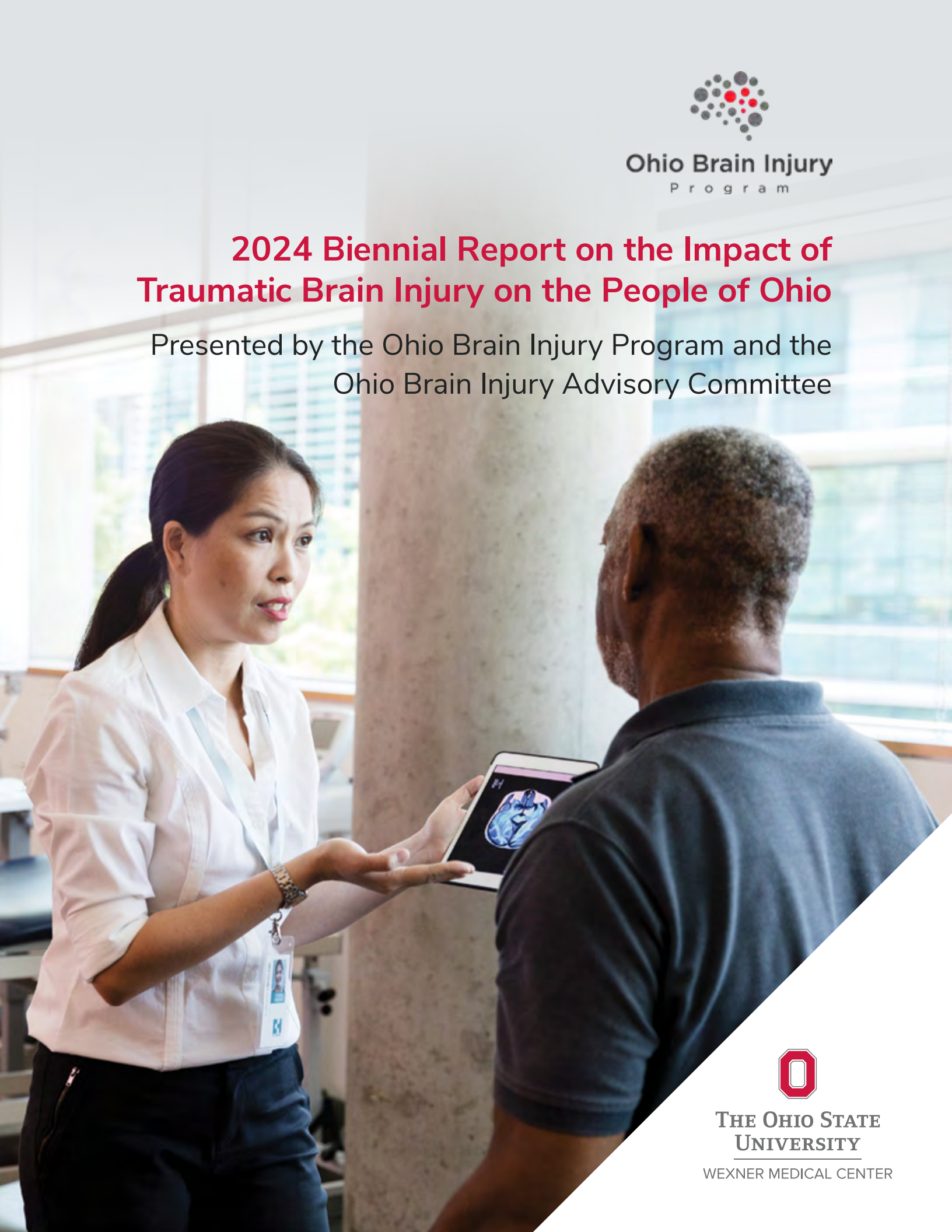
Ohio Brain Injury Program

# 2024 Biennial Report on the Impact of Traumatic Brain Injury on the People of Ohio

Presented by the Ohio Brain Injury Program and the Ohio Brain Injury Advisory Committee



The Ohio State University
Wexner Medical Center

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# Acknowledgments

This report was prepared by the staff of the Ohio Brain Injury Program and the Data Workgroup of the Brain Injury Advisory Committee in accordance with the requirement set forth in the Ohio Revised Code (ORC) 3335.60. The ORC states that the Brain Injury Program of Ohio will create a biennial report on the impact of brain injury on the state's population. The staff of the Ohio Brain Injury Program appreciates the work and ongoing commitment of the Brain Injury Advisory Committee members for their singular dedication and diligent efforts to the development of a program in Ohio that recognizes and serves the needs of the population affected by this life-changing injury within the state.

We would like to acknowledge the leadership and guidance of John Corrigan, PhD, executive director of the Brain Injury Program, for his outstanding leadership of the program, the Advisory Committee and the activities of its multiple workgroups. Most particularly, the Data Workgroup wishes to express deepest thanks to Dr. Corrigan for his guidance in the preparation of this report and his unfailing encouragement for its successful completion.

We wish to acknowledge the contributions of the members of the Data Workgroup for their many hours of work in the development and preparation of this report. Team members from the Ohio Department of Health and the Department of Public Safety combined their efforts to collect and present data from their respective data sets to provide insight into the experience of Ohio's population in the occurrence of traumatic brain injury.

## Brain Injury Advisory Committee Data Workgroup Members

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Copies of this report have been provided to members of the Ohio Brain Injury Advisory Committee for their information and review. Additional copies of this report, as well as previous reports, may be obtained by contacting Brei Miller at **614-293-8879** or **brei.miller@osumc.edu**.

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THE OHIO BRAIN INJURY PROGRAM AND THE BRAIN INJURY ADVISORY COMMITTEE

# Introduction

This report was prepared in accordance with the requirements set forth in the Ohio Revised Code 3335.60, which states that the Brain Injury Program of Ohio will prepare a biennial report on the impact of traumatic brain injury (TBI) on the population of Ohio. The information in this report comes from data collected in 2020 and 2021.

This is the 10th such report containing data from the Ohio Trauma Registry, collected by the Ohio Department of Public Safety. It is the fifth report to include Ohio discharge diagnosis data for inpatient hospitalizations and emergency department (ED) visits (collected by the Ohio Hospital Association [OHA]) and data on deaths, compiled by the Ohio Department of Health (ODH). It is the fourth report to include data on the prevalence of TBI in the state, collected from the Ohio Behavioral Risk Factor Surveillance System by the ODH.

Because the data sources differ substantially in methodology, the data reported also differ such that direct comparisons and correlations are not always possible. Therefore, the data are presented and analyzed separately to give multiple views of the burden of TBI in Ohio. Detailed information on respective selection criteria precedes the data presentation in each section.

This report uses the Centers for Disease Control and Prevention definition of TBI: *An injury caused by a bump, blow or jolt to the head, or a penetrating head injury, that disrupts the normal function of the brain.*

The Traumatic Brain Injury Model Systems National Data and Statistical Center provides a more detailed definition: *TBI is defined as damage to brain tissue caused by an external mechanical force as evidenced by medically documented loss of consciousness or post-traumatic amnesia due to brain trauma or by objective neurological findings that can be reasonably attributed to TBI on physical examination or mental status examination.*

For the purposes of this report, these definitions are considered equivalent.

# Executive summary

> *"Now, after 15 months of hard work with a superb committee of clinicians, research scholars, and epidemiologists who have devoted their careers to the study and care of TBI, and after eloquent testimony from people living with TBI and their families, I can see the topic more accurately for what it is: complex in texture, massive in scale, full of important research challenges, and largely as unrecognized — or as misunderstood — by the public and most clinicians as it was initially to me. TBI is not the name of an isolated, sometimes dramatic, but largely evanescent event. Instead, TBI is a significant, but remarkably hidden, burden for patients, families, public health, and health care costs throughout the nation, and in every demographic group."*

Source: *Traumatic Brain Injury – A Roadmap for Accelerating Progress*, National Academies of Sciences, Engineering, and Medicine, preface by Donald Berwick

This report presents information on the impact of TBI on the people and the state of Ohio. It addresses multiple characteristics of the public health burden of TBI. These distinct but related elements illustrate the substantial burden for survivors, families and society at large.

**Incidence: The actual number of injuries that occur in Ohio during a specific time period**

- In 2021, there were 2,914 TBI-related deaths, 11,470 TBI-related hospitalizations and 101,176 TBI-related ED visits. (Sources: ODH Bureau of Vital Statistics and OHA)
- In 2021, for every 100,000 residents, 23 had a TBI-related death. Over the previous 10 years, TBI-related deaths increased 29%. (Source: ODH Bureau of Vital Statistics)
- In 2021, suicide was the leading intent/mechanism of TBI-related death, which was largely attributed to deaths among males. (Source: ODH Bureau of Vital Statistics)
- Black non-Hispanic males had the highest rate of TBI-related deaths from 2012 to 2021. In 2021, homicide was the leading intent/mechanism among this group, accounting for 42% of TBI-related deaths. (Source: ODH Bureau of Vital Statistics)
- Unintentional falls were the second-leading intent/mechanism of TBI-related deaths and the leading intent/mechanism of TBI-related hospitalizations and ED visits in 2021. (Sources: ODH Bureau of Vital Statistics and OHA)
- The largest proportion of TBI-related ED visits was among young adults aged 15 to 24 years old (16%). However, older adults who were 75 to 84 years of age made up the largest proportion of TBI-related hospitalizations (19.5%). Adults aged 85 years old and older had the highest rate of TBI-related ED visits, hospitalizations and deaths. (Source: OHA)
- In the 2020-2021 time period, 20.6% to 21.0% of the injuries reported to the Ohio Trauma Registry were TBIs. (Source: Ohio Trauma Registry [OTR])
- There are clear trends presented among the TBIs: The majority of TBIs are among males, due to falls and most frequently occur in the 75 to 84 years age category. They most frequently occur in the home, and patients are most frequently discharged home without additional services. (Source: OTR)



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- Patients who are discharged somewhere other than home without services more frequently have an injury severity score (ISS) of 9 or above. (Source: OTR)
- The most common method of payment for hospital treatment for TBI, irrespective of patient discharge status, is Medicare, due to a larger percentage of TBIs occurring in older age groups. (Source: OTR)
- Patients most frequently spend one day at the hospital following their TBI. (Source: OTR)
- Deaths among TBI patients occur more frequently among males and among those ages 75 years and older. The highest case fatality rates are for penetrating injuries, while falls remain the most common mechanism of injury. (Source: OTR)

**Prevalence: The number of Ohioans who have sustained a TBI in their lifetime**

- An estimated 1.65 million (23.2%) adults in Ohio have had at least one TBI in their lifetime. More than 1.1 million (16.2%) have had at least one TBI with loss of consciousness (LOC).
- Compared to all adult Ohioans, those with a history of TBI with LOC are more likely to:
  - » Have less than a high school education.
  - » Have a household income less than $15,000.
  - » Be unable to work.
- More than 450,000 Ohio adults reported having both a disability and a history of TBI with LOC.
- Among the more than 200,000 (2.9%) Ohio adults who have a history of moderate to severe TBI (> 30 minutes LOC), approximately 101,000 (50.5%) also reported having a current disability.
- Disability due to cognitive problems, limited mobility and not being able to live independently are the most common causes of disability for people with TBI.
- Compared to all adult Ohioans, those with a history of TBI with LOC had:
  - » More days when poor physical health kept them from activities.
  - » More days when their mental health was not good.
  - » A greater likelihood of having chronic health conditions.
- Compared to all adult Ohioans, those with a history of TBI with LOC were more likely to smoke cigarettes, drink to excess and experience depression.
- The regional distribution of TBI suggests that rural areas, particularly those in Appalachia, have a higher prevalence of TBI among the adults living there.

(Source for prevalence data above: Behavioral Risk Factor Surveillance System [BRFSS])

**Cost: The financial, societal and human costs of the injury**

- Because TBI is a chronic disease with far-reaching and long-lasting impact, the costs attributable to it extend far beyond those incurred immediately after the injury.
- The costs of medical care and treatment are compounded by such necessities as durable medical equipment, care and attendance, rehabilitation, lost wages, special services (e.g., education, legal, psychosocial), ancillary medical conditions and housing, all of which accrue over the course of the chronic disease history.
- Lifetime costs for Ohioans injured in 2014 are estimated at $5 billion just for medical care and lost wages. (Source: Ohio Brain Injury Advisory Committee, 2019 Biennial Report)

**Personal Loss: The lived experience of lives changed forever**

Repeated concussions sustained by a young athlete have a cumulative effect that can produce tragic, life-changing results.



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# Prologue: Traumatic brain injury is always a personal story

"My eldest son is an athlete. His love of all sports, but particularly soccer and basketball, isn't just a passion; it pulses through his veins, much like the story of his Aunt Sam. At almost 9 years old, he knows better than most athletes and coaches the importance of protecting not only his body, but especially his head. You see, his Aunt Sam's story has been shared with him his entire life, and while it started when she was around his age, the key parts began 19 years ago when my only sister sustained a concussion that altered her life and, by proxy, each of the lives of those around her.

"Twelve years ago, my sister — who had spent seven years learning, understanding and mourning the loss of her athletic dreams, career aspirations and so much more — found her purpose in sharing her story via her testimony for House Bill 143. Despite all she had lost, she knew that every athlete deserved the chance to safely follow their dreams. A year later, Sam was able to join the governor of Ohio and sign HB 143 into law. It was one of the greatest days of her life. She knew it would protect athletes in the way she wished she'd been protected. Unfortunately, not even a full year after signing this bill, due to complications from her TBI and the array of medical complications the TBI gave her, Sam died at 23 years old. While Sam never got to meet her niece and nephews on earth, her passion, love and advocacy continue to protect them each and every day.

"Brain injuries are hard to see and understand, yet they go beyond the affected parts of the injured person and reach every aspect of their community. That is why I share Sam's story. It is also a part of mine. So, without further ado, I invite you to read my sister's story, her testimony for HB 143, her legacy."

*— Danielle Nesser Gregor*

**Sam Nesser's testimony for House Bill 143 – June 4, 2011**

"Chairman Wachtman and members of the committee, my name is Sam Nesser. I am 21, and I am a brain injury survivor. On Saturday, July 10, 2004, my life changed forever. I was at a basketball camp at the University of North Carolina with my high school team. I was an incoming freshman and was playing in a basketball game when I went up for a rebound and got knocked down, landing headfirst and suffering severe whiplash and a severe concussion. That concussion was the end of sports for someone who had played year-round basketball and soccer since I was 5 and ruined my chances at what seemed like a promising future college scholarship.

"Little did I know that was just the beginning of a long journey … a journey to find the right doctors, the right diagnoses and the right education. Meanwhile, I struggled with everyday things. I suffered from severe headaches, dizziness, exhaustion, memory loss and [I] lost a lot of my cognitive skills. I was started on many medications for pain and depression. I started physical

therapy and speech therapy. I have continued taking physical therapy, even now, with the same therapist I started with in 2005. I have been hospitalized many, many times with a lot of medical problems. I was finally diagnosed six months after my injury with a traumatic brain injury (after neuropysch testing). Over the years, I have been diagnosed with fibromyalgia, irritable bowel syndrome, a neurogenic bladder, post-traumatic stress disorder and chronic headaches, all because of suffering too many concussions in sports that finally led to the diagnosis of traumatic brain injury.

"When I went back to school for my freshman year, I couldn't stand the lights, noise and smells, and was often sick from school. My grades slid, and I became more depressed as friends left me because they couldn't understand my condition and thought I was 'faking it.' I eventually left my school for an online school so I could work at my own pace, but I still couldn't keep up. It wasn't until I found Buckeye Online School for Success two years ago that they got me an IEP [individualized education plan] and had me undergo testing to see where I was in my education. It turns out that I was working at a fourth and fifth grade level. So they put me in special education, and I was finally able to do my work again and had to relearn a lot of school stuff. I am finally getting As and Bs again. I'm currently working on my high school diploma. I hope to finish high school in February 2012 and walk across the stage with my class that spring. I would like to go into the medical field after college. I have a lot more hope now because I got a service dog named Linus a couple months ago. He helps with my emotional and physical needs and has been a godsend. I will be training with him for another year, and we hope to take him to visit hospitalized patients and nursing home residents in six to eight months. He is a part of the family now, as you can see today.

"I hope my story can help prevent this from happening to other young athletes. If House Bill 143 had been law when I was playing basketball and soccer, I think things would have been much different. You see, back when I was playing basketball and soccer, there wasn't much information about concussions or the effect they could have on you. I suffered concussion after concussion, not even knowing what they were at the time or knowing that I needed to see a doctor or trainer for each one of them. There was always so much pressure to come back from any injury as fast as possible, including concussions. There was pressure from the other parents, pressure from the coaches and pressure from my own teammates. Had House Bill 143 been law, I would have been forced to see a doctor or trainer, and maybe this would have never happened. My parents would have never allowed me to come back into the game so fast, and they would have never allowed me to come back until my symptoms were resolved. My coaches would have been forced to face the facts and have more training to allow them to know more about concussions, and how to look for the symptoms of concussions. Maybe there wouldn't have been as much pressure to come back sooner. My doctors now believe that after the concussion I suffered April 1, 2004, which knocked me out, I had a condition called post-concussion syndrome going into basketball camp in North Carolina that July.

"This bill is important to me because I don't want anyone to go through what I've had to go through. What I've gone through has been so hard on myself, my parents, my family and my few friends that have stood by my side. I wouldn't wish this on my worst enemy.





"I would like to thank my mom and dad, sister Danielle, brother-in-law Aaron, cousin Kati and all my other family who have all stood by my side through this very challenging time. I would also like to thank Representatives O'Brien and Stinziano for introducing this bill regarding youth concussions, and for the opportunity to speak today. I also would like to thank Suzanne and Stephanie from the Brain Injury Association of Ohio, and the Brain Injury Association of Ohio for all their help and support. I am now ready to take any questions you may have for me."

Gov. John Kasich signed House Bill 143 – Ohio's Return-to-Play Concussion Law – in December 2012. Sam Nesser is shown in the photo taken in the Office of Governor Kasich. She is standing next to the right of the governor wearing a red dress with her service dog, Linus.

## Section 1

# Data from death certificates, hospitalizations and emergency department visits

### Ohio death certificate data

- The Ohio death certificate data in this report was provided by the Ohio Department of Health (ODH) Bureau of Vital Statistics. The analysis was conducted by the ODH Violence and Injury Epidemiology and Surveillance Section.
- The analysis was restricted to Ohio residents and includes Ohio residents who died out of the state.
- Rates were calculated by dividing the number of deaths related to traumatic brain injury (TBI) by the number of Ohio residents, based on estimates from the National Center for Health Statistics (NCHS). Where appropriate, rates were age-adjusted to the 2000 U.S. standard population to allow a comparison of the overall risk of dying among different populations.
- Injury deaths were defined as death with an injury listed as the underlying cause of death from the International Classification of Diseases, Tenth Revision (ICD-10 codes V01-Y36, Y85-Y87, Y89 and *U01-*U03). From the injury death subset, TBI-related deaths include records with one of the following ICD-10 codes in any field of the multiple cause of death file: S01.0-S01.9, S02.0, S02.1, S02.3, S02.7-S02.9, S04.0, S06.0-S06.9, S07.0, S07.1, S07.8, S07.9, S09.7-S09.9, T90.1, T90.2, T90.4, T90.5, T90.8 and T90.9.

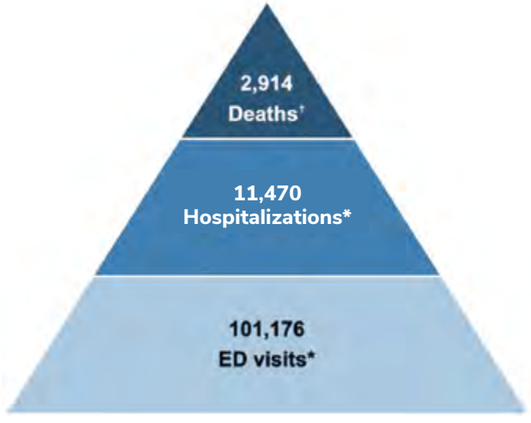
### Ohio hospitalization data

- The Ohio hospitalization discharge data in this report was provided by the Ohio Hospital Association (OHA). The analysis was conducted by the ODH Violence and Injury Epidemiology and Surveillance Section.
- The analysis includes nonfatal hospital inpatient visits of Ohio residents in nonfederal acute care facilities in Ohio. It does not include federal hospitals such as the Veterans Health Administration and other federally funded rehabilitation centers and psychiatric hospitals.
- Rates were calculated by dividing the number of TBI-related hospitalizations by the number of Ohio residents based on estimates from NCHS. Where appropriate, rates were age-adjusted to the 2000 U.S. standard population to allow a comparison of the overall risk of hospitalization among different populations.
- Injury hospital inpatient visits were defined as a hospital admission with an injury listed in the principal diagnosis discharge field (International Classification of Diseases, Tenth Revision, Clinical Modification [ICD-10-CM] codes S00-S99, T07-T34, T36-T50 with a sixth character of 1-4 [except for T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9 and T49.9, which are included if the fifth character is 1-4], T51-T65, T66-T76, T79, O9A.2-O9A.5, T84.04 and M97). From the injury hospital subset, TBI hospital inpatient visits include records with one of the following diagnosis codes: S02.0, S02.1, S02.80, S02.81, S02.82, S02.91, S04.02, S04.03, S04.04, S06, S07.1 and T74.4. Hospital inpatient visits related to unspecified injury of the head include records that have a diagnosis code of S09.90 and no other TBI diagnoses codes (defined above). TBI and unspecified injury of the head are presented separately in Figure 1.14 on page 20 and together in subsequent figures and tables in Section 1 of this report.

