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Mental and physical health disorders following paediatric traumatic injury: a population-based longitudinal study in Manitoba, Canada

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ABSTRACT

Importance Paediatric traumatic injury (PTI) is a leading cause of hospitalisation among children. Little is known about subsequent mental and physical health disorders while accounting for pre-injury health.

Objective To compare pre-injury and post-injury mental and physical disorders in survivors of PTI with an uninjured matched cohort from the general population. This study hypothesised injured youth will have increased rates of mental and physical disorders relative to matched uninjured youth in the post-injury period.

Design Retrospective longitudinal cohort study using linked administrative health data to examine paediatric patients hospitalised for injury between 1 January 2004 and 31 December 2016, measured 2 years pre-injury and 2 years post-injury.

Setting Population-based study in Manitoba, Canada.

Participants Youth<18 years old who survived to discharge after an injury requiring hospitalisation in the study period (n=9551) were matched 1:5 (age, sex and region) to youth from the general uninjured population (n=47 755).

Exposure(s) PTI that required hospitalisation.

Main outcomes and measures Mental disorders (anxiety, depression and substance use) and physical disorders (arthritis, cancer, diabetes, gastrointestinal, hypertension and total respiratory morbidity) were measured at physician visits and hospitalisations 2 years pre-injury and post-injury. Generalised estimating equations were used to estimate adjusted rate ratios (ARR).

Results This study examined 9551 in the injured cohort and 47 755 matches in the uninjured cohort. Injured individuals had increased ARRs for all mental disorders (p<0.0006) pre-injury (anxiety=1.30 (95% CI, 1.16 to 1.47); depression=2.00 (95% CI, 1.73 to 2.32); substance use=4.99 (95% CI, 3.08 to 5.20); any mental disorder=1.50 (95% CI, 1.37 to 1.66)) and post-injury (anxiety=1.66 (95% CI, 1.51 to 1.82); depression=2.87 (95% CI, 2.57 to 3.21); substance use=3.25 (95% CI, 2.64 to 3.99); any mental disorder=1.90 (95% CI, 1.76 to 2.04)). For physical disorders, injured individuals had increased ARRs (p<0.0006) pre-injury for arthritis (1.50 (95% CI, 1.39 to 1.60)), cancer (1.97 (95% CI, 1.35 to 2.88)), gastrointestinal (1.12 (95% CI, 1.06 to 1.18)) and any physical disorder (1.14 (95% CI, 1.11 to 1.18)). Post-injury, the injured had higher ARRs (p<0.0006) for arthritis (2.02 (95% CI, 1.91 to 2.15)), cancer (1.97 (95% CI, 1.35 to 2.88)), diabetes (1.76 (95% CI, 1.33 to 2.32)), gastrointestinal (1.19 (95% CI, 1.12 to 1.27)), hypertension (2.36 (95% CI, 1.83 to 3.06)) and any physical disorder (1.33 (95% CI, 1.29 to 1.37)). Comparing the pre-injury and post-injury periods, ARRs for injured showed a difference over time for all mental disorders except substance use and all physical disorders except gastrointestinal and total respiratory morbidity compared with matched uninjured. Greater injury severity was associated with two times greater ARR for developing any mental health disorder, and the injured had three times the ARR for dying by suicide (p<0.0006).

Conclusions and relevance Child survivors of traumatic injury had increased relative rates of mental and physical disorders compared with a matched uninjured cohort. These findings support targeted intervention strategies for this population at the time of hospitalisation.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This retrospective cohort study compared an injured paediatric cohort with a matched (5:1) uninjured paediatric cohort using propensity score weights in a generalised estimating equation to reduce bias.
⇒ This study used large population-based datasets to examine a wide range of mental and physical disorders measured 2 years pre-injury and 2 years post-injury.
⇒ Use of administrative data overcomes limitations of other studies including recollection bias, diagnostic variability and loss to follow-up.
⇒ Administrative health records reflect treatment prevalence and exclude individuals who seek care in other settings or do not seek care.
⇒ Complete diagnostic information was not available as outpatient care visits were limited to one International Classification of Diseases diagnosis code per patient.

