

What Should I Know Before Using TBI Data?

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DATA CONSIDERATIONS

The [Injury and Violence Prevention Branch \(IVPB\)](#) traumatic brain injury (TBI) data can be used in many ways, from identifying risks, tracking trends, and developing effective prevention strategies, to supporting advocacy, funding decisions, and public awareness campaigns.

This document outlines what you should know and consider before using IVPB TBI data resources.

How TBI is Measured

Who Is Included in TBI Data?

TBI data are limited to NC residents.

Residence describes the area where someone has reported that they live.

- Limiting to residents allows for rate calculations using NC resident population estimates.
 - This ensures that the information used to calculate rates is consistent.
 - Limiting to residents allows for more accurate comparisons across groups and between counties.
- Limiting to residents excludes people that experience a TBI in a given county but are not residents of that county.
 - Someone living in a county, but who has not yet updated their residence status to that county would also be excluded.

Differences in Injury Location and Residence

Where a TBI occurs or where a TBI is treated can be different from where a person lives.

- This is especially true in rural areas where a single hospital or health care facility may serve a large area across multiple counties.
- Someone may experience a fall injury in one county and then be transported to and treated in a hospital in another county.
 - This transfer of care to another county is common for people with serious injuries that require treatment at a designated trauma center.
- This difference is not shown in the IVPB TBI data because these data are normally based on residence rather than injury location.

For more information, visit [Understanding Injury Surveillance Case Definitions](#).



What Is Counted in TBI Data?



IVPB data include TBI that results from any form of injury.

- TBI can be caused by a bump, blow, jolt, or penetration to the head that disrupts the normal function of the brain.
 - This is normally caused by another type of injury, like a firearm injury, fall, or motor vehicle traffic injury.
- IVPB data include TBIs caused by all mechanisms and intents of injury.
 - For more information on intent, visit [Injury Mechanism and Intent](#).
- The specific causes of TBI are also monitored to understand how TBI happens and help inform TBI prevention.

IVPB data include TBIs that are treated in a hospital setting or that result in death.

Non-fatal fall injury data do not capture:

- TBI treated outside of the ED or hospital
 - This can include TBI treated at urgent care clinics, by primary care providers, or by other health care providers.
- TBI where someone does not seek medical care or that are treated at home
 - Symptoms of TBI may not appear right away and may contribute to people not seeking medical care.
 - While data are not available to show exactly how many of these TBIs occur, IVPB does use survey data to understand how many people report being knocked unconscious.
 - See the section on [Behavioral Risk Factor Surveillance System \(BRFSS\) data](#) for more information.
- TBIs that may be missed or misdiagnosed
 - Symptoms of TBI can be similar to other medical conditions that are common among older adults, like dementia, and may not be identified as a TBI.¹
- Severity of TBI
 - IVPB cannot directly measure how severe TBIs are from the datasets we use.
 - Differentiating data by data source (deaths, hospitalizations, and ED visits) can provide some insight but is not sufficient alone to fully understand TBI severity.
- Consequences of TBI
 - While some TBI can lead to short-term health problems, others like TBI during childhood can impact brain development or have other long-lasting impacts.¹
 - IVPB is not able to monitor the long-term impacts of TBI.
 - TBI can put someone at risk of experiencing additional injuries or injury-related death, including falls, self-inflicted injuries, overdose, or another TBI.²⁻⁴
 - These subsequent injuries would be identified in IVPB data if they were treated in a hospital or resulted in death but may not be documented as being related to a previous TBI.

What Else is Measured to Monitor TBI Risk?

IVPB also monitors hospitalizations and ED visits for unspecified head injury.

- This includes any record with an ICD-10-CM code for unspecified head injury (S09.90) that does not also include a code for a diagnosed TBI.