### Ohio emergency department visit data

- The Ohio emergency department (ED) visit discharge data in this report was provided by OHA. The analysis was conducted by the ODH Violence and Injury Epidemiology and Surveillance Section.
- The analysis includes nonfatal ED visits of Ohio residents in nonfederal acute care facilities in Ohio. It does not include federal hospitals, and it excludes ED visits that resulted in a hospital admission.
- Rates were calculated by dividing the number of TBI-related ED visits by the number of Ohio residents based on estimates from NCHS. Where appropriate, rates were age-adjusted to the 2000 U.S. standard population to allow a comparison among different populations of the risk of TBI-related ED visits.
- Injury ED visits were defined as an ED visit with an injury listed in any diagnosis discharge field (ICD-10-CM codes S00-S99, T07-T34, T36-T50 with a sixth character of 1-4 [except for T36.9, T37.9, T39.9, T41.4, T42.7, T43.9, T45.9, T47.9 and T49.9, which are included if the fifth character is 1-4], T51-T65, T66-T76, T79, O9A.2-O9A.5, T84.04 and M97) or a valid external cause code listed in any diagnosis discharge field (ICD-10-CM codes V00-V99, W00-X58, X71-X83, X92-Y09, Y21-Y33 and Y35-Y38). From the injury ED subset, TBI ED visits included records with one of the following diagnosis codes: S02.0, S02.1, S02.80, S02.81, S02.82, S02.91, S04.02, S04.03, S04.04, S06, S07.1 and T74.4. ED visits related to unspecified injury of the head include records that have a diagnosis code of S09.90 and no other TBI diagnoses codes (defined above). TBI and unspecified injury of the head are presented separately in Figure 1.19 on page 23, and together in subsequent figures and tables in Section 1 of this report.

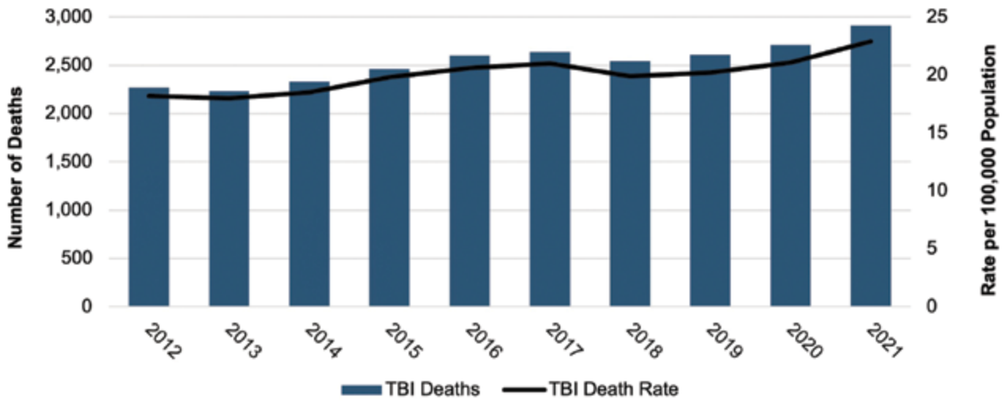
**Figure 1.1. TBI pyramid, Ohio, 2021**




†Source: ODH Bureau of Vital Statistics
*Source: Ohio Hospital Association

Figure 1.1 depicts the number of TBI cases in 2021 among Ohioans broken down by deaths, hospitalizations and ED visits. In 2021, there were 2,914 TBI-related deaths, 11,470 TBI-related hospitalizations and 101,176 TBI-related ED visits.

**Figure 1.2. Number and age-adjusted rate of TBI deaths by year, Ohio, 2012–2021**




TBI is a major cause of death and disability. From 2012 to 2021, the number of TBI deaths increased 28% (from 2,268 to 2,914), and the rate of TBI deaths increased 26% (from 18.2 to 22.9 per 100,000 population). A rate measures the frequency of an event (in this case, a TBI death) in a given population (Ohio resident population) over a specified period of time (one year) and is typically multiplied by 100,000 population for interpretability. In 2021, for every 100,000 Ohio residents, 23 died from a TBI-related injury.





**Figure 1.3. Age-adjusted TBI death rate by county of residence, Ohio, 2017–2021**

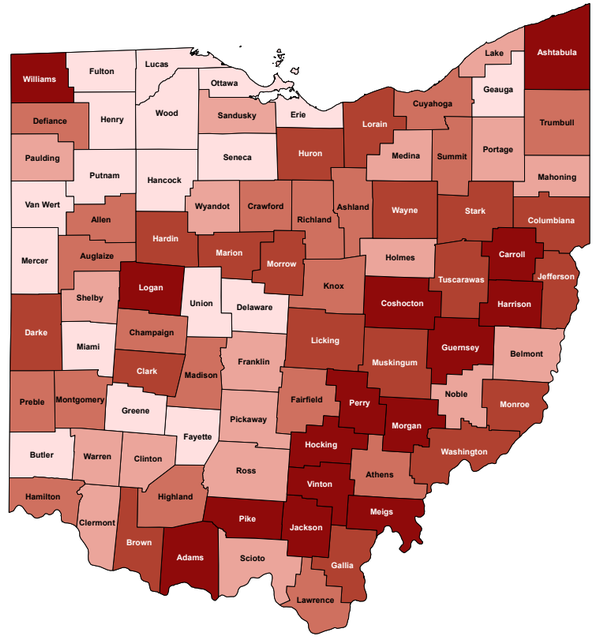



Figure 1.3 shows the average, age-adjusted TBI death rate by county from 2017 to 2021. During this time period, Vinton County had the highest rate in Ohio — for every 100,000 residents of Vinton County, 40 died from a TBI-related injury. Counties in the Appalachian region of Ohio have the highest rates of TBI-related death.

**Death Rates per 100,000 Population**

- 10.8 - 17.5
- 17.6 - 20.5
- 20.6 - 23.0
- 23.1 - 25.9
- 26.0 - 40.0

**Figure 1.4. Number of TBI deaths by age and sex, Ohio, 2021**

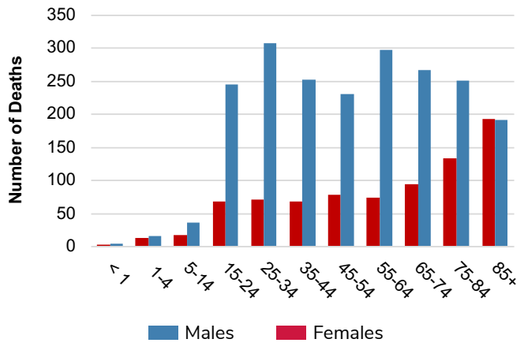
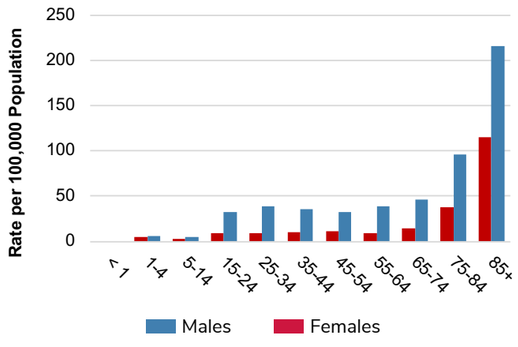



**Figure 1.5. TBI death rate by age and sex, Ohio, 2021**




Figures 1.4 and 1.5 show the number and rate of TBI deaths, respectively, among Ohioans in 2021. Males were disproportionately burdened by TBI death across the lifespan — rates were over three times higher among males when compared with females. The TBI death rate was highest among older adults and, in both males and females, increased with age for adults 55 years old and older.

**Figure 1.6. Number of TBI deaths by select intent/mechanism, Ohio, 2012–2021**

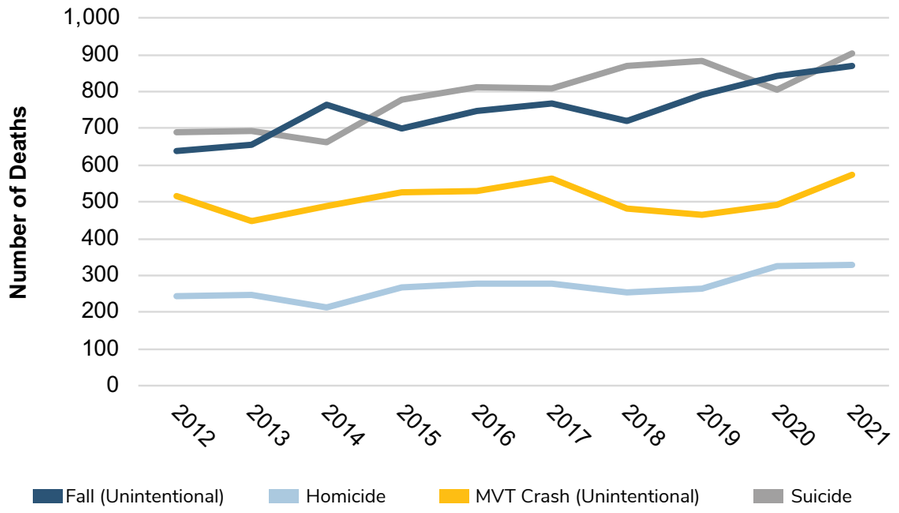
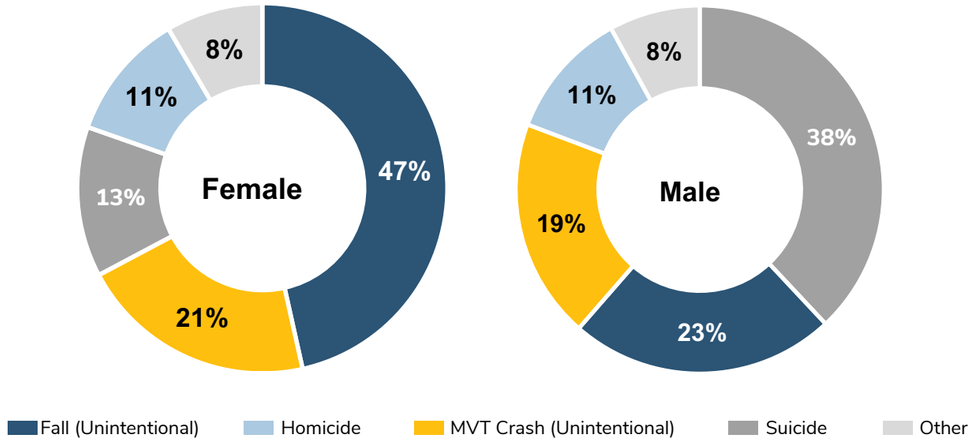



**Figure 1.7. Percentage of TBI deaths by select intent/mechanism and sex, Ohio, 2021**

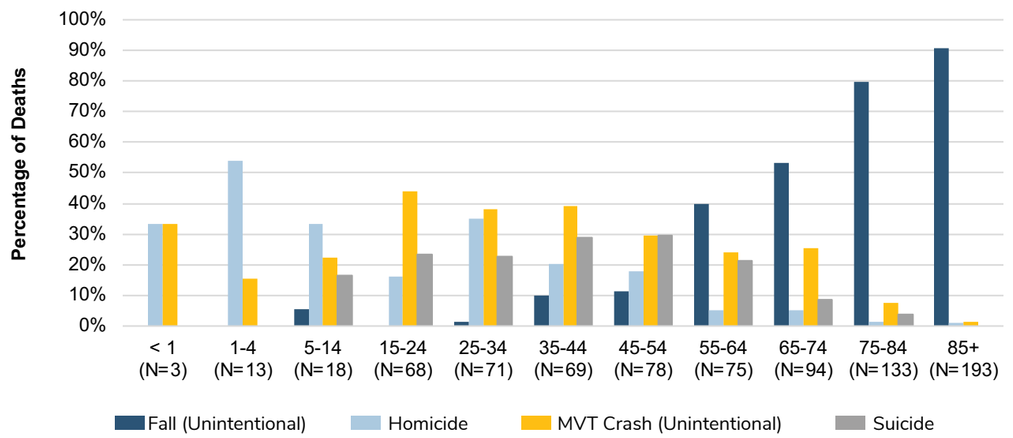



Suicide was the leading intent/mechanism for TBI deaths among Ohioans in most years shown. From 2012 to 2021, suicide-related TBI deaths increased 31% (from 690 to 905), and unintentional fall-related TBI deaths increased 36% (from 638 to 870). In 2021, unintentional fall was the leading intent/mechanism of TBI deaths (47%) among females, followed by unintentional motor vehicle traffic (MVT) crash (21%). Among males, the largest proportion of TBI deaths was attributed to suicide (38%), followed by unintentional fall (23%).





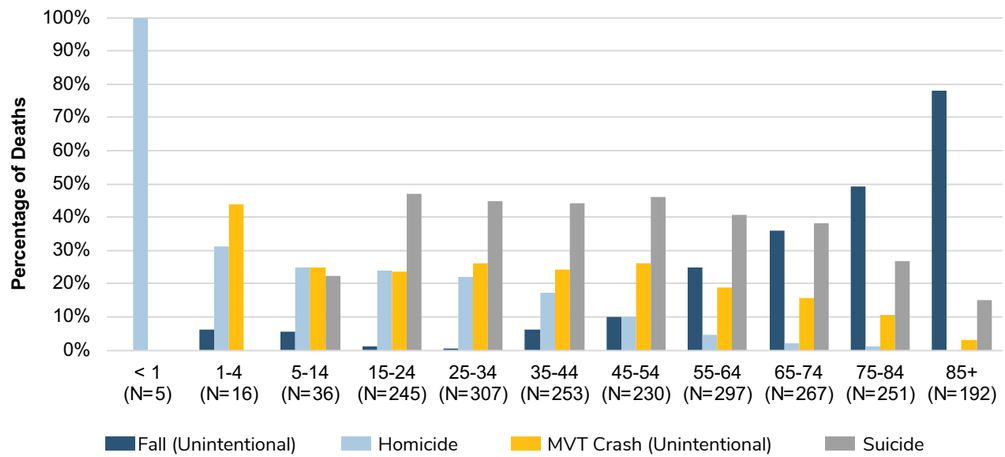
**Figure 1.8. Percentage of TBI deaths among females by select intent/mechanism* and age group, Ohio, 2021**




**Not all intent/mechanism combinations are presented. Therefore, data presented by age category may not sum to 100%.*

Among females 15 to 44 years of age, unintentional MVT crash was the leading intent/mechanism for TBI deaths. The percentage of unintentional fall-related TBI deaths among females increased with age starting at 35 years old. At 55 years of age and older, unintentional falls accounted for the largest percentage of TBI deaths.

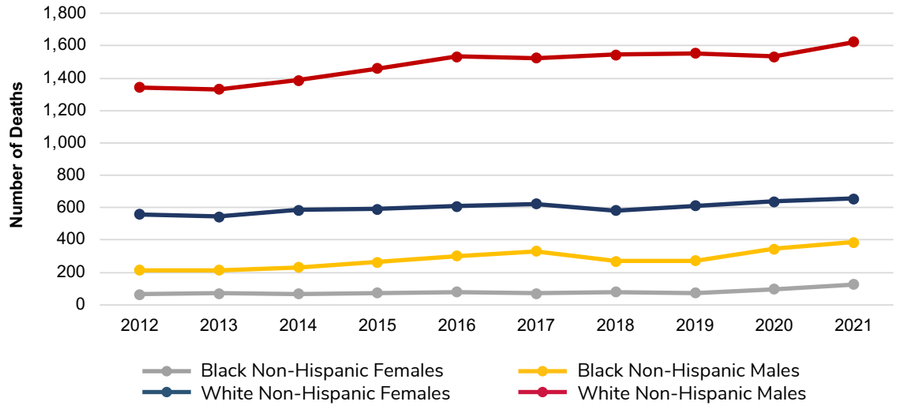
**Figure 1.9. Percentage of TBI deaths among males by select intent/mechanism* and age group, Ohio, 2021**




**Not all intent/mechanism combinations are presented. Therefore, data presented by age category may not sum to 100%.*

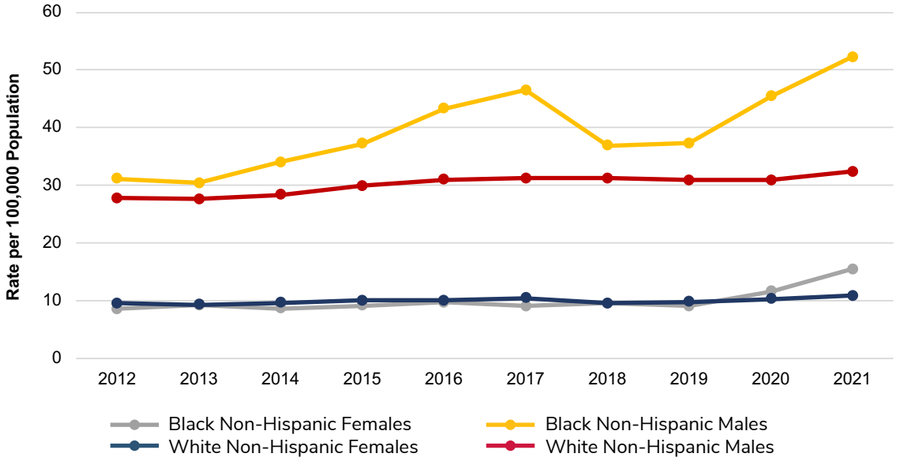
Suicide accounted for the largest percentage of TBI deaths among males 15 to 74 years of age. The percentage of unintentional fall-related TBI deaths among males increased with age starting at 25 years old, becoming the largest contributor to TBI deaths for those 75 years old and older.

**Figure 1.10. Number of TBI deaths by race/ethnicity and sex, Ohio, 2012–2021**




From 2012 to 2021, White non-Hispanic males had the highest number of TBI deaths. In 2021, they made up 56% of TBI deaths, compared with 39% of the total population.

**Figure 1.11. TBI death rates by race/ethnicity and sex, Ohio, 2012–2021**



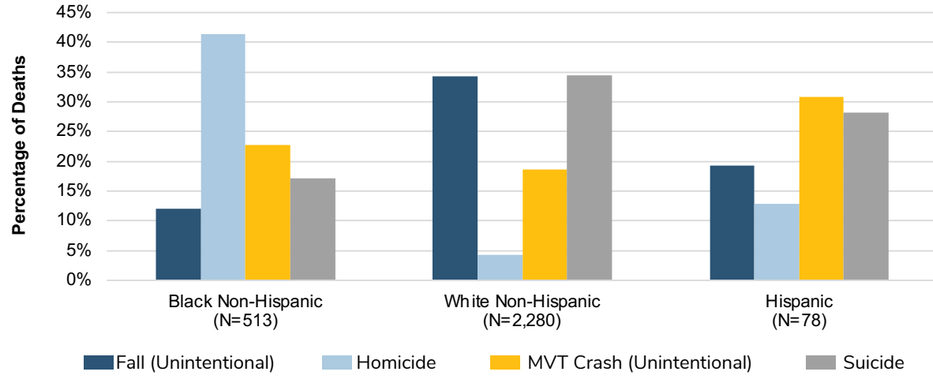

Black non-Hispanic males had the highest rates of TBI deaths in all years shown, increasing 41% from 2018 to 2021. 2021 had the highest TBI death rate among Black non-Hispanic males since 2007. White non-Hispanic males had the second highest TBI death rate during the time period shown, which increased 17% from 2012 to 2021.

The rates of TBI deaths among White non-Hispanic females and Black non-Hispanic females were similar over time, with notably lower rates compared with their male counterparts. The death rate among Black non-Hispanic females increased 71% from 2019 to 2021, surpassing White non-Hispanic females in 2020.



