alabama Head and Spinal Cord Injury Report 2020

ALABAMA DEPARTMENT OF PUBLIC HEALTH
EST. 1875

2020 Alabama Head and Spinal Cord Injury Registry (AHSCIR) Report

Data Period:
January 1, 2020 – December 31, 2020

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Acknowledgement

The Office of Emergency Medical Services (OEMS) wishes to thank everyone who made this report possible, especially the Trauma Registrars and other personnel throughout the state for their diligent work in reporting trauma data to the repository, as required. The OEMS realizes that COVID-19 provided many challenges for continued trauma data entry.

Effective October 1, 2020, OEMS transitioned from Digital Innovation (DI) Systems to the ESO Gen-6 database following ESO's acquisition of DI. Gen-6 is a new trauma reporting system. ESO currently serves thousands of customers throughout North America with a broad software portfolio, including EMS, Fire, and hospital software platforms. The OEMS appreciates everyone who participated in Gen-6 testing, training, and system step-up.

Overview

According to Johns Hopkins University School of Medicine, "the brain is a complex organ that controls thought, memory, emotion, touch, motor skills, vision, breathing, temperature, hunger, and every process that regulates our body. Together, the brain and spinal cord that extends from it, make up the central nervous system, or CNS." Because of the importance of the CNS to physiology, the organs are encased in bony structures, the skull and spinal column respectively, to protect them. Mechanical forces placed upon the body, either blunt forces (example, kinetic energy from a fall from height) or penetrating forces (examples, a bullet or knife) can result in disruption of the organic structure of the CNS, and therefore the disruption of the function of the CNS. Mechanical disruption of tissue of any type is called "trauma," from the Greek root τραῦμα (traumatikos) meaning "a wound, hurt, or defeat." The significance of trauma of the CNS is the debilitation and frequently permanent disabilities imparted upon the patient.

The Mayo Clinic identifies the people most at risk of traumatic brain injury as children (especially under 4 years of age), young adults (especially those 15 to 24 years of age), adults aged 60 years and older, and males of any age group. Traumatic brain injury leads to issues involving consciousness (coma, vegetative state, brain death, and reduced consciousness or cognition); physical issues such as seizures, fluid buildup on the brain (hydrocephalus), as well as infections and vascular damage (resulting in swelling or stroke). One of the most frequently occurring mechanisms of TBI are falls (resulting in blunt injury), especially in the elderly.

Spinal cord injury risks are found to be greatest in ages mirroring TBI, although a high frequency is observed in adults between 25 and 39 years of age and especially because of

motor vehicle accidents. SCI (occurring with or without associated TBI) is responsible for partial or full paralysis of the body, at and below the level of injury. A study conducted by Miller School of Medicine at the University of Miami identified that, since 2015 approximately 38 percent of SCI occurred in motor vehicle accidents, 32 percent in falls, 14 percent due to violence, 8 percent due to sports injuries, and 7 percent due to other causes.

Whereas, TBI and SCI most often occur independently of one another, a significant commonality lies in the post traumatic care and rehabilitation required for management of both processes. TBI often results in cognitive deficits where SCI results in some level of paralysis. Both processes often require lengthy hospital stays and even more lengthy rehabilitative phases to return the patient to as close to pre-injury normalcy as possible.

The Alabama Head and Spinal Cord Injury Registry (AHSCIR) and the Role of the Alabama Department of Rehabilitation Services (ADRS)

The ADRS is charged with offering rehabilitation services to patients with moderate to severe traumatic brain and/or spinal cord injuries. At times, patients are unaware of, or have difficulty understanding, state supported rehabilitation services – the result of which leads to inadequate rehabilitation, disability management, and work force re-entry assistance. Patients who have sustained debilitating injuries are identified and linked with ADRS via the AHSCIR, a registry mandated by Alabama Act 98-611. This law, which requires all hospitals in Alabama to submit data related to head and/or spinal cord injury cases to the Alabama Department of Public Health (ADPH), was passed in May 1998. The Alabama Trauma Registry (ATR), established after AHSCIR data collection began in 1999, strives to broaden collection efforts to include data related to all types of trauma. Those requesting services have been provided appropriate need-based referral information. More specifically, development of the ATR component pertains to an expansion of the head and spinal cord injury registry into a larger, more comprehensive program. Trauma registry personnel in the OEMS collect statewide data by working with hospitals at all levels of trauma care (acute and ancillary). Ultimately, registry data analysis and injury pattern evaluations will permit researchers and policymakers to identify better ways of reducing injury mortality and morbidity in Alabama.

It is important to provide the public with mortality and morbidity statistics to accurately illustrate the impact injuries have on individuals, families, and society. Additionally, the information assists with the design of prevention programs to mitigate the long-term effects of injuries in Alabama. As previously described, the ADRS uses the AHSCIR data to locate patients suffering from head and/or spinal cord injuries to make them aware of state supported services and perform follow-up treatment and referrals.

Neurological Injury Resulting in Death in Alabama

The data presented herein includes mortality (death) statistics. For patients entered into the AHSCIR, mortality statistics are in relation to deaths occurring after arrival at the hospital and taking place during interventional and stabilization phases of care. Further, no intention is outlined for the injury mechanisms. Many Alabama residents and visitors succumb to devastating neurological injuries and are found deceased by law enforcement, fire, and emergency medical services (EMS) agencies. The OEMS routinely provides prehospital electronic patient care report (e-PCR) data, working closely with the ADPH Center for Health Statistics, the Alabama Violent Death Reporting System (AVDRS), Maternal Mortality Review (MMRP), Child Death Review System (CDR), Fetal and Infant Mortality Review (FIMR), Sudden Unexplained Drug Overdose Review System (SUDORS) and also participates in the ADPH Fatality Committee. Data presented in this report only involves those patients entered into the AHSCIR; therefore, surviving to hospital arrival and listed mortality or fatality rates are comparative only to those hospitalized patients and not to the general population of Alabama.

A report was published in the Centers for Disease Control and Prevention (CDC) Morbidity and Mortality Weekly Report (MMWR) on October 15, 2021, by Daugherty, et. al, outlining the fact that some disparity exists between regions of the United States in the mortality of Traumatic Brain Injury. Particularly, between the years of 2016 to 2018 TBI-related deaths were lowest in the Northeast United States (U.S.) (12.8 per 100,000) and highest in the Southern U.S. and Midwest U.S. (19.2 per 100,000 and 18.1 per 100,000, respectively). This report highlights the fact that approximately one million U.S. deaths over the past two decades have involved TBI and that TBI rates vary by state; recognizing that states with higher rates tend to have greater proportions of TBI patients in rural areas. The three highest rates were found in Alaska (34.8), Wyoming (32.6), and Montana (29.5). All three states are well known for isolated wilderness.

Daugherty J, Zhou H, Sarmiento K, Waltzman D. *Differences in State Traumatic Brain Injury Related Deaths, by Principal Mechanisms of Injury, Intent, and Percentage of Population Living in Rural Areas – United States, 2016 – 2018*. MMWR Morb Mortal Mkly Rep 2021;70:1447-1452

Methods

The ATR entered 15,554 patients in the Year 2020. Of that 15,554 patients, 682 (4 percent) were recorded as dying during either the initial emergency department phase of care, or during subsequent medical interventional phases.

The AHSCIR is a subset of the ATR. AHSCIR report inclusion criteria used in previous years, prior to the Gen-6 implementation, are outlined below and include the core diagnoses used in this year's report. The number of patients who are applicable when considering the previous criteria for the 2020 group are 7,863. Of that group, 441 patients (6 percent) died either during initial or subsequent medical intervention. It is noteworthy that the 2019 AHSCIR report found 4,693 patients who were within the previously used diagnosis criteria and that the 2018 report found 4,413 patients meeting the same criteria.

A cursory review of the totals indicates that the number of patients within the system in general are increasing every year. The 2020 report narrows its focus upon those patients specifically diagnosed by clinicians as having experienced neurological trauma within the skull (traumatic brain injury) or within the spinal canal (spinal cord injury). By excluding patients identified as having fractures or injuries which may or may not include underlying traumatic brain or spinal cord injury, we include only those patients with the most precise and devastating diagnoses who are most likely to require rehabilitative services. The dropped group will include some undeterminable number of patients who have experienced the injuries of interest but were not specifically identified by ICD-10 diagnosis codes.

Precise medical charting is accomplished using the International Statistical Classification of Diseases and Related Health Problems (ICD), a globally used diagnostic tool for epidemiology, health management, and clinical purposes such as charting for insurance repayment for services. ICD is maintained by the World Health Organization (WHO), the primary healthcare influencer within the United Nations system. ICD is currently in its tenth version (ICD-10) first published in 1994. The most pertinent strength of the ICD-10 system is the precision of the diagnosis codes by body system. A very narrow set of injury codes for central neurological injuries were identified to choose patients of interest experiencing TBI and SCI. Use of inclusive criteria such as "head injury" or "back injury" would increase the spectrum of patients under study, which would convolute the meaning of representation in the target group.

The ICD-10 coding rules also improve the usefulness of mortality statistics by giving preference to certain categories, by consolidating conditions, and by systematically selecting a single cause of death from a reported sequence of conditions. The single selected cause for tabulation is called the "underlying cause of death," and the other reported causes are the "no underlying causes of death." The combination of underlying

and no underlying causes is the "multiple causes of death." Herein, we predominately consider the primary area of anatomical and physiological injury to be the cause of death even if other comorbidities could contribute to the process of dying, such as diabetes or underlying cardiac disease.

PREVIOUS CRITERIA

Begin with	End with	Description
SPINAL CORD INJURIES (SCI)		
S12.000 – S12.9XX	A or B	Fracture of cervical vertebra and other parts of neck
S13.0XX	A	Traumatic rupture of cervical intervertebral disc
S14.0XX – S14.9XX	A	Injury of nerves and spinal cord at neck level
S17.0XX – S17.9XX	A	Crushing injury of neck
S24.0XX – S24.9XX	A	Injury of nerves and spinal cord at thorax level
S32.000 – S32.059	A or B	Fracture of lumbar spine and pelvis
S34.01X – S34.9XX	A	Injury lumbar/sacral spinal cord and nerves
TRAUMATIC BRAIN INJURY (TBI)		
S01.00X – S01.05X	A	Open wound
S01.80X – S01.95X	A	Open wound
S02.3XX	A or B	Fracture of skull or facial bones
S04.02X – S04.049	A	Injury to optic chiasm and optic tract
S06.0X0 – S06.9X	A	Intracranial injury
S07.0XX – S07.9XX	A	Crushing injury of head
S08.89X	A	Avulsion and traumatic amputation of part of head
S09.8XXA – S09.90X	A	Other and NOS injury of head
T74.4XX	A	Shaken infant syndrome

2020 REPORT CRITERIA

Brain	Spinal Cord
S07 Crushing Injuries of the Head Skull, Other Parts of Head, Unspecified ***NOTE: Crush injuries of the head are highly likely synonymous with TBI.***	***S14 Injury of Nerves and Spinal Cord at Neck Level*** C1, C2, C3, C4, C5, C6, C7, C8* central cord syndrome, lesion, anterior cord syndrome, Brown-Sequard syndrome, other
S06 Intracranial Injury Traumatic cerebral edema, Diffuse TBI, Focal TBI, Epidural hemorrhage, Traumatic Subdural Hemorrhage, Traumatic Subarachnoid Hemorrhage, other specified intracranial injuries, unspecified intracranial injury, Traumatic Brain Compression and Herniation	***S24 Injury of Nerves and Spinal Cord at Thorax Level*** T1, T2-T6, T7-T10, T11-T12 unspecified, complete lesion, incomplete lesion, Brown-Sequard syndrome, anterior versus posterior, other
S04 Injury of Cranial Nerves Injury of optic nerve, oculomotor, trochlear, trigeminal, abducent, facial, acoustic, accessory, olfactory, other, unspecified	***S34 Injury of Lumbar/Sacral Spinal Cord and Nerves*** L1, L2, L3, L4, L5 Concussion, edema, unspecified, complete lesion, incomplete lesion, unspecified, other

****NOTE: Humans have 7 cervical vertebrae and 8 cervical nerves.***

DATA USE AND COMPARABILITY

All data contained in this report must be interpreted with careful judgment. It is important to note that the information presented in this report is based on data from the AHSCIR, which was submitted as of October 8, 2021. The data in this report is not comparable to state or federal data from other sources, due to variations in collection and analytical techniques. Less severe head and spinal cord injuries are under-represented in this analysis by design. Consequently, some less severe injuries are not included in the AHSCIR case definition, thereby, permitting registrars to omit reporting them. Additionally, mortality may be underestimated because of cases in which individuals expired at the scene and bypassed hospitals. The statistical significance of the summary data for the SCI and combined TBI/SCI cases is also limited by the small population size regarding some respective data subgroups. Cases admitted to a given hospital and then transferred to another hospital during treatment may erroneously be counted twice if the transfer was not coordinated through the Alabama Trauma Communication Center.

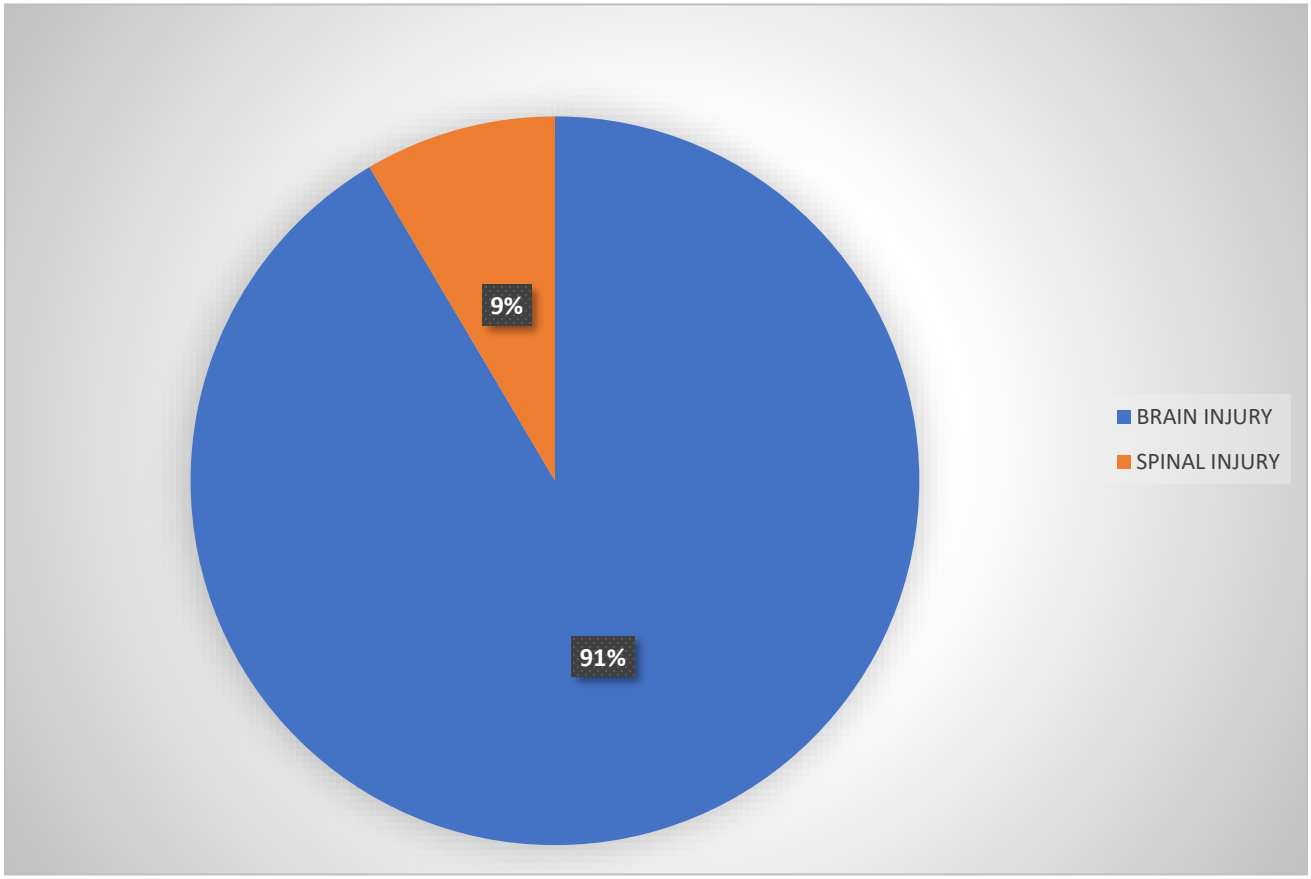
RESULTS

The ATR received reports of 3,717 neurological injuries of the head and spinal cord for Year 2020 compared to 4,693 reported head and spinal cord injury cases that were included in this report for Year 2019. The disparity likely results from the application of the ESO Gen-6 database and utilization of more concise inclusion diagnoses. Reduction of activity within the state's population during the COVID-19 period of 2020 may also play a role.

