



Presented by: Matthew E. Peters, MD  
March 15, 2021

# Suicide and Traumatic Brain Injury

Untangling the Complex Relationship

# Disclosures

- None relevant to this presentation

# Outline

- Background Information on Suicide
- Suicidal ideation post-TBI
- Suicide attempts / completions post-TBI
- A Focus on Veterans
- Considering Mechanisms
- Conclusion

# Suicide Background

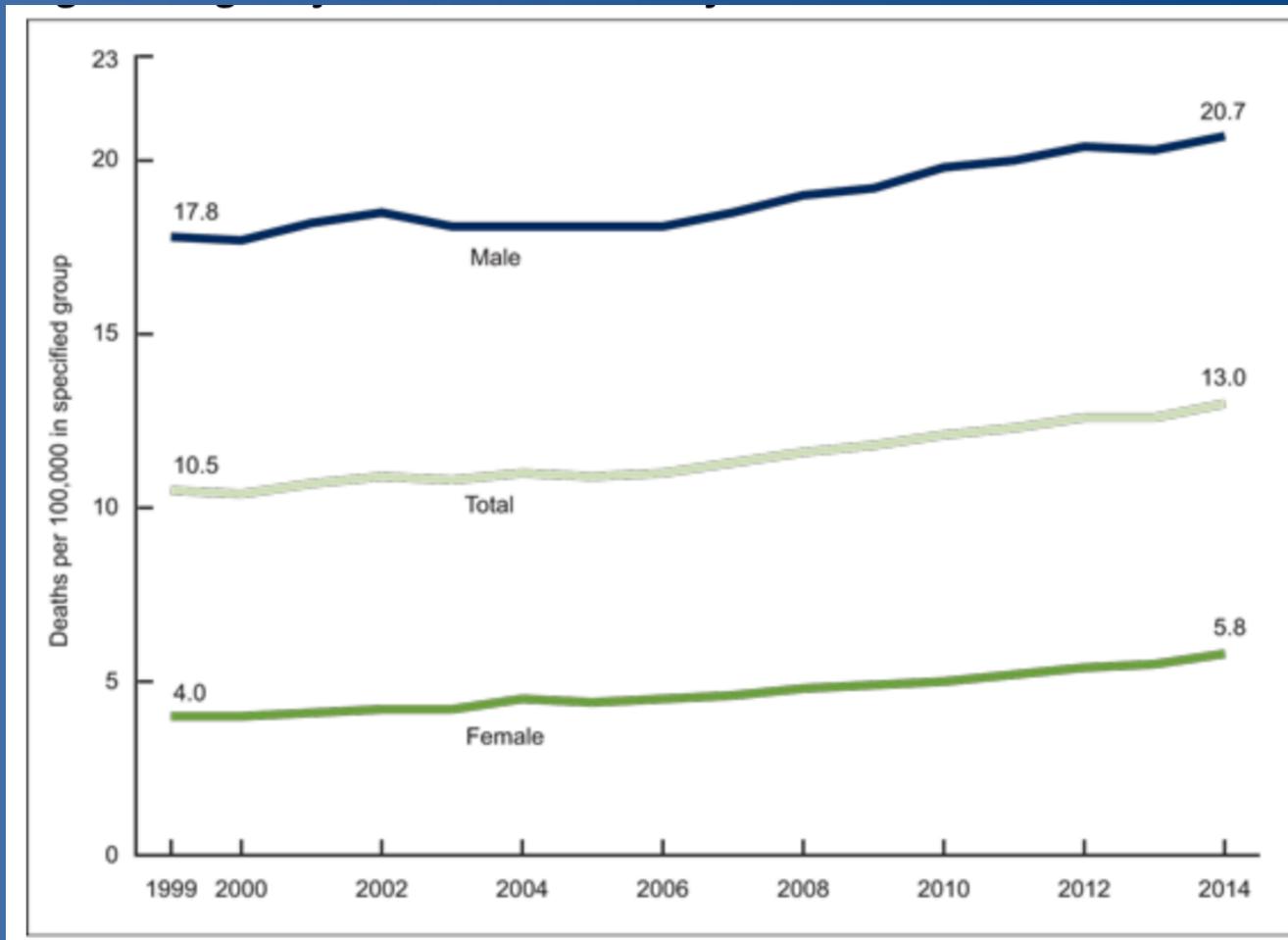
## Demographics



- Suicide rates are increasing compared to generally declining mortality
  - 24% increase between 1999 and 2014
- One of the 10 leading causes of death overall
  - In 2018, 48,344 recorded suicides
- Women more likely to attempt, men more likely to complete
- Veterans at higher risk than general population