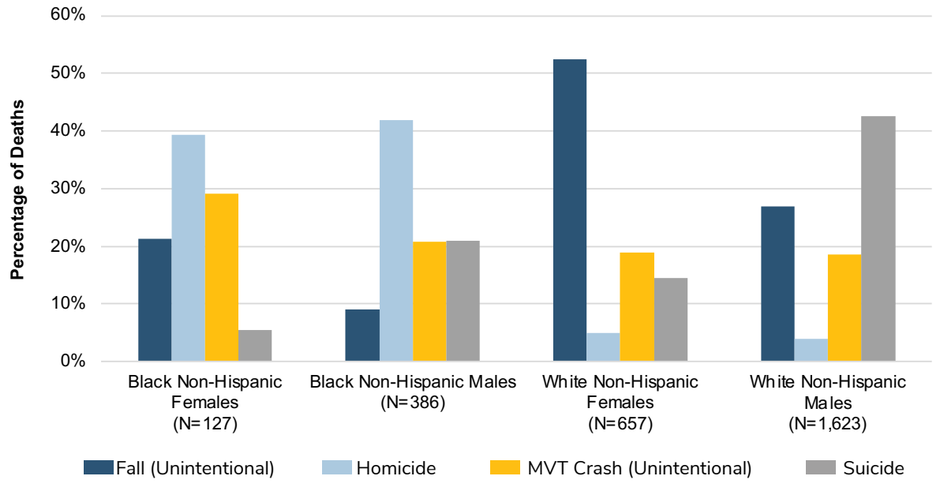


**Figure 1.12. Percentage of TBI deaths by race/ethnicity and intent/mechanism, Ohio, 2021**



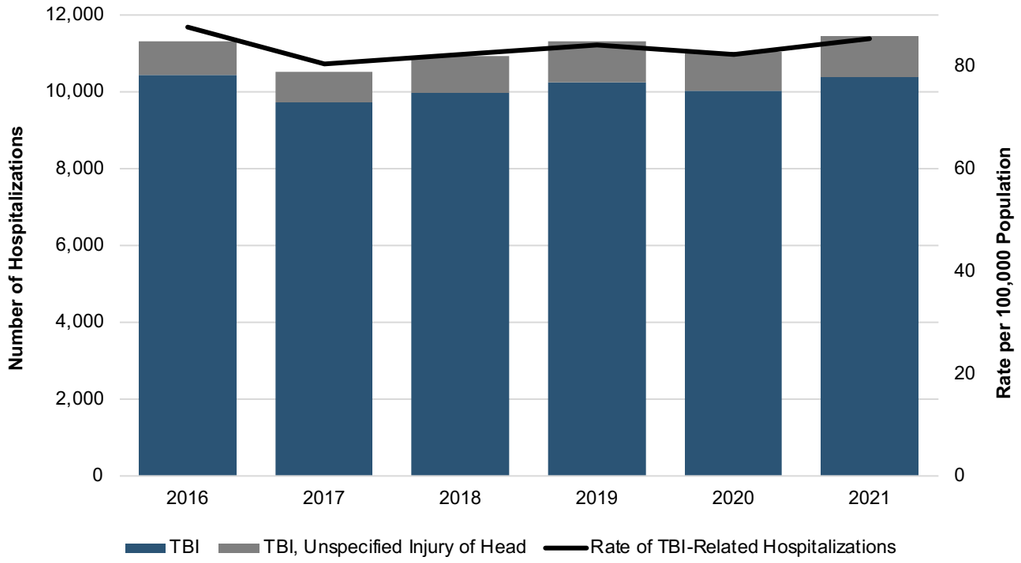

Among White non-Hispanic Ohioans, the leading intent/mechanism of TBI deaths in 2021 was tied between suicide and unintentional fall, each accounting for 34% of TBI deaths. Homicide was the leading intent/mechanism of TBI death among Black non-Hispanic Ohioans, accounting for 41% of TBI deaths compared with 13% among Hispanic Ohioans and 4% among White non-Hispanic Ohioans. Among Hispanic Ohioans, unintentional MVT crash was the leading intent/mechanism of TBI death, accounting for 31% of deaths, with suicide as the second-leading intent/mechanism of death.

**Figure 1.13. Percentage of TBI deaths by sex, race/ethnicity and intent/mechanism, Ohio, 2021**




Among White non-Hispanic females, unintentional falls accounted for the majority of TBI deaths (53%) in 2021. Among White non-Hispanic males, the largest proportion of TBI deaths was attributed to suicide (43%). Homicide was the leading intent/mechanism of TBI deaths among both female and male Black non-Hispanic Ohioans, accounting for 39% and 42% of TBI deaths, respectively.

**Figure 1.14. Number of TBI-related hospitalizations by year, Ohio, 2016–2021**




**TBI** includes diagnoses codes S02.0, S02.1, S02.80, S02.81, S02.82, S02.91, S04.02, S04.3, S04.04, S06, S07.1 and T74.4.
**TBI, Unspecified Injury of Head** includes diagnosis code S09.90.
Figure 1.14 includes Ohio residents and excludes fatal cases. The numbers represent all visits, not unique individuals.
*Source: Ohio Hospital Association*

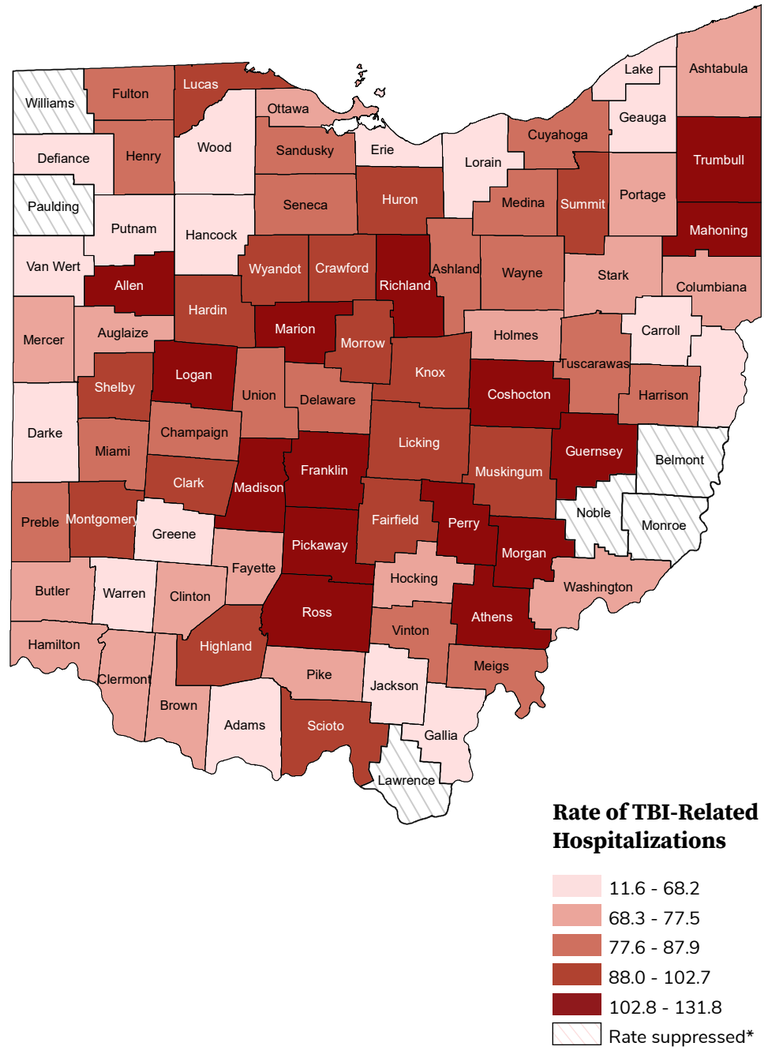
Previously, the ICD-9-CM-based surveillance definition for TBI-related hospitalizations included the head injury unspecified code (959.01). National guidelines to define TBI-related hospitalizations following the transition from ICD-9-CM to ICD-10-CM are still being tested, but they currently propose to examine TBI and "TBI, unspecified injury of the head" (S09.90) separately. Therefore, the numbers for each are presented separately in Figure 1.14 for comparison. They are combined in the age-adjusted rate presented in Figure 1.14 and in all other figures and tables for conciseness.

Figure 1.14 shows the number and rate of TBI-related hospitalizations by year, from 2016 to 2021. These data include Ohio residents and exclude fatal cases. Overall, in 2016, there were 11,318 TBI-related hospitalizations (10,444 TBI visits and 874 TBI, unspecified injury of the head visits). The number of overall TBI-related hospitalizations decreased to 10,535 in 2017. However, since 2017, the number and rate of overall TBI-related hospitalizations have increased by 9% and 6%, respectively. In 2021, there were 11,470 TBI-related hospitalizations (10,402 TBI visits and 1,068 TBI, unspecified injury of the head visits) and 85 TBI-related hospitalizations per 100,000 Ohioans.





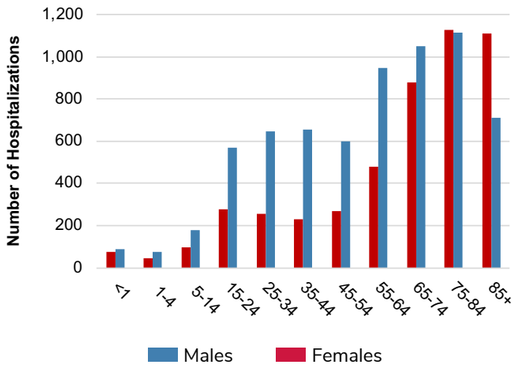
**Figure 1.15. Age-adjusted rate of TBI-related hospitalizations by county of residence, Ohio, 2021**




**Rates are suppressed when counts < 11*
*Source: Ohio Hospital Association*

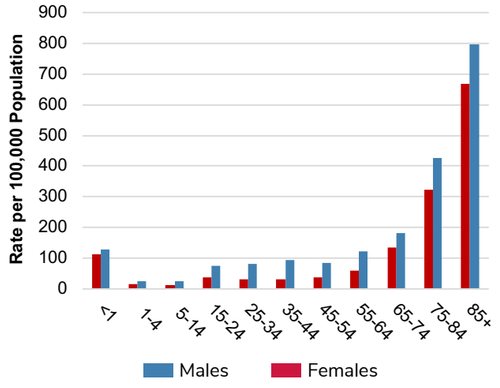
Figure 1.15 shows the age-adjusted rate of TBI-related hospitalizations by county in 2021. During this time period, Madison County had the highest rate in Ohio — for every 100,000 residents of Madison County, nearly 132 had a TBI-related hospitalization.

**Figure 1.16. Number of TBI-related hospitalizations by age and sex, Ohio, 2021**




*Source: Ohio Hospital Association*

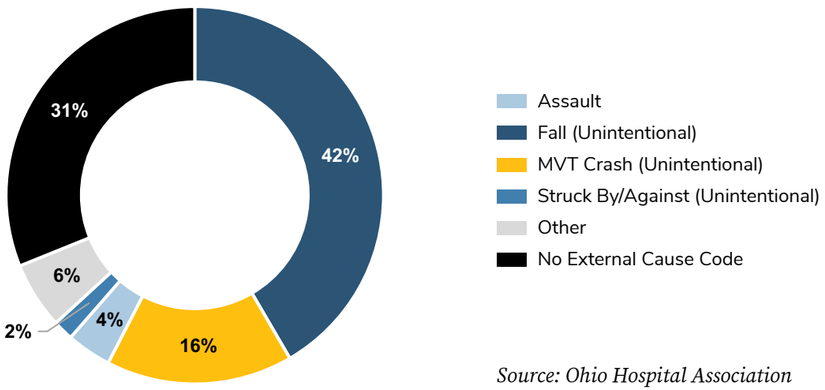
**Figure 1.17. Rate of TBI-related hospitalizations by age and sex, Ohio, 2021**




*Source: Ohio Hospital Association*

Figures 1.16 and 1.17 show the number and rate of TBI-related hospitalizations, respectively, by age and sex in Ohio in 2021. Prior to 75 years of age, males had a higher number of TBI-related hospitalizations compared with their female counterparts. Among adults aged 75 years and older, females had a higher number of hospitalizations than males. Males had a higher rate of TBI-related hospitalizations across the lifespan. TBI-related hospitalization rates were lowest for both females and males for the age range of 5 to 14 years old (13.9 per 100,000 population and 24.1 per 100,000 population, respectively). Rates were highest among adults 75 years old and older.

**Figure 1.18. Percentage of TBI-related hospitalizations by intent/mechanism, Ohio, 2021**



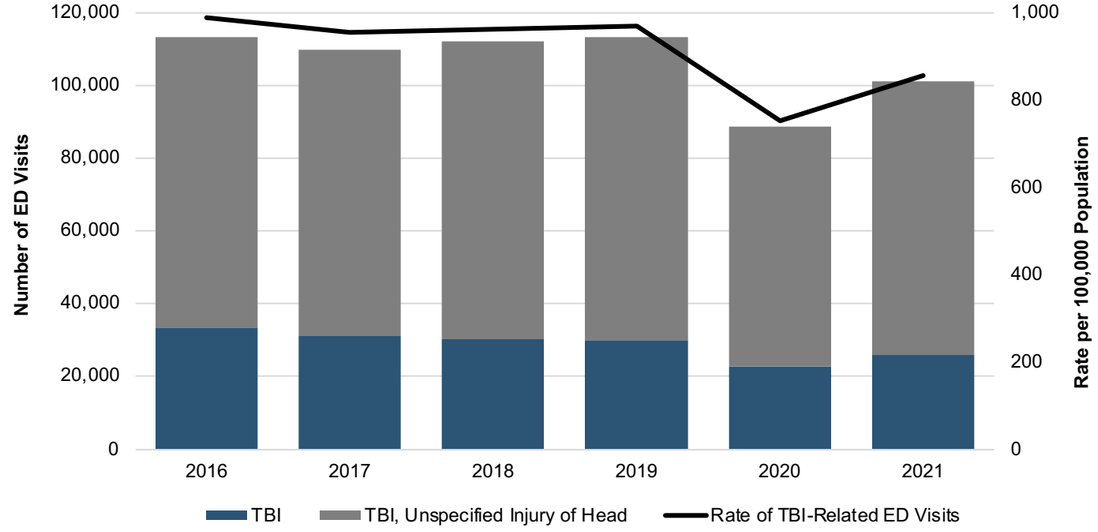

*Source: Ohio Hospital Association*

In 2021, unintentional fall was the leading intent/mechanism of TBI-related hospitalizations, accounting for 42% of visits. Unintentional MVT crash accounted for 16% of visits, followed by assault (4%). In 31% of hospitalizations, an external cause code (which is used to determine the intent and mechanism of an injury) was not reported.





**Figure 1.19. Number of TBI-related ED visits by year, Ohio, 2016–2021**

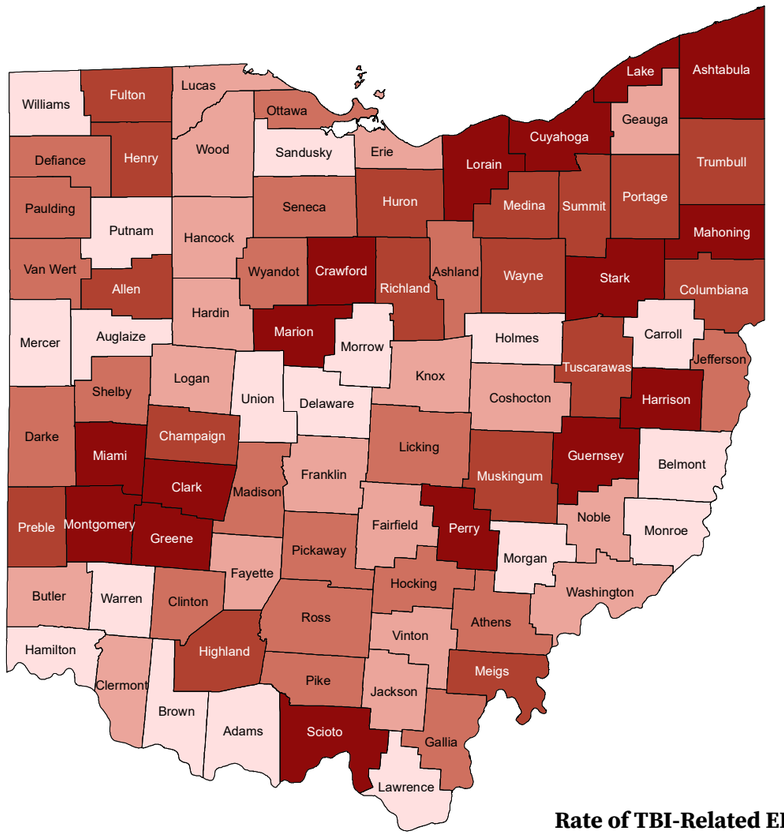



**TBI** includes diagnoses codes S02.0, S02.1, S02.80, S02.81, S02.82, S02.91, S04.02, S04.3, S04.04, S06, S07.1 and T74.4.
**TBI, Unspecified Injury of Head** includes diagnosis code S09.90.
Figure 1.19 includes Ohio residents, and it excludes fatal and hospital admitted cases. The numbers represent all visits, not unique individuals.
*Source: Ohio Hospital Association*

Previously, the ICD-9-CM-based surveillance definition for TBI-related ED visits included the head injury unspecified code (959.01). National guidelines to define TBI-related ED visits following the transition from ICD-9-CM to ICD-10-CM are still being tested, but they currently propose to examine TBI and "TBI, unspecified injury of the head" (S09.90) separately. Therefore, the numbers for each are presented separately in Figure 1.19 for comparison. They are combined in the age-adjusted rate presented in Figure 1.19 and in all other figures and tables for conciseness.

Figure 1.19 shows the number and rate of TBI-related ED visits by year, from 2016 to 2021. These data include Ohio residents and exclude hospital-admitted and fatal cases. Overall, TBI-related ED visits are largely attributed to visits for TBI, unspecified injury of the head (depicted in grey). The overall TBI-related ED visits remained relatively consistent from 2016 to 2019, and while visits for TBI, unspecified injury of the head increased from 2017 to 2019, TBI visits (depicted in blue) continued to decrease slightly through 2019. There was a significant decrease in the number and rate of TBI-related ED visits in 2020. In 2021, there were 101,176 TBI-related ED visits (25,900 TBI visits and 75,276 TBI, unspecified injury of the head visits) and nearly 857 TBI-related ED visits per 100,000 population.

**Figure 1.20. Age-adjusted rate of TBI-related ED visits by county of residence, Ohio, 2021**



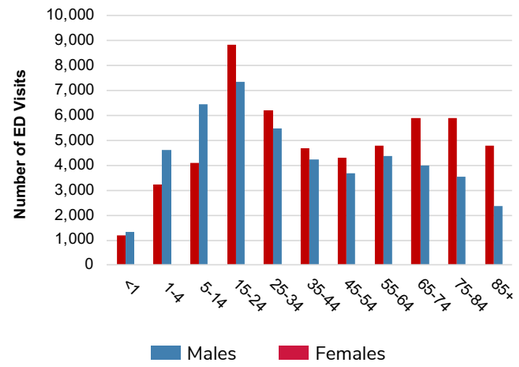

*Source: Ohio Hospital Association*

Figure 1.20 shows the age-adjusted rate of TBI-related ED visits by county in 2021. During this time period, Perry County had the highest rate in Ohio — for every 100,000 residents of Perry County, nearly 1,560 had a TBI-related ED visit.



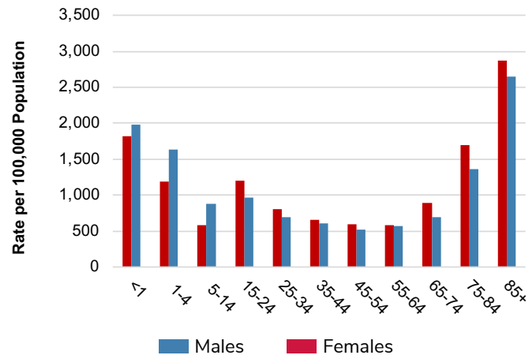


**Figure 1.21. Number of TBI-related ED visits by age and sex, Ohio, 2021**




*Source: Ohio Hospital Association*

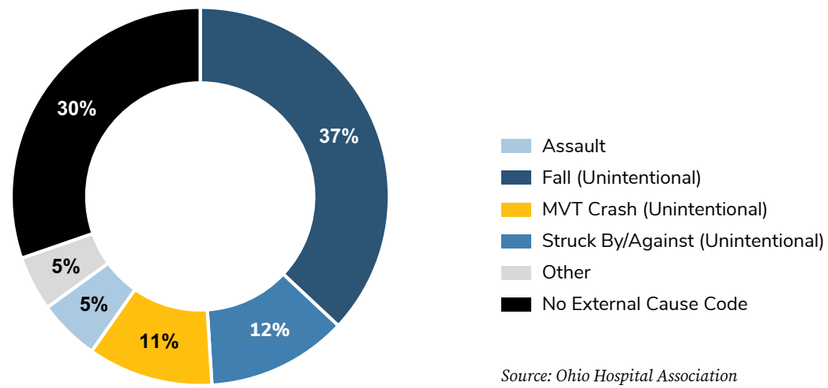
**Figure 1.22. Rate of TBI-related ED visits by age and sex, Ohio, 2021**




*Source: Ohio Hospital Association*

Figures 1.21 and 1.22 show the number and rate of TBI-related ED visits, respectively, by age and sex. For younger age groups (0 to 14 years), males had a higher number and rate of TBI-related ED visits than their female counterparts. Among Ohioans aged 15 years and older, females had a higher number and rate of ED visits. The rate of TBI-related ED visits was highest at either end of the age spectrum, peaking among adults 85 years of age and older, followed by children less than 1 year old. The rate was lowest for females between the ages of 55 and 64 years old (584.5 per 100,000 population) and for males between the ages of 45 and 54 years old (525.3 per 100,000 population).

**Figure 1.23. Percentage of TBI-related ED visits by intent/mechanism, Ohio, 2021**




*Source: Ohio Hospital Association*

In 2021, unintentional fall was the leading intent/mechanism of TBI-related ED visits, accounting for 37% of visits. Unintentional struck by/against, injuries resulting from being unintentionally struck by or against an object or person, accounted for 12% of visits, followed by unintentional MVT crash (11%). In 30% of TBI-related ED visits, an external cause code (which is used to determine the intent and mechanism of an injury) was not reported.