INTRODUCTION

Paediatric traumatic injury (PTI) has devastating consequences and is the leading cause of death in those under the age of 18.[1 2] Over

20 000 children are hospitalised yearly for injuries in Canada, with falls and transport injuries (motor vehicle collisions, cycling and pedestrian) as the most common causes.[1] PTI can have lasting consequences for survivors' mental and physical health; profound effects on quality of life, well-being and psychological adjustment may lead to the development of mental and physical disorders. Several studies have found an increased risk of anxiety and depression,[3–5] substance use[6] and post-traumatic stress syndrome (PTSS) or post-traumatic stress disorder (PTSD)[3 7] following paediatric injury. There is overlap between symptoms of post-traumatic stress and depression[8] and anxiety,[9] and it has been suggested that the physical impacts of stress and trauma (ie, the allostatic load) lead to negative physiological effects.[10] While research has examined physical functioning following paediatric injury,[11] there is a lack of research on the risk of developing physical disorders post-injury. In adults, arthritis, cancer, cardiovascular disease, gastrointestinal illness and diabetes have been associated with the post-injury period.[12 13] Post-injury inflammation may contribute to the development of these chronic illnesses.[14] Burn injury in childhood has been associated with later respiratory illness and arthritis,[15] and trauma in childhood has been linked to disorders such as cancer, diabetes, cardiovascular illness and obesity.[16] Symptoms of post-traumatic stress are associated with musculoskeletal pain, cardiovascular disorders and gastrointestinal illness.[17] Research has found that decreased mental and physical health following paediatric injury can be long-lasting[16] and persist into adulthood.[15]

As childhood is a crucial period for growth and maturation,[18] it is important to study these sequelae. Most research that has examined the association between PTIs and mental and physical disorders in children is limited by lack of comparison groups,[5] single injury focus[19 20] and reporting only post-injury disorder rates.[21] Studies investigating post-injury effects without comparison groups risk detecting rates of mental and physical disorders that reflect underlying population trends instead of the effects resulting from the PTI. Research using a control cohort reporting only post-injury comparative rates also may overlook a difference between the cohorts that existed pre-injury. Where pre-injury health and follow-up were examined, studies were limited by small sample size and self-report survey[22] or lack of an uninjured comparison group.[5]

With a growing body of knowledge about the relationship between injury and mental and physical disorders, further investigation addressing current methodological limitations is necessary to further our understanding of PTI outcomes in children. Use of linked population-based administrative data allows for a large sample, matched comparison group and examination of a wide range of mental and physical disorders over time. In addition, these datasets overcome biases of self-report including recall bias and loss to follow-up. The goal of this study was to examine relative rates of mental and physical disorders among children hospitalised for PTI compared with an uninjured matched cohort, taking into consideration pre-existing mental and physical health. We hypothesised that children with PTI would have increased relative rates of mental and physical disorders compared with a matched cohort in the post-injury period.

METHODS

Overview

This retrospective population-based longitudinal cohort study examined mental and physical disorders in hospitalised survivors of PTI ('injured') and a matched (1:5) uninjured cohort in the general population ('uninjured').

Data sources

The Children's Hospital at the Health Sciences Centre in Winnipeg is the only paediatric regional trauma centre for the 1.3 million inhabitants of Manitoba. The Trauma Registry at the Children's Hospital contains clinical information on all children hospitalised for PTI. The Trauma Registry was linked to administrative data at the Population Health Research Data Repository housed at the Manitoba Centre for Health Policy (MCHP). The repository contains de-identified individual level data for the population of Manitoba that is linkable across data sets anonymously via a unique scrambled personal health information number (PHIN).[23] These data include diagnoses of physical and mental disorders based on physician billing and hospital discharge information.

Study population

Patients <18 years of age admitted to hospital for a PTI between 1 January 2004 and 31 December 2016, and who survived discharge, formed the injured cohort. PTI was defined as an acute physical injury requiring hospitalisation of >1 day. Mechanisms of injury reflect those listed in the National Trauma Registry[24] and based on the classification of Becker *et al*.[25] The Injury Severity Score (ISS) was used to assess severity[26]; major and minor injury were defined as an ISS score >12 and ≤12, respectively.[24] Injured youth were matched 1:5 to youth in the general Manitoba population with no prior history of hospitalisation for traumatic injury. Matching was based on age relative to date of injury (index date) ±1 year, sex and geography (11 health regions in Manitoba). Requirements for inclusion in both cohorts were a valid PHIN, Manitoba address (postal code and municipality code) for 1 year prior to index date and a minimum of 30 days of Manitoba Health insurance coverage after the index date. Individuals were excluded if they did not meet the inclusion criteria, had a duplicate PHIN or sought healthcare in other settings. In addition, individuals who died and their matches were removed. Patients with traumatic brain injury were excluded due to a unique mental health trajectory post-injury.[27] The study population included 9551 youth in the injured cohort and 47 755 youth in the uninjured cohort (n=57 306). A Strengthening the