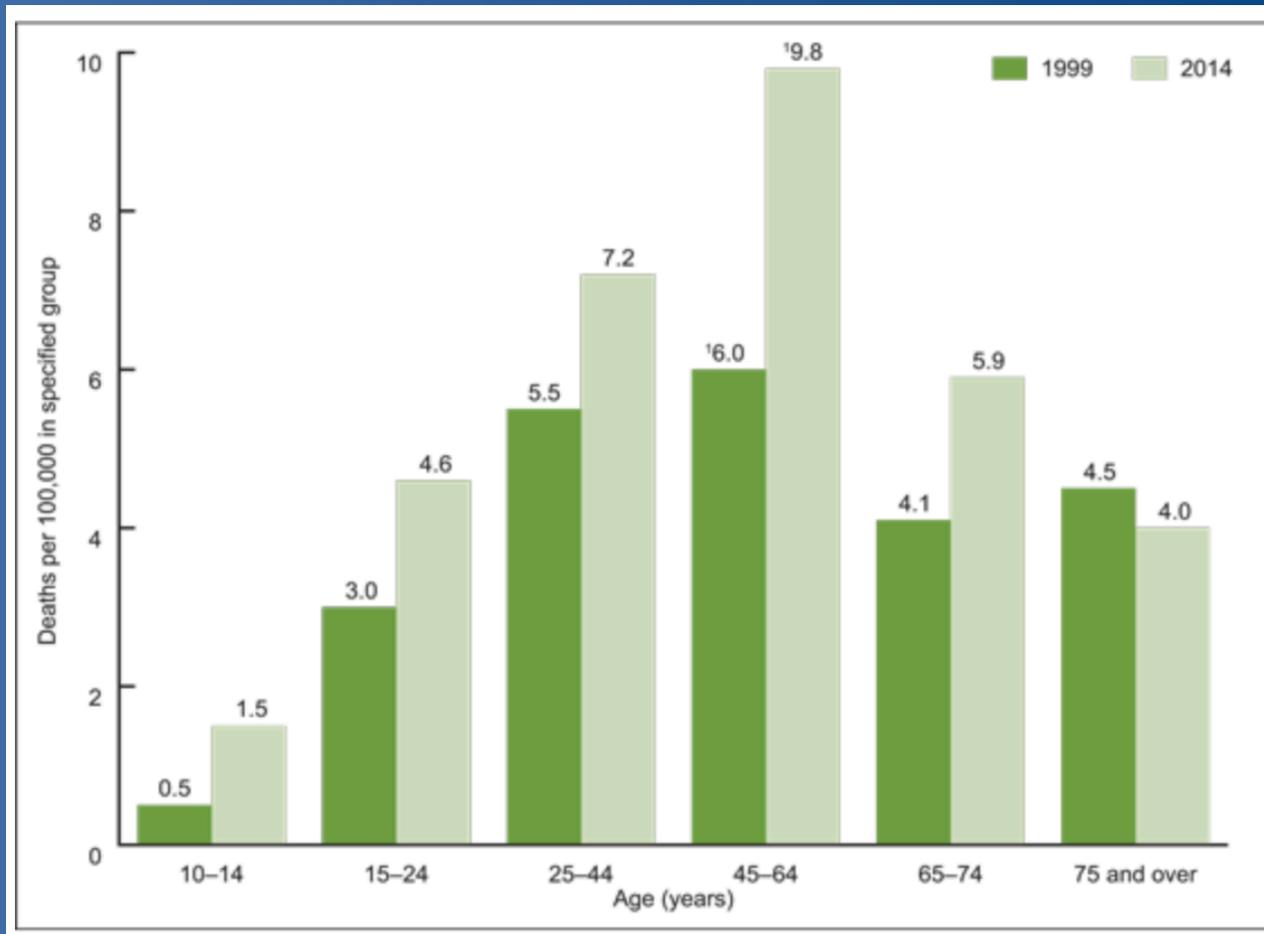
# Suicide Background

## Suicide Rates, by Sex: U.S., 1999-2014



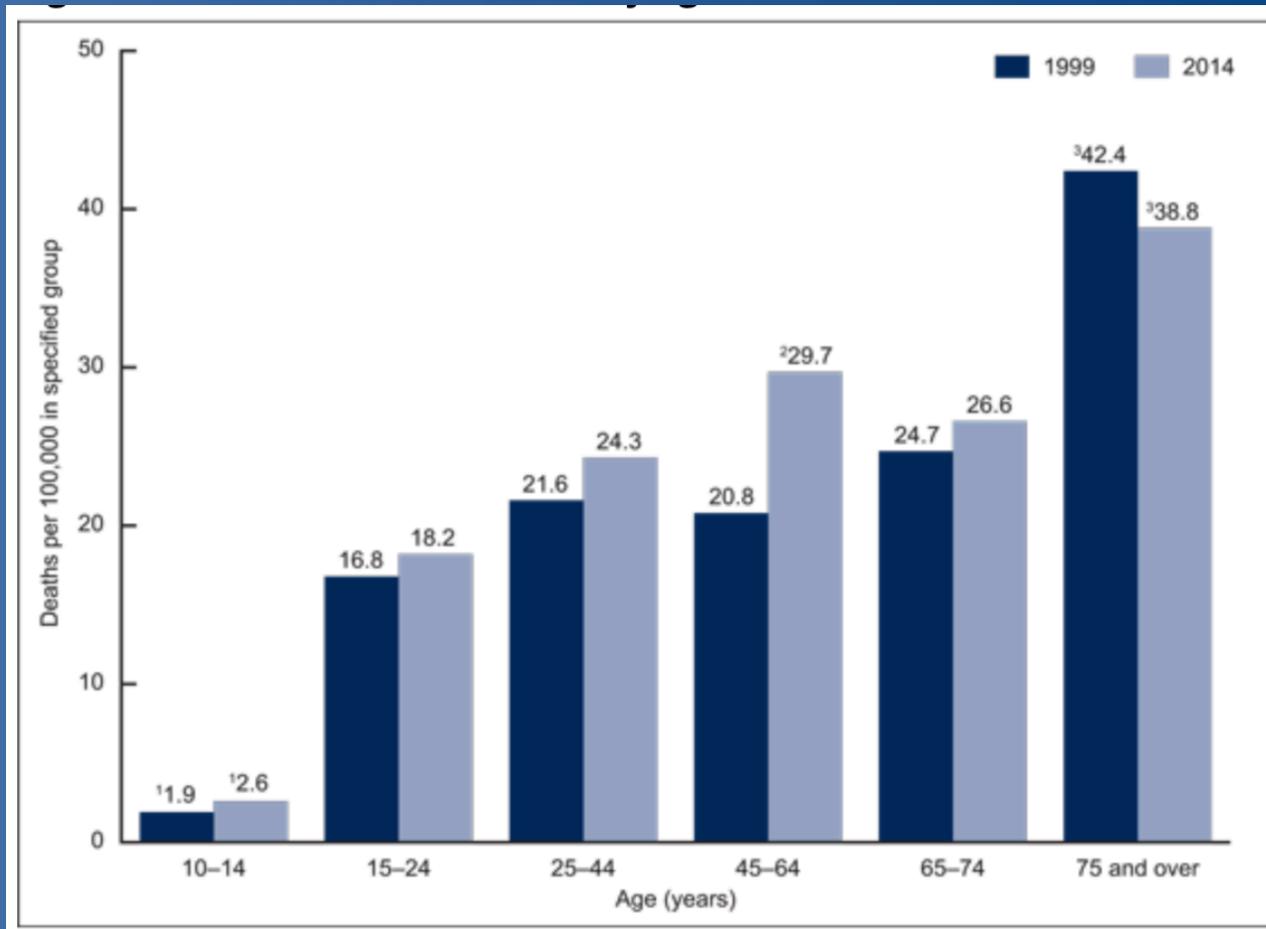
# Suicide Background

## Suicide Rates for Females, by Age: U.S., 1999 and 2014



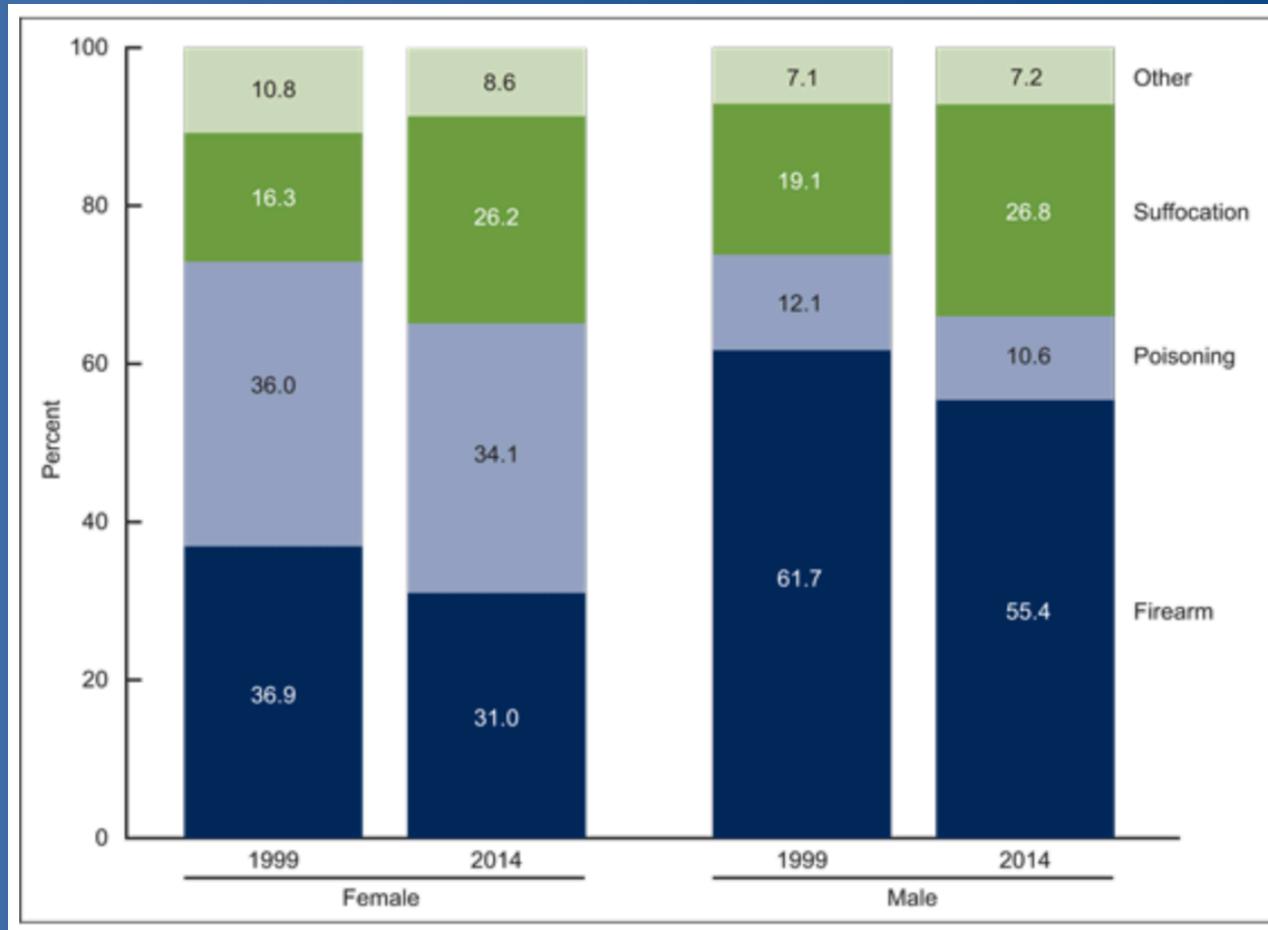
# Suicide Background

## Suicide Rates for Males, by Age: U.S., 1999 and 2014



# Suicide Background

## Suicide Deaths, by Method and Sex: U.S., 1999 and 2014



# Suicide Background

## Definitions

- **Suicide-related Ideation**
  - When questioned, any thoughts of engaging in suicide-related behaviors, regardless of intent or plan
- **Suicide-related Communications**
  - Same as above, but spontaneously initiated via verbal or non-verbal communication
- **Suicidal Behavior**
  - Preparatory behavior or self-inflicted potentially injurious behavior for which there is evidence of intent to die