**Table 1.1. Number and rate of TBI-related ED visits, hospitalizations and deaths by demographics, Ohio, 2021**

| Demographic Characteristics | % of Ohio Population | Emergency Department Visits* | | Hospitalizations* | | Deaths† | |
|---|---|---|---|---|---|---|---|
| | | N (% Distribution) | Rate§ | N (% Distribution) | Rate§ | N (% Distribution) | Rate§ |
| **Total** | | 101,176 | 856.9 | 11,470 | 85.5 | 2,914 | 22.9 |
| **Age** | | | | | | | |
| <1 year | 1.1 | 2,514 (2.5) | 1,900.0 | 161 (1.4) | 121.7 | 8 (0.3) | -- |
| 1 – 4 years | 4.7 | 7,836 (7.7) | 1,419.5 | 120 (1.0) | 21.7 | 29 (1.0) | 5.3 |
| 5 – 14 years | 12.3 | 10,529 (10.4) | 732 | 275 (2.4) | 19.1 | 54 (1.9) | 3.8 |
| 15 – 24 years | 12.8 | 16,162 (16.0) | 1,082.3 | 846 (7.4) | 56.7 | 313 (10.7) | 21.0 |
| 25 – 34 years | 13.4 | 11,656 (11.5) | 746.3 | 900 (7.8) | 57.6 | 378 (13.0) | 24.2 |
| 35 – 44 years | 12.1 | 8,910 (8.8) | 631.6 | 885 (7.7) | 62.7 | 322 (11.1) | 22.8 |
| 45 – 54 years | 12.1 | 7,972 (7.9) | 561.4 | 867 (7.6) | 61.1 | 308 (10.6) | 21.7 |
| 55 – 64 years | 13.6 | 9,140 (9.0) | 575.9 | 1,424 (12.4) | 89.7 | 372 (12.8) | 23.4 |
| 65 – 74 years | 10.5 | 9,875 (9.8) | 800.7 | 1,931 (16.8) | 156.6 | 361 (12.4) | 29.3 |
| 75 – 84 years | 5.2 | 9,438 (9.3) | 1,550.3 | 2,240 (19.5) | 367.9 | 384 (13.2) | 63.1 |
| 85+ years | 2.2 | 7,141 (7.1) | 2,793.7 | 1,820 (15.9) | 712.0 | 385 (13.2) | 150.6 |
| **Sex** | | | | | | | |
| Female | 51.0 | 53,792 (53.2) | 869.3 | 4,839 (42.2) | 63.3 | 815 (28.0) | 11.5 |
| Male | 49.0 | 47,377 (46.8) | 839.4 | 6,630 (57.8) | 109.2 | 2,099 (72.0) | 35.2 |
| **Race/Ethnicity** | | | | | | | |
| Black Non-Hispanic | 13.7 | 17,344 (17.1) | 1,078.90 | 1,518 (13.2) | 98.0 | 513 (17.6) | 33.0 |
| White Non-Hispanic | 79.1 | 75,684 (74.8) | 803.4 | 9,282 (80.9) | 81.6 | 2,280 (78.2) | 21.1 |
| Hispanic | 4.2 | 4,052 (4.0) | 863.2 | 298 (2.6) | 80.5 | 78 (2.7) | 18.2 |

** Source: Ohio Hospital Association*
*† Source: ODH Bureau of Vital Statistics*

§ Rates presented for age groups are age-specific. Rates presented for total, sex and race/ethnicity are age-adjusted to the 2000 U.S. standard population. Rates are calculated per 100,000 population.
Race/ethnicity categories are mutually exclusive. Hispanic includes any race. Categories may not total 100% due to missing demographic data.

In 2021, the age-adjusted rate of TBI-related ED visits was 856.9 per 100,000 population, the age-adjusted rate of TBI-related hospitalizations was 85.5 per 100,000 population, and the age-adjusted rate of TBI-related deaths was 22.9 per 100,000 population. While TBI-related ED visits were more likely to be female (53.2%), males made up a larger proportion of TBI-related hospitalizations (57.8%) and deaths (72%). Overall, males had more than 1.7 times the age-adjusted hospitalization rate and more than three times the age-adjusted death rate when compared with females.

While the largest proportion of TBI-related ED visits was among adolescents and young adults aged 15 to 24 years old (16%), older adults aged 75 to 84 years old made up the largest proportion of TBI-related hospitalizations (19.5%). Older adults aged 75 years and older accounted for 26.4% of TBI-related deaths. Older adults aged 85 years and older had the highest rate of TBI-related ED visits, hospitalizations and deaths. Black non-Hispanic Ohioans had the highest rate of TBI-related ED visits, hospitalizations and deaths.



THE OHIO BRAIN INJURY PROGRAM AND THE BRAIN INJURY ADVISORY COMMITTEE

## Summary

The number and rate of TBI-related deaths among Ohioans increased from 2012 to 2021, and TBI continues to be a public health problem.

As the data in this report show, the intent/mechanism of TBI-related deaths vary by demographic group, requiring multifaceted solutions to address and reverse the rising trend. From 2017 to 2021, Appalachian counties had the highest average age-adjusted rate of TBI-related deaths. Vinton County had the highest rate in Ohio — for every 100,000 residents, nearly 40 died from a TBI-related injury.

In 2021, suicide was the leading intent/mechanism of TBI-related death among Ohioans. This was largely attributed to deaths among males. In 2021, 38% of TBI-related deaths among males were attributed to suicide, which was a leading intent/mechanism for TBI-related deaths among White non-Hispanic males and the second-leading intent/mechanism among Black non-Hispanic males.

When compared with other demographic groups, Black non-Hispanic males had the highest rate of TBI-related death from 2012 to 2021. In 2021, homicide was the leading intent/mechanism among both Black non-Hispanic males and females, accounting for 42% and 39% of TBI-related deaths, respectively.

Unintentional fall was the second leading intent/mechanism of TBI-related deaths in 2021 and the leading intent/mechanism of TBI-related hospitalizations (42%) and ED visits (37%). TBI-related ED visits were more likely to be female (53%). However, males made up a larger proportion of TBI-related hospitalizations (58%) and deaths (72%).

While the largest proportion of TBI-related ED visits was among young adults aged 15 to 24 years old (16%), older adults aged 75 to 84 years of age made up the largest proportion of TBI-related hospitalizations (19.5%) and deaths (13%). Adults 85 years old and older had the highest rate of TBI-related ED visits, hospitalizations and deaths.

## Section 2

# Ohio Trauma Registry data from the Ohio Department of Public Safety Division of Emergency Medical Services


The Ohio Trauma Registry (OTR) data supplied for this report that which are current as of July 2023. They primarily include OTR data from 2020 and 2021. Certain tables and figures, where noted, also include data from 2017 through 2019.

### The Ohio Trauma Acute Care Registry

The Ohio Trauma Acute Care Registry (TACR) is Ohio's data system for sustained traumatic injuries that arrive at an Ohio facility. The system collects injury, care, hospital status and discharge status data on patients with traumatic injuries. Data are reported by trauma hospitals, acute care hospitals and free-standing emergency departments that receive patients with traumatic injuries. The Ohio TACR is maintained by the Division of Emergency Medical Services (EMS) at the Ohio Department of Public Safety. Traumatic brain injury (TBI) data for Section 2 of this report were extracted and analyzed from this data system.

## Trauma inclusion criteria

### Trauma Patient Definition

To ensure consistent data collection across the state of Ohio and to follow the National Trauma Data Standard, a trauma patient is defined as a patient sustaining a traumatic injury and meeting the patient inclusion criteria described below.

## Patient inclusion criteria

**To be included in the Ohio TACR:**

- The patient must have incurred at least one of the injury diagnostic codes defined in the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) no more than 30 days prior to presentation for initial treatment:
  - **J70.5 with character modifier of A only** (respiratory conditions due to smoke inhalation – initial encounter)
  - **S00-S99 with seventh character modifier of A, B or C only** (injuries to specific body parts – initial encounter)
  - **T07** (unspecified multiple injuries)
  - **T14** (injury of unspecified body region)
  - **T20-T28 with seventh character modifier of A only** (burns by specified body parts – initial encounter)
  - **T30-T32** (burn by total body surface area percentage)
  - **T33 with character modifier of A only** (superficial frostbite – initial encounter)
  - **T34 with character modifier of A only** (frostbite with tissue necrosis – initial encounter)
  - **T67 with character modifier of A only** (effects of heat and light – initial encounter)
  - **T68 with character modifier of A only** (hypothermia – initial encounter)
  - **T69 with character modifier of A only** (other effects of reduced temperature – initial encounter)
  - **T70.4 with character modifier of A only** (effects of high-pressure fluids – initial encounter)
  - **T70.8 with character modifier of A only** (other effects of air pressure and water pressure – initial encounter)
  - **T70.9 with character modifier of A only** (effect of air pressure and water pressure, unspecified – initial encounter)
  - **T71 with character modifier of A only** (asphyxiation – initial encounter)
  - **T74.1 with character modifier of A only** (physical abuse, confirmed – initial encounter)
  - **T74.4 with character modifier of A only** (shaken infant syndrome – initial encounter)
  - **T75.0 with character modifier of A only** (effects of lightning – initial encounter)
  - **T75.1 with character modifier of A only** (unspecified effects of drowning and nonfatal submersion – initial encounter)
  - **T75.4 with character modifier of A only** (electrocution – initial encounter)
  - **T79.A1-T79.A9 with seventh character modifier of A only** (traumatic compartment syndrome – initial encounter)
- The patient also must meet *at least* one of these criteria:
  - On initial presentation for treatment of an injury, be admitted to a hospital or hospital observation unit as defined by a physician order regardless of the length of stay.
  - Be transferred via EMS transport (including air ambulance) from one hospital (or free-standing emergency department) to another hospital, regardless of the patient's length of stay or admission status.
  - Have an outcome of death resulting from the traumatic injury (independent of hospital admission or hospital transfer status).

## Patient exclusion criteria

Patients with the following isolated ICD-10-CM codes are excluded from the Ohio TACR:

- **S72.00-S72.14** (fracture of head/neck of femur ***only if*** age > 70 ***and*** it resulted from slipping, tripping, stumbling or a same-level fall, which are codes W01.0, W18.30, W18.31 and W18.39)
- **S00, S10, S20, S30, S40, S50, S60, S70, S80, S90** (abrasion or contusion injuries – patients with abrasion or contusion injuries who were transferred in/out for treatment of injuries or died because of injuries would be included in the registry)
- **Seventh character modifiers of D through S** (late effects)

## Traumatic Brain Injury Selection Criteria

Injuries were identified as TBIs based on their reported Abbreviated Injury Scale (AIS) pre-dot codes. AIS is a trauma injury classification system that describes the injury and its severity. The pre-dot code consists of the six digits that occur before a decimal point that indicate body region, anatomical structure and level of injury.[1] The post-dot code (also known as the severity score[2]) consists of the digit after the decimal that indicates the injury's severity. TBIs were defined as injuries that had an AIS pre-dot code that was one of the following:

- Equal to **113000**
- Between **120199** and **123099**
- Between **130202** and **132699**
- Between **140202** and **140299**
- Between **140402** and **140499**
- Between **140602** and **140699**
- Equal to **140799**
- Between **161000** and **161013**

[1] Association for the Advancement of Automotive Medicine. (2016). Abbreviated Injury Scale© 2005 Update 2008. (T. Gennarelli, & E. Woodzin, Eds.) Chicago, Illinois.

[2] Centers for Disease Control and Prevention. (n.d.). Discussion document on *injury* severity measurement in administrative datasets [PDF File]. Retrieved from https://www.cdc.gov/nchs/data/injury/DicussionDocu.pdf.





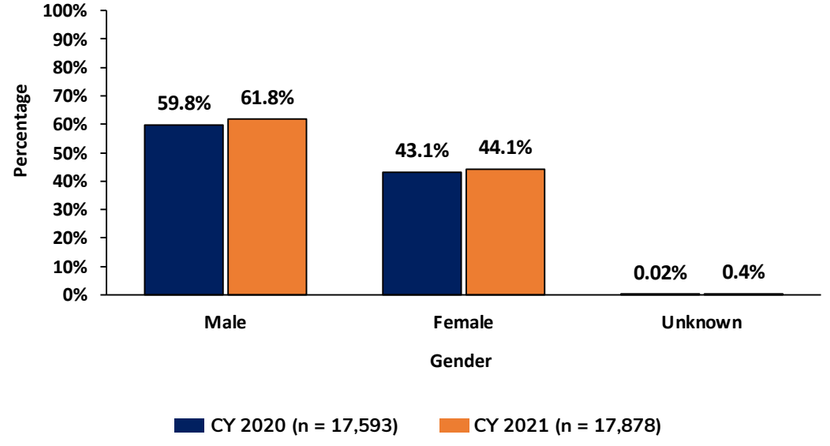
## Morbidity data

**Table 2.1. Number and percentage of TBIs by year, Ohio Trauma Registry, CY 2017–CY 2021**

| Year | TBIs | Total Injuries Reported | Percentage |
|---|---|---|---|
| **2017** | 16,800 | 68,308 | 24.6 |
| **2018** | 17,104 | 68,402 | 25.0 |
| **2019** | 17,201 | 74,739 | 23.0 |
| **2020** | 17,593 | 83,606 | 21.0 |
| **2021** | 17,878 | 86,899 | 20.6 |

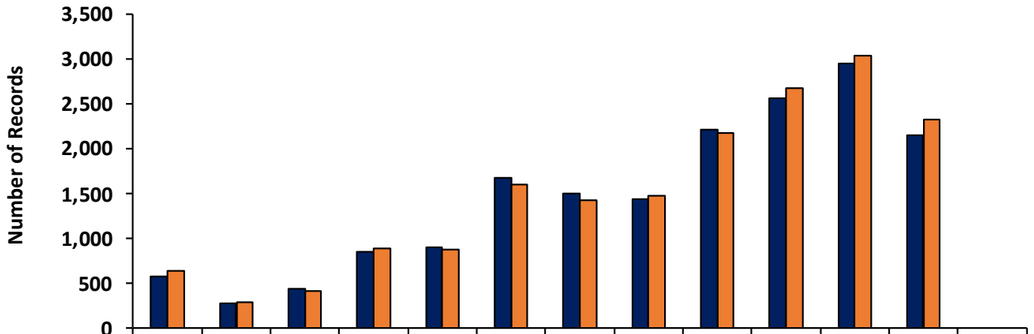
In calendar year (CY) 2020, there were 17,593 TBIs reported to the Ohio Trauma Registry (OTR), which comprised 21.0% of the total number of injuries reported to the registry in that calendar year. In CY 2021, there were 17,878 TBIs reported to the OTR, which comprised 20.6% of the total number of injuries reported to the registry in that calendar year.

**Figure 2.1. Percentage of TBIs by gender and year, Ohio Trauma Registry, CY 2020–CY 2021**




For both calendar years, the majority of TBI patients were male (CY 2020: 59.8%; CY 2021: 61.8%).

**Figure 2.2. Percentage of TBIs by age category and year, Ohio Trauma Registry, CY 2020–CY 2021**

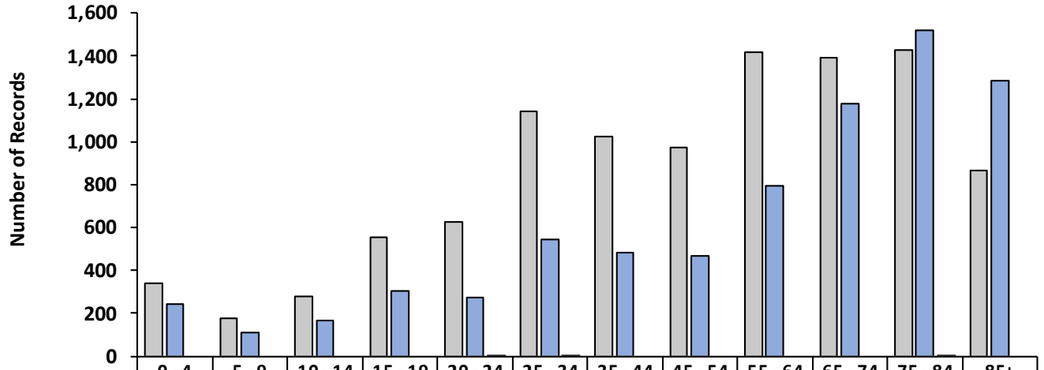



| | 0 - 4 | 5 - 9 | 10 - 14 | 15 - 19 | 20 - 24 | 25 - 34 | 35 - 44 | 45 - 54 | 55 - 64 | 65 - 74 | 75 - 84 | 85+ | Not Valued |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CY 2020 (n = 17,593) | 585 | 285 | 441 | 858 | 904 | 1,685 | 1,510 | 1,439 | 2,214 | 2,568 | 2,951 | 2,153 | 0 |
| CY 2021 (n = 17,878) | 649 | 297 | 420 | 893 | 884 | 1,603 | 1,431 | 1,480 | 2,178 | 2,673 | 3,041 | 2,329 | 0 |

Age Category

For both calendar years, TBIs were most often reported for those ages 55 years and older, with the highest incidence in the 75-84 age category.

**Figure 2.3. Percentage of TBIs by age category and gender, Ohio Trauma Registry, CY 2020 (n = 17,593)**




| | 0 - 4 | 5 - 9 | 10 - 14 | 15 - 19 | 20 - 24 | 25 - 34 | 35 - 44 | 45 - 54 | 55 - 64 | 65 - 74 | 75 - 84 | 85+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Male (n = 10,220) | 341 | 176 | 277 | 553 | 627 | 1,141 | 1,025 | 972 | 1,418 | 1,393 | 1,430 | 867 |
| Female (n = 7,369) | 244 | 109 | 164 | 305 | 276 | 543 | 485 | 467 | 796 | 1,175 | 1,519 | 1,286 |
| Unknown (n = 4) | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 0 |

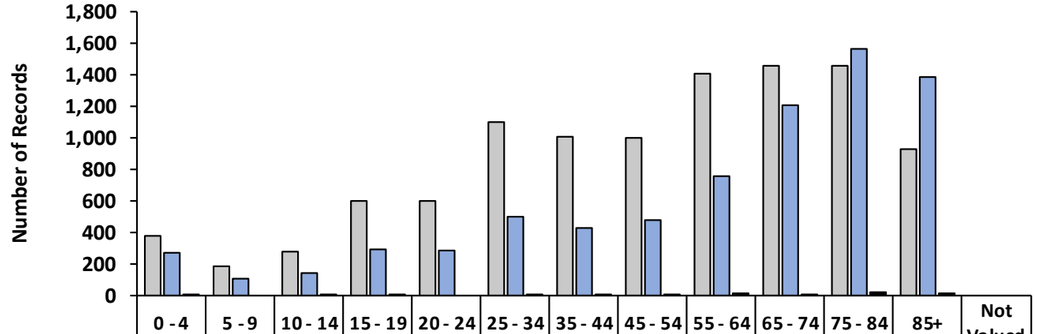
Age Category

In CY 2020, TBIs among males occurred most frequently in the 55-64 and 75-84 year age categories. Among females, TBIs occurred most frequently in the 75-84 years and 85+ age categories.





**Figure 2.4. Percentage of TBIs by age category and gender, Ohio Trauma Registry, CY 2021 (n = 17,878)**

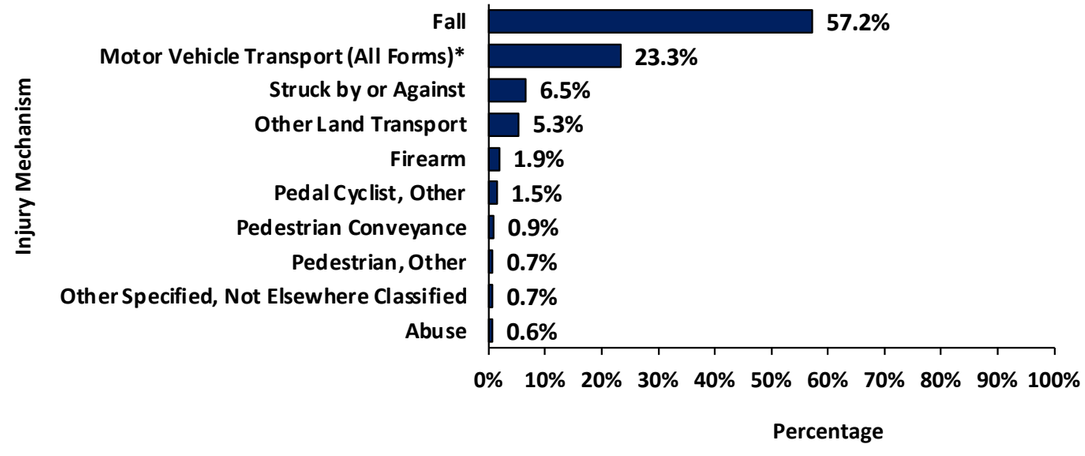



| | 0 - 4 | 5 - 9 | 10 - 14 | 15 - 19 | 20 - 24 | 25 - 34 | 35 - 44 | 45 - 54 | 55 - 64 | 65 - 74 | 75 - 84 | 85+ | Not Valued |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Male (n = 10,392) | 376 | 188 | 276 | 596 | 596 | 1,102 | 1,004 | 1,001 | 1,406 | 1,460 | 1,459 | 928 | 0 |
| Female (n = 7,420) | 272 | 109 | 142 | 294 | 288 | 499 | 426 | 477 | 758 | 1,206 | 1,563 | 1,386 | 0 |
| Unknown (n = 66) | 1 | 0 | 2 | 3 | 0 | 2 | 1 | 2 | 14 | 7 | 19 | 15 | 0 |

Age Category

In CY 2021, TBIs among males occurred most frequently in the 65-74 and 75-84 year age categories. TBIs among females occurred most frequently in the 75-84 years and 85+ age categories.