TBI exclusively constituted 91 percent (n = 3,401) of the reported cases and SCI exclusively constituted 9 percent (n = 316). This document will use the term TBI when referring to blunt or penetrating head injuries resulting in diagnosis of injury of central nervous system neurons above the level of the spinal cord. SCI will be used in referring to blunt or penetrating injury of the spine below the level of brain. Separate analyses are presented for combined neurological injury, traumatic brain injury, and spinal cord injury.

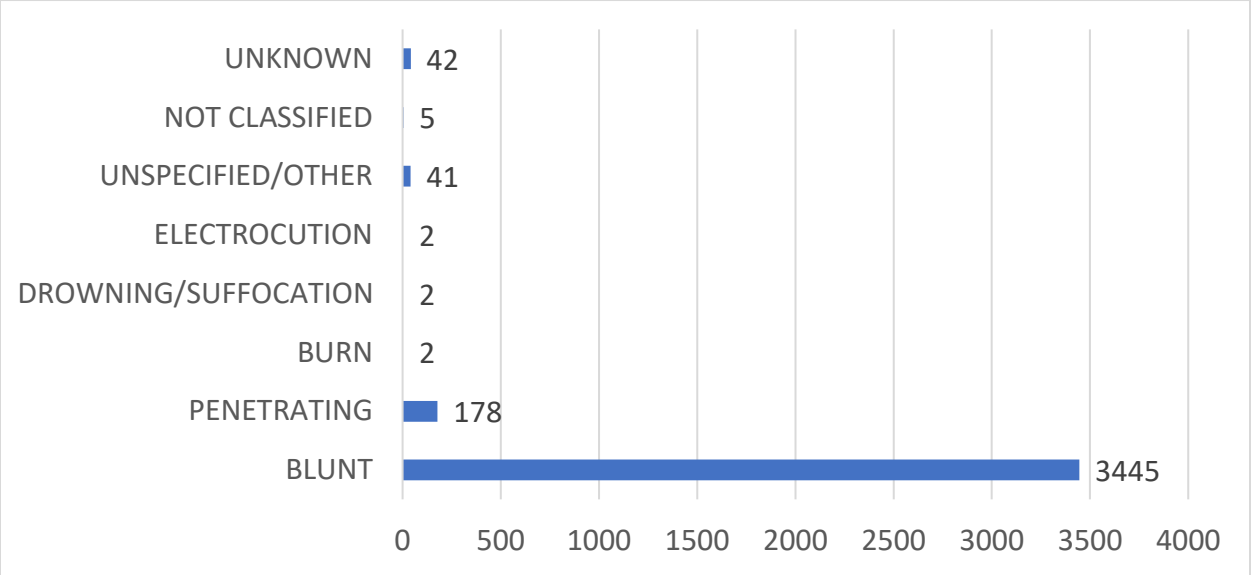
Disclaimer: Calculation for this report used Microsoft Excel for Office 365 (2016).

Type (Level) of Neurological Injury
January 1, 2020 – December 31, 2020
(n = 3,717)



NOTE: This data represents the presence of injury within individual patients. The injury level should be considered the primary area of traumatic neurological insult. Past studies have found that typically about 1 percent of patients have a combination of traumatic brain and spinal cord injuries. Combination injuries have been omitted in this report.

Neurological Trauma Cases by Mechanism of Injury
January 1, 2020 – December 31, 2020
(n = 3,717)

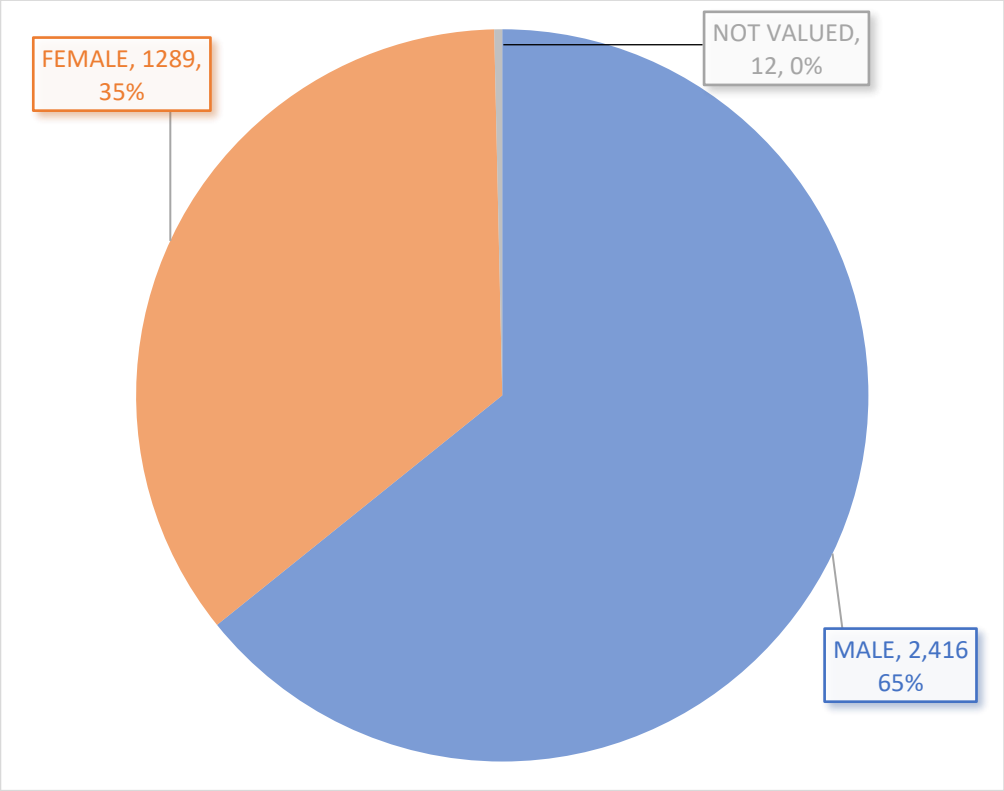


Ninety-three percent (n = 3,445) of the cases were injuries due to blunt trauma. Penetrating injuries accounted for 5 percent (n=178) of the traumatic neurological injury cases for 2020.

Type	Count	Percentage
Blunt	3,445	93%
Penetrating	178	5%
Burn	2	0%
Electrocution	2	0%
Drowning/Suffocation	2	0%
Not Valued	88	2%
Total	**3,717**	**100%**

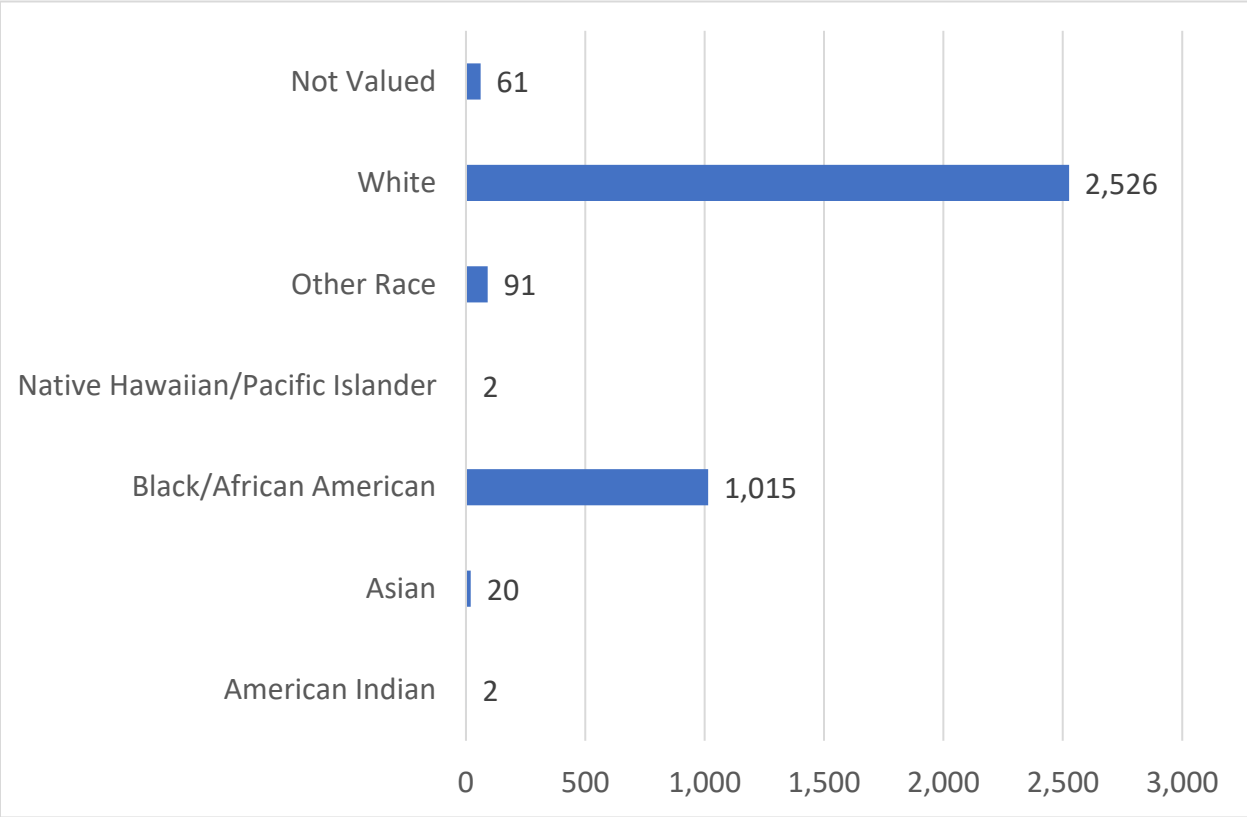
Not Valued Blanks/Unknown/Non-Applicable/Unspecified/Other

Neurological Trauma Cases by Gender
January 1, 2020 – December 31, 2020
(n = 3,717)



Gender	Count	Percentage
Male	2,416	65%
Female	1,289	35%
Not Valued	12	0%
Total	**3,717**	**100%**
Not Valued	Blanks/Unknown/Non-Applicable/Unspecified/Other	

Neurological Trauma Cases by Race
January 1, 2020 – December 31, 2020
(n = 3,717)



Race	Count	Percentage
Other Race	91	2%
Black/African American	1,015	27%
White	2,526	68%
Hawaiian/Pacific Islander	2	0%
Asian	20	1%
American Indian	2	0%
Not Valued	61	2%
Total	**3,717**	**100%**
Not Valued	Blanks/Unknown/Non-Applicable/Unspecified/Other	

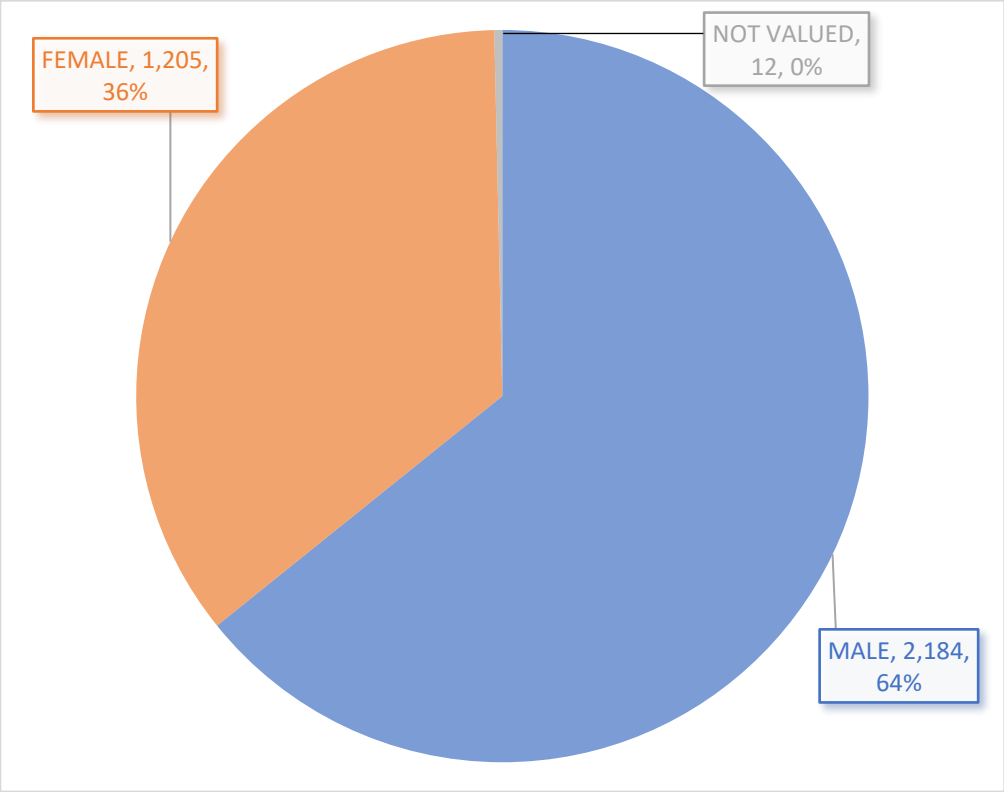
Traumatic Brain Injury (TBI)

TBI occurs when an external mechanical force (either blunt or penetrating) causes a physical or physiological disruption and dysfunction of the brain. Blunt mechanical forces can be caused by a violent blow or jolt to the head particularly (being hit in the head by a baseball, for example) or applied to the body in general resulting in movement of the brain within the skull (such as in shaken baby syndrome). The inner structure of the skull cranium (brain vault) contains many jagged features that may injure the brain or cranial nerves. The base, or floor, of the cranium contains most of the jagged structures and the bottom of the brain is the location of the 12 pairs of cranial nerves. The origin of the cranial nerves lies within the brain and brain stem (the brain's interface with the spinal cord). They are contained within the skull above the level of the cervical spinal cord, and their injury was included into the ICD-10 criteria for brain injury for this report. Any force or mechanism that does not result in significant penetration, in this case of the head, is said to be "blunt force trauma." Blunt force trauma resulting in TBI is often associated with motor vehicle crashes, falls, and impacts to the head in sports, objects dropped upon the head, other impacts of the head, and the head impacting upon other objects. Perusal of the data (highlighted below) reveals that 91 percent (3,401) of the 3,717 neurological injuries registered in 2020 in Alabama were diagnosed with TBI. Of the 3,401 TBI cases identified, 93 percent (3,178) were documented as occurring with blunt force trauma.

Of the remaining 7 percent (223) of TBI patients, 138 (4 percent of all TBI) suffered from penetrating trauma of the head. Penetrating trauma typically involves foreign objects (knives, arrows, projectiles such as bullets and shrapnel or wreckage) forcibly penetrating the skull. Of the 138 penetrating trauma TBI patients, 124 (90 percent) were firearms injuries and 13 (9 percent) were documented as otherwise "cut or pierced." One patient (1 percent) was documented as "natural or environmental" and no additional information is known. Of firearms related penetrating trauma, 55 patients died during treatment (44 percent fatality rate among firearms related injury) where 2 patients from the "cut or pierced" penetrating trauma group died (15 percent among cut or pierce related injury). The environmental or natural penetrating trauma patient survived the treatment phase.

