HEalth And Dementia outcomes following Traumatic Brain Injury (HEAD-TBI)

AIMS

Dementia is a leading cause of death in Scotland and poses a major public health challenge. At present there are no effective therapies for dementia, and an estimated 90,000 individuals in Scotland are living with the condition. Traumatic brain injury (TBI) is now recognised as a major risk factor for dementia, as well as a wide range of other health conditions which potentially may also increase dementia risk. The study 'HEalth And Dementia outcomes following Traumatic Brain Injury (HEAD-TBI)' aimed to explore the link between TBI and dementia, in turn, helping us identify ways that we might act to reduce this risk.

The main aims of the study were to:

- Explore the risk of dementias and wider neurodegenerative diseases in individuals with a history of TBI compared to individuals in the general population with no history of brain injury. The term 'neurodegenerative diseases' covers a range of degenerative brain diseases such as Alzheimer's dementia, other dementias, motor neurone disease, and Parkinson's disease.
- Compare causes of death, as well as a range of both physical health outcomes and mental health outcomes in individuals with a history of TBI compared to individuals in the general population with no history of brain injury.

KEY FINDINGS

- Neurodegenerative diseases were increased in individuals with a history of TBI.
- Those with a history of TBI showed increased risk of common causes of death such as cerebrovascular disease, ischaemic heart disease, and respiratory disease.
- Having a TBI prior to 18-years-old is associated with subsequent increased risk of mental health outcomes later in life.

WHAT DID THE STUDY INVOLVE?

We used National Health Service (NHS) hospital records and identified 362,706 individuals in Scotland with a history of TBI prior to 2023. Every individual with TBI was matched with 3 non-injured individuals from the general population – only individuals with no prior hospitalisation for TBI were included in the general population comparison group. They were matched on sex, year of birth, and socioeconomic status which used last known postcode to account for factors such as crime rates, access to health care, schooling etc. We used hospitalisation, death record certification, prescription, and mental health hospitalisation data to assess whether risk of certain health outcomes were increased in individuals with a history of TBI. These datasets also contained useful information regarding age at first TBI, age at all hospitalisations, prescriptions, and death (if death had occurred), socioeconomic status, and sex.

WHAT WERE THE RESULTS AND WHAT DO THEY MEAN?

- Neurodegenerative diseases were increased in individuals with a history of TBI. We found 4·7% of the TBI cohort had died from neurodegenerative disease, compared with 2·6% of the general population, making those with a history of TBI nearly twice as likely to die from degenerative brain diseases (Hazard ratio 1·84; 95%CI 1·80-1·87; p<0·001) (Figure 1). Risk was greatest for those with a history of TBI for deaths relating to non-Alzheimer's dementias, and risk was lowest for motor neurone disease. Cause of death was taken from both primary and contributory causes of death from National Records of Scotland (NRS) death certification.

- When assessing the top common causes of death in Scotland, individuals with a history of TBI showed increased risk of death due to cerebrovascular disease, ischaemic heart disease, and respiratory disease. Risk of lung cancer was however reduced (Figure 1). Future studies are required to further explore why these diseases may be increased or decreased following TBI.

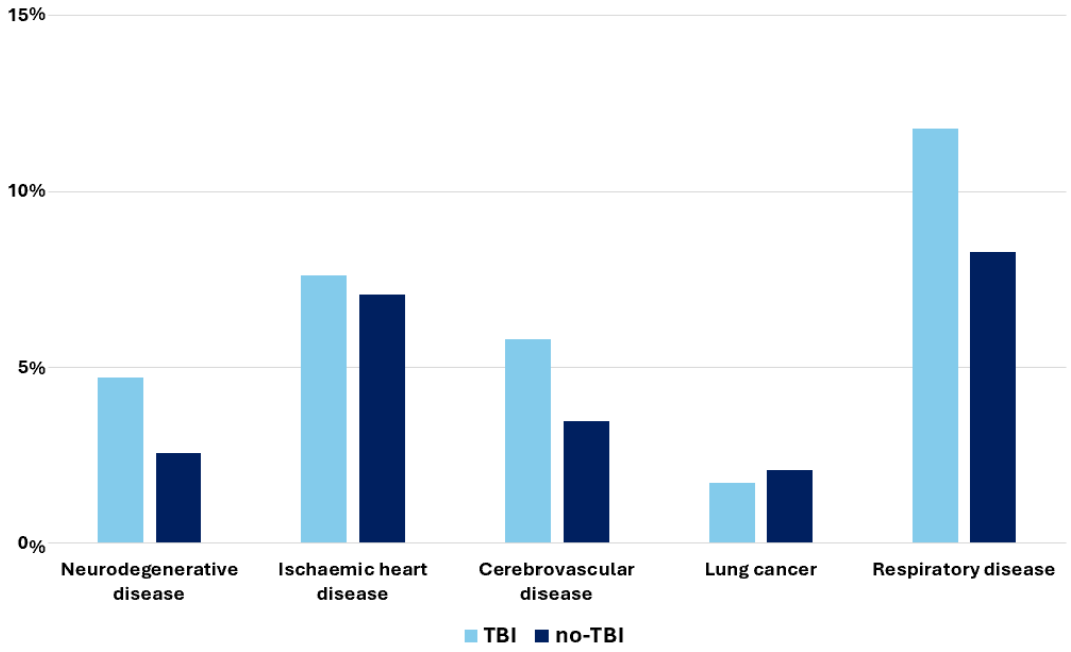

Figure 1: Top 5 most common causes of death in the Scottish population. Comparison between individuals with a history of TBI and a matched non-injured general population group.