# Suicide Background

## Definitions

- Warning Signs
  - Behaviors a person shows (e.g., buying a gun) or statements that they make (e.g., "I'd be better off dead") that suggest a risk of suicide
- Risk Factors
  - Predictors of suicidal behavior
- Protective Factors
  - Counterbalance suicide risk

# Suicide Background

## Risk Factors (not a complete list)

- Previous suicide attempts
- Access to means
- Family history of suicide
- Alcohol / substance abuse
- Previous psychiatric diagnosis
- Co-morbid health problems
- Impulsivity and poor self control
- Recent losses – financial, physical, personal
- Hopelessness

# Suicide Background

## Protective Factors (not a complete list)

- Sense of responsibility to family
- Spirituality
- Life satisfaction
- Children in the home
- Positive social support
- Positive therapeutic relationship

# Suicide & TBI

## Common Risk Factors

- Shared risk factors include:
  - Age
  - Male
  - Substance use
  - Psychiatric disorders
  - Aggressive behavior
- Additionally, sustaining a TBI may lead to changes in roles and impairment of problem-solving strategies

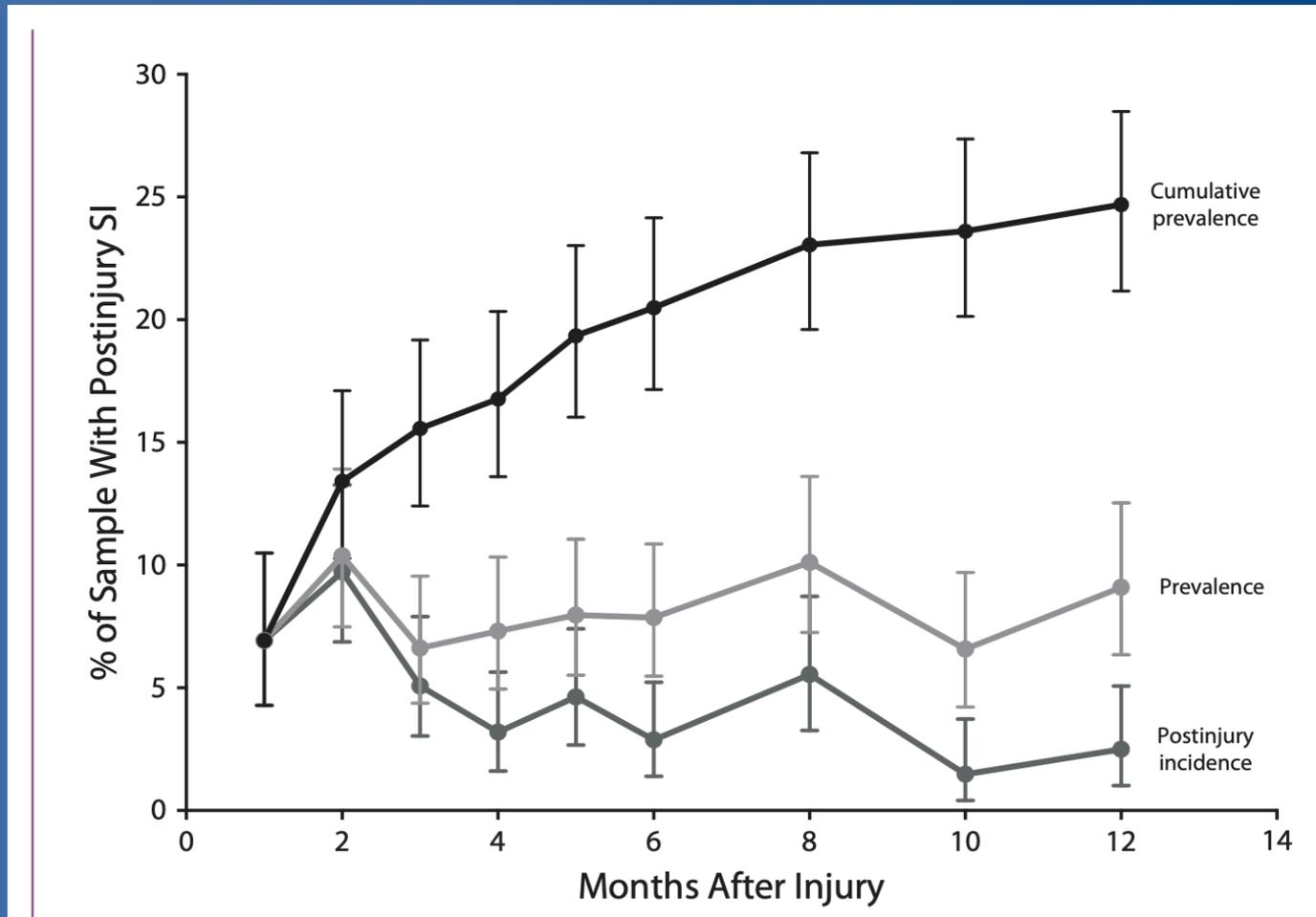
# Suicidal Ideation After TBI

## Research Study Looking at First Year Post-TBI

- Participants were from a clinical trial
- 559 adult patients admitted to Harborview Medical Center in Seattle, Washington
- Complicated mild, moderate, or severe TBI
- **25% of sample reported suicidal ideation** during one or more assessments over a one-year period post-TBI (22% at 3 or more)
  - This is a rate seven times higher than in the general population

# Suicidal Ideation After TBI

## Research Study Looking at First Year Post-TBI



# Suicidal Ideation After TBI

## Research Study Looking at First Year Post-TBI

- **Strongest predictor of suicidal ideation was initial depression score (on PHQ8) after injury**
  - 53% reported depression at first assessment
- **Other predictors:**
  - Prior suicide attempt (12%) or psychiatric hospitalization
  - History of depressive, bipolar, or anxiety disorder
  - Less than high school education
  - Medicaid insurance
- **47% of participants with suicidal ideation were already receiving mental health treatment at time of injury compared to 23% without suicidal ideation**

# Suicidal Ideation After TBI

## Takeaways

- Suicidal ideation was seen in 25% of participants within a year of TBI
- Unlike conditions like cancer, where risk increases acutely after diagnosis and then decreases, suicidal ideation appears to increase after TBI and remain elevated through at least the first year
- Risk factors for reporting suicidal ideation are easily collected via clinical interview
- How this translates into suicide attempts / completions is not clear from this study

# Suicide Attempt Following TBI

## Taiwan National Health Insurance Research Database

- Taiwan National Health Insurance Research Database contains medical data of more than 99% of 23.74 million Taiwan residents
- Study included 17,504 individuals with TBI
- During a median observation time of 4.2 years, those with **history of TBI had 2.23 times higher risk of attempted suicide:**
  - 0.88% (154) of the 17,504 individuals with TBI
  - 0.44% (314) out of 70,016 matched non-TBI controls