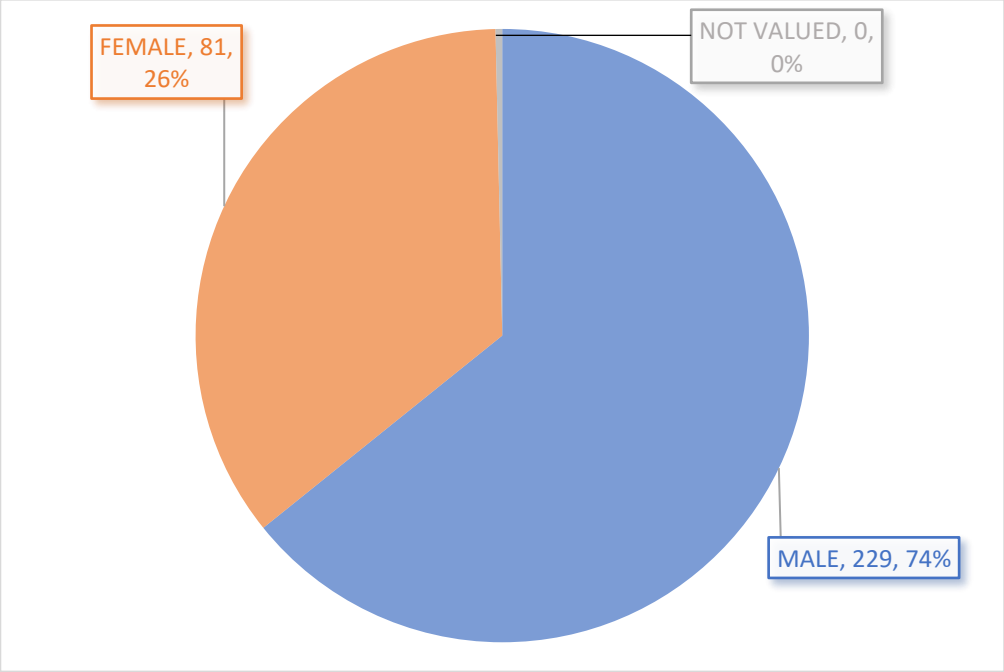
Neurological Injuries	TBI	Blunt	Penetrating	Firearms
3,707	3,401	3,178	138	124
% of Total Neurological Injury		**% of TBI**		**% of Firearms**
TBI = 91.75% Blunt TBI = 85.73% Penetrating TBI = 3.72% Firearms TBI = 3.35% Firearms TBI Fatality = 1.48%		Blunt = 93.44% Penetrating = 4.06% Firearms Penetrating = 3.65% Firearms Penetrating Fatality = 1.62%		Survived = 69 Died = 55 Survival = 55.65% Mortality = 44.35%

TBI Cases by Gender
January 1, 2020 – December 31, 2020
(n = 3,401)



A cursory review reveals that males predominate the injury population for neurological injuries in general and for TBI in particular. U.S. Census estimates for 2020 outline that Alabama had a population of approximately 4,903,185 citizens. Of those, approximately 48 percent are male and 51 percent are female. Elementary calculation of odds ratio (relative risk) finds that the risk of males experiencing TBI versus female, compared to the general population, are 94 percent greater, or almost twice the risk.

TBI Case Fatalities by Gender
January 1, 2020 – December 31, 2020
(n=310)

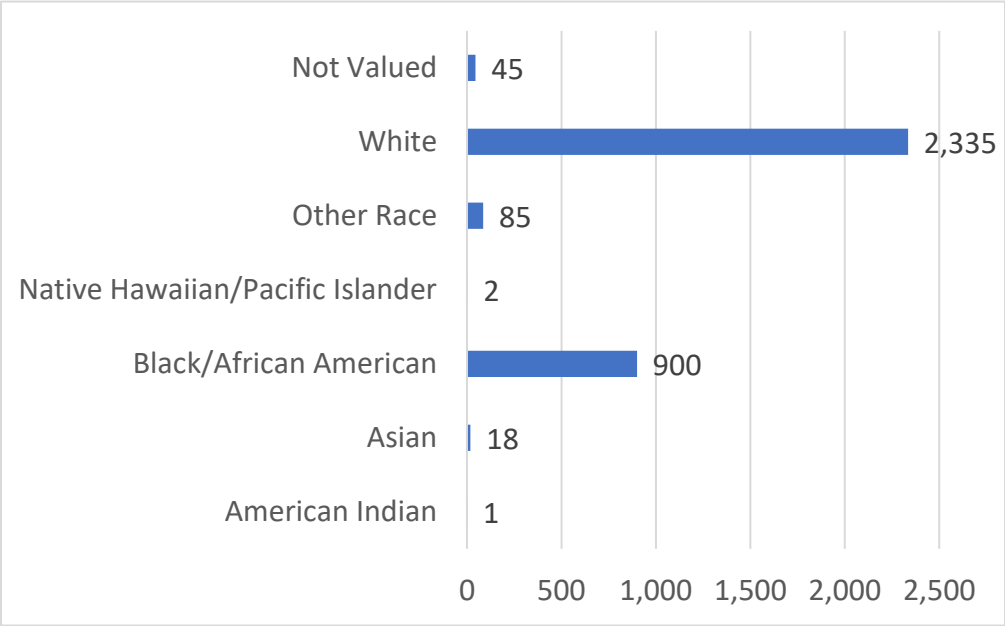


Gender	Count	Percentage	Fatalities	Population Percentage	Fatality Proportion
Male	2,184	64%	229	11%	74%
Female	1,205	36%	81	7%	26%
Not Valued	12	0%	0	0%	0%
Total	**3,401**	**100%**	**310**	**18%**	**100%**
Not Valued	Blanks/Unknown/Non-Applicable/Unspecified/Other				

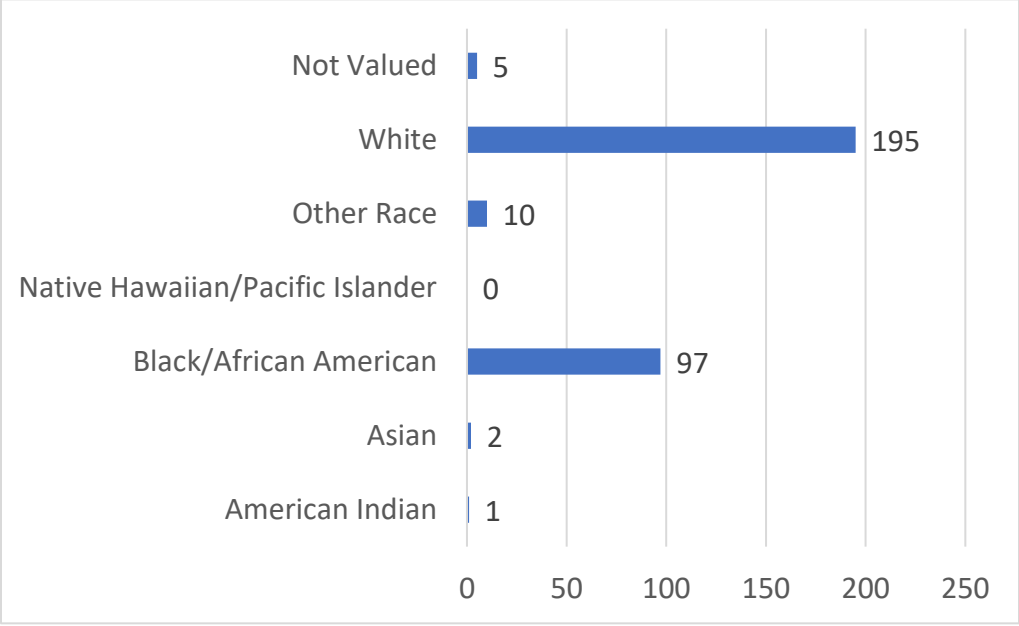
While males predominate the injury population in general, they also significantly predominate the TBI fatality proportion. Odds ratio calculation regarding gender and fatality finds that the odds of male TBI patients dying during the treatment phase is 63 percent higher than female TBI patients. It is noteworthy to point out that slightly less than 10 percent of TBI patients died because of their injuries, where slightly more than 90 percent of the injured survived to experience the recovery and rehabilitation process. Likely, the high survivability rate is due to emergency services available in Alabama in reasonably close proximity. Survivability, however, translates into the necessity of rehabilitation.

TBI Cases and Fatality by Race
January 1, 2020 – December 31, 2020

TBI Incidence by Race
(n = 3,386)



TBI Mortality by Race
(n = 310)



TBI Race and Mortality Statistics
(n = 3,401)

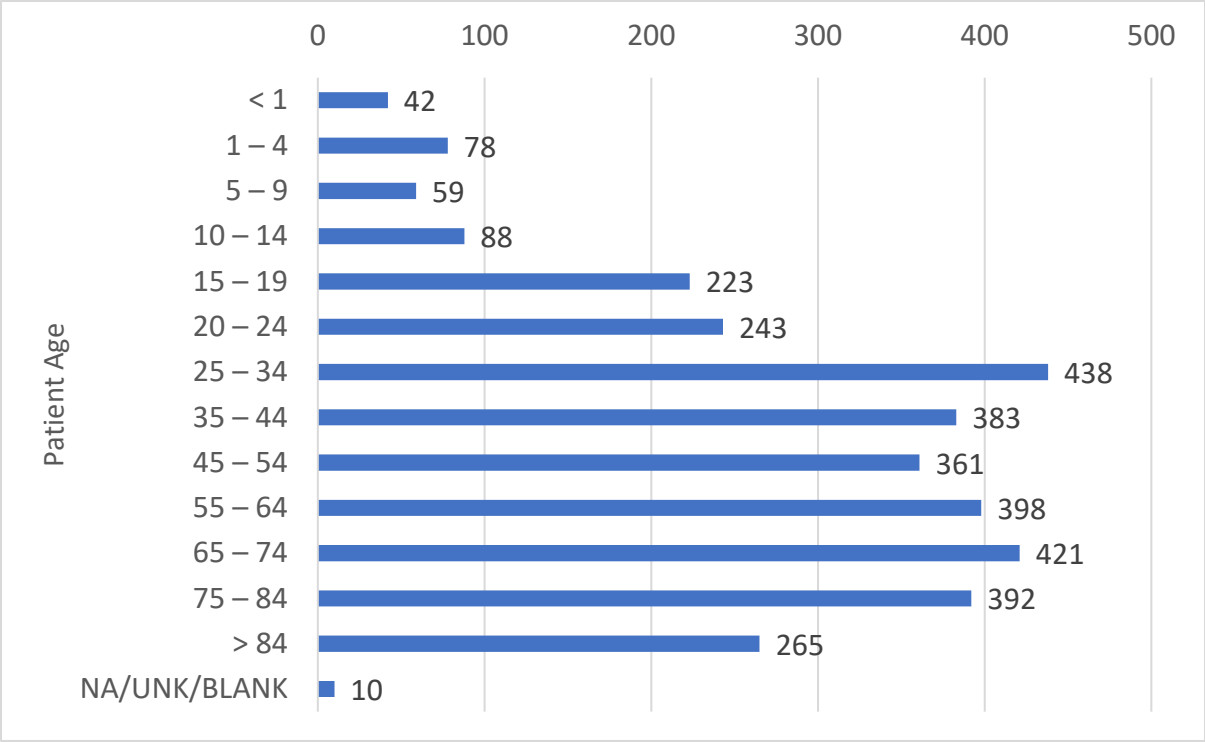
Race	Count	Population Percentage	Fatalities	Fatality Proportion
American Indian	1	0%	1	0%
Asian	18	0%	2	1%
Black/African American	900	27%	97	31%
Native Hawaiian /Pacific Islander	2	0%	0	0%
Other Race	85	3%	10	3%
White	2,335	69%	195	63%
Not Valued	45	1%	5	2%
Omitted from Calculation	15	---	---	---
Total	**3,401**	**100%**	**310**	**100%**

As established earlier, 3,401 observations of TBI were recorded from the 2020 patient group of 3,717 neurological trauma patients entered into the Registry database. Of that 3,401 observations, 15 were dropped upon evaluation of race. Those records had no value entered into the race data element and were dropped. Further, it is noteworthy that Hispanic ethnicity is not an isolated race value. Hispanic identity is considered an ethnicity and is considered a subset, generally of black or white race status in data evaluation. This is unique in TBI evaluation as often the patient cannot express his or her declared Hispanic heritage or identification.

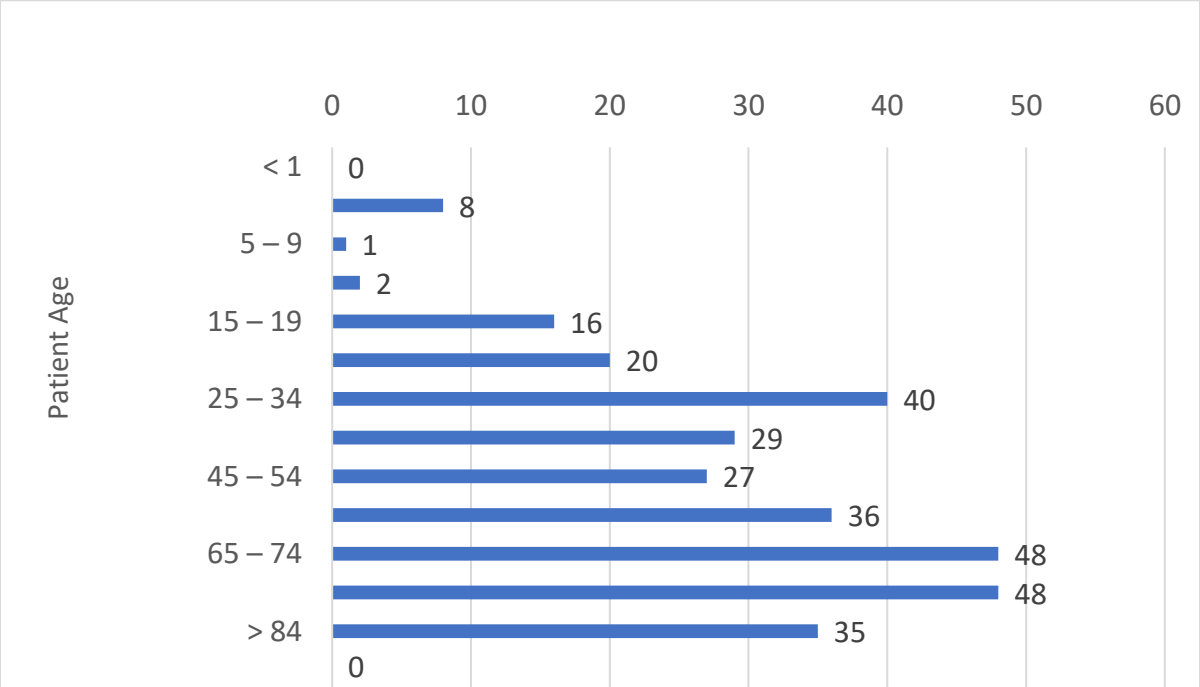
Odds ratio analysis of race and outcome of mortality was performed in comparison of black/African American (n = 900) versus white race (n = 2,335) as control and all non-black/African American race (n = 2,486) as control and no statistical evidence was found for influence of race in outcome of mortality. Further, U.S. Census 2019 population estimates were compared to the racial components of represented TBI patients and very similar patterns of population proportion were observed. White alone was estimated to constitute 69 percent of Alabama's population, and white alone, not Hispanic or Latino constitute 65 percent compared to 63 percent of the observed patients. Black/African American alone were estimated to constitute 27 percent of Alabama's population compared to 31 percent of the patient population. It was also observed that the Other Race categories were similarly comparable to the U.S. Census population estimates for their groupings.