- TBI indicators that include unspecified head injury should be used along with the standard TBI indicator for a more complete understanding of TBI.
 - Unspecified head injury is not included in the TBI indicator to more accurately identify changes in TBI trends over time.
 - There are almost four times as many ED visits for unspecified head injury as there are for TBI.
 - Using a combined indicator of unspecified head injury and TBI without also considering the TBI indicator alone can inflate TBI numbers and mask changes over time.
- Monitoring unspecified head injury alongside TBI helps provide a broader view of overall TBI risk.
- See the [Unspecified Head Injury section](#) below for more information on changes to the TBI definition over time.

Considerations for TBI Data by Data Source

No single data source captures the full scope of TBI in NC. Data sources should be used together to more fully understand the statewide impact of TBI.

For more information on a specific data source, visit [Data Sources IVPB Uses for Injury Surveillance](#).



TBI-Related Death Data

IVPB uses vital statistics death certificate data to monitor TBI-related deaths.

- TBI-related deaths include deaths caused by an injury where TBI was listed as an underlying cause of death.
 - Primary causes of death are the injuries or conditions that directly resulted in the death.
 - An underlying cause of death is an injury or condition that started the chain of events that led to the primary cause of death (directly or indirectly).
- Causes of TBI are identified using the primary cause listed on the death certificate.
- TBI and causes of TBI are identified in the death certificate data using ICD-10 codes.
 - For more information, visit [Understanding Injury Surveillance Case Definitions](#).

TBI-Related Hospital Discharge Data

Hospital discharge data are encounter-based, meaning that the same person may have multiple hospital stays during any given time period.

Identifying Unintentional TBI-Related Hospitalizations

- ICD-10-CM codes are used to group and classify diagnoses and reasons for health care visits in administrative health care systems, including hospital discharge data.
 - ICD-10-CM codes are intended for administrative and billing purposes, not public health surveillance.
 - This purpose can affect which codes are or are not assigned to a record and therefore which events are included or excluded as fall injury cases.
 - For more information on ICD-10-CM codes, visit [Understanding Injury Surveillance Case Definitions](#).

- TBI-related hospitalizations include injury hospitalizations that have an ICD-10-CM code for TBI included anywhere in the record.
 - Injury hospitalizations are required to have an ICD-10-CM code for an injury listed as the primary diagnosis.
- IVPB does not exclude hospitalizations that result in death.
 - Including hospitalizations resulting in death helps to understand the full burden of TBIs and other injuries on the NC health care system.
 - This can contribute to a difference in the number of TBI-related hospitalizations IVPB identifies compared to those shared by CDC or other sources.
- For more detailed information on how these cases are identified, see [Injury Surveillance Technical Notes](#).

Costs of TBI-Related Hospitalizations

Hospital discharge data include information on the total charges billed for the hospital.

- This information can be used to understand the financial costs of TBI-related hospitalizations.
- The total charges billed is not necessarily the same amount that was paid for the hospital visit.
 - Insurance companies typically negotiate the rates for hospital charges down.

TBI-Related ED Visit Data

ED visit data are also encounter-based. The same person may have multiple ED visits during any given time period.

Data Quality

- Trends may be impacted by missing data.
- There were changes in the number of people going to the ED for any reason (ED utilization) during the COVID-19 pandemic.
 - See the [TBI and COVID-19 section](#) below for more information.



Using Provisional Data

Provisional ED visit data are sometimes used to:

- Share information about TBI in NC quickly.
- Spot changes in trends before the final data are available.
- See patterns that help us know when to take action.

Provisional numbers can change as more information becomes available.

- Provisional data should be used carefully because there may be missing information or delays in reporting.

For more information on provisional data and when they become available, visit [Using Provisional Data for Monitoring Injuries](#).

Identifying TBI-Related ED Visits

ICD-10-CM codes are also used to identify ED visits for TBI. For more information, visit [Understanding Injury Surveillance Case Definitions](#).

- ED visits with an ICD-10-CM code for a TBI anywhere in the record are included.
- IVPB does not exclude ED visits where the patient is admitted to the hospital or visits that result in death.
 - Including ED visits resulting in hospitalization or death helps us understand the full burden of TBIs and other injuries on the NC health care system.