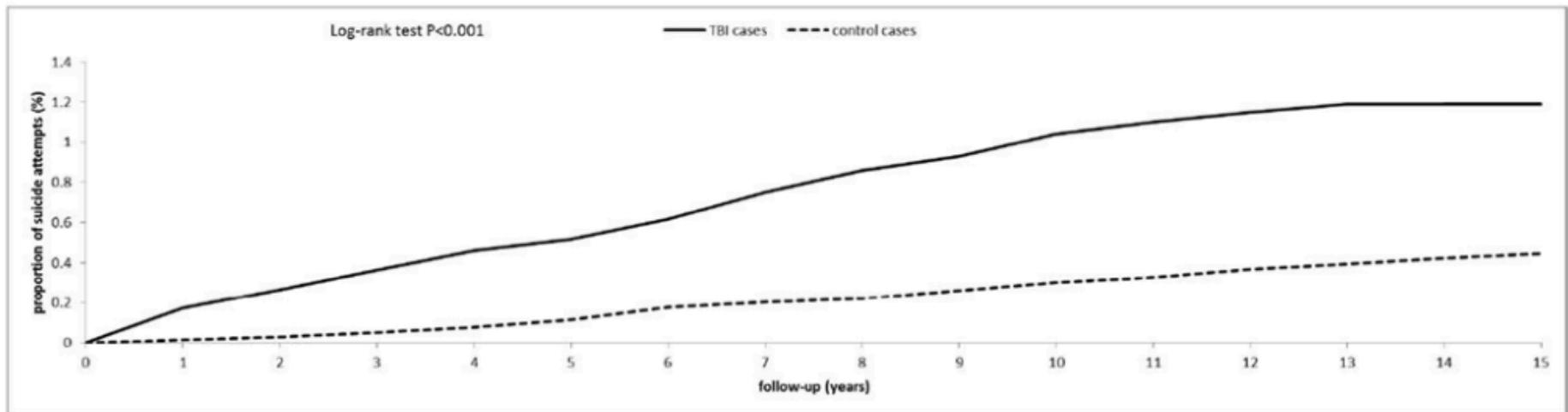
# Suicide Attempt Following TBI

Taiwan National Health Insurance Research Database

- Risk factors for suicide attempt following TBI:
  - Women higher rates than men
  - Increased suicide risk compared to controls in all age groups
  - Depression
  - Alcohol-attributed disease
  - Increased TBI severity

# Suicide Attempt Following TBI

Taiwan National Health Insurance Research Database



# Completed Suicide Post-TBI

## Danish National Patient Registry

- Danish National Patient Registry data from 1977-2014 of over 7 million individuals with 567,823 individuals (7.6%) with a medical contact for TBI
- Of 34,529 individuals who died by suicide during that time, 3536 (10%) had medical contact for TBI
  - 2701 mild TBI
  - 661 severe TBI
  - 174 skull fracture without documented TBI

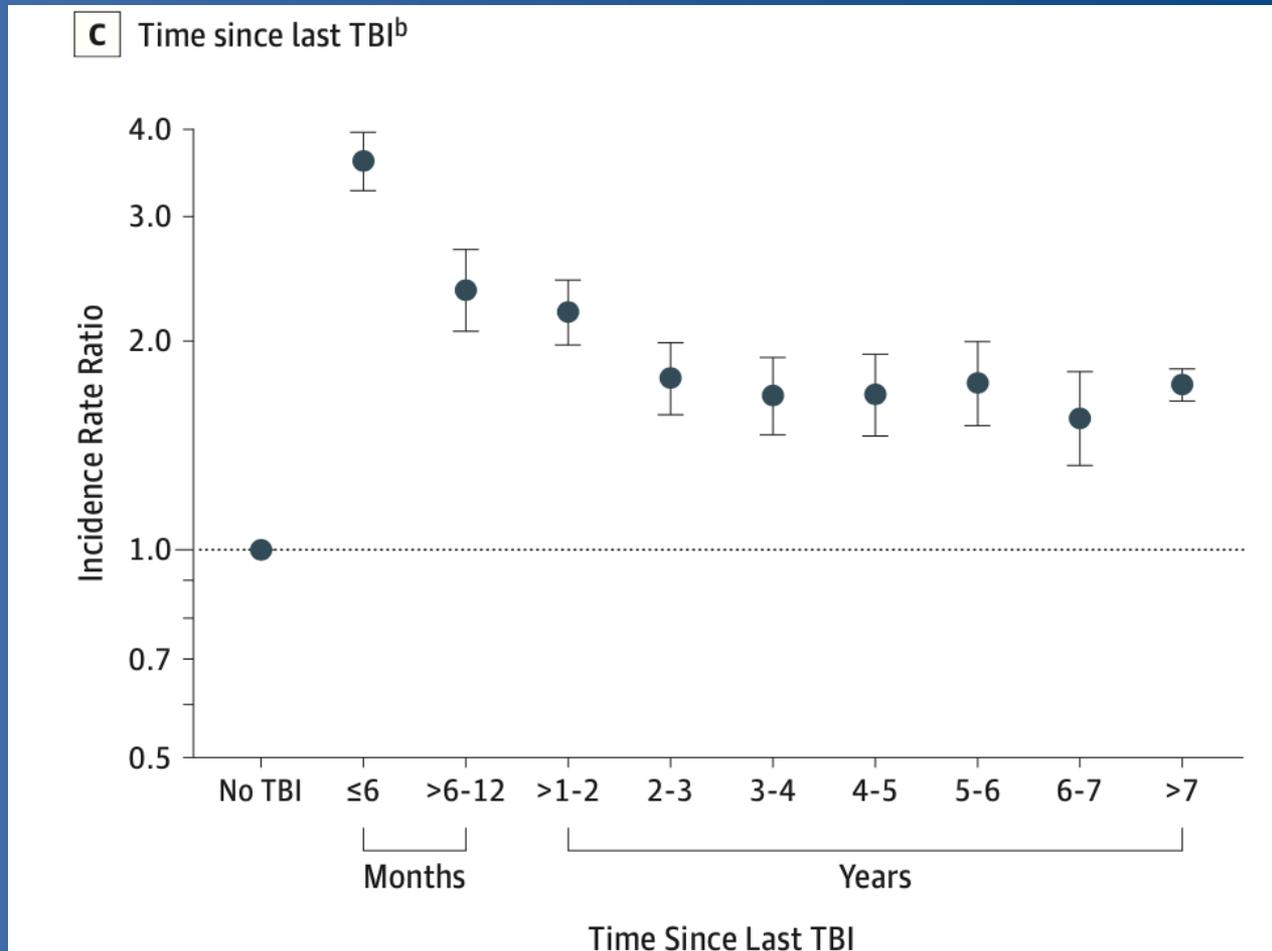
# Completed Suicide Post-TBI

## Danish National Patient Registry

- Risk increased with:
  - Closer temporal proximity to TBI
  - More medical contacts for TBI
  - Increasing number of days in treatment for TBI
- Severe TBI higher risk than mild TBI
- Higher risk in individuals with a psychological illness before or after TBI