TBI Cases and Fatality by Age
January 1, 2020 – December 31, 2020

TBI Incidence by Age
(n = 3,401)



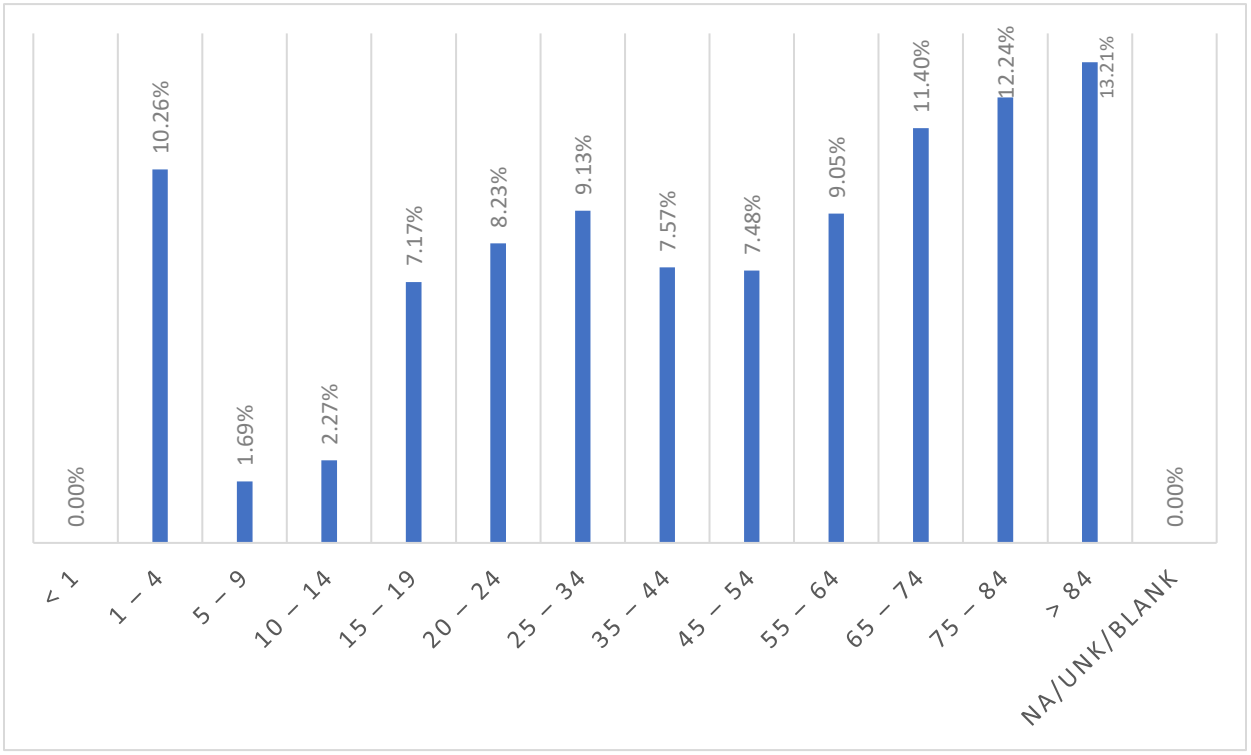
TBI Mortality by Age
(n = 310)



TBI Age and Mortality Statistics
(n = 3,401)

AGE GROUP YEARS	COUNT	PERCENT	DEATHS	FATALITY RATE
< 1	42	1.23%	0	0.00%
1 – 4	78	2.29%	8	10.26%
5 – 9	59	1.73%	1	1.69%
10 – 14	88	2.59%	2	2.27%
15 – 19	223	6.56%	16	7.17%
20 – 24	243	7.14%	20	8.23%
25 – 34	438	12.88%	40	9.13%
35 – 44	383	11.26%	29	7.57%
45 – 54	361	10.61%	27	7.48%
55 – 64	398	11.70%	36	9.05%
65 – 74	421	12.38%	48	11.40%
75 – 84	392	11.53%	48	12.24%
> 84	265	7.79%	35	13.21%
NA/UNK/BLANK	10	0.29%	0	0.00%
TOTALS	**3401**	**100.00%**	**310**	**OVERALL 9.12%**

TBI Fatality Rate by Age Comparison
(n = 310)



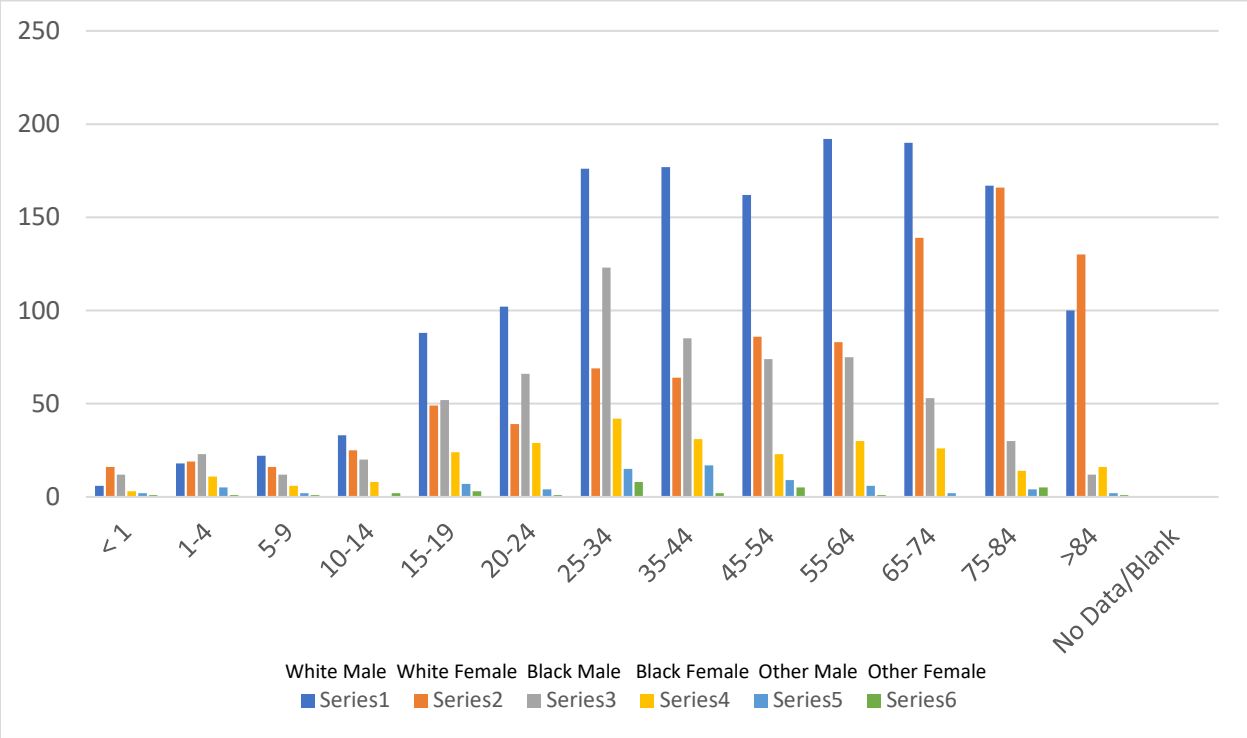
Incidence of TBI below 15 years of age is far lower than other categories and with fatality being sparse with exception of the 1-4 years of age category. Injury and death totals peak in the 25-34 and 65 to >84 year categories, while fatality rate progressively increases with age.

TBI Cases by Age, Gender, and Race: Comparison Table
January 1, 2020 – December 31, 2020
(n = 3,340)

Upon query for observations regarding combination factors (gender, race, and age) the Gen-6 system automatically dropped 61 (2 percent of the 3,401 total) observations. Data systems are often programmed to drop observations with missing data points to equivalently evaluate multiple element observations, which is particularly important for inferential statistics, such as regression analysis. Proportional analysis was conducted upon the remaining 3,340 observations and are compared below.

Age	White Male	White Female	Black Male	Black Female	Other Male	Other Female	Total	% Total
< 1	6	16	12	3	2	1	**40**	1%
1-4	18	19	23	11	5	1	**77**	2%
5-9	22	16	12	6	2	1	**59**	2%
10-14	33	25	20	8	0	2	**88**	3%
15-19	88	49	52	24	7	3	**223**	7%
20-24	102	39	66	29	4	1	**241**	7%
25-34	176	69	123	42	15	8	**433**	13%
35-44	177	64	85	31	17	2	**376**	11%
45-54	162	86	74	23	9	5	**359**	11%
55-64	192	83	75	30	6	1	**387**	12%
65-74	190	139	53	26	2	0	**410**	12%
75-84	167	166	30	14	4	5	**386**	12%
>84	100	130	12	16	2	1	**261**	8%
No Data/Blank	0	0	0	0	0	0	**0**	0%
Total	**1,433**	**901**	**637**	**263**	**75**	**31**	**3,340**	**100%**
% Total	**43%**	**27%**	**19%**	**8%**	**2%**	**1%**	**100%**	

TBI Age Distribution by Gender and Race



It is noted that white males lead every age category after age 5. White females almost match the number of white males of age 74-84 years and surpass white males after age 84 years. Although with fewer contributing occurrences, males of black/African American race and the composite "Other Races" categories predominate with similar patterns. Races other than white and black/African American were grouped to demonstrate the male gender predomination more clearly.

Discharge Disposition (From Emergency Department Phase of Care) Following TBI
January 1, 2020 – December 31, 2020
(n = 3,401)

Emergency Department Discharge Disposition	Facility Count	Facility Percentage
Acute Care Facility	265	7.79%
Another Type of Inpatient Facility	10	0.29%
Burn Center	0	0.00%
Burn Unit	1	0.03%
Child Protective Agency	0	0.00%
Correctional Facility/Court/Law Enforcement	3	0.09%
Floor	807	23.73%
Home or Self Care (Routine Discharge)	478	14.05%
Home with Services	1	0.03%
Hospice	0	0.00%
Intensive Care Unit (ICU)	1,327	39.02%
Intermediate Care Facility	21	0.62%
Interventional Radiology	14	0.41%
Labor and Delivery	2	0.06%
Left Against Medical Advice (AMA)	17	0.50%
Long-Term Care Facility	0	0.00%
Mental Health/Psychiatric Hospital	3	0.09%
Morgue	40	1.18%
Neonatal/Pediatric Care Unit	14	0.41%
Nursing Home	0	0.00%
Observational Unit	17	0.50%
Operating Room (Surgery)	221	6.50%
Rehabilitation (Inpatient) Facility	1	0.03%
Skilled Nursing Facility	0	0.00%
Step-Down Unit	92	2.71%
Telemetry Unit	35	1.03%
Blank/NA/Unknown	32	0.94%
TOTALS	**3,401**	**100.00%**

Of the 3,401 patients observed to have suffered TBI, 2,831 (83 percent) were known to have been transferred into another medical interventional environment following discharge from the ED. Only one patient was listed to have transferred directly into an inpatient rehabilitation facility. The proportion of patients who were ultimately transferred into inpatient or provided outpatient rehabilitation services is unknown. Being that 83 percent of all patients remained under medical care following the ED phase of intervention and with a combined proportion of 57 percent (approximately 1,923 patients) being transferred into acute or intermediate care, intensive care, surgery, or step-down evaluation, it is likely that rehabilitation services were required for approximately 500 to 1,000 patients. These estimates are in keeping with proportions outlined by the CDC "Traumatic Brain Injury in the United States: A Report to Congress" in 1999. The report is available online at: (https://www.cdc.gov/traumaticbraininjury/pubs/tbi_report_to_congress.html)

Whereas the incidence of TBI has been reducing from peaks observed in the early 1980s, likely due to mandated and improved safety ergonomics in general, the physically devastating nature of TBI remains. The large proportion of post-ED hospitalized patients within Alabama's 2020 TBI population attests to that fact. Not considered here are the true fatality rates of TBI patients who were declared deceased in the field, and unknown are the proportion of patients who perished due to their injuries after leaving the ED. Data collection mechanisms in Alabama, as with any data collection system, are susceptible to incomplete data entry which sometimes limits information. Whereas, mortality numbers of patients beyond the hospital phase of care cannot be fully accounted, information regarding patients entering the ADRS is available from that agency.

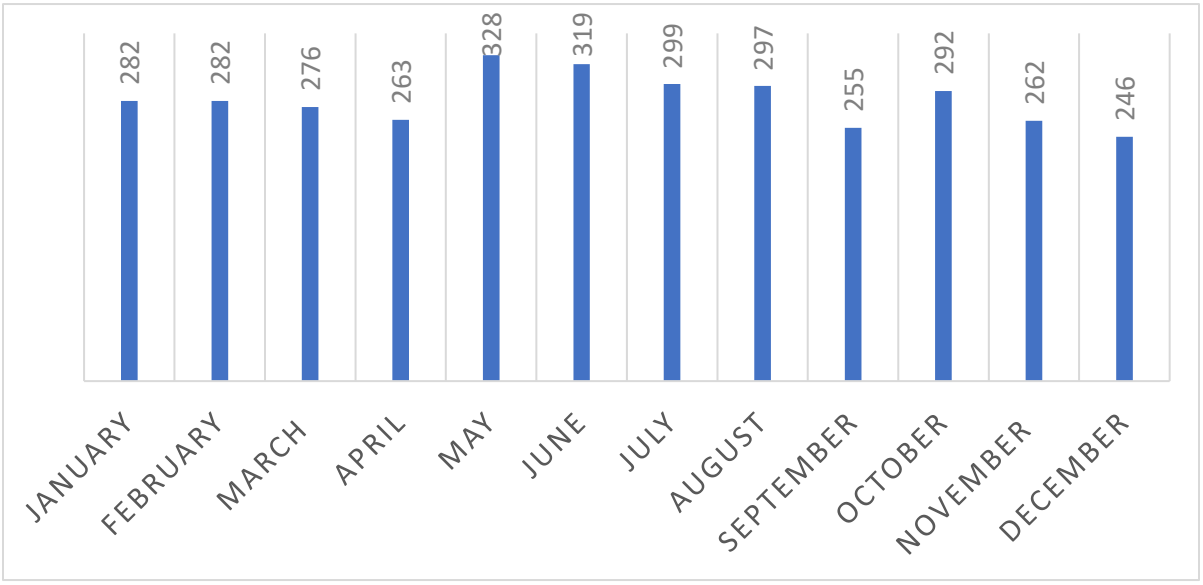
Mechanism of Injury Occurrence in TBI Cases
and Fatality as Outcome by Gender
January 1, 2020 – December 31, 2020
(n = 3,401)