- These records are excluded in national case definitions. This variation in case definitions can contribute to a difference in the number of TBI-related ED visits IVPB identifies compared to those shared by CDC or other sources.
- ICD-10-CM codes are intended for administrative and billing purposes, not public health surveillance.
 - This purpose can affect which codes are or are not assigned to a record and therefore which events are included or excluded as TBI cases.
- Some ED visit case definitions, called syndromes, also search the chief complaint and/or triage notes fields for keywords to identify head injury-related ED visits.
 - Because these definitions also use keywords, they identify more ED visits than when using ICD-10-CM codes alone.
 - The two main TBI ED visit syndromes look at ICD-10-CM codes alone.
- For more detailed information on how these cases are identified, see [Injury Surveillance Technical Notes](#).

ED Visits with Multiple ICD-10-CM Codes

Some TBI-related ED visits may receive ICD-10-CM codes that identify multiple causes of the TBI, in addition to the TBI code itself. Visits may also include ICD-10-CM codes for other injuries that were not the cause of the TBI.

Multiple Mechanisms of Injury

- For records with a code for TBI, there may be codes to describe multiple types of injuries. For example, an unintentional fall and an unintentional striking injury (being struck by or against an object).

Multiple Injury Intents

- For records with a TBI code, there may be codes to describe multiple types of injury intents, for example an unintentional striking injury and a striking injury from an assault.
 - The ICD-10-CM coding guidance defaults to classifying most injuries as unintentional.
 - Because of this, multiple codes may be used to document different aspects of the ED visit, which can contribute to conflicting or inconsistent coding.

Multiple Mechanisms and Injury Intents

- In some instances, records with a TBI code may have multiple injury codes with conflicting intent information, like a code for an unintentional fall injury in addition to a code for a striking injury from an assault.

A visit with multiple ICD-10-CM codes is counted once in each mechanism and intent category that applies to that ED visit, but only as one TBI-related injury ED visit and only once in the total number of injury ED visits.

For example:

- A TBI-related ED visit that had a code for both an unintentional fall and an unintentional striking injury would be counted one time each in:
 - The total number of unintentional injury ED visits
 - The total number of fall injury ED visits
 - The total number of struck by or against ED visits
 - The total number of TBI-related ED visits
 - The total number of injury ED visits

- Similarly, if multiple types of injuries were identified, that had different mechanism and intent categories, such as a code for both an unintentional fall injury and a striking injury from assault, it would be counted once in each category:
 - The total number of unintentional injury ED visits
 - The total number of assault ED visits
 - The total number of fall injury ED visits
 - The total number of struck by or against injury ED visits
 - The total number of TBI-related ED visits
 - The total number of injury ED visits

Injury ICD-10-CM Codes in the ED Visit Record

How IVPB Counts the Injury ED Visit

(each box represents the visit being counted once in the number of injuries by intent, mechanism, and total injury)

ED Visit	Multiple Intents	Intent	Mechanism	TBI	Total Injury
ED Visit A	• Unintentional Striking Injury • Assault Striking Injury	Unintentional	Struck by or Against	Firearm	Injury ED Visit
		Assault			
ED Visit B	Multiple Types of Injuries • Unintentional Striking Injury • Unintentional Fall	Unintentional	Struck by or Against	Firearm	Injury ED Visit
			Fall	Fall	
ED Visit C	Multiple Injuries and Intents • Unintentional Striking Injury • Assault Striking Injury • Unintentional Fall	Unintentional	Fall	Fall	Injury ED Visit
		Assault	Struck by or Against	Firearm	

Survey Data

IVPB uses data from the NC Behavioral Risk Factor Surveillance System (BRFSS) and the NC Youth Risk Behavior Survey (YRBS) to understand self-reported experiences of TBI.

- Survey data can provide more context on the burden of TBI in NC and can be used to understand connections to other health behaviors, and risk and protective factors.