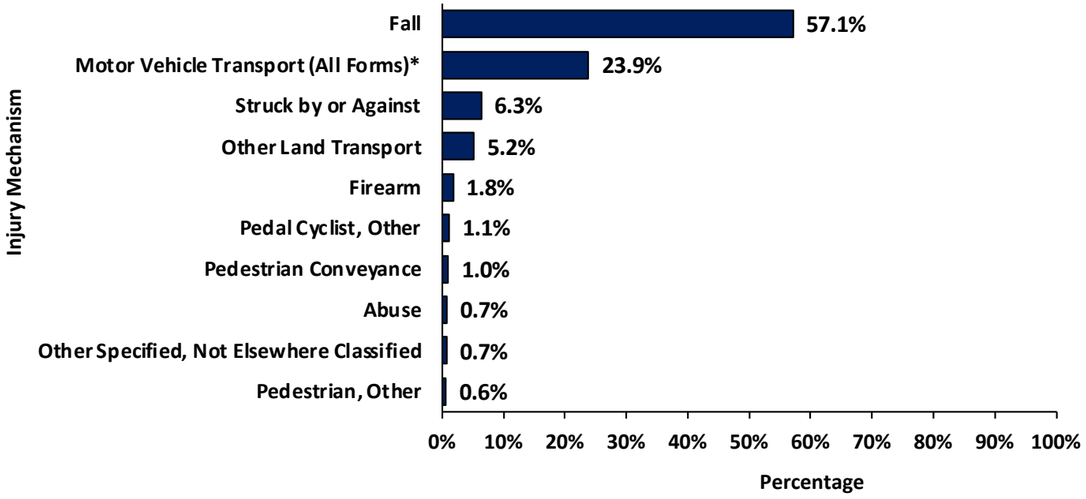
**Figure 2.5. Top 10 mechanisms of injury for TBIs, Ohio Trauma Registry, CY 2020 (n = 17,593)**




*TBIs involving motor vehicle transport include forms where the injury occurred to an occupant of the motor vehicle, a pedestrian, a motorcyclist, a pedal cyclist, other or unspecified.

In CY 2020, the most frequent injury mechanism among TBI patients was falls (57.2%), followed by injuries sustained by motor vehicle transport incidents (23.3%).

**Figure 2.6. Top 10 mechanisms of injury for TBIs, Ohio Trauma Registry, CY 2021 (n = 17,878)**



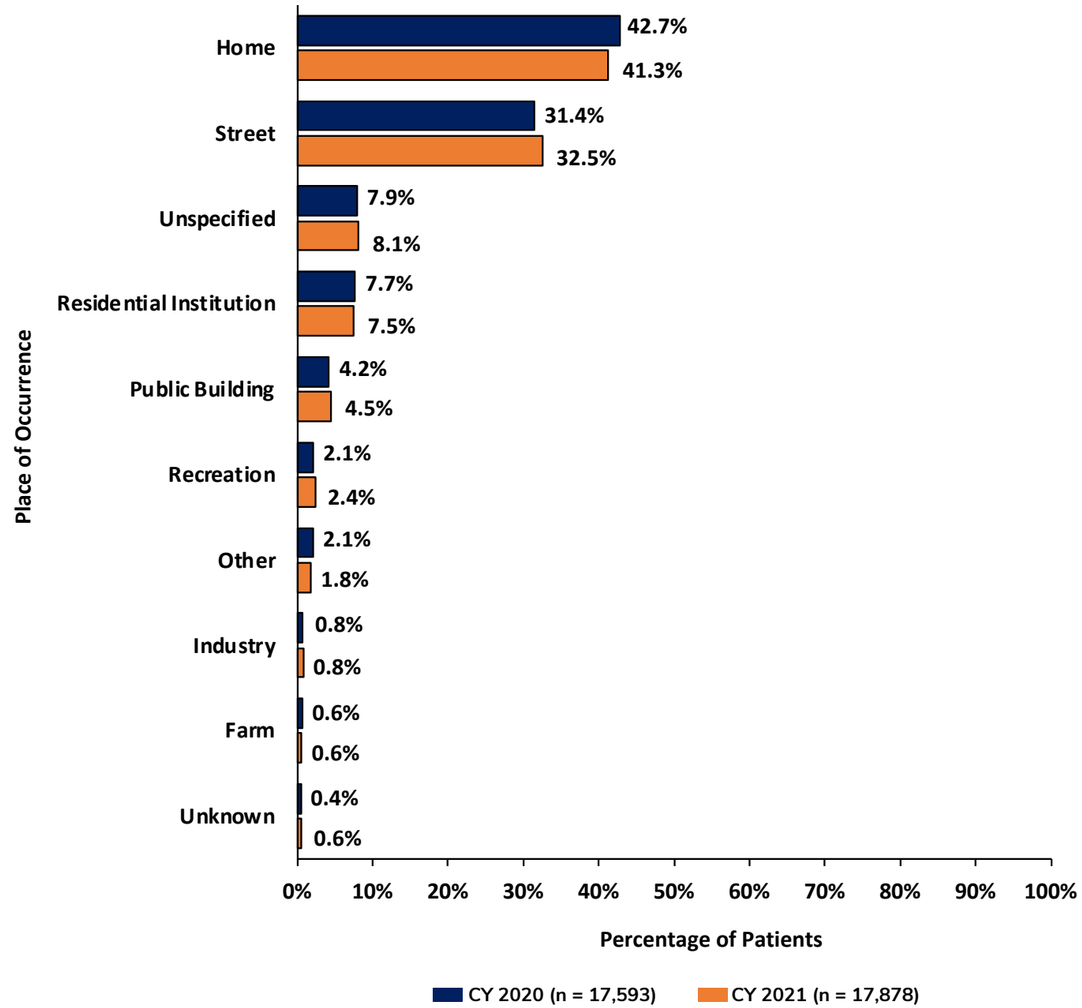

*TBIs involving motor vehicle transport include forms where the injury occurred to an occupant of the motor vehicle, a pedestrian, a motorcyclist, a pedal cyclist, other or unspecified.

In CY 2021, the most frequent injury mechanism among TBI patients was falls (57.1%), followed by injuries sustained by motor vehicle transport incidents (23.9%).



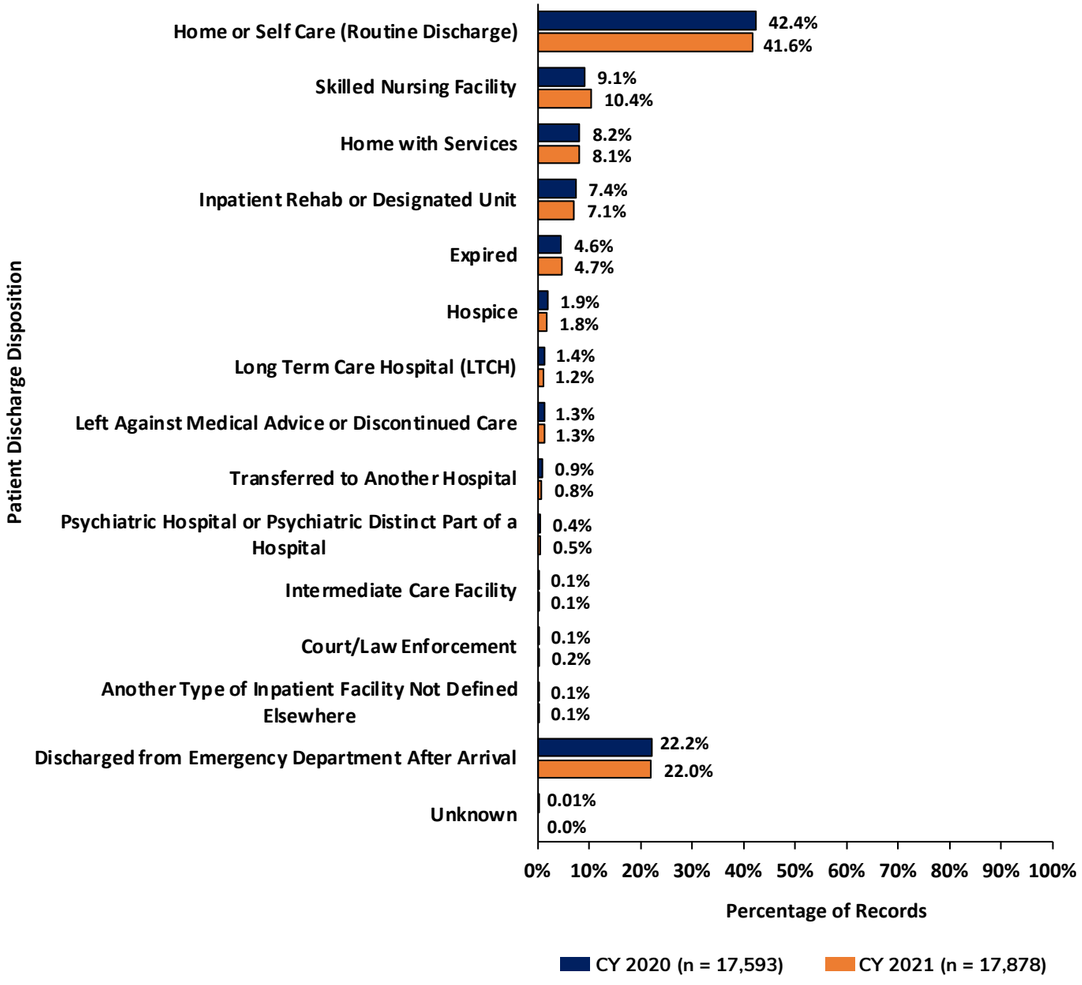


**Figure 2.7. Percentage of TBIs by place of occurrence and year, Ohio Trauma Registry, CY 2020–CY 2021**




Across both calendar years, the most common place of occurrence for TBIs was home (CY 2020: 42.7%; CY 2021: 41.3%), followed by street (CY 2020: 31.4%; CY 2021: 32.5%).

**Figure 2.8. Percentage of TBIs by patient discharge disposition, all patients, Ohio Trauma Registry, CY 2020–CY 2021**

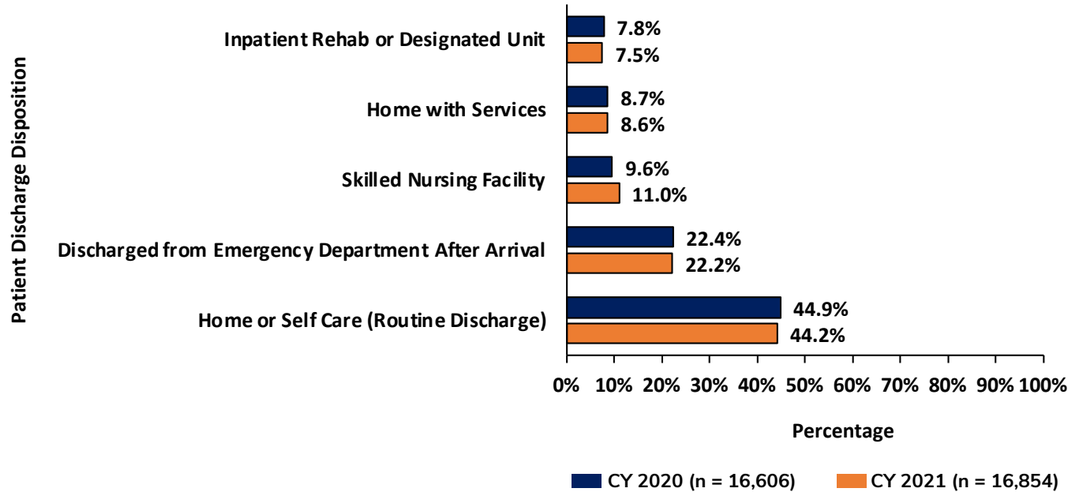



For both calendar years, the most common patient discharge disposition for TBIs, regardless of discharge status, was sending the patient home without any additional services as a routine discharge (CY 2020: 42.4%; CY 2021: 41.6%).



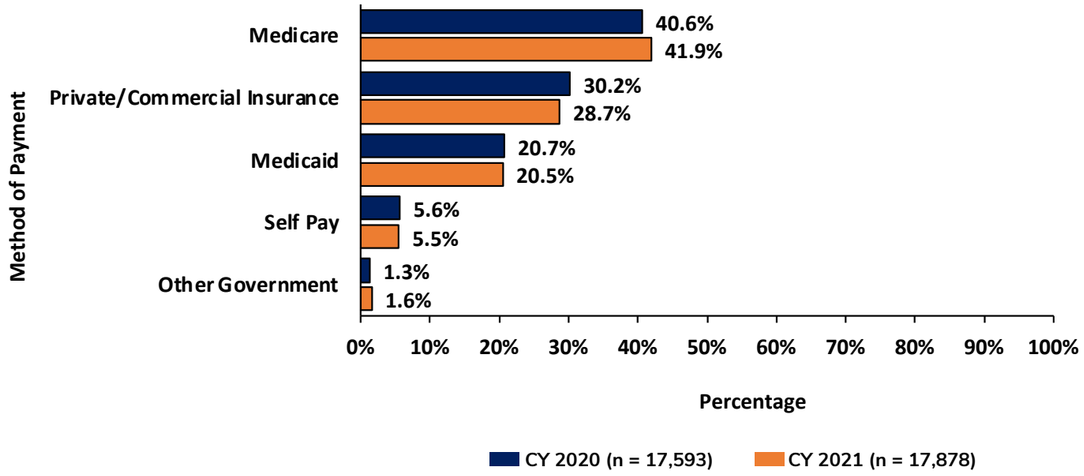


**Figure 2.9. Top five patient discharge dispositions for TBIs, alive patients at time of discharge, Ohio Trauma Registry, CY 2020–CY 2021**



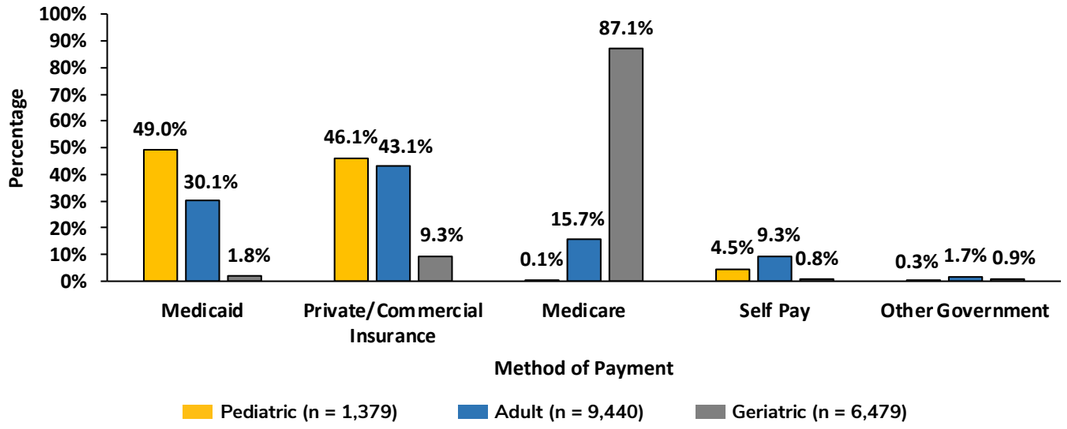

Across both calendar years, TBI patients who were alive when discharged were most frequently sent home without any additional services as a routine discharge (CY 2020: 44.9%; CY 2021: 44.2%).

**Figure 2.10. Top five methods of payment for care among TBIs, Ohio Trauma Registry, CY 2020–CY 2021**



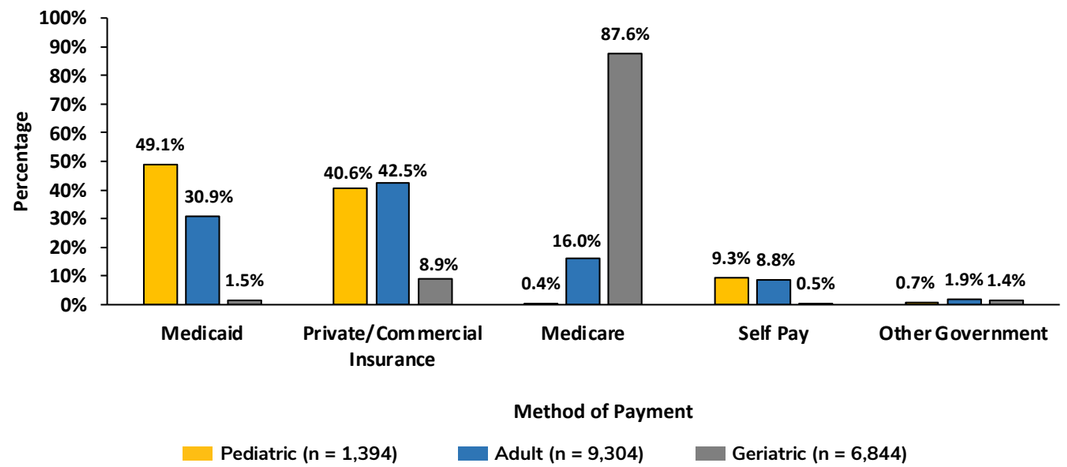

For both CY 2020 and 2021, the most common method of payment for care was Medicare (CY 2020: 40.6%; CY 2021: 41.9%), followed by private/commercial insurance (CY 2020: 30.2%; CY 2021: 28.7%).

**Figure 2.11. Select methods of payment for care among TBIs by patient type, Ohio Trauma Registry, CY 2020 (n = 17,316)**




Patient type breaks down TBI patients' ages into three categories: pediatric (0-15 years), adult (16-69 years) and geriatric (70+ years). In 2020, pediatric TBI patients were mostly likely to have Medicaid as their method of payment (49.0%). Adult TBI patients most frequently used some sort of private/commercial insurance (43.1%), and the majority of geriatric TBI patients (87.1%) used Medicare as their method of payment.

**Figure 2.12. Select methods of payment for care among TBIs by patient type, Ohio Trauma Registry, CY 2021 (n = 17,542)**

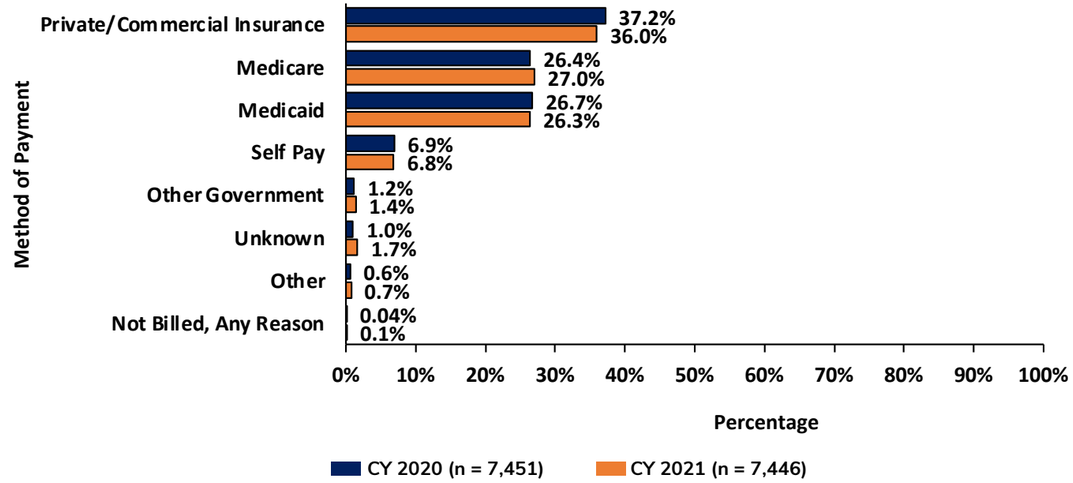



Similar to 2020 data, in 2021 pediatric TBI patients most often used Medicaid as their method of payment (49.1%). Adult TBI patients most frequently used some sort of private/commercial insurance (42.5%), and the majority of geriatric TBI patients used Medicare as their method of payment (87.6%).



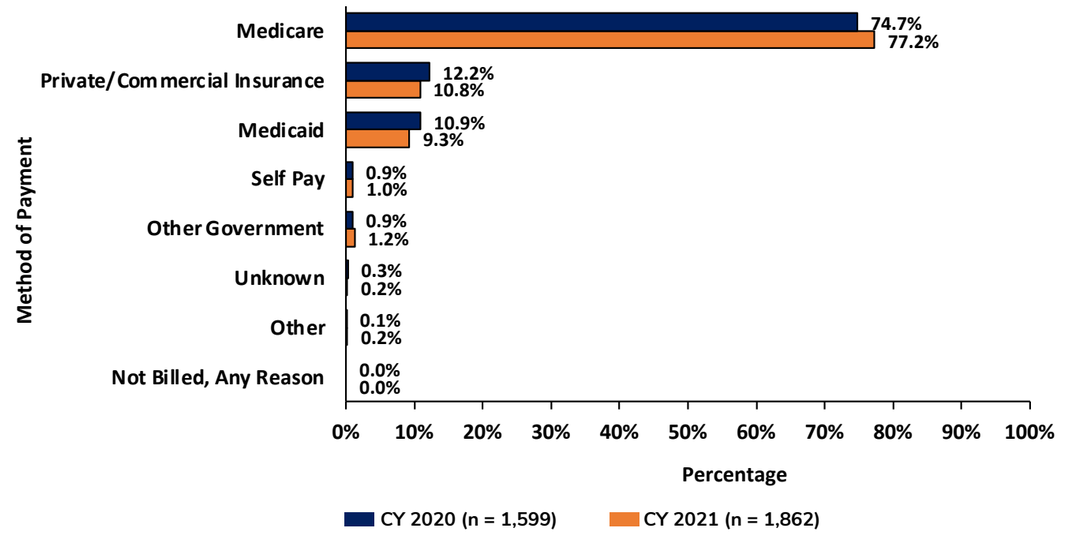


**Figure 2.13. Methods of payment for care among TBI patients discharged home without services, Ohio Trauma Registry, CY 2020–CY 2021**



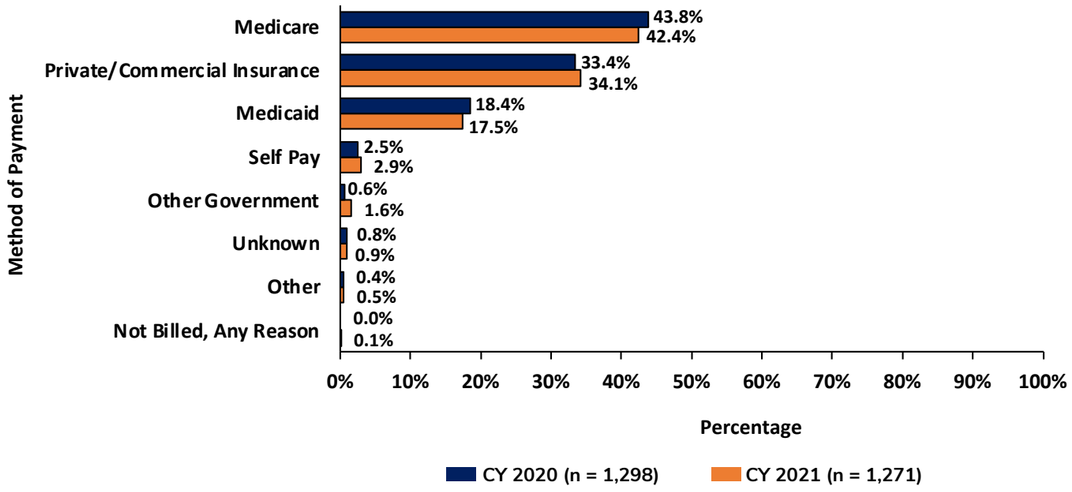

For both CY 2020 and 2021, the most common method of payment for care for TBI patients discharged home without services was private/commercial insurance (CY 2020: 37.2%; CY 2021: 36.0%).