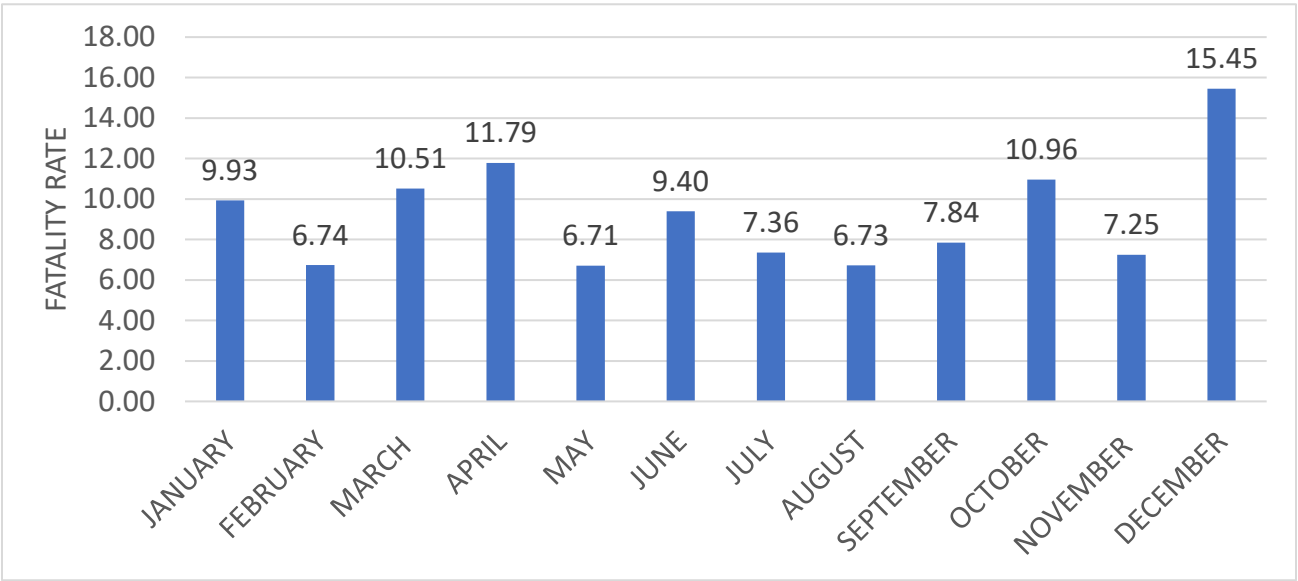
Mechanism Of Injury	Percent of Females	Percent of Males	Fatality Rate Female	Fatality Rate Male
Cut or Pierce	0.08%	0.55%	0.00%	16.67%
Drowning/Submersion	0.00%	0.00%	0.00%	0.00%
Fall	47.63%	32.74%	7.14%	10.49%
Fire or Flame	0.00%	0.00%	0.00%	0.00%
Hot Object or Substance	0.00%	0.00%	0.00%	0.00%
Firearm	1.49%	4.90%	38.89%	44.86%
Machinery	0.00%	0.18%	0.00%	0.00%
*MVT-Occupant	27.97%	27.24%	5.34%	7.73%
MVT-Motorcyclist	1.33%	4.03%	0.00%	14.77%
MVT-Pedal Cyclist	0.17%	0.50%	0.00%	27.27%
MVT-Pedestrian	2.32%	2.93%	21.43%	21.88%
MVT-Other	0.00%	0.00%	0.00%	0.00%
MVT-Unspecified	2.57%	2.38%	6.45%	13.46%
Pedal Cyclist, Other	0.41%	0.78%	0.00%	0.00%
Pedestrian, Other	0.17%	0.78%	0.00%	5.88%
Other Land Transport	9.21%	11.72%	0.90%	2.73%
Other Transport	0.08%	0.09%	0.00%	0.00%
Natural or Environmental	0.50%	0.60%	0.00%	0.00%
Overexertion	0.00%	0.00%	0.00%	0.00%
Poisoning	0.00%	0.00%	0.00%	0.00%
Struck by or Against	3.32%	7.74%	2.50%	3.55%
Suffocation/Asphyxiation	0.00%	0.05%	0.00%	0.00%
Other Specified, Classifiable	0.17%	0.46%	50.00%	20.00%
Other Specified, Not Elsewhere Classified	0.25%	0.50%	0.00%	0.00%
Pedestrian Conveyance	0.25%	0.18%	0.00%	0.00%
Electrical	0.08%	0.00%	0.00%	0.00%
Mechanical	0.08%	0.14%	0.00%	0.00%
Explosion	0.00%	0.00%	0.00%	0.00%
*Abuse	0.17%	0.09%	0.00%	100.00%
Not Classified	0.58%	0.69%	28.57%	6.67%
Blank/NA/Unk	1.16%	0.73%	14.29%	12.50%

**NOTE: The proportion values of the preceding table are interpreted as, for example, 0.17 percent of females (n = 1,205) and 0.09 percent of males (n = 2,184) or about two of each gender incurred TBI through a mechanism of abuse. Of those two population subsets, no females and all males who were injured through a mechanism of abuse died, which reflects a 100 percent mortality rate for men incurring abuse. "MVT" is an acronym for "Motor Vehicle Transportation" which is subset with a qualifier such as "occupant" (which indicates either driver or passenger).*

A cursory review reveals that falls are a predominant mechanism of injury; 48 percent of females and 33 percent of males incur TBI by falling. As a result of a fall, 7 percent of the females who fall and 10 percent of the males who fall end up dying in the ED during care. The second most prevalent mechanism of injury is MVT-Occupant (or being involved in a motor vehicle crash) as either the driver or a passenger. Of females, 28 percent incurred TBI via a motor vehicle crash, while 27 percent of males likewise incurred TBI. Of females incurring TBI via a motor vehicle crash, 5 percent died as a result, while 8 percent of males died. The mortality rate for motorcycle accidents was 15 percent for males and (0 percent for females) and bicycle accidents were 27 percent fatal for males (and again 0 percent for females). The rate for pedestrian accidents is almost equivalent in males and females and the resulting death rates are again almost equivalent at slightly 21 percent. TBI is devastating in patients whose impacts were sufficient to cause injury despite the use of a helmet, and other injuries incurred could have also contributed to death. The high death rates in the injuries incurred outside of a vehicle's protection mechanisms also speak to the effectiveness of modern vehicular safety devices. The highest death rates of classifiable mechanisms are those of firearm injury. Although the population percentage of both males and females who incur TBI secondary to firearm injury are minimal with 1 percent of females and 5 percent of males, the resulting death rates are 39 percent and 45 percent respectively.

TBI Occurrence and Fatality by Month
January 1, 2020 – December 31, 2020
(n = 3,401)



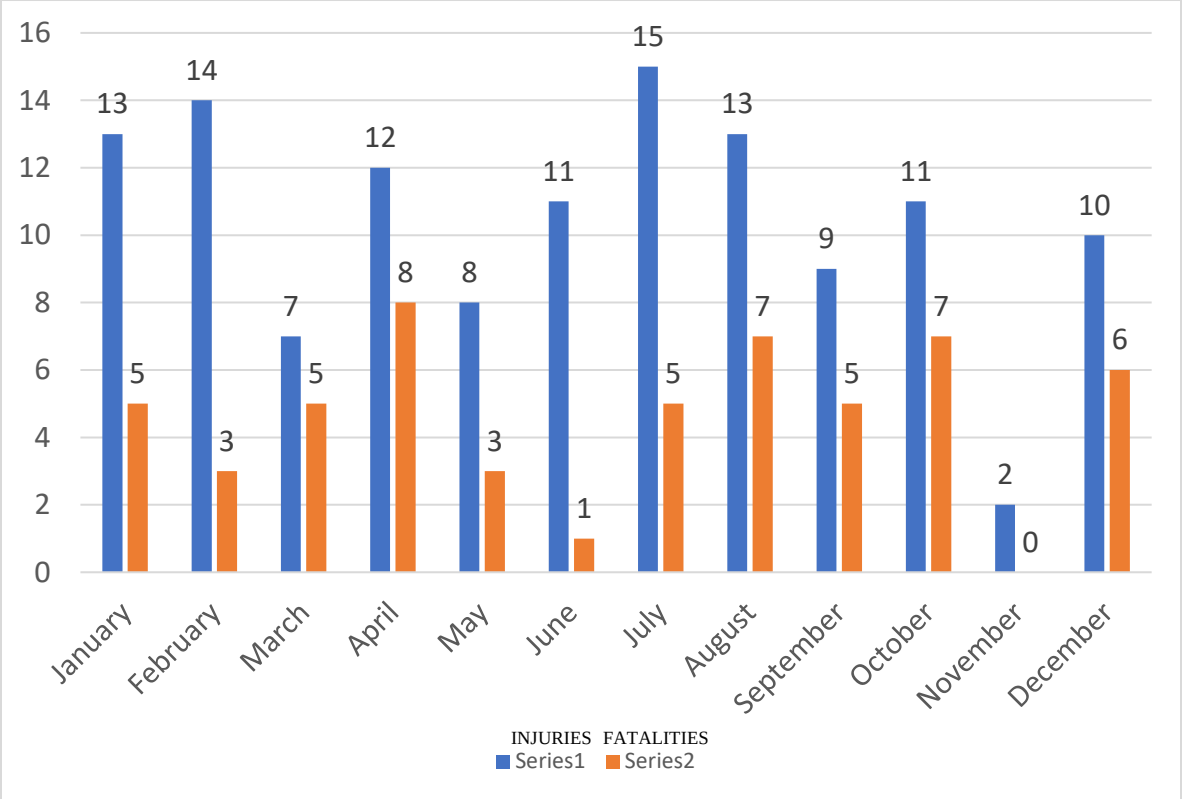


Of the 3,401 patients who experienced TBI in this study, only 125 (7 percent) experienced firearms injury. Firearms injuries averaged 10.42 per month, with a low of 7 incidents in March and a high of 15 incidents in July. The highest fatality rate for firearms injuries was 8 out of 12 (67 percent) in April and the lowest was 0 out of 2 injuries (0 percent) in November. In the TBI subgroup, the greatest number of injuries were incurred from falls and motor vehicle accidents. It is likely that falls and motor vehicle related injuries during the high traffic months of November and December contributed significantly to the overall

fatality rates. In the month of December, of the 256 injuries observed, 91 (37 percent) were falls, of which 18 (20 percent) died. Similarly, 123 (48 percent) injuries were of some vehicular nature, of which 13 (11 percent) died.

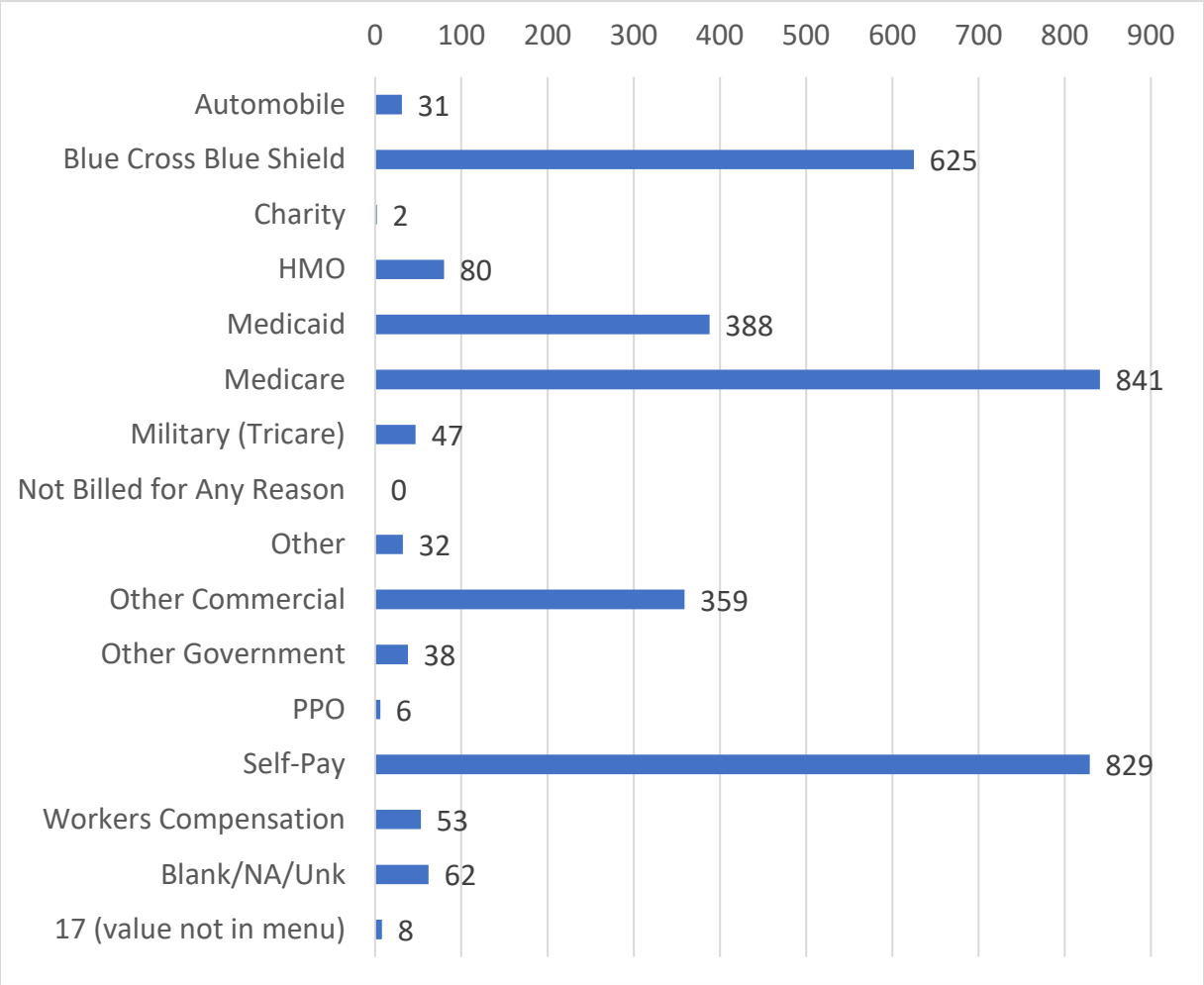
Firearms TBI Injury Per Month
January 1, 2020 – December 31, 2020
(n = 125)

Firearms TBI Fatality Per Month
(n = 55)



Firearms-related TBI averages 10.42 occurrences per month, ranging from 2 incidents in November to 15 incidents in July. Similarly, firearms-related TBI fatalities average 4.58 occurrences per month, ranging from 0 in November to 8 in April. Note that these statistics only involve those patients entered into the AHSCIR and are not reflective of general firearms injury incidence or fatality within the state of Alabama.

TBI Cases by Payer Source
January 1, 2020 – December 31, 2020
(n = 3,401)



Of the 3,401 TBI patients, all patients were billed for services. Source of payment is not known or not clear on 102 patients (3 percent). Two patients were written off as charity (1 percent). 2,468 patients (73 percent) were billed to some sort of insurance or were otherwise covered for charges. The remaining 829 patients (24 percent) were billed as "self pay" which is typically done when there is no billable insurance. The largest single payer of all categories is Medicare (841 patients or 25 percent of all TBI patients). Medicare is reserved for patients of advanced age or verified disability.

TBI Case Primary Payer Source and Fatality Statistics
(n = 3,401)

Primary Payer	Count	Percent	Deaths	Fatality Rate
Automobile	31	0.91%	1	3.23%
Blue Cross Blue Shield	625	18.38%	38	6.08%
Charity	2	0.06%	0	0.00%
HMO	80	2.35%	8	10.00%
Medicaid	388	11.41%	26	6.70%
Medicare	841	24.73%	91	10.82%
Military (Tricare)	47	1.38%	3	6.38%
Not Billed for Any Reason	0	0.00%	0	0.00%
Other	32	0.94%	5	15.63%
Other Commercial	359	10.56%	48	13.37%
Other Government	38	1.12%	3	7.89%
PPO	6	0.18%	1	16.67%
Self-Pay	829	24.38%	75	9.05%
Workers Compensation	53	1.56%	6	11.32%
Blank/NA/Unk	62	1.82%	4	6.45%
17 (value not in menu)	8	0.24%	1	12.50%
TOTALS	**3,401**	**100.00%**	**310**	

It is noteworthy that 75 (24 percent) of the 310 fatalities were verified as “self-pay”; therefore, may or may not have the ability or resources to pay hospital charges for services rendered. Further, 829 (24 percent) of all TBI patients were also listed at “self-pay” as noted previously.

Spinal Cord Injury (SCI)

The Mayo Clinic (2020) defines a spinal cord injury as damage to any part of the spinal cord or nerves at the end of the spinal canal. Spinal cord injuries in many instances often cause permanent changes in strength, sensation, and other body functions below the site of the injury. Spinal cord injuries result from damage to the vertebrae, ligaments, or disks of the spinal column or to the spinal cord itself.

A traumatic spinal cord injury may stem from a sudden, traumatic blow to the spine that fractures, dislocates, crushes, or compresses one or more of the vertebrae. It also may result from a gunshot or knife wound that penetrates and cuts the spinal cord. Additional damage usually occurs over days or weeks because of bleeding, swelling, inflammation, and fluid accumulation in and around the spinal cord. A non-traumatic spinal cord injury may be caused by arthritis, cancer, inflammation, infections, or disk degeneration of the spine.