NC BRFSS

- The NC BRFSS surveys adults living in NC about behaviors and experiences that impact their health. TBI-related questions have included:
 - If someone has been knocked out or lost consciousness during their lifetime.
 - If so, how long they were knocked out or unconscious
 - How old were they the first time they were knocked out or lost consciousness
- NC BRFSS data are available statewide and regionally.
 - NC BRFSS data are not available at the county level.

- The NC BRFSS is conducted every year. However, the questions included in the NC BRFSS vary from year-to-year and may change over time.
 - As of 2026, the TBI module has not been included in NC BRFSS since [2019](#).
 - For information on the specific questions asked and when they are included in the survey visit [NC State Center for Health Statistics, BRFSS](#)

NC YRBS

- NC YRBS surveys middle and high school students in NC to assess youth behaviors that impact their health and includes a question about TBI.
 - The survey asks students how many times they have experienced a concussion from playing sports or being physically active.
- The survey is implemented in the spring of every odd numbered year, and questions included in the survey may change over time.
 - Visit [NC Healthy Schools Data](#) for more information on specific questions asked and to access YRBS data.
- NC YRBS data are available statewide and regionally.
 - NC YRBS data are not available at the county level.

Visit [Data Sources IVPB Uses for Injury Surveillance](#) for more information on how IVPB uses NC BRFSS and YRBS data.

Considerations For Using Survey Data

Survey data are self-reported and may show different rates of TBI than what people actually experienced. Survey data related to TBI can be affected by:

- **Social Desirability Bias** – People may report experiencing fewer TBIs than they actually do or may report not experiencing them at all when they have.
 - People may be embarrassed by or not want others to know about their health issues.
 - People may respond with what they think will make them look good.
- **Recall Bias** – People may forget how many times they experienced a TBI, or looking back, not recognize how severe the event was.
- **Nonresponse Bias** – People may not respond to the survey questions about TBI.
 - They may choose to skip the question.
 - Some respondents may have stopped taking the survey before getting to that question.
 - They may choose not to participate in the survey at all.

Changes in TBI Metrics Over Time

TBI case definitions have not changed much over the years.

If changes are made, they are also applied to historical data whenever possible.

- Changes are applied retroactively so that data can be counted the same way across multiple years of data.
 - This allows IVPB to accurately monitor trends.
- Because of this, data IVPB shared before a change was implemented can be different from data shared for the same time-period today.
 - Use the data resources posted to the [Traumatic Brain Injury Data](#) webpage to be sure you are accessing the most up-to-date information on TBI in NC.
 - If you have questions about data you have received from IVPB previously, email us at InjuryData@dhhs.nc.gov.



ICD-10-CM Coding Transition

- The system used to code diagnoses and other information in ED visit, hospital discharge, and other outpatient data was updated in 2015.
- The codes used previously (ICD-9-CM codes) are not directly comparable to the new codes (ICD-10-CM codes).
- Since the data are not comparable, data from before 2016 are not usually shared.
- For more information on this transition and impacts to injury surveillance, visit [ICD-10-CM Coding Transition](#).

Unspecified Head Injury

- Unspecified head injury was removed from the TBI case definition after the ICD-10-CM coding transition.
 - A new TBI indicator including ICD-10-CM code S09.90 for unspecified head injury was created to continue monitoring ED visits and hospitalizations that include unspecified head injury.
 - TBI indicators that include unspecified head injury should be used along with the standard TBI indicator for a more complete understanding of TBI.
- Removing unspecified head injuries caused an artificial drop in the overall number of TBI events identified before and after the ICD-10-CM transition.
 - The current definition that excludes unspecified head injuries more specifically captures events related to TBI.
 - See the [What Is Counted in TBI Data?](#) above for more information on unspecified head injury.

TBI and COVID-19

There have been many implications from the COVID-19 pandemic that began in 2020, including major changes to the numbers and rates of TBI and related health outcomes.