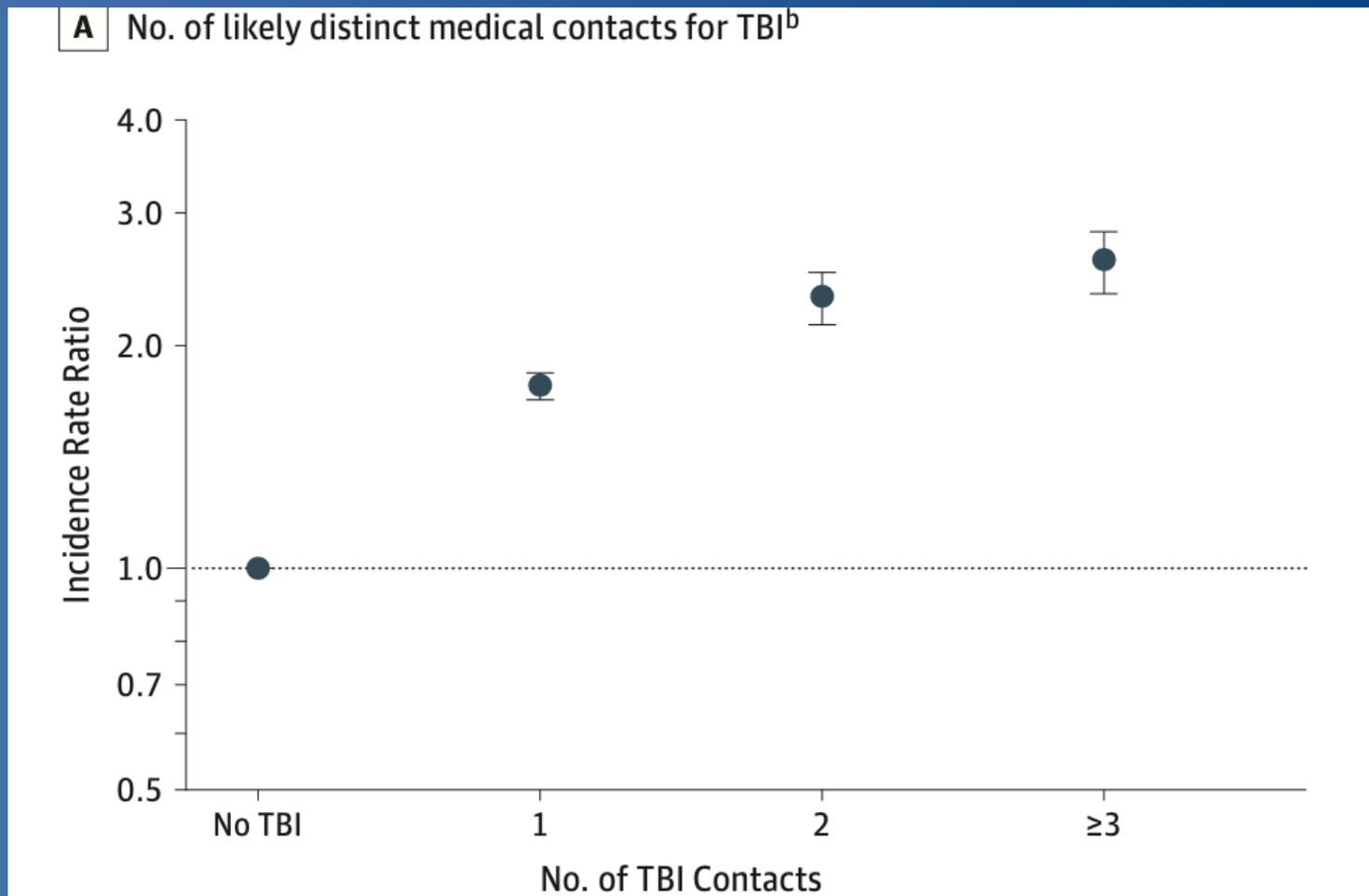
# Completed Suicide Post-TBI

## Danish National Patient Registry – Time Since Last TBI



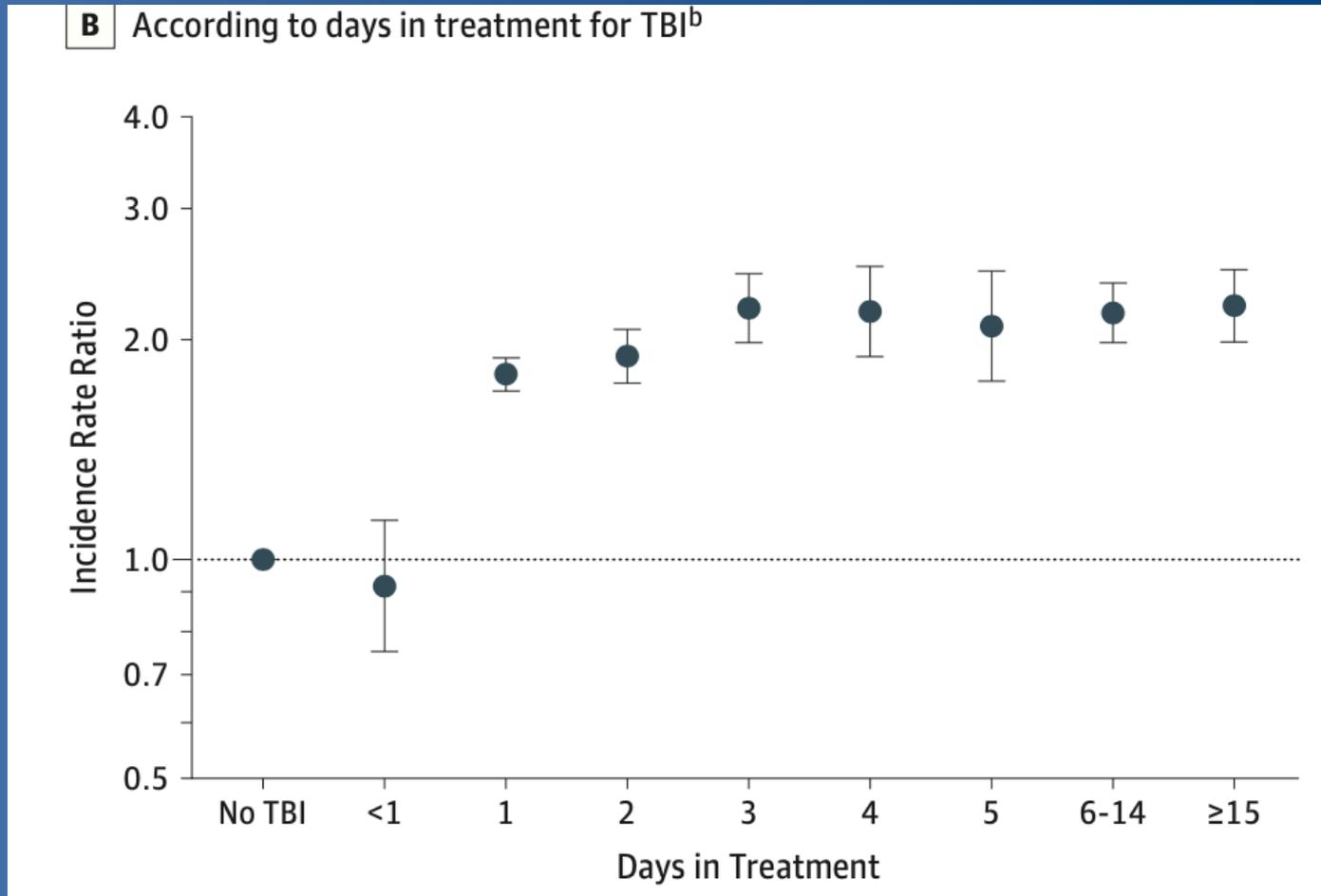
# Completed Suicide Post-TBI

## Danish National Patient Registry – Distinct Contacts for TBI



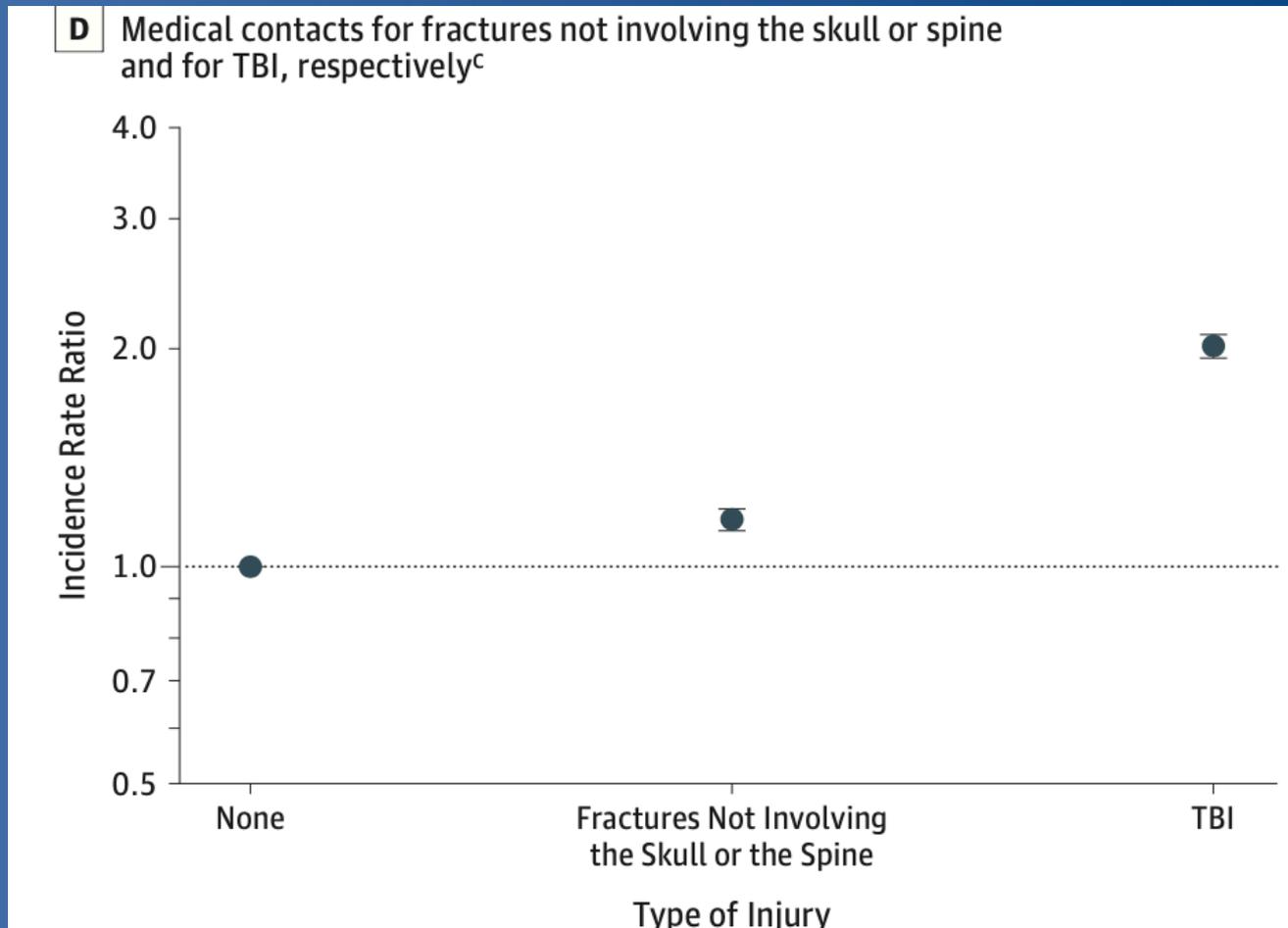
# Completed Suicide Post-TBI

## Danish National Patient Registry – Days in Treatment for TBI



# Completed Suicide Post-TBI

## Danish National Patient Registry – TBI vs. Other Injury



# Suicide Risk Following mild TBI

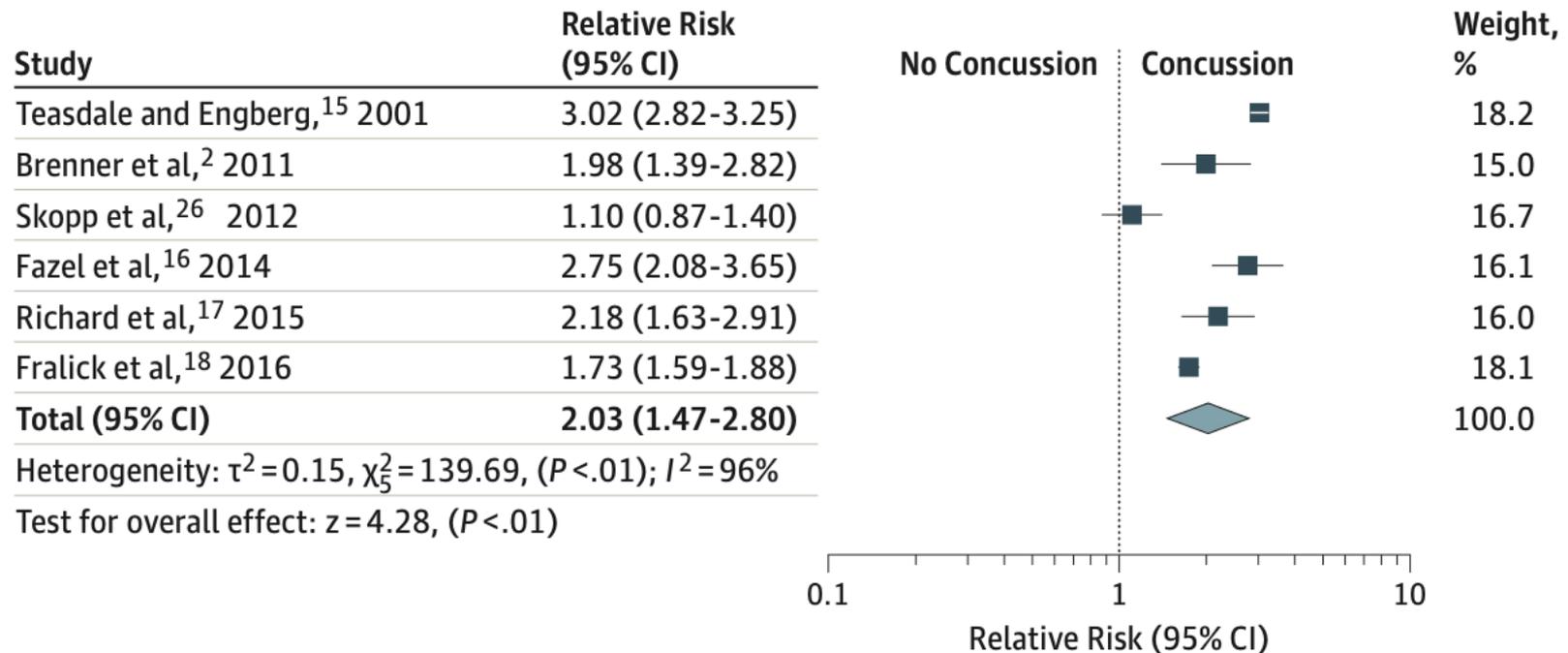
## Meta-analysis

- Meta-analysis looking at mild TBI / concussion using a systematic review of the literature, including:
  - 10 cohort studies (n=713,706)
  - 5 cross-sectional studies (n=4420)
  - 2 case-control studies (n=446)
- Experiencing mild TBI / concussion was associated with a **2-fold higher risk of suicide**
- Also associated with a higher risk of suicide attempt and suicide ideation
- Seen in studies with and without military personnel

# Suicide Risk Following mild TBI

## Meta-analysis

Figure 2. Meta-analysis of Risk of Suicide After Concussion and/or Mild Traumatic Brain Injury



# Suicide & TBI

## Suicide Attempts and Completions Takeaways

- Large population-based studies from Taiwan and Denmark showed increased risk of suicide attempts and completions, respectively, post-TBI
- Significant risk factors
  - Higher TBI severity
  - Psychological illness before or after TBI
  - More medical contacts for TBI (assume distinct TBI events)
  - Increasing number of days in treatment for TBI
  - Closer temporal proximity to TBI
- Meta-analysis confirmed that even mild TBI / concussion associated with 2-fold higher suicide risk

# A Focus on Veterans

## Completed Suicide Post-TBI

- Study of Veteran's Affairs data with 194,337 mild TBI and 20,888 moderate/severe TBI
  - Veterans with TBI had significantly higher prevalence estimates of all psychiatric diagnosis
    - Most pronounced with PTSD (60.5% vs. 15.0%)
- Controlling for age, gender, psychiatric diagnoses, and other chronic conditions, **veteran's with history of TBI were twice as likely to die by suicide**
  - 68% used firearms with moderate/severe TBI being a higher risk for using firearms