**Figure 2.14. Methods of payment for care among TBI patients discharged to a skilled nursing facility, Ohio Trauma Registry, CY 2020–CY 2021**



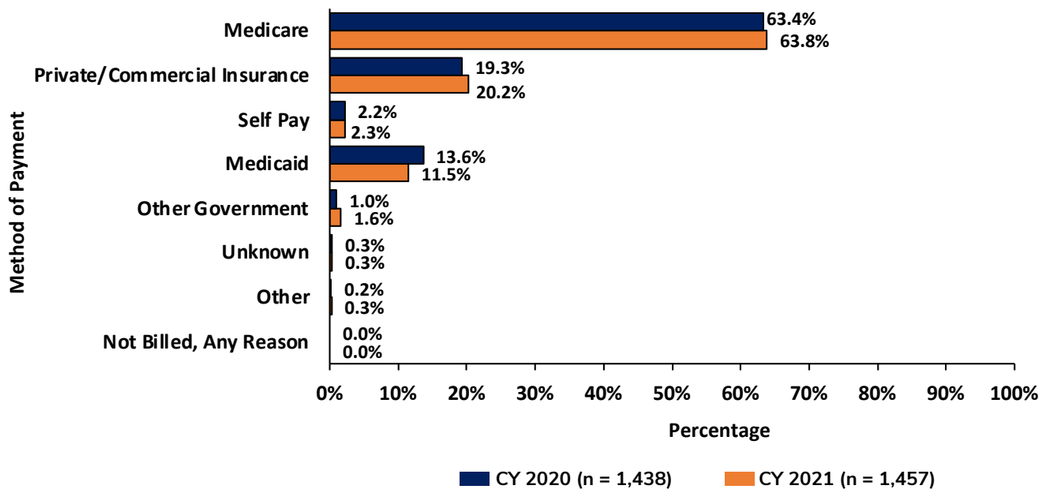

For both CY 2020 and 2021, the most common method of payment for care for TBI patients discharged to a skilled nursing facility was Medicare (CY 2020: 74.7%; CY 2021: 77.2%).

**Figure 2.15. Methods of payment for care among TBI patients discharged to an inpatient rehab facility or designated unit, Ohio Trauma Registry, CY 2020–CY 2021**




For both CY 2020 and 2021, the most common method of payment for care for TBI patients discharged to an inpatient rehab facility or designated unit was Medicare (CY 2020: 43.8%; CY 2021: 42.4%).

**Figure 2.16. Methods of payment for care among TBI patients discharged home with services, Ohio Trauma Registry, CY 2020–CY 2021**

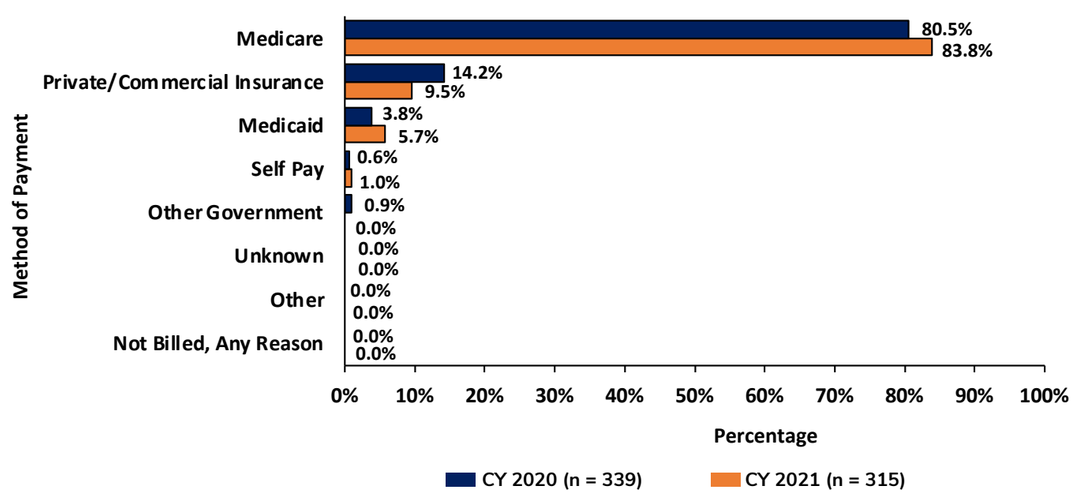



For both CY 2020 and 2021, the most common method of payment for care for TBI patients discharged home with additional services was Medicare (CY 2020: 63.4%; CY 2021: 63.8%).





**Figure 2.17. Methods of payment for care among TBI patients discharged to hospice, Ohio Trauma Registry, CY 2020–CY 2021**




For both CY 2020 and 2021, the most common method of payment for care for TBI patients discharged to hospice was Medicare (CY 2020: 80.5%; CY 2021: 83.8%).

## Injury severity

The Injury Severity Score (ISS) is an assessment of the patient's injury severity. The score is based on the Abbreviated Injury Scale (AIS), another scoring system for injury severity. When a patient is injured, each area of the body is assigned an AIS score depending on the injury severity. ISS is calculated by squaring the AIS score from the three most severely injured body areas and adding them together. ISS scores range from 0 to 75. The higher the ISS score, the more severe the injury.

**Table 2.2. ISS and length of hospital stay among TBIs, Ohio Trauma Registry, CY 2020**

| Injury severity score | 1 Day | 2 Days | 3 Days | 4 Days | 5 Days | 6 Days | 7 Days | 8+ Days | Not Recorded | Total Number of Records |
|---|---|---|---|---|---|---|---|---|---|---|
| **1 – 8** | 3,753 | 903 | 405 | 271 | 157 | 134 | 66 | 217 | 8 | 5,914 |
| **9 – 15** | 2,737 | 878 | 620 | 392 | 275 | 188 | 147 | 497 | 6 | 5,740 |
| **16 – 24** | 917 | 428 | 369 | 282 | 212 | 186 | 148 | 695 | 3 | 3,240 |
| **25+** | 895 | 176 | 174 | 146 | 145 | 122 | 98 | 942 | 1 | 2,699 |
| **Not Calculable** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **8,302** | **2,385** | **1,568** | **1,091** | **789** | **630** | **459** | **2,351** | **18** | **17,593** |

**Table 2.3. ISS and length of hospital stay among TBIs, Ohio Trauma Registry, CY 2021**

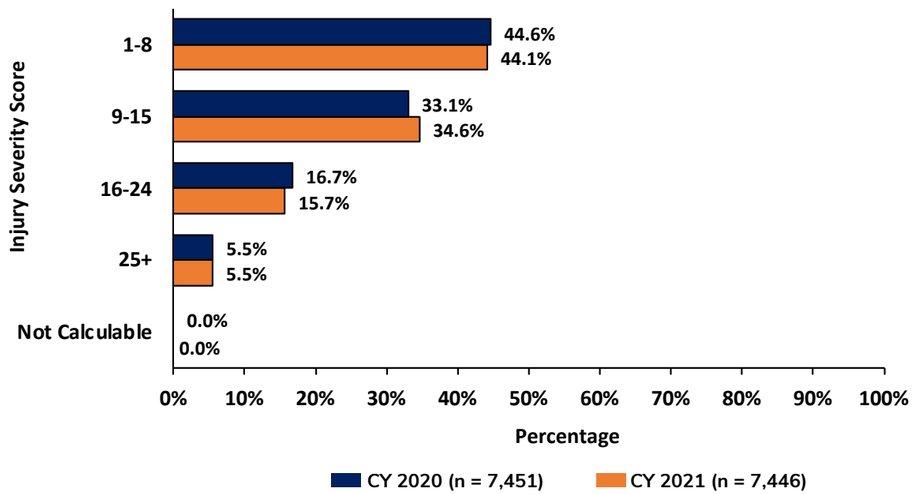
| Injury severity score | 1 Day | 2 Days | 3 Days | 4 Days | 5 Days | 6 Days | 7 Days | 8+ Days | Not Recorded | Total Number of Records |
|---|---|---|---|---|---|---|---|---|---|---|
| **1 – 8** | 3,463 | 954 | 473 | 270 | 198 | 127 | 83 | 300 | 1 | 5,869 |
| **9 – 15** | 2,800 | 950 | 599 | 453 | 250 | 175 | 151 | 631 | 3 | 6,012 |
| **16 – 24** | 939 | 403 | 330 | 258 | 235 | 186 | 131 | 783 | 0 | 3,265 |
| **25+** | 829 | 193 | 174 | 158 | 125 | 107 | 118 | 1,026 | 0 | 2,730 |
| **Not Calculable** | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 |
| **Total** | **8,032** | **2,500** | **1,576** | **1,140** | **808** | **595** | **483** | **2,740** | **4** | **17,878** |

Across both calendar years, patients with TBIs who had an ISS of 25+ had a higher frequency of hospital stays lasting eight days or longer compared to other scores. The majority of TBIs with an ISS between 1 and 8 stayed only a single day at the hospital.



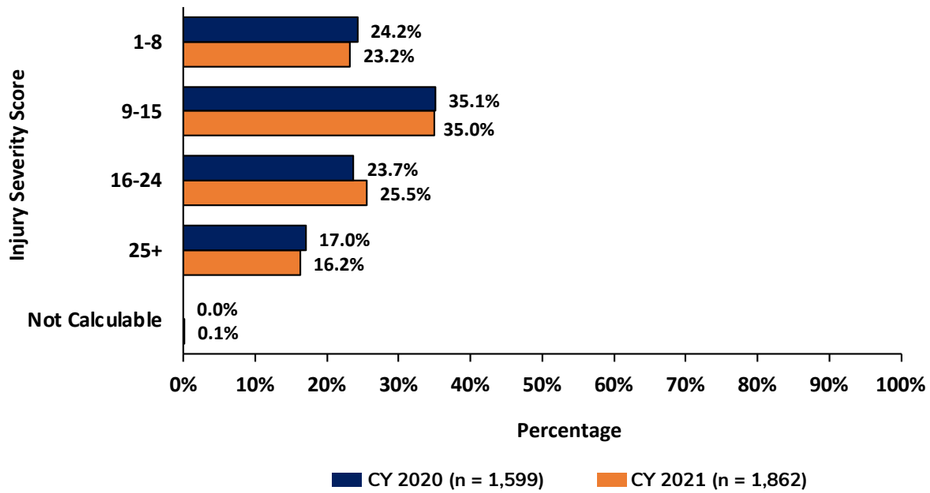


**Figure 2.18. ISS for TBI patients discharged home without services, Ohio Trauma Registry, CY 2020–CY 2021**



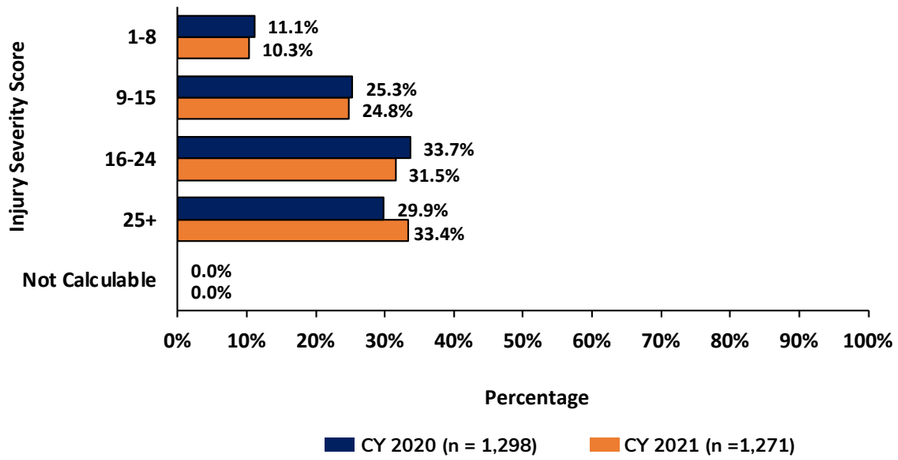

For both CY 2020 and CY 2021, TBI patients who were discharged home without services were most likely to have an ISS in the 1-8 range (CY 2020: 44.6%; CY 2021: 44.1%).

**Figure 2.19. ISS for TBI patients discharged to a skilled nursing facility, Ohio Trauma Registry, CY 2020–CY 2021**



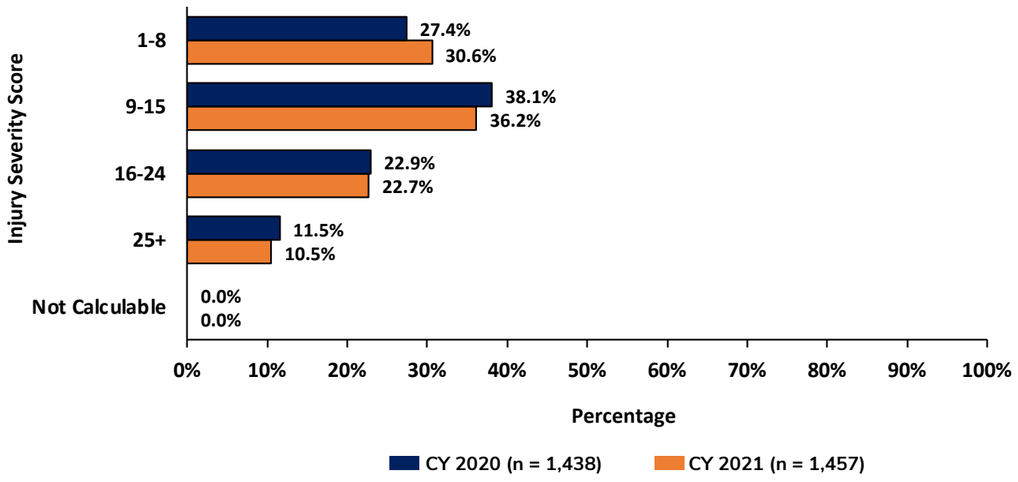

For both CY 2020 and CY 2021, TBI patients who were discharged to a skilled nursing facility were most likely to have an ISS between 9 and 15 (CY 2020: 35.1%; CY 2021: 35.0%).

**Figure 2.20. ISS for TBI patients discharged to an inpatient rehab facility or designated unit, Ohio Trauma Registry, CY 2020–CY 2021**




In CY 2020, TBI patients who were discharged to an inpatient rehab facility or designated unit were most likely to have an ISS between 16 and 24 (33.7%), followed by an ISS of 25+ (29.9%). In CY 2021, TBI patients who were discharged to an inpatient rehab facility or designated unit were most likely to have an ISS of 25+ (33.4%), followed by an ISS between 16 and 24 (31.5%).

**Figure 2.21. ISS for TBI patients discharged home with services, Ohio Trauma Registry, CY 2020–CY 2021**

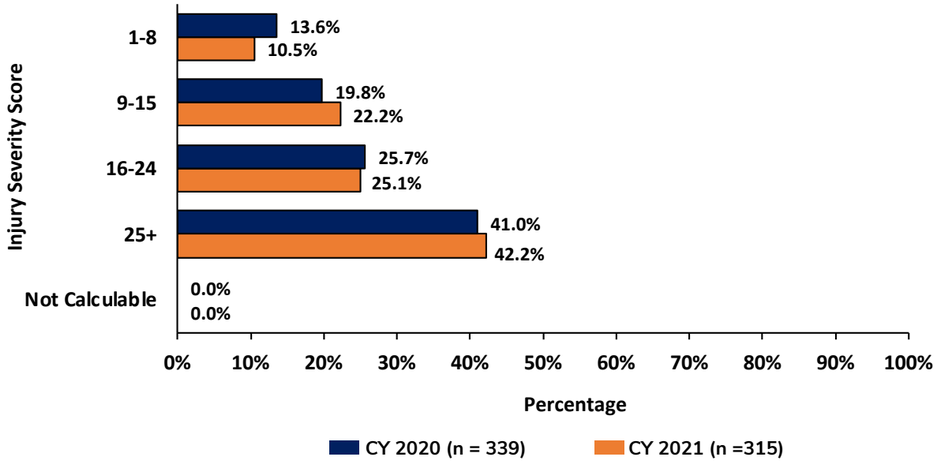



For both CY 2020 and CY 2021, TBI patients who were discharged home with services were most likely to have an ISS in the 9-15 range (CY 2020: 38.1%; CY 2021: 36.2%), followed by an ISS in the 1-8 range (CY 2020: 27.4%; CY 2021: 30.6%).





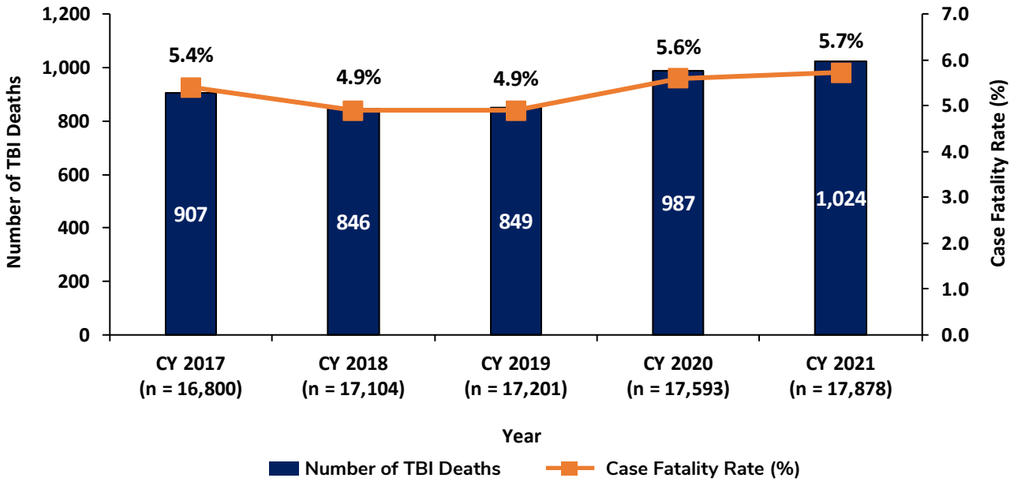
**Figure 2.22. ISS for TBI patients discharged to hospice, Ohio Trauma Registry, CY 2020–CY 2021**




For both CY 2020 and CY 2021, TBI patients who were discharged to hospice were most likely to have an ISS of 25+ (CY 2020: 41.0%; CY 2021: 42.2%), followed by an ISS between 16 and 24 (CY 2020: 25.7%; CY 2021: 25.1%).

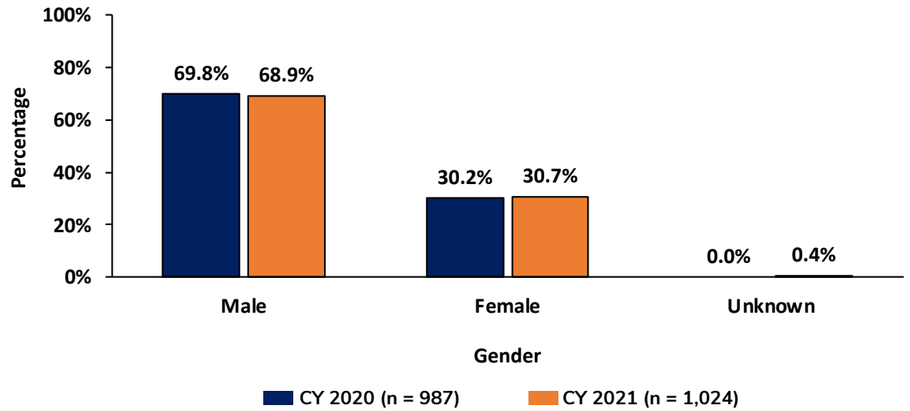
## Morbidity data

**Figure 2.23. Number of deaths and case fatality rates among TBIs by year, Ohio Trauma Registry, CY 2017–CY 2021**




There were 17,593 TBI records in CY 2020 and 17,878 in CY 2021. There were 987 deaths among TBI records in CY 2020 and 1,024 in CY 2021. The case fatality rate among TBI patients increased from 5.4% in CY 2017 to 5.7% in CY 2021.