- TBI deaths increased by 36% from 2019 to 2023.
- There were large impacts to ED visits during the pandemic.
 - There was a large drop in the number of people going to the ED for any reason (ED utilization) starting in March 2020 when the COVID-19 stay at home order was implemented.
 - ED utilization slowly increased but remained lower than normal throughout most of 2020.
 - This drop in ED utilization also impacted the number of ED visits for TBI, which dropped by almost 18% from 2019 to 2020.
 - TBI-related ED visits increased throughout the pandemic, representing a 15% increase from 2019 to 2023.
 - ED visits for related health outcomes, like unintentional fall injuries, also increased during the pandemic.
- All sports were halted and the rules of contact sports were revised during the pandemic. This resulted in a decrease in sports-related TBI injury.
- Changes to TBI in NC align with trends seen across the United States during the pandemic.

Who is Most Affected by Traumatic Brain Injury (TBI)?

Who we count — and how — changes what we know about traumatic brain injury.

The most reliable way to collect information on race and ethnicity is when it is self-reported, where individuals choose the race and ethnicity they use to describe themselves.

Asking someone to report their own race and ethnicity ensures the data are accurate.

- In some cases, race and ethnicity may not be self-reported and may instead be assigned based on someone's name or their appearance.
- This assumption may happen if the person was unresponsive when EMS responded or when they arrived at the ED.
- This assumption can result in misclassification of race and ethnicity, when someone is categorized into a racial or ethnic group that they do not identify with.

For more information on how race and ethnicity are collected in the data sources IVPB uses, and how IVPB groups race and ethnicity, visit [Using Injury Data by Race and Ethnicity](#).

Monitoring TBI by Demographic Groups

IVPB uses rates to compare the burden of traumatic brain injury across groups, including by age group, sex, and race/ethnicity.

- This approach allows IVPB to identify groups that are experiencing the greatest burden of TBI.
 - IVPB regularly breaks out data to consider differences in TBI by sex, age group, race/ethnicity, and by county.
 - Rates account for the size of the population and allow us to compare injuries that happened in small populations to injuries in larger groups.
 - Comparing rates helps us understand differences in injuries between groups.
 - For more information, visit [Understanding Counts and Rates](#).
- When data are broken out for specific groups, results may need to be suppressed if there are very few fall injuries within a given group.
 - When the number of injuries or deaths is small, it becomes difficult to separate data further to understand more specifically who was impacted.
 - Visit [Data Suppression and Working with Small Numbers](#)



FOR MORE RESOURCES:
Visit our [Injury Data Users Toolkit](#)

¹ Centers for Disease Control and Prevention (CDC). (2025, August 4). Facts about TBI: Traumatic brain injury & concussion. <https://www.cdc.gov/traumatic-brain-injury/data-research/facts-stats/index.html>

² Madsen, T., Erlangsen, A., Orlovskaya, S., Mofaddy, R., Nordentoft, M., & Benros, M. E. (2018). Association between traumatic brain injury and risk of suicide. *JAMA*, 320(6), 580–588. <https://doi.org/10.1001/jama.2018.10211>

³ Hammond, F.M., Ketchum, J., Dams-O'Connor, K., Corrigan, J.D., Miller, C., Haarbauer-Krupa, J., Faul, M., Trexler, L.E., & Harrison-Felix, C. (2020). Mortality Secondary to Unintentional Poisoning after Inpatient Rehabilitation among Individuals with Moderate to Severe Traumatic Brain Injury. *J Neurotrauma*, 37(23):2507–2516. <https://doi.org/10.1089/neu.2020.7038>

⁴ Hunzinger, K. J., & Schneider, A. L. C. (2023). Associations between head injury and subsequent risk of falls: Results from the Atherosclerosis Risk in Communities (ARIC) Study. *Neurology*, 101(22), e2234–e2242. <https://doi.org/10.1212/WNL.000000000000207949>