Mechanisms of Injury

The most common causes of spinal cord injuries are:

- Motor vehicle accidents. Auto and motorcycle accidents are the leading causes of spinal cord injuries, accounting for more than 35 percent of new spinal cord injuries each year.

- Falls. Spinal cord injury after age 65 is most often caused by a fall. Overall, falls cause more than one-quarter of spinal cord injuries.

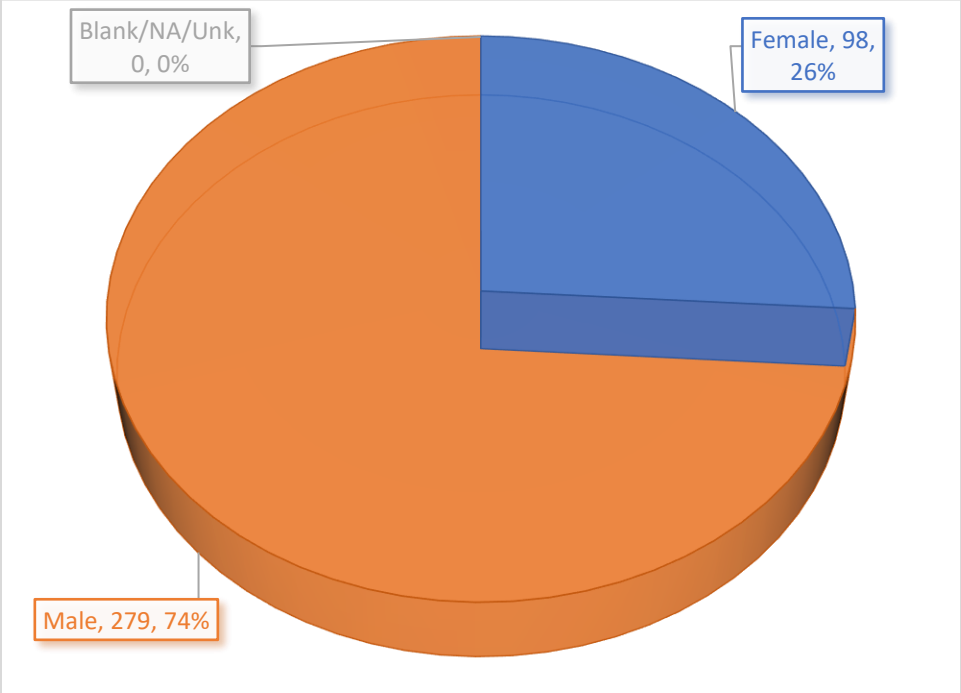
- Acts of violence. Around 15 percent of spinal cord injuries result from violent encounters, often involving gunshot and knife wounds, according to the National Spinal Cord Injury Statistical Center.

- Sports and recreation injuries. Athletic activities, such as impact sports and diving in shallow water, cause about 9 percent of spinal cord injuries.

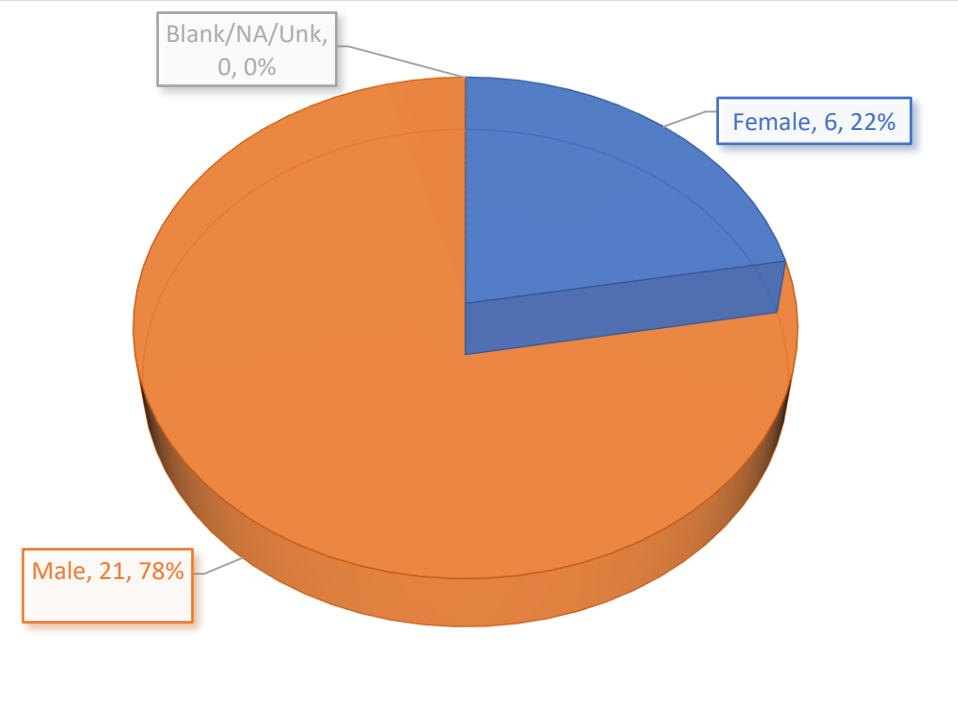
- Alcohol. Alcohol use is a factor in about 1 out of every 4 spinal cord injuries.

Diseases such as cancer, arthritis, osteoporosis, and inflammation of the spinal cord can also cause spinal cord injuries. (non-traumatic, disease-mediated cases are not counted in this report).

SCI Cases by Gender
January 1, 2020 – December 31, 2020
(n = 377)



SCI Case Fatalities by Gender
(n = 27)



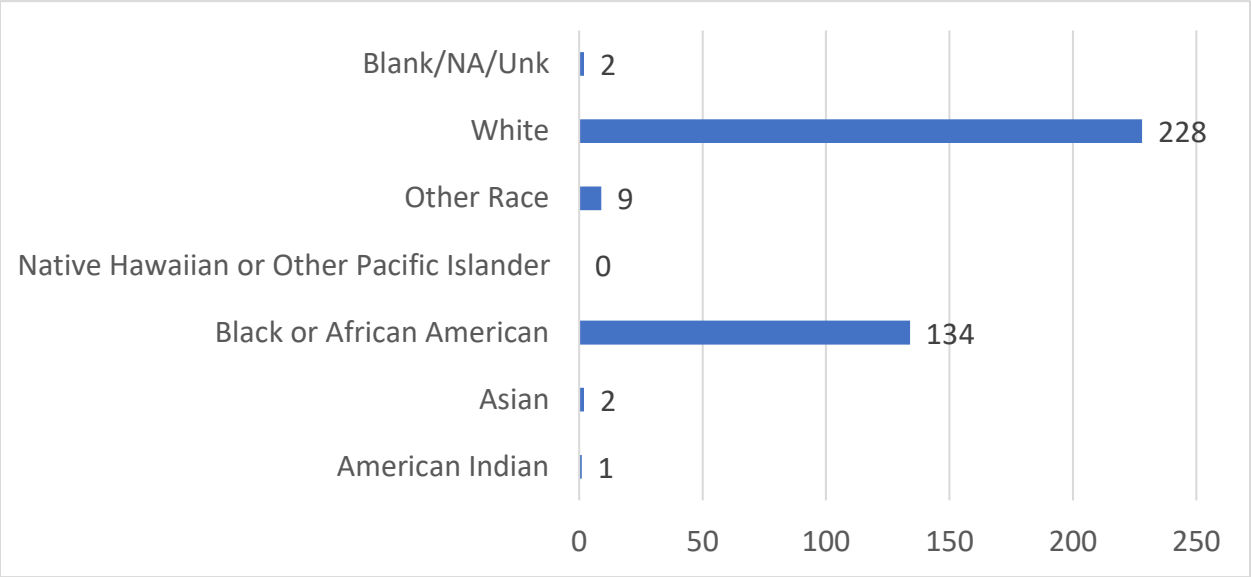
SCI Gender and Mortality Statistics
(n = 377)

Gender	Count	Percentage	Fatalities	Population Percentage	Fatality Proportion
Male	279	74%	21	8%	78%
Female	98	26%	6	6%	22%
Not Valued	0	0%	0	0%	0%
Total	**377**	**100%**	**27**	**14%**	**100%**
Not Valued	Blanks/Unknown/Non-Applicable/Unspecified/Other				

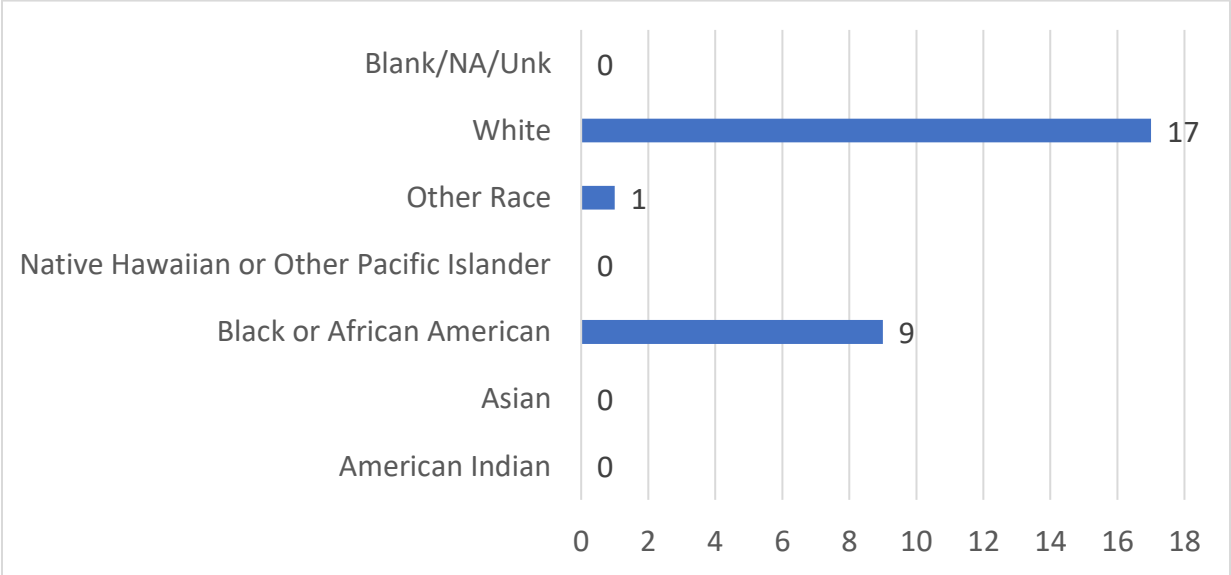
Males predominate neurological injuries in general, as well as in the TBI sub-group by a ratio of approximately 13:7, males to females, or 85 percent higher male presence. Males predominate over females in the SCI subgroup by approximately three males to every female. No obvious explanation for the disparity is evident. The odds ratio calculation of fatality from SCI finds males experiencing a 25 percent greater risk of fatality than females, a significant reduction from the risks of male deaths from TBI (63 percent risk excess). Given the predominance of males in the SCI subgroup, the risk of death appears more gender equivalent than in the TBI group. Overall mortality rates for TBI and SCI are 9 percent and 7 percent respectively.

SCI Cases by Race
January 1, 2020 – December 31, 2020
(n = 376*)

*One observation dropped from calculation by system for lack of appropriate data



SCI Mortality by Race
(n = 27)

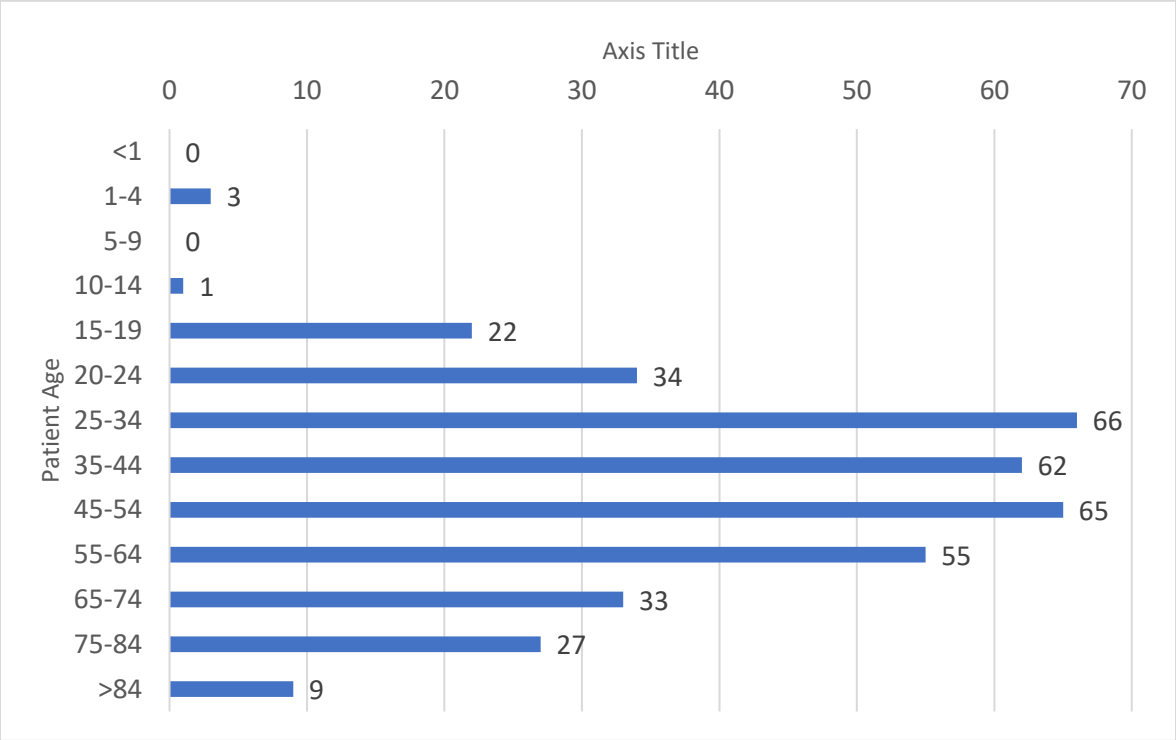


SCI Race and Mortality Statistics
(n = 377)

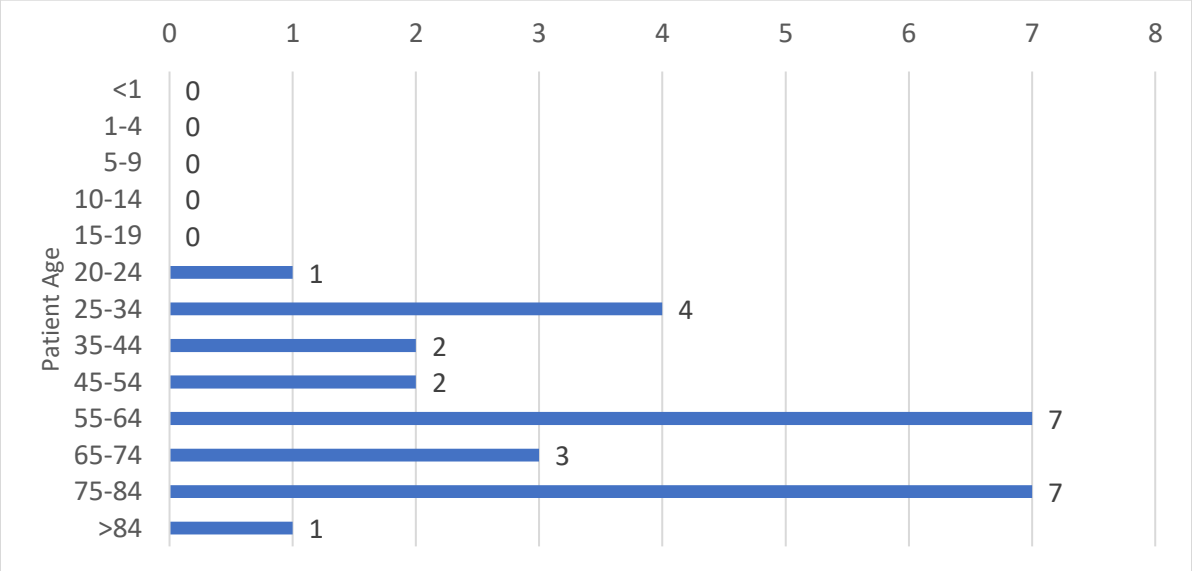
Race	Count	Population Percentage	Fatalities	Fatality Proportion
American Indian	1	0%	0	0%
Asian	2	1%	0	0%
Black/African American	134	36%	9	33%
Native Hawaiian /Pacific Islander	0	0%	0	0%
Other Race	9	2%	1	4%
White	228	60%	17	63%
Not Valued	2	1%	0	0%
Omitted from Calculation	1	---	---	---
Total	**377**	**100%**	**27**	**100%**
Not Valued	Blanks/Unknown/Non-Applicable/Unspecified/Other			

SCI race and outcome of mortality was compared to that of TBI listed previously and found to parallel with some minor random variation of proportions. It appears that patient race proportions coincide with population race proportions and that no evidence exists for outcome differences among races. Proportional comparisons for SCI cases are also complicated by the relatively small number of cases.