- Risk of mental health conditions was increased in our population exposed to TBI prior to the age of 18-years-old. Namely, depression, alcohol use disorders, anxiety and stress related disorders, drug use disorders, and bipolar and affective mood disorders (Figure 2). In terms of age specificity, risk was greatest for both depression and anxiety in those who sustained a TBI in their teenage years (13-18years), compared to individuals who sustained a TBI as a child (4-12years) or baby/toddler (0-3years). We focus on children and young people as they are an understudied population with huge potential for early intervention for treatment and education surrounding the health outcomes following TBI.

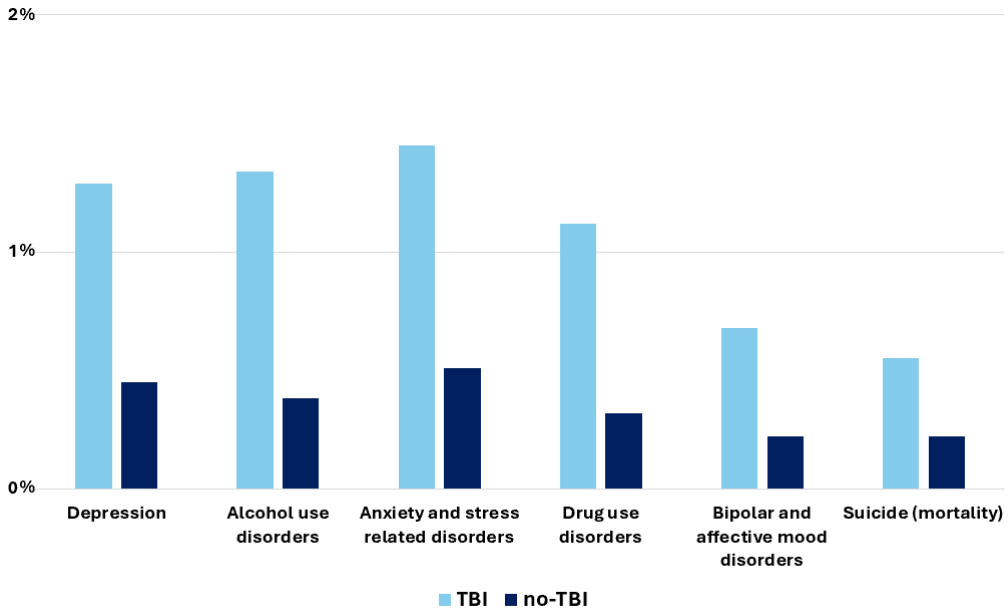

Figure 2: Mental health hospitalisations in individuals with and without TBI prior to the age of 18. Mental health conditions assessed comprise the top 5 most common mental health issues in Scotland, as well as suicide (taken from mortality data).

WHAT IMPACT COULD THE FINDINGS HAVE?

- This study highlights the need for better education and awareness surrounding the risk of long-term health outcomes following TBI, as well as an increase in strategies to prevent brain injury. Improved provision of education for medical professionals, participants of contact sport, and the general public is required.
- Future policy changes may consider closer monitoring of health following TBI, or the provision of additional health care support and health care advice for individuals following TBI.
- Individuals who play a contact sport (such as football, rugby, boxing etc.) are at greater risk of experiencing TBI. Further rule implementations should be considered to reduce risk throughout amateur to professional levels of contact sport.
- The greater understanding the long-term health outcomes following TBI is not only beneficial for survivors of TBI, but also for the carers and families of those living with long-term health outcomes following TBI.

- This study also highlights the need for integration of mental health services into post-care treatment of individuals, especially teenagers, who sustain TBI. Future studies should focus on prediction of which patients are most at risk of poor mental health following TBI and should seek to provide strategies for reducing risk.

HOW WILL THE OUTCOMES BE DISSEMINATED?

Key results of this study have been presented at a variety of conferences and events featuring a range of audiences - academics, healthcare professionals, charitable organisations, students, and the general population. The results of this research is also now included in University of Glasgow lectures to 4th year Neuroscience, and 4th year Medicine.

Some key conferences and events where this research has been presented include:

- National Neurotrauma Society: Austin Texas USA
- International Neurotrauma Society: Cambridge University, Cambridge, UK
- Paediatric Research Day: Queen Elizabeth University Hospital, Glasgow, UK
- Scottish Dementia Research Consortium: Radisson Blu, Glasgow, UK
- Traumatic brain injury symposium & Thomas TS Ingram memorial lecture: Royal Infirmary, Edinburgh, UK
- Pint of Science 2023, Glasgow, UK

CONCLUSION

HEAD-TBI has provided novel insights into the relationship between TBI and neurodegenerative disease risk, as well as wider physical health and mental health outcomes. Following on from these insights, there is potential to inform strategies to identify those at greatest risk of adverse outcome and possibilities for intervention to mitigate risk.

The study further highlights the need for integration of mental health services into post-care treatment of individuals, especially teenagers, who sustain TBI. Future studies should focus on prediction of which patients are most at risk of poor mental health following TBI and should seek to provide strategies for reducing risk.

RESEARCH TEAM & CONTACT

Dr Emma Russell
Dr Donald Lyall
Prof William Stewart

emma.russell@glasgow.ac.uk

Additional Information
The HEAD-TBI study was undertaken between October 2022 and April 2025.