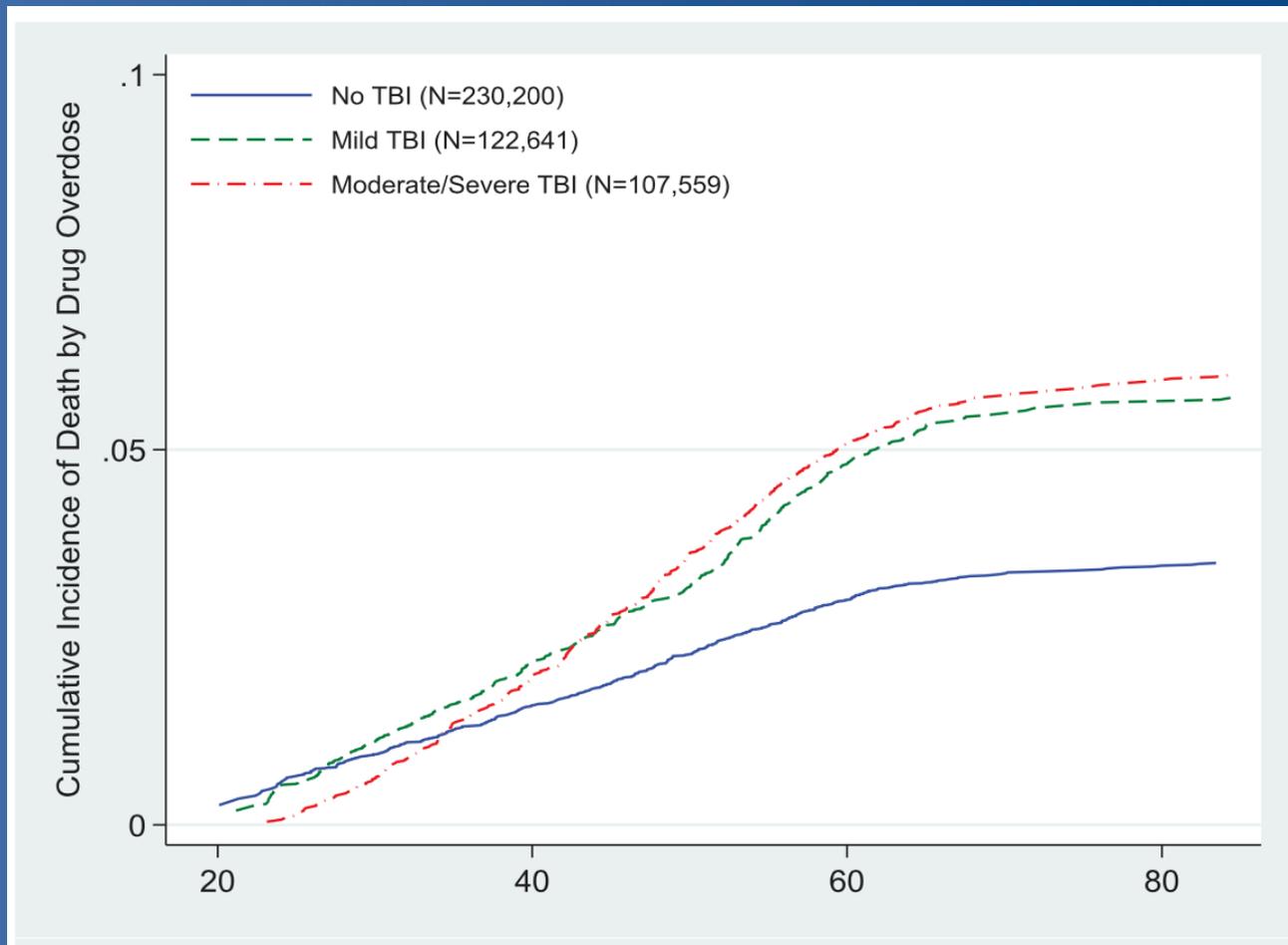
# A Focus on Veterans

## Completed Suicide Post-TBI

- A separate study of 460,400 veterans with a 1:1 ratio of TBI and no TBI history looked at mode of suicide
  - Mild TBI was the highest risk among those with TBI
- TBI was shown to be associated with suicide and unintended death by drug overdose and firearms

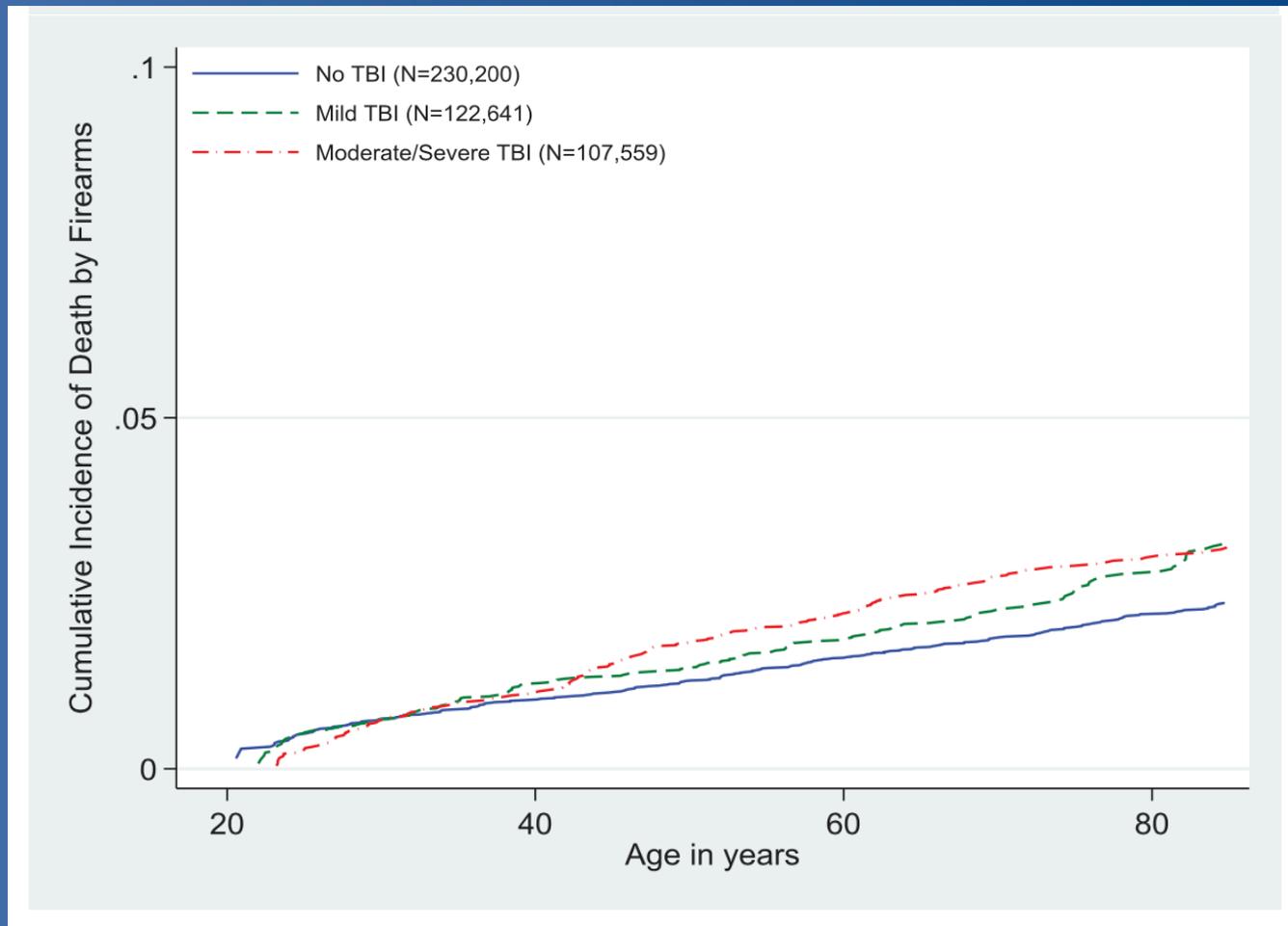
# A Focus on Veterans

## Completed Suicide Post-TBI – Drug Overdose



# A Focus on Veterans

## Completed Suicide Post-TBI – Firearm



# A Focus on Veterans

## Takeaways

- From the two studies reviewed, veterans with history of TBI twice as likely as veterans without to complete suicide
- Veterans with TBI have higher rates of psychiatric diagnoses independent of completing suicide
- Death by self-inflicted gunshot wound and drug overdose most common methods
  - Drug overdose often listed as unintended death by overdose rather than completed suicide
- Compared to general population, veteran's already at increased risk of suicide and TBI increases this risk