SCI Cases and Fatality by Age
January 1, 2020 – December 31, 2020
SCI Incidence by Age
(n = 377)



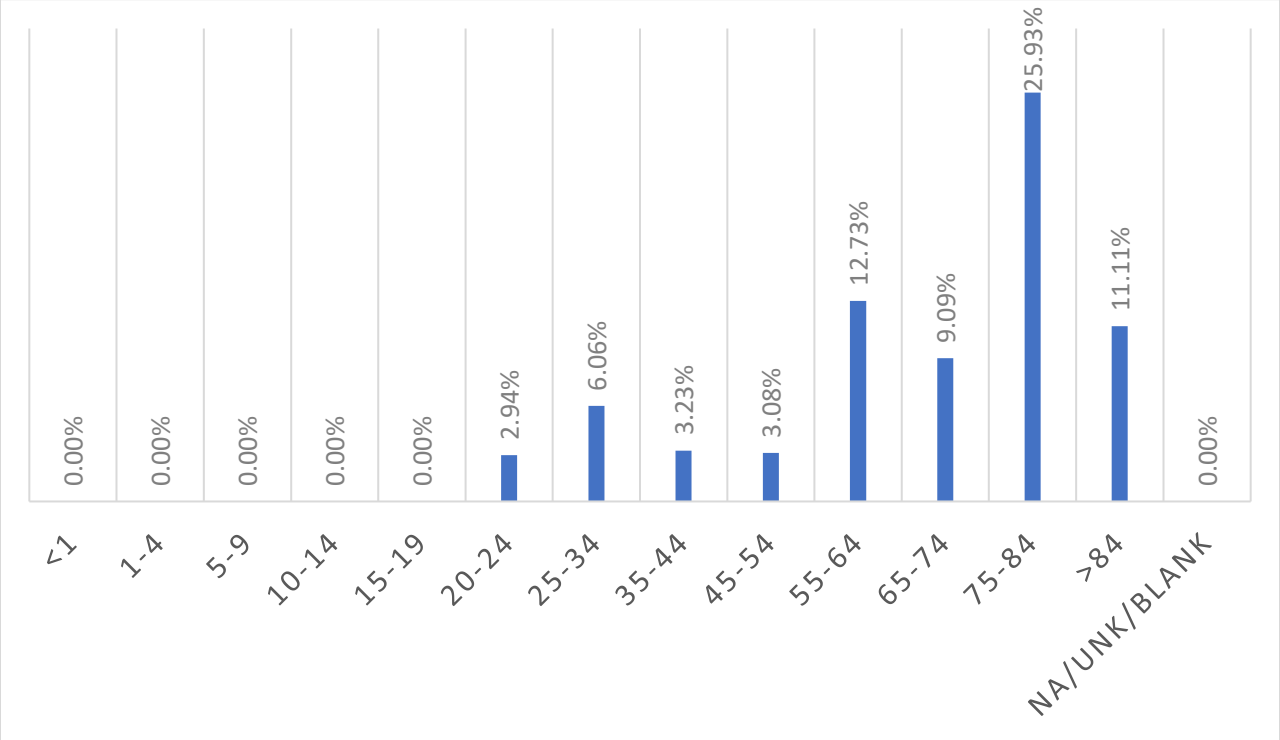
SCI Mortality by Age
(n = 27)



SCI Age and Mortality Statistics
(n = 377)

AGE GROUP YEARS	COUNT	PERCENT	DEATHS	FATALITY RATE
< 1	0	0.00%	0	0.00%
1 – 4	3	0.80%	0	0.00%
5 – 9	0	0.00%	0	0.00%
10 – 14	1	0.27%	0	0.00%
15 – 19	22	5.84%	0	0.00%
20 – 24	34	9.02%	1	2.94%
25 – 34	66	17.51%	4	6.06%
35 – 44	62	16.45%	2	3.23%
45 – 54	65	17.24%	2	3.08%
55 – 64	55	14.59%	7	12.73%
65 – 74	33	8.75%	3	9.09%
75 – 84	27	7.16%	7	25.93%
> 84	9	2.39%	1	11.11%
NA/UNK/BLANK	0	0.00%	0	0.00%
TOTALS	**377**	**100.00%**	**27**	**OVERALL 7.16%**

SCI Fatality by Age Comparison
(n = 27)



Ages from birth to 19 years comprise 7 percent of SCI patients and are without fatality. Fatalities are observed starting at age 20 years and increase as age progresses, peaking at age 55 to 64 years and significantly peaking at age 75 to 84 years. Incidence of SCI peaks at 25 to 64 years of age, attesting to a correlation of the injury process with the more active years of life.

In the TBI section, incidence of TBI by age, gender, and race was reviewed. Given that the SCI population is 89 percent fewer than the TBI population, a similar comparison will not be made. The small numbers within the SCI population are subject to greater variation due to statistical randomicity.

Discharge Disposition (From Emergency Department Phase of Care) Following SCI
January 1, 2020 – December 31, 2020
(n = 377)

Emergency Department Discharge Disposition	Facility Count	Facility Percentage
Acute Care Facility	24	6.37%
Another Type of Inpatient Facility	0	0.00%
Burn Center	0	0.00%
Burn Unit	0	0.00%
Child Protective Agency	0	0.00%
Correctional Facility/Court/Law Enforcement	0	0.00%
Floor	74	19.63%
Home or Self-Care (Routine Discharge)	7	1.86%
Home with Services	0	0.00%
Hospice	0	0.00%
Intensive Care Unit	203	53.85%
Intermediate Care Facility	1	0.27%
Interventional Radiology	1	0.27%
Labor and Delivery	0	0.00%
Left AMA	0	0.00%
Long-Term Care	0	0.00%
Mental Health/Psychiatric Hospital (Inpatient)	0	0.00%
Morgue	2	0.53%
Neonatal/Pediatric Care Unit	1	0.27%
Nursing Home	0	0.00%
Observation Unit	1	0.27%
Operating Room	53	14.06%
Rehab (Inpatient)	0	0.00%
Skilled Nursing Facility	0	0.00%
Step-Down Unit	2	0.53%
Telemetry Unit	4	1.06%
Blank/NA/Unk	4	1.06%
TOTALS	**377**	**100.00%**

Of the 377 SCI patients observed, 364 (97 percent) were known to have been transferred from the ED phase of care to another medical interventional environment; 203 (54 percent) went into intensive care unit (ICU) and 53 (14 percent) went to surgery. As large groups were transferred to interventional hospitalization, it stands to reason that a significant proportion of the SCI population would require state provided rehabilitation services either for limited or indefinite periods of time.

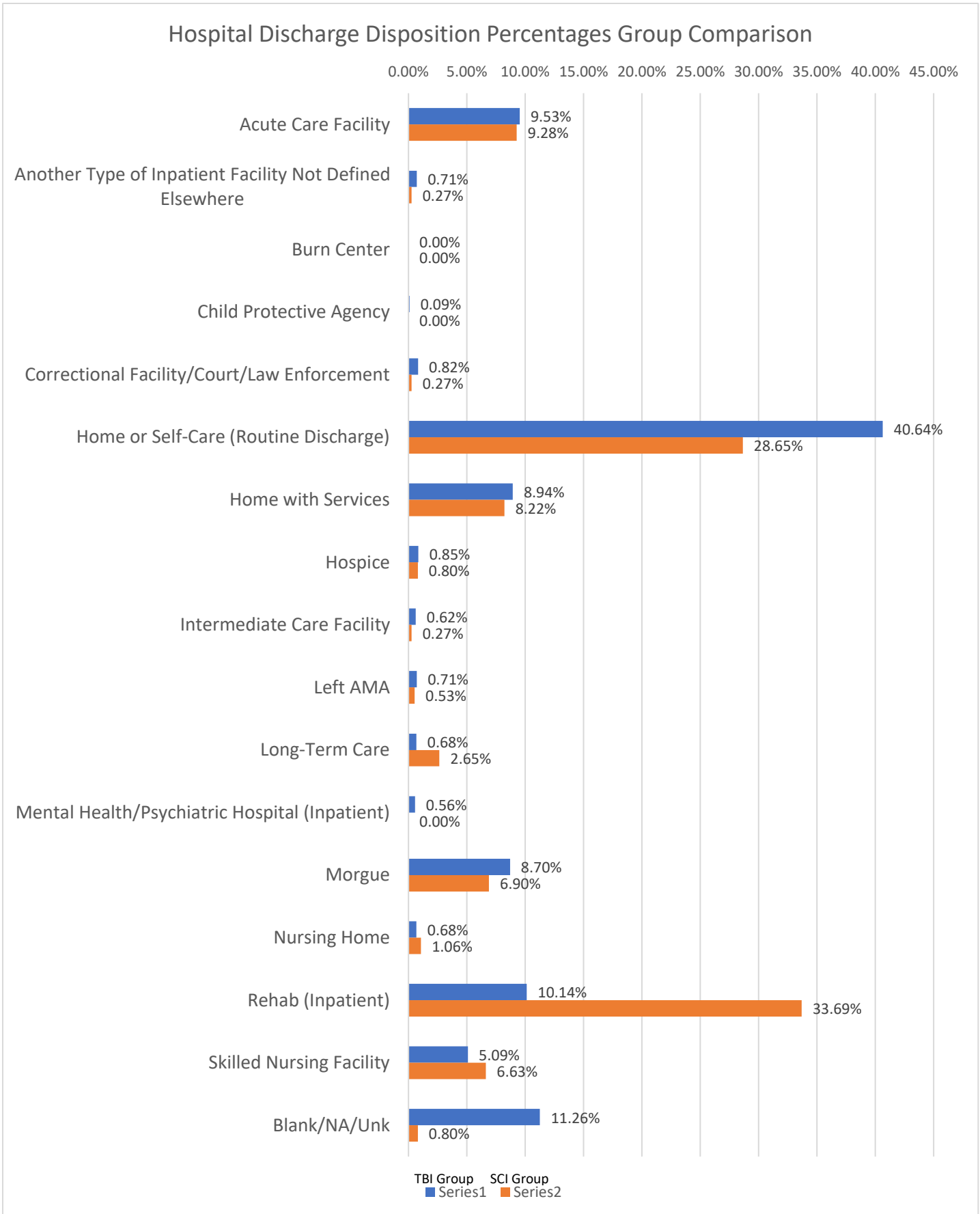
Whereas, the post ED phase dispositions of both TBI and SCI groups, post hospitalization disposition for either TBI or SCI has not been discussed. In the following section, the post hospitalization outcomes for both injury groups will be described and contrasted.

Hospital Discharge Dispositions of TBI and SCI Sub-Groups
January 1, 2020 – December 31, 2020
TBI (n = 3,401)
SCI (n = 377)

Hospital Discharge Disposition	TBI Group		SCI Group	
	Count	Percent	Count	Percent
Acute Care Facility	324	9.53%	35	9.28%
Another Type of Inpatient Facility	24	0.71%	1	027%
Burn Center	0	0.00%	0	0.00%
Child Protective Agency	3	0.09%	0	0.00%
Correctional Facility/Court/Law Enforcement	28	0.82%	1	0.27%
Home or Self-Care (Routine Discharge)	1,382	40.64%	108	28.65%
Home with Services	304	8.94%	31	8.22%
Hospice	29	0.85%	3	0.80%
Intermediate Care Facility	21	0.62%	1	0.27%
Left AMA	24	0.71%	2	0.53%
Long-Term Care	23	0.68%	10	2.65%
Mental Health/Psychiatric Hospital	19	0.56%	0	0.00%
Morgue	296	8.70%	26	6.90%
Nursing Home	23	0.68%	4	1.06%
Rehab (Inpatient)	345	10.14%	127	33.69%
Skilled Nursing Facility	173	5.09%	25	6.63%
Blank/NA/Unk	383	11.26%	3	0.80%
TOTALS	**3,401**	**100.00%**	**377**	**100.00%**

A cursory review finds that 90 percent of outcomes compared between groups are within a few percentage points and most are virtually identical. The exceptions are those patients discharged to home without supportive services being necessary (routine discharge) for which 41 percent of TBI patients and 29 percent of SCI patients are listed, and those patients who were discharged to inpatient rehabilitation facilities for which 10 percent of TBI patients and 34 percent of SCI patients were listed.

A graph chart comparing each hospital discharge disposition proportion is listed on the following page.

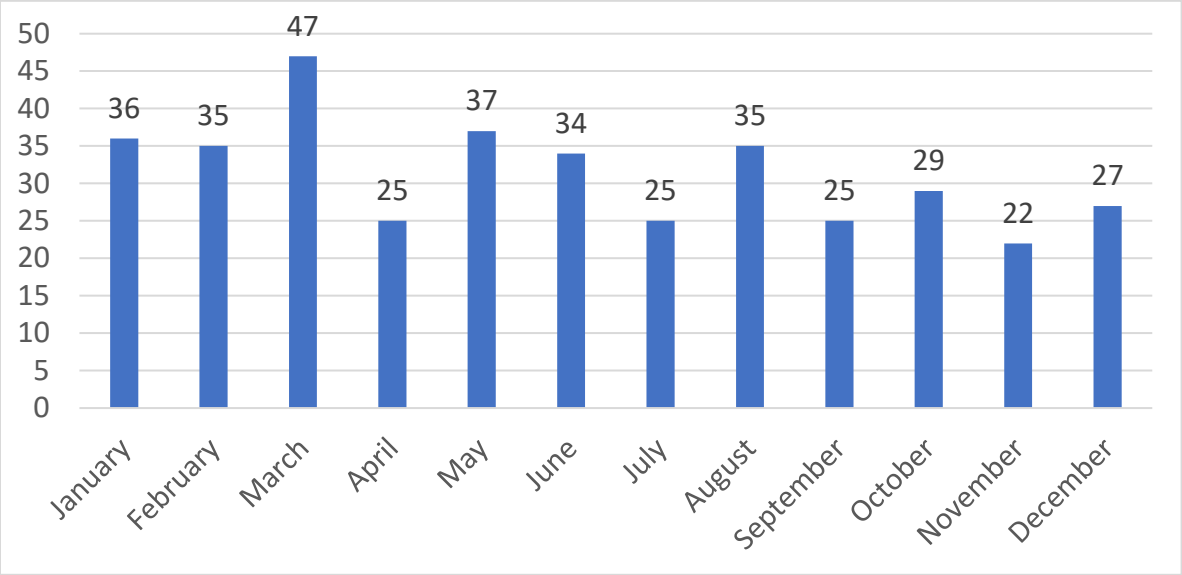

Hospital Discharge Disposition Percentages Group Comparison
0.00% 5.00% 10.00% 15.00% 20.00% 25.00% 30.00% 35.00% 40.00% 45.00%
Acute Care Facility
9.53%
9.28%
Another Type of Inpatient Facility Not Defined Elsewhere
0.71%
0.27%
Burn Center
0.00%
0.00%
Child Protective Agency
0.09%
0.00%
Correctional Facility/Court/Law Enforcement
0.82%
0.27%
Home or Self-Care (Routine Discharge)
40.64%
28.65%
Home with Services
8.94%
8.22%
Hospice
0.85%
0.80%
Intermediate Care Facility
0.62%
0.27%
Left AMA
0.71%
0.53%
Long-Term Care
0.68%
2.65%
Mental Health/Psychiatric Hospital (Inpatient)
0.56%
0.00%
Morgue
8.70%
6.90%
Nursing Home
0.68%
1.06%
Rehab (Inpatient)
10.14%
33.69%
Skilled Nursing Facility
5.09%
6.63%
Blank/NA/Unk
11.26%
0.80%
TBI Group SCI Group
Series1 Series2