**Figure 2.24. Percentage of TBI deaths by gender and year, Ohio Trauma Registry, CY 2020–CY 2021**




For both calendar years, the majority of TBI deaths were male (CY 2020: 69.8%; CY 2021: 68.9%).

**Table 2.4. Number of deaths and case fatality rates among TBIs by year and age category, Ohio Trauma Registry, CY 2020–CY 2021**

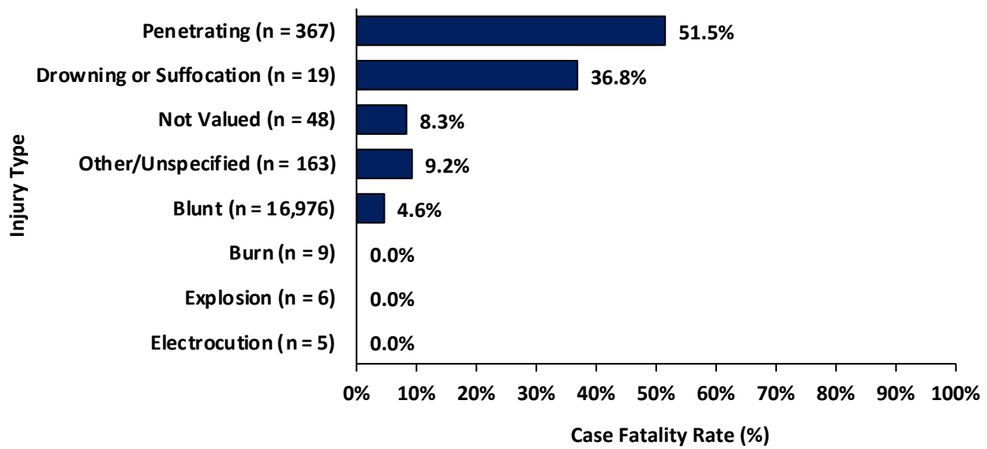
| | CY 2020 | | | CY 2021 | | |
|---|---|---|---|---|---|---|
| Age category | TBI fatalities | Total TBIs | Case fatality rate (%) | TBI fatalities | Total TBIs | Case fatality rate (%) |
| 0-4 years | 19 | 585 | 3.2 | 21 | 649 | 3.2 |
| 5-9 | 6 | 285 | 2.1 | 10 | 297 | 3.4 |
| 10-14 | 17 | 441 | 3.9 | 8 | 420 | 1.9 |
| 15-19 | 44 | 858 | 5.1 | 62 | 893 | 6.9 |
| 20-24 | 66 | 904 | 7.3 | 49 | 884 | 5.5 |
| 25-34 | 119 | 1,685 | 7.1 | 112 | 1,603 | 7.0 |
| 35-44 | 85 | 1,510 | 5.6 | 79 | 1,431 | 5.5 |
| 45-54 | 87 | 1,439 | 6.0 | 81 | 1,480 | 5.5 |
| 55-64 | 123 | 2,214 | 5.6 | 140 | 2,178 | 6.4 |
| 65-74 | 132 | 2,568 | 5.1 | 135 | 2,673 | 5.1 |
| 75-84 | 164 | 2,951 | 5.6 | 163 | 3,041 | 5.4 |
| 85+ | 125 | 2,153 | 5.8 | 164 | 2,329 | 7.0 |
| **Total** | **987** | **17,593** | **5.6** | **1,024** | **17,878** | **5.7** |

For both calendar years, a higher proportion of TBI fatalities occurred in age groups 55 years and older. However, in CY 2020 the highest case fatality rates occurred in the 20-24 (7.3%), 25-34 (7.1%) and 45-54 (6.0%) age categories. In CY 2021, the highest case fatality rates occurred in the 85+ (7.0%), 25-34 (7.0%) and 15-19 (6.9%) age categories.



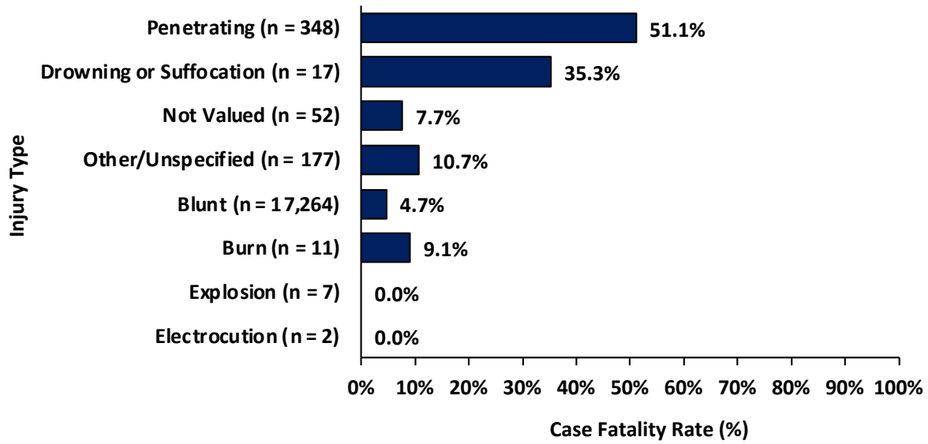


**Figure 2.25. Case fatality rates among TBIs by injury type, Ohio Trauma Registry, CY 2020 (n = 17,593)**



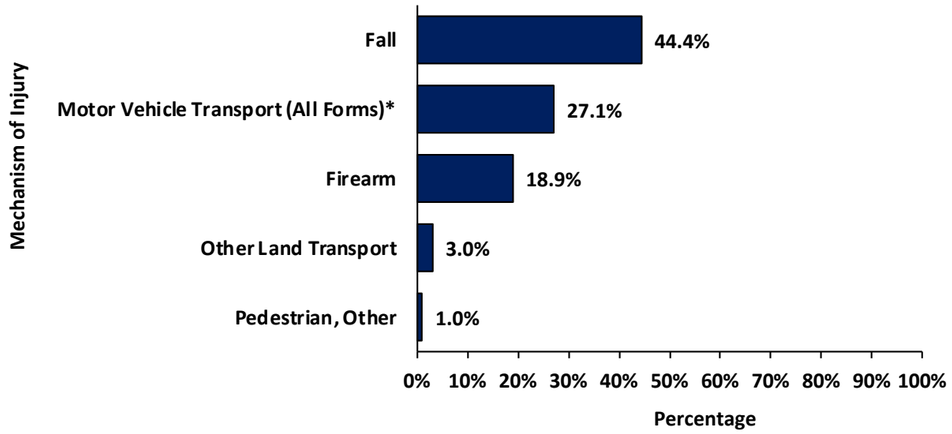

Among TBI patients in CY 2020, penetrating injuries had the highest case fatality rate (51.5%), followed by drowning or suffocation (36.8%).

**Figure 2.26. Case fatality rates among TBIs by injury type, Ohio Trauma Registry, CY 2021 (n = 17,878)**




Among TBI patients in CY 2021, penetrating injuries causing TBIs had the highest case fatality rate (51.1%), followed by drowning or suffocation (35.3%).

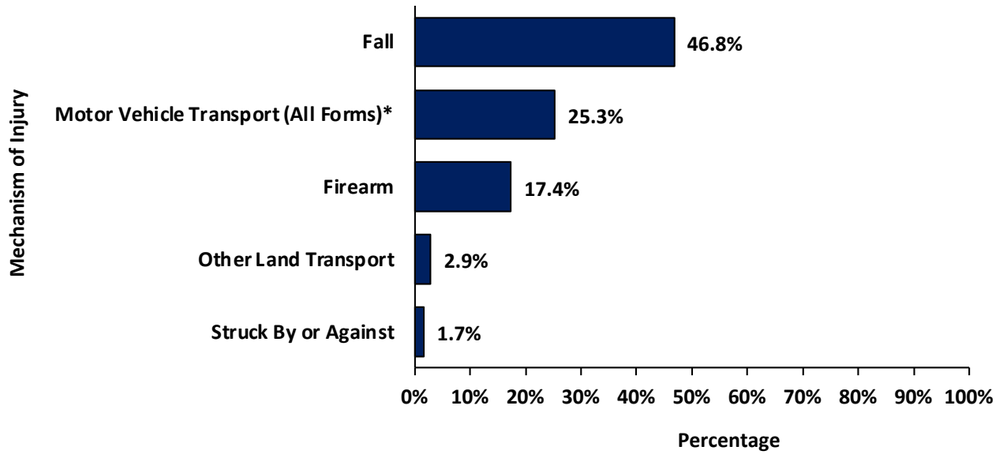
**Figure 2.27. Top five mechanisms of injury for TBI deaths, Ohio Trauma Registry, CY 2020 (n = 987)**




*TBIs involving motor vehicle transport include forms where the injury occurred to an occupant of the motor vehicle, a pedestrian, a motorcyclist, a pedal cyclist, other or unspecified.

In CY 2020, the most frequent injury mechanism among TBI deaths was falls (44.4%), followed by injuries sustained by motor vehicle transport incidents (27.1%).

**Figure 2.28. Top five mechanisms of injury for TBI deaths, Ohio Trauma Registry, CY 2021 (n = 1,024)**




*TBIs involving motor vehicle transport include forms where the injury occurred to an occupant of the motor vehicle, a pedestrian, a motorcyclist, a pedal cyclist, other, or unspecified.

In CY 2021, the most frequent injury mechanism among TBI deaths was falls (46.8%), followed by injuries sustained by motor vehicle transport incidents (25.3%).



THE OHIO BRAIN INJURY PROGRAM AND THE BRAIN INJURY ADVISORY COMMITTEE

## Summary

In 2020, 21.0% of total injuries reported to the OTR were TBIs. In 2021, they represented 20.6% of the total injuries.

There are clear trends among Ohioans with TBIs in 2020 and 2021:

- The majority of TBIs were among males.
- More than half of all TBIs were caused by falls.
- TBIs occurred most frequently between ages 75 and 84 years, with 65 to 74 years as the next most frequent age category.
- TBIs occurred more frequently in the home than any other location.
- Patients were most frequently discharged home without needing additional services.

For both years, more than 60% of patients with TBI use either Medicare or Medicaid as their method of payment. The most common method of payment was Medicare, since a larger percentage of TBIs occur in older age groups.

Patients most frequently spent one day at the hospital following their TBI.

Deaths among patients with TBI occurred more frequently among males and among those in the 75- to 84-year age group. The highest case fatality rates were for penetrating injuries, followed by drowning or suffocation.

## Section 3

# Ohio traumatic brain injury prevalence data from the Behavioral Risk Factor Surveillance System Survey

The Behavioral Risk Factor Surveillance System (BRFSS) is an annual cross-sectional telephone survey developed by the Centers for Disease Control and Prevention. The survey collects information at the state level regarding health risk behaviors among non-institutionalized adults aged 18 years and older. The BRFSS uses complex weighting processes (design weight and iterative proportional fitting methodologies) to make generalizations from the sample to the state population. The Ohio BRFSS is conducted by the Ohio Department of Health.

Beginning in 2014, the Ohio BRFSS included a traumatic brain injury (TBI) module. This module was adapted from The Ohio State University Traumatic Brain Injury Identification Method (OSU TBI-ID), which was developed by the Ohio Valley Center for Brain Injury Prevention and Rehabilitation at The Ohio State University Wexner Medical Center. The TBI module was included in the survey to provide vital information about lifetime prevalence of TBI in the Ohio adult population. The TBI module was subsequently included in the 2016 survey and has been included each survey year through the 2021 data included in this report.

The Ohio BRFSS consists of modules that are asked of all respondents, in addition to modules that are asked of only a group of respondents. These randomly assigned groups are known as splits, and they are used in the survey design to increase the number of modules that can be assessed without lengthening the questionnaire for respondents. For the 2020 BRFSS Survey, the TBI module was included in Split 1; it was included in Split 2 for the 2021 survey.

- This report's analysis includes data from the 2020-2021 Ohio BRFSS.
- The data were reweighted based on the proportion of the sample size from each year (2020, Split 1 = 9,966 respondents; 2021, Split 2 = 4,384 respondents).
- Our analysis accounts for the complex survey design and excludes "missing," "don't know/not sure" and "refused" responses.

Data from the lifetime history of TBI module of the BRFSS has produced significant insight into the prevalence of TBI in Ohio and the impact of these injuries on quality of life, including health, disability, behavioral health and socio-economic status.

## Table 3.1. Lifetime prevalence of TBI with loss of consciousness (LOC) and total TBI among adults 18+ years by demographic, 2020–2021

| Demographic characteristics | Overall sample population | TBI with LOC | | Total TBI* | |
|---|---|---|---|---|---|
| | Ohio estimate (% distribution) | Ohio estimate | Estimate % | Ohio estimate | Estimate % |
| **Total** | **7,098,760** | **1,147,525** | **16.2** | **1,647,062** | **23.2** |
| **Sex** | | | | | |
| Female | 3,701,757 (52.1) | 487,338 | 13.2 | 694,802 | 18.8 |
| Male | 3,397,003 (47.9) | 660,186 | 19.4 | 952,260 | 28.0 |
| **Age** | | | | | |
| 18-24 years | 875,461 (12.3) | 104,069 | 11.9 | 204,796 | 23.4 |
| 25-34 | 1,184,657 (16.7) | 233,079 | 19.7 | 321,898 | 27.2 |
| 35-44 | 1,043,362 (14.7) | 207,080 | 19.8 | 273,342 | 26.2 |
| 45-54 | 1,045,483 (14.7) | 173,262 | 16.6 | 258,403 | 24.7 |
| 55-64 | 1,240,055 (17.5) | 221,219 | 17.8 | 308,877 | 24.9 |
| 65+ | 1,709,742 (24.1) | 208,816 | 12.2 | 279,747 | 16.4 |
| **Race/Ethnicity** | | | | | |
| White Non-Hispanic | 5,771,293 (81.3) | 949,384 | 16.5 | 1,354,060 | 23.5 |
| Black Non-Hispanic | 799,476 (11.3) | 95,994 | 12.0 | 154,061 | 19.3 |
| Other Non-Hispanic | 314,581 (4.4) | 58,834 | 18.7 | 78,961 | 25.1 |
| Hispanic | 213,410 (3.0) | 43,314 | 20.3 | 59,981 | 28.1 |
| **Marital status** | | | | | |
| Married | 3,488,408 (49.1) | 533,504 | 15.3 | 746,078 | 21.4 |
| Never married | 2,098,010 (29.6) | 352,728 | 16.8 | 537,034 | 25.6 |
| All else | 1,512,342 (21.3) | 261,293 | 17.3 | 363,950 | 24.1 |
| **# Children living household** | | | | | |
| 0 | 4,726,558 (67.6) | 751,413 | 15.9 | 1,080,719 | 22.9 |
| 1 | 1,048,172 (15.0) | 167,637 | 16.0 | 247,563 | 23.6 |
| 2 | 695,043 (9.9) | 103,130 | 14.8 | 147,402 | 21.2 |
| 3+ | 518,970 (7.4) | 110,689 | 21.3 | 144,599 | 27.9 |
| **Highest level of education completed** | | | | | |
| < High school (HS) | 668,896 (9.4) | 129,958 | 19.4 | 191,899 | 28.7 |
| HS diploma or GED diploma | 2,314,751 (32.7) | 352,860 | 15.2 | 517,050 | 22.3 |
| Some college | 2,192,743 (30.9) | 391,322 | 17.8 | 547,860 | 25.0 |
| College degree or more | 1,910,089 (27.0) | 273,313 | 14.3 | 390,181 | 20.4 |
| **Employment status** | | | | | |
| Employed/Self-employed | 3,951,371 (56.2) | 663,377 | 16.8 | 942,547 | 23.9 |
| Unemployed | 468,529 (6.7) | 74,858 | 16.0 | 127,444 | 27.2 |
| Retired | 1,510,065 (21.5) | 181,946 | 12.0 | 256,122 | 17.0 |
| Unable to work | 471,302 (6.7) | 147,490 | 31.3 | 203,597 | 43.2 |
| Homemaker | 323,155 (4.6) | 40,784 | 12.6 | 54,396 | 16.8 |
| Student | 305,023 (4.3) | 28,404 | 9.3 | 48,135 | 15.8 |
| **Annual Household Income** | | | | | |
| < $15,000 | 397,468 (6.7) | 99,153 | 24.9 | 133,650 | 33.6 |
| $15,000 – $24,999 | 865,530 (14.6) | 165,712 | 19.1 | 234,096 | 27.0 |
| $25,000 – $34,999 | 634,987 (10.7) | 107,383 | 16.9 | 153,473 | 24.2 |
| $35,000 – $49,999 | 823,778 (13.9) | 123,420 | 15.0 | 195,141 | 23.7 |
| $50,000+ | 3,189,249 (54.0) | 499,235 | 15.7 | 720,372 | 22.6 |

*Combines TBI without LOC and TBI with LOC.
Analysis excludes respondents who had missing, don't know/not sure and refused responses.
Source: Ohio BRFSS, including module on lifetime history of TBI (2020, Split; 1 and 2021, Split 2).





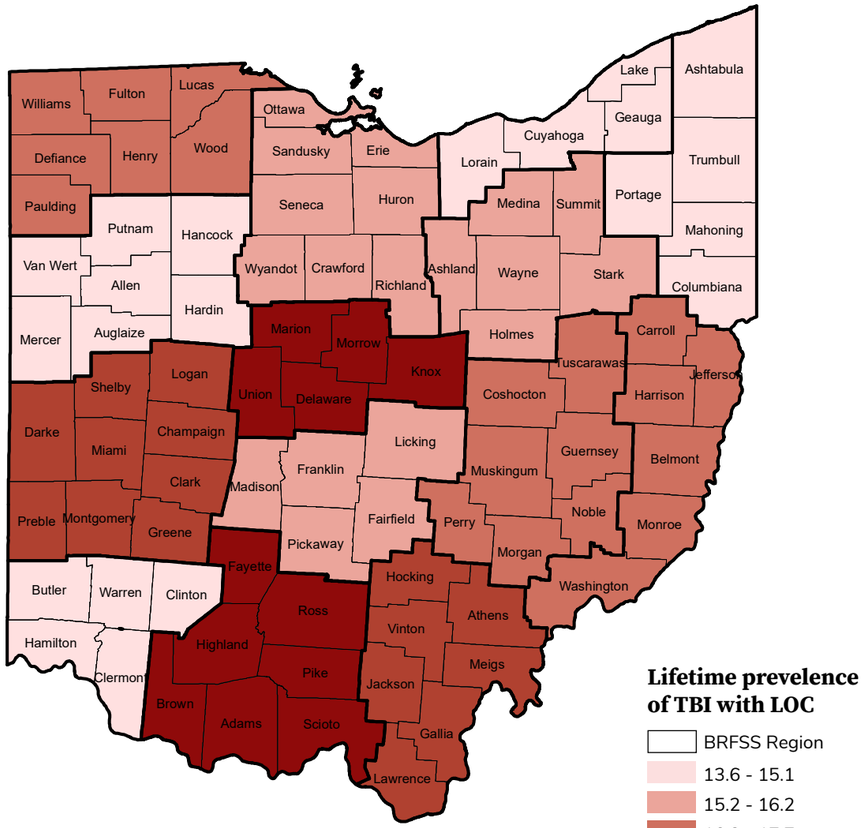
## Table 3.2. Lifetime prevalence of TBI among adults 18+ years by geographic region of residence, Ohio, 2020–2021

| Region | Ohio sample | Severity of TBI | | | | All TBI with LOC | Age at first TBI with LOC* | |
|---|---|---|---|---|---|---|---|---|
| | | TBI with no LOC | < 5 mins LOC | 5-30 mins LOC | > 30 mins LOC | | < 20 years | ≥20 years |
| | Ohio estimate (% distribution) | % | % | % | % | % | % | % |
| **Total** | **7,098,760** | **8.4** | **9.0** | **2.7** | **2.9** | **16.2** | **10.1** | **5.8** |
| Region 1 | 427,579 (6.0) | 7.5 | 10.2 | 3.2 | 1.8 | 16.7 | 10.2 | 5.6 |
| Region 2 | 229,941 (3.2) | 5.0 | 5.4 | 4.3 | 2.9 | 14.0 | 9.4 | 4.6 |
| Region 3 | 312,680 (4.4) | 8.3 | 8.7 | 1.7 | 2.9 | 15.3 | 9.8 | 5.0 |
| Region 4 | 1,042,206 (14.7) | 9.6 | 7.8 | 1.9 | 4.2 | 15.1 | 8.5 | 6.9 |
| Region 5 | 786,669 (11.1) | 9.1 | 9.2 | 3.1 | 2.6 | 16.2 | 10.0 | 5.7 |
| Region 6 | 488,109 (6.9) | 8.6 | 8.6 | 2.0 | 2.6 | 14.9 | 9.2 | 5.5 |
| Region 7 | 256,712 (3.6) | 7.6 | 11.2 | 3.8 | 3.8 | 20.6 | 12.0 | 6.7 |
| Region 8 | 998,516 (14.1) | 9.6 | 8.2 | 3.8 | 2.5 | 15.3 | 10.0 | 5.4 |
| Region 9 | 755,940 (10.6) | 7.2 | 11.6 | 2.8 | 2.8 | 19.5 | 13.5 | 5.9 |
| Region 10 | 970,330 (13.7) | 6.9 | 9.0 | 1.7 | 2.2 | 13.6 | 8.6 | 5.0 |
| Region 11 | 247,469 (3.5) | 9.8 | 10.2 | 3.4 | 4.1 | 20.4 | 11.2 | 8.3 |
| Region 12 | 239,103 (3.4) | 8.6 | 9.3 | 3.2 | 2.6 | 17.7 | 11.2 | 5.3 |
| Region 13 | 167,514 (2.4) | 11.0 | 8.4 | 3.5 | 3.2 | 16.7 | 9.7 | 6.5 |
| Region 14 | 175,992 (2.5) | 7.7 | 9.6 | 2.4 | 3.7 | 18.3 | 11.1 | 6.6 |

*Includes respondents ≥ 20 years of age.
Analysis excludes respondents who had missing, don't know/not sure and refused responses.
– Data suppressed when denominator < 50 or when the RSE > 30.
Source: Ohio BRFSS, including module on lifetime history of TBI (2020, Split; 1 and 2021, Split 2).