# Suicide & TBI

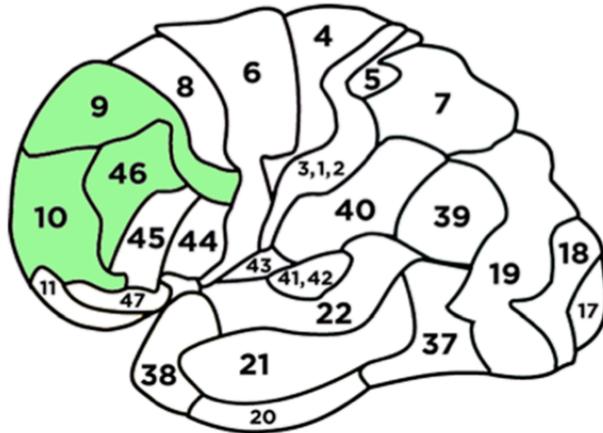
## Considering Mechanisms

- The structure-function relationships of the most common cognitive (e.g., executive dysfunction) and other neuropsychiatric syndromes (e.g., depression, anxiety) presenting post-TBI have been theorized
- Outside of just conceptualizing cause, these relationships are important for biomarker development

# Suicide & TBI

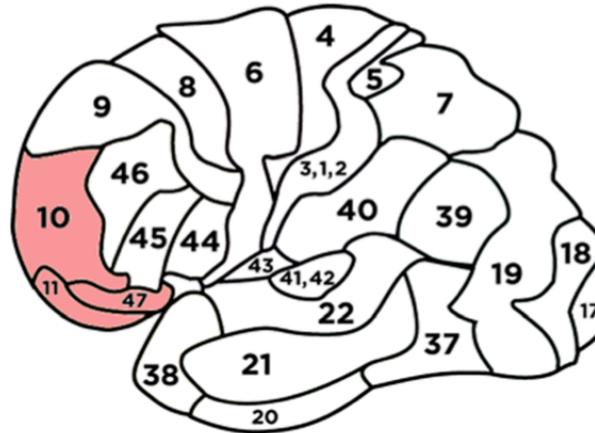
## Considering Mechanisms

“Up is Down”



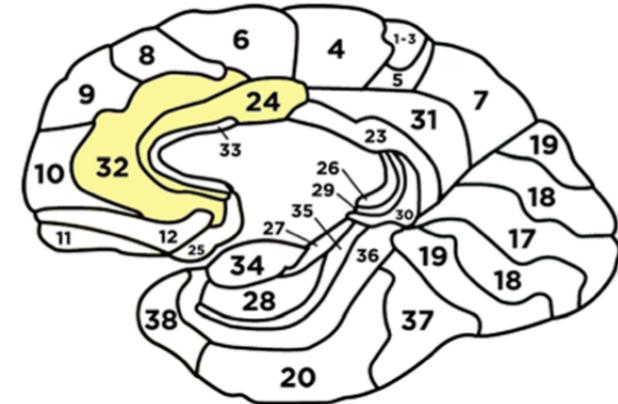
**Dorsolateral Prefrontal Loop**  
Dysexecutive Syndrome

“Down is Up”



**Orbitomedial Frontal Loop**  
Disinhibition Syndrome

“Middle is Flat”

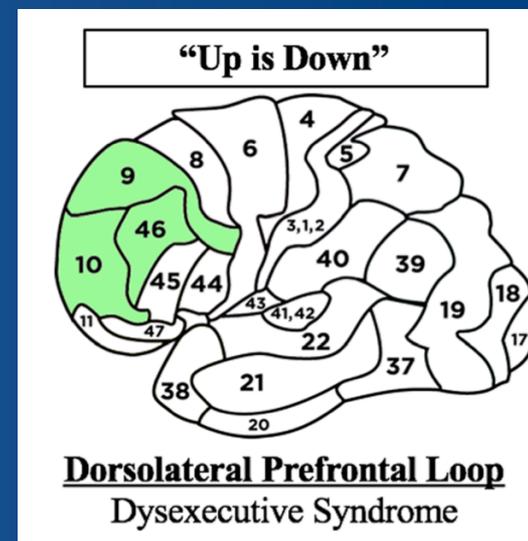


**Anterior Cingulate Loop**  
Apathy Syndrome

# Suicide & TBI

## Considering Mechanisms – Dorsolateral Prefrontal Loop

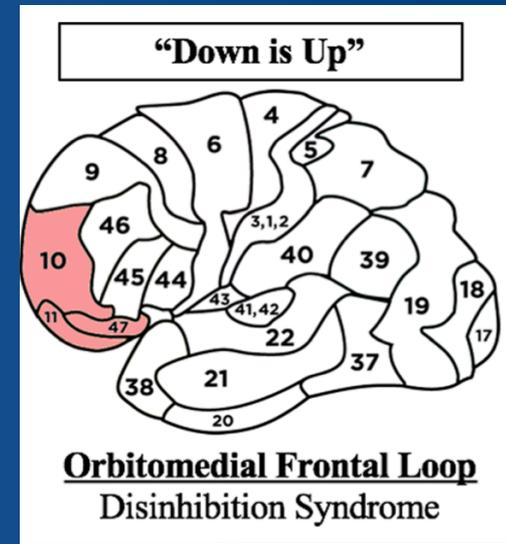
- Modulates cognitive processes, such as working memory and executive function
- In dysexecutive syndrome, the brain's ability to act as an executive is down
  - Trouble retrieving stored information
  - Difficulty planning complex tasks
  - New onset depressive symptoms



# Suicide & TBI

## Considering Mechanisms – Orbitomedial Frontal Loop

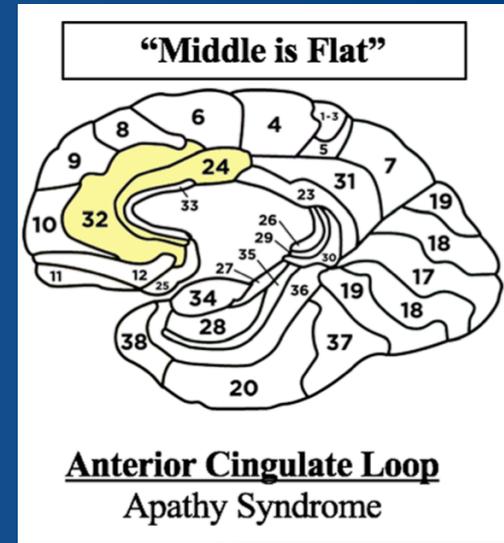
- Determines the time, place, and strategy for environmentally elicited behavioral responses
- In disinhibition syndrome, the number of inappropriate behaviors is up:
  - Increased emotional lability
  - Impulsivity
  - Lack of social tact



# Suicide & TBI

## Considering Mechanisms – Anterior Cingulate Loop

- Modulates motivated and reward-related behaviors
- In apathy syndrome, there is a global loss (flattening) of motivation and emotional responsivity:
  - Decrease in goal-directed behaviors
  - Lack of emotion
  - Lack of desire, passion, motivation



# Suicide & TBI

## Considering Mechanisms - Takeaways

- The reason these circuits are important is that the cause of suicidality may vary depending on the circuit damaged
  - Pushed to suicidal / dangerous behavior due to disinhibition vs. pulled to suicidality by depression

- TBI and suicide have some common risk factors
  - e.g., substance use, psychiatric diagnoses, role change
- Post-TBI, suicidal ideation is seen in 25% of individuals and this risk remains through at least a year post-TBI
- In both general and military populations, TBI appears to double risk of suicide

# Conclusions

- These studies confirm established risk factors, many of which are easily accessible from clinical interview:
  - Higher TBI severity
  - Previous or new onset psychiatric diagnosis, including substance abuse
  - Previous suicide attempts
- Access to firearms important consideration, especially in veteran's

# Conclusions

- Considering the most common underlying circuit damage, which has been well-theorized in TBI, can assist in treatment planning
- Neuropsychiatrists and behavioral neurologists trained in TBI-related cognitive and other neuropsychiatric syndromes are uniquely poised to treat these individuals

# Conclusions

- Suicide is a rare event and TBI is hard to accurately diagnose

# Questions?