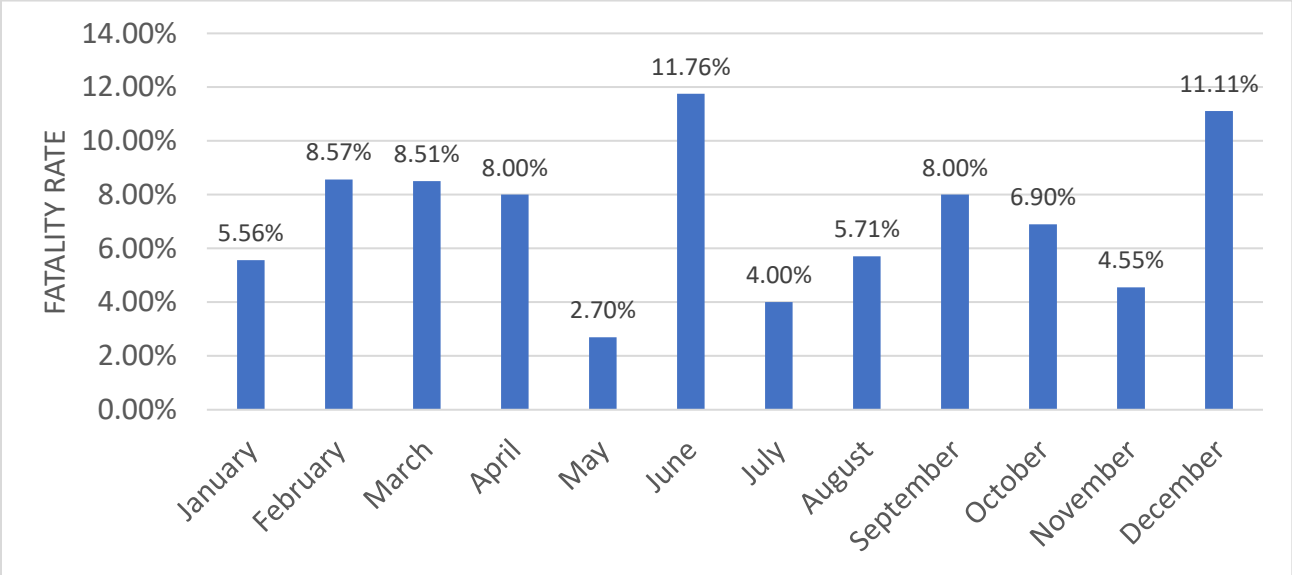
Mechanism of Injury Occurrence in SCI Cases and Fatality as Outcome
January 1, 2020 – December 31, 2020
(n = 377)

Primary Mechanism of Injury	Count	Percent	Deaths	Fatality Rate
Cut or Pierce	0	0.00%	0	0.00%
Drowning/Submersion	0	0.00%	0	0.00%
Fall	104	27.59%	10	9.62%
Fire or Flame	0	0.00%	0	0.00%
Hot Object or Substance	2	0.53%	0	0.00%
Firearm	41	10.88%	4	9.76%
Machinery	2	0.53%	0	0.00%
MVT-Occupant	123	32.63%	8	6.50%
MVT-Motorcyclist	22	5.84%	1	4.55%
MVT-Pedal Cyclist	3	0.80%	0	0.00%
MVT-Pedestrian	6	1.59%	0	0.00%
MVT-Other	0	0.00%	0	0.00%
MVT-Unspecified	14	3.71%	0	0.00%
Pedal Cyclist, Other	4	1.06%	0	0.00%
Pedestrian, Other	3	0.80%	1	33.33%
Other Land Transport	31	8.22%	2	6.45%
Other Transport	1	0.27%	0	0.00%
Natural or Environmental	3	0.80%	0	0.00%
Overexertion	0	0.00%	0	0.00%
Poisoning	0	0.00%	0	0.00%
Struck by or Against	10	2.65%	1	10.00%
Suffocation/Asphyxiation	0	0.00%	0	0.00%
Other Specified, Classifiable	1	0.27%	0	0.00%
Other Specified, Not Elsewhere Classified	3	0.80%	0	0.00%
Pedestrian Conveyance	1	0.27%	0	0.00%
Electrical	0	0.00%	0	0.00%
Mechanical	1	0.27%	0	0.00%
Explosion	0	0.00%	0	0.00%
Abuse	0	0.00%	0	0.00%
Not Classified	0	0.00%	0	0.00%
Blank/NA/Unk	2	0.53%	0	0.00%
TOTALS	**377**	**100.00%**	**27**	**7.16% Overall**

Of the 377 SCI patients observed, 123 (33 percent) were injured in motor vehicle accidents as either the driver or occupant. Further, 104 (28 percent) were injured during a fall. Forty-one patients (11 percent) were injured by firearms, of which 4 (10 percent) died during treatment. Twenty-two patients (6 percent) were injured in motorcycle accidents, of which 1 died (5 percent). Whereas, only 3 patients (1 percent) were injured in pedestrian accidents other than MVT related and 6 patients (2 percent) in MVT related pedestrian accidents. The only pedestrian fatality was within the other than MVT related category and its categorial fatality rate of 33 percent was only the result of the small number and statistical randomicity. A total of 186 (49 percent) injuries were related to vehicles in some way.

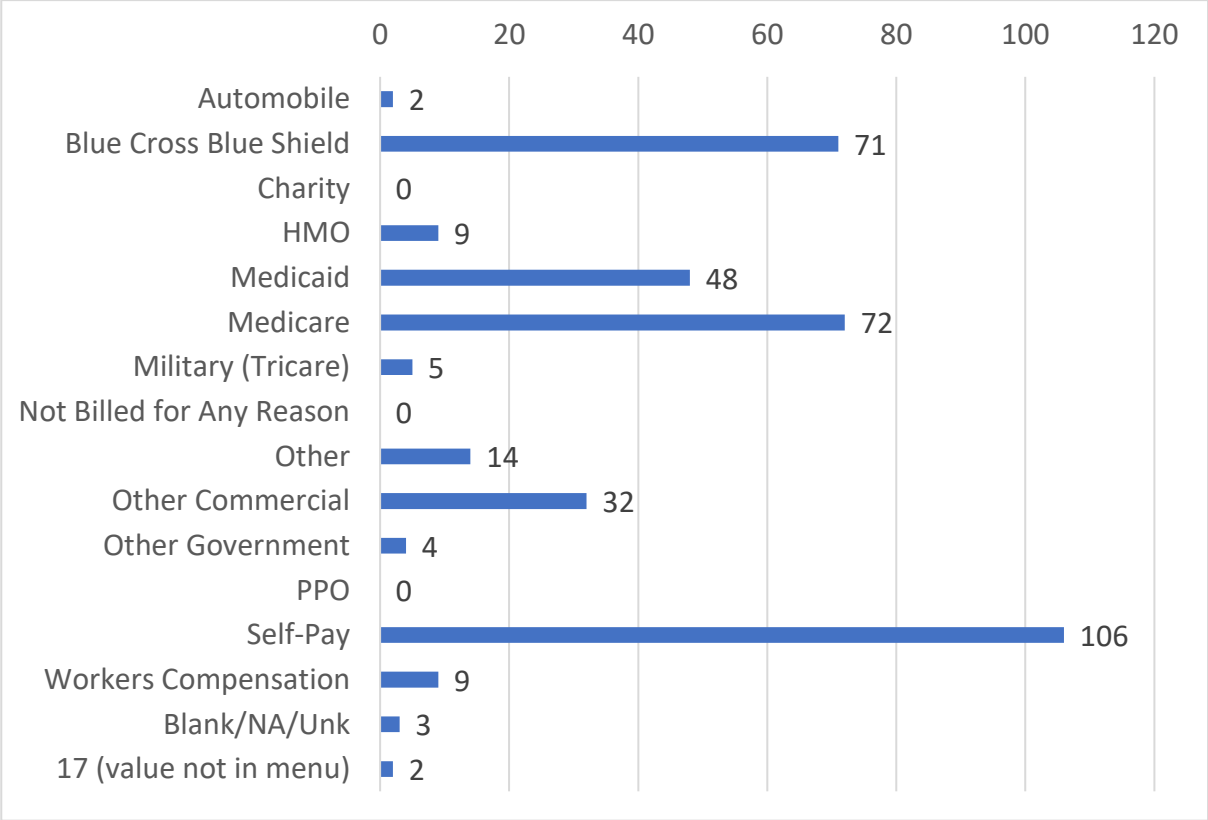
SCI Occurrence and Fatality by Month
January 1, 2020 – December 31, 2020
(n = 377)





The average injury count per month for SCI in 2020 was 31.42 (high of 47 in March and a low of 22 in November). The average monthly SCI fatality rate for 2020 was 7 percent (high of 12 percent in June and low of 3 percent in May). Given the small numbers per month, it appears that the occurrences and fatality rate variation do not reflect any seasonal changes in incidence or lethality and that variation is likely random statistical variation.

SCI Cases by Payer Source
January 1, 2020 – December 31, 2020
(n = 377)

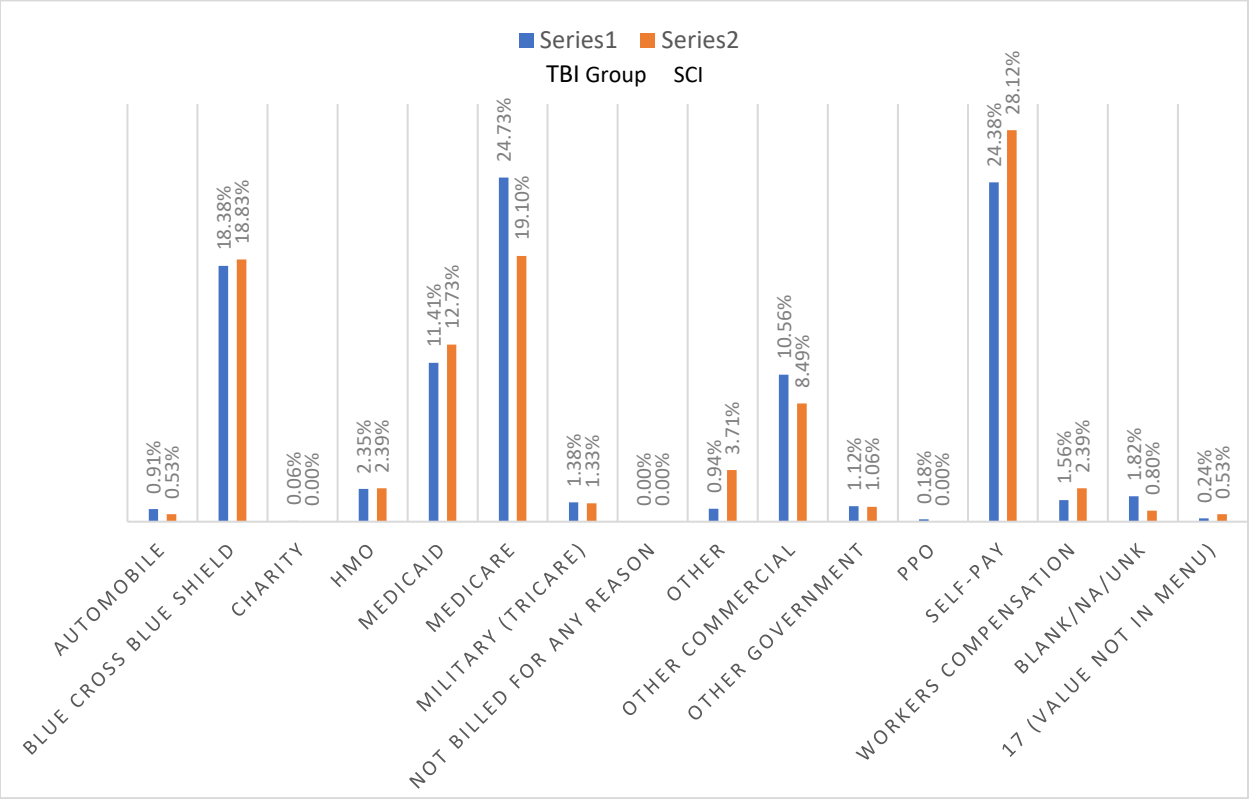


Of the 377 SCI patients, all patients were billed for services. Source of payment is not known or not clear on 19 patients (5 percent). No patients were written off for charity. Two hundred sixty-six patients (71 percent) were billed to some sort of insurance or were otherwise covered for charges. The remaining 106 patients (28 percent) were billed as "self-pay" which is typically done when there is no billable insurance. The largest single payer of all categories is Medicaid (72 patients or 19 percent of all SCI patients).

It is noteworthy that, of the total number of patients entered into the AHSCIR for 2020 (3,717), the proportions of the payer sources of TBI patients compared to SCI patients does not vary significantly. This speaks to the homogeneity of the injury group as a whole. A chart comparing payer source proportions for the two groups is displayed on the following page.

PAYER SOURCE PROPORTION COMPARISON

TBI GROUP VERSUS SCI GROUP



SCI Case Primary Payer Source and Fatality Statistics
(n = 377)

Primary Payer	Count	Percent	Deaths	Fatality Rate
Automobile	2	0.53%	0	0.00%
Blue Cross Blue Shield	71	18.83%	1	1.41%
Charity	0	0.00%	0	0.00%
HMO	9	2.39%	1	11.11%
Medicaid	48	12.73%	2	4.17%
Medicare	72	19.10%	10	13.89%
Military (Tricare)	5	1.33%	0	0.00%
Not Billed for Any Reason	0	0.00%	0	0.00%
Other	14	3.71%	2	14.29%
Other Commercial	32	8.49%	4	12.50%
Other Government	4	1.06%	0	0.00%
PPO	0	0.00%	0	0.00%
Self-Pay	106	28.12%	7	6.60%
Workers Compensation	9	2.39%	0	0.00%
Blank/NA/Unk	3	0.80%	0	0.00%
17 (value not in menu)	2	0.53%	0	0.00%
TOTALS	**377**	**100.00%**	**27**	

Conclusion

In 2020, participating Alabama hospitals entered a total of 3,717 patients meeting the defined ICD-10 diagnosis criteria for injury of the central nervous system. The ICD-10 selection criteria were designed to isolate those patients of interest who had suffered TBI or SCI. Previous studies have shown that 3 percent of patients were likely to have suffered a combination of injuries; however, those patients were assigned either TBI or SCI designations depending upon the primary injured areas. It was determined that 91 percent of neurological injury patients were primarily TBI and that 9 percent of patients were primarily SCI. The two subgroups were compared and contrasted to search for differences in causes, severities, financial burden, and outcomes including mortality. Survival status was especially considered for potential entry into the Alabama Department of Rehabilitation Services.

Studies in previous years were completed with a different database and likely with wider inclusion criteria and included a larger number of patients. Whereas COVID-19 may have influenced population activities during 2020, and also may have affected hospital dynamics as to personnel available or dedicated to entering the data, the degree of influence is unknown. Reduction of patient numbers, therefore, should not be suspected to have any other causality. Our review isolated those patients with injury diagnosis specifically of interest. Such patients are traditionally found to have experienced devastating or potentially devastating injuries. Overall survivability was found to be at or around 90 percent in general and hospitalization potential, and thus the potential for rehabilitative services was found to be significant.