Region 1: Defiance, Fulton, Henry, Lucas, Paulding, Williams and Wood counties
Region 2: Allen, Auglaize, Hancock, Hardin, Mercer, Putnam and Van Wert counties
Region 3: Crawford, Erie, Huron, Ottawa, Richland, Sandusky, Seneca and Wyandot counties
Region 4: Cuyahoga, Geauga, Lake and Lorain counties
Region 5: Ashland, Holmes, Medina, Stark, Summit and Wayne counties
Region 6: Ashtabula, Columbiana, Mahoning, Portage and Trumbull counties
Region 7: Delaware, Knox, Marion, Morrow and Union counties
Region 8: Fairfield, Franklin, Licking, Madison and Pickaway counties
Region 9: Champaign, Clark, Darke, Greene, Logan, Miami, Montgomery, Preble and Shelby counties
Region 10: Butler, Clermont, Clinton, Hamilton and Warren counties
Region 11: Adams, Brown, Fayette, Highland, Pike, Ross and Scioto counties
Region 12: Coshocton, Guernsey, Morgan, Muskingum, Noble, Perry and Tuscarawas counties
Region 13: Belmont, Carroll, Harrison, Jefferson, Monroe and Washington counties
Region 14: Athens, Gallia, Hocking, Jackson, Lawrence, Meigs and Vinton counties

## Figure 3.1. Lifetime prevalence of TBI with LOC among adults 18+ years by geographic region of residence, Ohio, 2020–2021




Region 1: Defiance, Fulton, Henry, Lucas, Paulding, Williams and Wood counties
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Region 13: Belmont, Carroll, Harrison, Jefferson, Monroe and Washington counties
Region 14: Athens, Gallia, Hocking, Jackson, Lawrence, Meigs and Vinton counties





## Table 3.3. Prevalence of current health conditions and behaviors among all adults and adults with a lifetime history of TBI, by severity of TBI and age at first TBI with LOC, Ohio, 2020–2021

| Current health condition/behavior | Overall adult population | Lifetime history of TBI | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Severity of TBI | | | | All TBI with LOC | Age at first TBI with LOC* | |
| | | TBI with no LOC | < 5 min LOC | 5-30 min LOC | > 30 min LOC | | < 20 years | ≥20 years |
| | % | % | % | % | % | % | % | % |
| Any Disability | 28.3 | 41.7 | 34.2 | 44.3 | 50.5 | 40.8 | 35.0 | 50.2 |
| Hearing | 6.7 | 8.9 | 8.6 | 8.8 | 10.0 | 8.9 | 8.2 | 10.3 |
| Vision | 4.4 | 6.5 | 5.5 | 5.3 | 12.8 | 7.2 | 5.6 | 9.6 |
| Cognition | 12.1 | 25.1 | 17.8 | 26.1 | 31.6 | 22.8 | 18.7 | 28.1 |
| Mobility | 14.0 | 17.9 | 15.8 | 22.9 | 33.1 | 22.1 | 17.9 | 28.8 |
| Self-Care | 3.2 | 6.1 | 3.4 | 9.8 | 7.4 | 6.1 | 5.6 | 5.9 |
| Independent Living | 7.7 | 11.6 | 12.4 | 19.8 | 17.9 | 15.3 | 13.1 | 18.3 |
| Fair or poor health vs. great/good health | 16.7 | 21.1 | 20.5 | 30.8 | 35.6 | 26.0 | 22.5 | 32.3 |
| 1-7 days of physical health not good | 16.8 | 23.9 | 19.5 | 19.3 | 16.4 | 18.5 | 19.6 | 13.9 |
| 8-30 days of physical health not good | 14.0 | 20.9 | 18.3 | 27.2 | 31.5 | 23.7 | 19.9 | 30.8 |
| 1-7 days of poor health, keeping from activities | 22.6 | 27.8 | 27.0 | 25.6 | 12.9 | 23.0 | 25.6 | 19.2 |
| 8-30 days of poor health, keeping from activities | 22.0 | 27.9 | 26.7 | 36.0 | 39.3 | 32.1 | 28.5 | 37.3 |
| Chronic health problem£ | 52.4 | 59.7 | 57.3 | 67.6 | 69.1 | 62.2 | 57.7 | 70.1 |
| Binge drinking† | 16.6 | 23.0 | 24.5 | 17.7 | 20.6 | 22.1 | 24.5 | 20.4 |
| Heavy drinking§ | 6.0 | 7.5 | 9.8 | -- | 10.2 | 8.8 | 9.6 | 8.5 |
| Smoke (cigarettes) | 18.9 | 23.7 | 24.9 | 30.6 | 32.0 | 27.8 | 25.6 | 32.5 |
| Depressive disorder | 23.3 | 40.2 | 32.3 | 43.4 | 40.7 | 36.2 | 34.7 | 37.7 |
| Mental health not good¶ | 29.1 | 43.4 | 41.1 | 44.2 | 39.3 | 41.6 | 40.7 | 41.5 |

*Includes respondents ≥ 20 years of age.

**£ Chronic health problem** includes heart attack; angina or coronary heart disease; stroke; asthma; skin cancer; other types of cancer; chronic obstructive pulmonary disease, emphysema or chronic bronchitis; some form of arthritis, rheumatoid arthritis, gout, lupus or fibromyalgia; and kidney disease and diabetes (not pregnancy-related).

**† Binge drinking** is defined as males having five or more drinks on one occasion, and females having four or more drinks on one occasion, in the past 30 days.

**§ Heavy drinking** is defined as males having more than 14 drinks per week, and females having more than seven drinks per week, in the past 30 days.

**¶ Mental health not good** reflects mental health reported as not good on more than five days in the past 30 days.

Analysis excludes respondents who had missing, don't know/not sure and refused responses.

– Data suppressed when denominator < 50 or when the RSE > 30.

Source: Ohio BRFSS, including module on lifetime history of TBI (2020, Split; 1 and 2021, Split 2).

### Summary of Findings from the 2020-2021 Ohio BRFSS

- An estimated 1.65 million (23.2%) adults in Ohio have had at least one TBI in their lifetime. More than 1.1 million (16.2%) have had at least one TBI with LOC.
- Compared to all adult Ohioans, those with a history of TBI with LOC are more likely to:
  - » Have less than a high school education.
  - » Have a household income less than $15,000.
  - » Be unable to work.
- More than 450,000 Ohio adults reported having both a disability and a history of TBI with LOC.
- Among the more than 200,000 (2.9%) Ohio adults who have a history of moderate to severe TBI (> 30 minutes LOC), approximately 101,000 (50.5%) also reported having a current disability.
- Disability due to cognitive problems, limited mobility and not being able to live independently are the most common causes of disability for people with TBI.
- Compared to all adult Ohioans, those with a history of TBI with LOC had:
  - » More days when poor physical health kept them from activities.
  - » More days when their mental health was not good.
  - » A greater likelihood of having chronic health conditions.
- Compared to all adult Ohioans, those with a history of TBI with LOC were more likely to smoke cigarettes, drink to excess and experience depression.
- The regional distribution of TBI suggests that rural areas, particularly those in Appalachia, have a higher prevalence of TBI among the adults living there.

These findings indicate a relationship between lifetime history of TBI and poor health and social outcomes, such as disability, physical and mental health, employment and household income. While we cannot determine if these associations are causal, they clearly convey that persons with a history of TBI have long-term health and social problems that go beyond the initial effects of the injury.

## Section 4

# The costs of traumatic brain injury

Traumatic brain injury (TBI) is becoming recognized as a major public health problem and a major cause of death and disability. Despite our best efforts for primary prevention, cases continue to increase and represent, for many, the beginning of a disease process with lifelong implications. This 2024 report gives in-depth information on the incidence and prevalence of TBI in the state of Ohio. The statistics represent individuals who face a life-changing event, resulting in consequences that impact their future well-being and generate significant costs, both human and financial for them and society as a whole.

The very nature of TBI introduces unique complexities of medical care and long-term management. Variations in patient history, age at onset, type and severity of injury make predictions of each recovery course uncertain. Individually tailored rehabilitation regimens are needed that account for the unique patient circumstances, pace of response to therapy and progress. There is no one-size-fits-all schedule for recovery. Therefore, treatment often is time-consuming, protracted and costly. However, the prospect of returning the survivor to a "new normal" — with opportunities to lead a productive future life — far outweighs the investment needed for optimal care, rehabilitation and community supports.

> *"Research shows that a failure to achieve a self-perceived productive role in society after a brain injury comes at an economic cost to the injured, their families and society. The opposite is also true; those who return to work showed positive outcomes and self-reported satisfaction."*[1]

### Understanding the costs associated with TBI

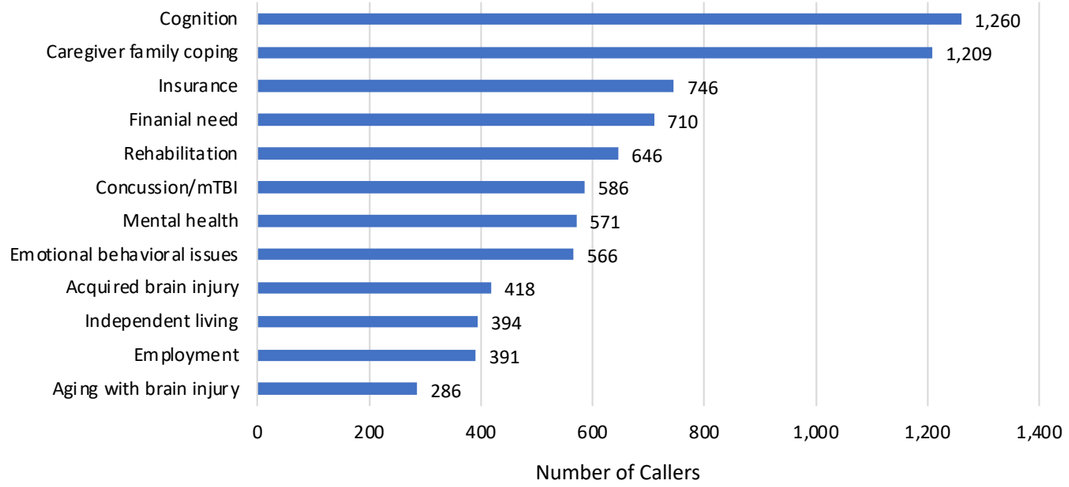
A brain injury is not a circumscribed event. It is the beginning of a chronic disease process with a range of possible sequalae and complications that, in themselves, generate additional expense.

Data supplied by the Brain Injury Association of America (BIAA) show that individuals who have suffered TBI continue to reach out to the organization for information on resources and assistance long after the initial injury. Nearly 5,000 calls were received by the BIAA National Brain Injury Information Center Helpline in 2022, and 51% of those calls were made over three years post-injury.

**Figure 4.1. Percentage of calls to BIAA Helpline by time since injury, 2022**


Source: Brain Injury Association of America

**Figure 4.2. Most frequent topics requested by callers to BIAA Helpline, January–June 2023**




Source: Brain Injury Association of America

The majority of caller inquiries after three years post-injury were related to concerns about cognition. Disturbances of cognition — which may disrupt executive functions of decision making, impulse control and behavior — are frequently the most disabling factors resulting

from TBI.[2] Additional topics demonstrate the ongoing needs for resource information and/or assistance, which reflect the persistence of physical, psychosocial, rehabilitation and financial need long after injury. Successful rehabilitation efforts, as well as established support systems designed to provide long-term optimal health, are critical features of an effective secondary and tertiary prevention strategy. This strategy will ensure that each survivor receives the right treatment, at the right time and in the right amount, and prevent the development of secondary complications. This extended prevention strategy is the key to controlling the long-term costs of brain injury.

### How big is the problem?

Almost 235,000 Ohio adults have had at least one TBI with loss of consciousness in their lifetime and, of those, almost 50% subsequently report having a disability. As a group, they have a higher incidence of poor general health, chronic illness, mental health issues and cigarette smoking.[3] Someone with a TBI is twice as likely to develop Alzheimer's disease.[4] Earning power is reduced or outright eliminated, spreading costs of living to the public sector. Disorders of behavior, cognition and impulse control are implicated in as yet undefined numbers of aberrant behaviors related to incidences of substance use disorders, domestic violence and other criminal behaviors.

Consequently, the total costs of TBI are huge, and not just because of the direct medical care needed subsequent to the injury. They are spread across multiple dimensions, tapping both private and public resources.

- Lifetime costs for Ohioans for those cases identified in data from 2014 are estimated at $5 billion, which only accounts for medical care and lost wages.[5]
- A study of the annual health care costs of nonfatal TBI cases in the United States paid by private insurers, Medicaid and Medicare showed the overall cost to be $48.3 billion.[6] The costs included were utilization, medical expenses and prescription drug claims. An impressive amount, however it captures only a fraction of the entire basket of costs driven by the lifetime needs across the spectrum of immediate care and treatment, rehabilitation, facility charges, lost wages, job training, special education, modified housing and long-term care.
- The lifetime costs of a patient's treatment for a TBI are estimated to range from $85,000 to $3 million.[7]
- Estimates show that up to 53% of people who are homeless are affected with a brain injury.[8]

### Breakdown of specific costs

- Average cost of a hospital stay in the U.S. in 2017 for TBI ranged from $12,637 to $28,828.[9]
- Long-term care facility cost can range from $600,000 to $1.9 million per year.[10]
- The average cost of nursing homes in Ohio for a semi-private room is $7,300/month and a private room is $8,091/month (regional variations).[11]
- Average cost of rehabilitation (physical therapy, occupational therapy, speech/hearing therapy) in the U.S. is about $125/hour.[12]





- Intensive rehabilitation cost for survivors with severe injury may average more than $1,000/day.[13]
- In the U.S., the prevalence of long-term disability is estimated to cost between $3.2 and $5.3 million.[14]
- Additional costs not quantified:
  - » Psychosocial costs
  - » Durable medical equipment
  - » Lost wages for the survivor and/or caregivers
  - » Housing
  - » Special education
  - » Medication

### Financing mechanisms

The staggering costs associated with TBI are spread over a variety of payment entities. Unfortunately, there is no systematic coordination nor commonality in the terms and conditions of the financing mechanisms, so care plans are not uniformly supported. Internal policy limits cap the number of treatments allowed, which brings a "hard stop" to rehabilitation regardless of the need or promise of efficacy. Waiting periods on approvals for treatment introduce interruptions or terminations of needed treatment, which, in turn, reduce the opportunity to achieve optimal outcomes. Insurance coverage may be lost entirely if its source is an employer-provided plan with benefits dependent on the ability of the beneficiary to continue working. Each of these scenarios results in an overall increase in total costs over time, most likely through an alternate payer (frequently the public sector). Each also increases the likelihood of poorer outcomes, in turn generating even greater costs.

The Ohio biennial report of 2024, Section 2, shows the breakdown on methods of payment for care among patients with TBI in various categories of discharge status in calendar years 2020 and 2021. The top four payers were private/commercial insurance, Medicare, Medicaid and self-pay.

**Table 4.1. Methods of payment for care among TBI patients by discharge status, CY 2021**

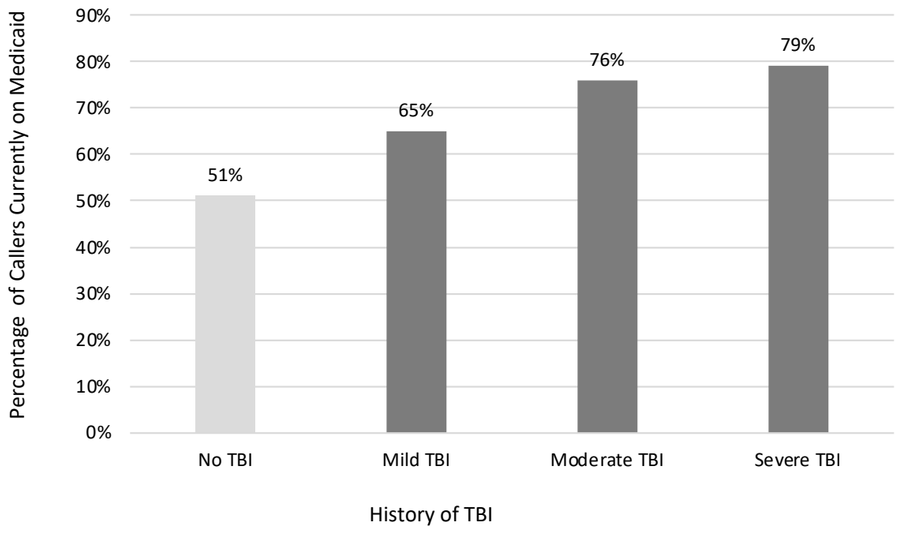
| Payer | Home/No services | Skilled nursing facility | Inpatient rehabilitation | Home with services | Hospice |
|---|---|---|---|---|---|
| Medicare | 27.0% | 77.2% | 42.4% | 63.8% | 83.8% |
| Medicaid | 26.3% | 9.3% | 17.5% | 11.5% | 5.7% |
| Insurance | 36.0% | 10.8% | 34.1% | 20.2% | 9.5% |
| Self-pay | 6.8% | 1.0% | 2.9% | 2.3% | 1.0% |

As has been noted, each of these payers presents varying coverage terms and benefits restrictions or limits. Definitive studies documenting the implications of such differences are few and far between, but recognition of their impact on affecting treatment and rehabilitation are becoming increasingly noted.

A study completed by Jonathan Theros et al. published by the *Journal of Neurotrauma* addressed this question by comparing the experience of Californians following the acute care episode. Researchers concluded that those individuals who were privately insured had greater access to the more expensive level of care in the inpatient rehabilitation setting than publicly insured individuals, who were more frequently assigned to the skilled nursing care level. Though this reduced the cost burden to the public payer, it reduced the opportunity for improved outcomes that, in turn, offered the prospect of decreased long-term costs because of decreased dependence on public benefits.[15]

The Ohio Department of Medicaid's Ohio Benefits Long-Term Services and Supports (OBLTSS) program helps allow Ohioans with disability to remain living in the community. Among other initiatives, OBLTSS created a unified way for individuals to receive information and connect to programs and services in Ohio. The OBLTSS Hotline is the "front door" for individuals and their families who want information about resources available in Ohio. The hotline includes a standardized assessment of needs that is completed when a person first makes contact. The assessment includes screening questions that allow identification of a lifetime history of at least one TBI that resulted in loss of consciousness.

**Figure 4.3. Percentage of current Medicaid use among callers to the OBLTSS Hotline by history of TBI**








Aggregate data on the number of callers with brain injury show that more than 50 callers per week have had a TBI with loss of consciousness, and 10 per week have had one that is considered moderate or severe. These data also show a very marked relationship between a history of experiencing a TBI and receiving Medicaid services. The figure below shows that about half of callers without a history of TBI are on Medicaid, while approximately 75% of those with a history of TBI receive Medicaid services. This serves as another indication of how the public health costs of TBI fall disproportionately on publicly funded programs.

The Centers for Disease Control and Prevention (CDC) acknowledges the difficulty of evaluating the impact and efficacy of rehabilitation protocols because of the complexities of TBI and the unique response of individuals. The CDC recognizes variations in injury characteristics and calls for vigorous research efforts to better diagram best practices in rehabilitation prescriptions and delivery methods, along with the cost-benefit ratio, noting:

> Evidence suggests that rehabilitation services can improve a person's quality of life and can improve the likelihood of achieving community integration, including returning to work or school, living independently and enjoying social and leisure activities.[16]

In effect, realizing the return on investment possible within the context of a frequent, significant injury that is chronic in nature expands the prevention model beyond that of primary to secondary and tertiary levels. Access to such services reduces costs over time and produces the best cost/benefit return.

1 Edmonds C. The Steep Cost of Brain Injury Recovery. 2016 Dec 28. **https://news.northwestern.edu/stories/2015/12/opinion-next-avenue-brain-injury**

2 Humphreys J, et al. The costs of traumatic brain injury: a literature review. *Clinicoecon Outcomes Res.* 2013;5:281-287.

3 Ohio Brain Injury Advisory Committee. 2022 Biennial Report on the Impact of Traumatic Brain Injury on the People of Ohio.

4 March 30 Hearing on Charge #7 Interim Report to the 85th Texas Legislature House Committee on Insurance. **http://tlchouse.granicus.com/MediaPlayer.php?view_id=37&clip_id=11837** – 2022 dissemination

5 Ohio Brain Injury Advisory Committee. 2019 Biennial Report on the Impact of Traumatic Brain Injury on the People of Ohio. 2020 December.

6 Cost of traumatic brain injury. **https://brainandspinalcord.org**

7 Edmunds, Chandi

8 Ibid

9 **http://tbi.com/cost of traumatic brain injury/**

10 ibid

11 **http://www.elderlifefinancial.com/cost-of-care/cost-of-senior-care-ohio/**

12 **http://tbi.com/cost of traumatic brain injury/**

13 **http://www.brainandspinacord.org/medical-expenses-traumatic-brain-injury/**

14 **http://tbi.com/cost of traumatic brain injury/**

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