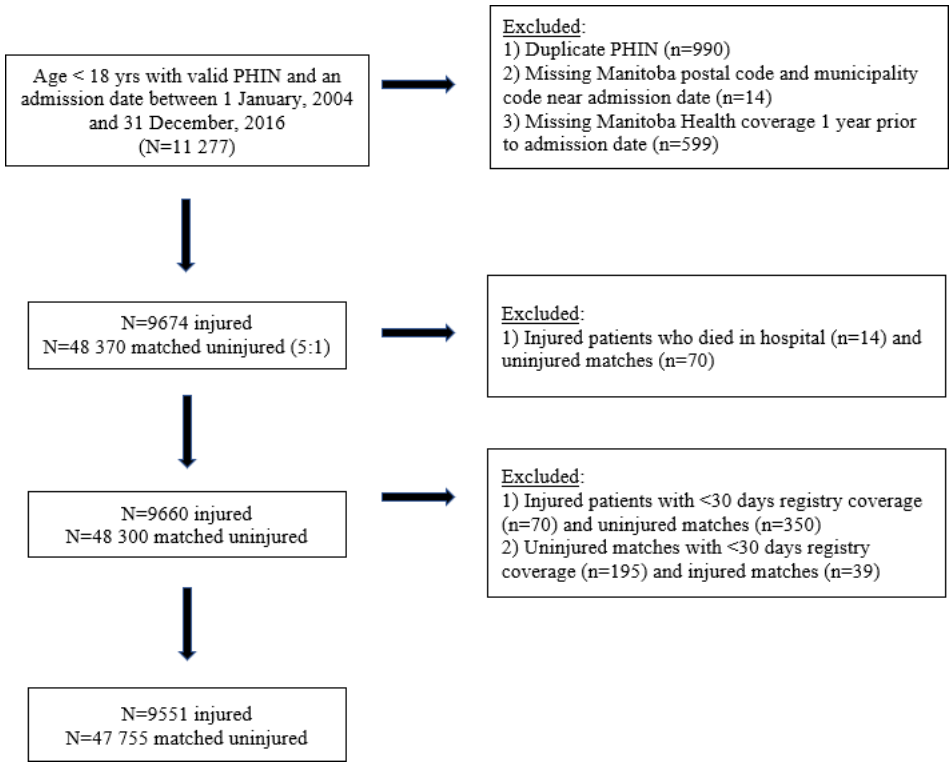

Figure 1 Strengthening the Reporting of Observational Studies in Epidemiology flow diagram. PHIN, personal health information number.

Reporting of Observational Studies in Epidemiology flow diagram is shown in figure 1.[28]

Outcome variables

Diagnoses of mental and physical disorders were obtained from physician visits and hospitalisations 2 years pre-index and post-index date using International Classification of Diseases (ICD) codes (online supplemental eTable 1). Mental disorders examined were anxiety, depression and substance use disorders. 'Any mental disorder' combined anxiety, depression and substance use disorders into one variable. One or more outpatient visits and/or one or more hospitalisations during the pre-index or post-index period were considered an outcome diagnosis. Physical health diagnoses included arthritis, cancer, diabetes, gastrointestinal illness, hypertension and total respiratory morbidity (see online supplemental eTable 1 for details). 'Any physical disorder' included one or more of the physical health diagnoses. These health outcomes were chosen for this study based on their association with increased morbidity and data availability at the MCHP.[15 29–31] Coding for health outcomes of interest is based on validated diagnostic definitions for the Manitoba population.[32 33]

Statistical analysis

Descriptive statistics for the PTI and uninjured cohorts were calculated for socio-demographic variables (sex, geography, income and age) using t-tests and χ^2 tests to compare cohorts. Contingency tables were generated for the pre-index and post-index periods to examine mental and physical disorders for both cohorts, resulting in unadjusted relative rates (URR). To minimise the risk of type II error from the multiple analyses, a Bonferroni correction was applied and cohorts were considered statistically different from each other when p<0.0006 (two-tailed). A propensity score was generated from a logistic regression model, which included binary indicators for sex (male/female), geography (rural/urban), neighbourhood income (low/high) and age group (≤4years/>4 years). Comparisons of individual propensity score distributions showed sufficient overlap. This suggested that the application of the weights of inverse probability of treatment (IPTW) would result in a comparable distribution of variables between the cohorts, confirming the feasibility of comparing the groups.[34] Generalised estimating equations (GEE) were created for each study outcome to account for the correlations among repeat observations of longitudinal data.[35] The GEE was unstructured using sandwich estimators and adjusted relative rates (ARR) used for comparison were calculated. An average treatment effect was estimated and used as a weight applied in the GEE model. The weight established estimates representing population average treatment effects with optimal balance between the cohorts.[34] This allowed for comparability between the groups and reduction of potential bias. In addition, a time offset (log person-years) was included to account for the effect of time in the study and for participants leaving the study early due to death or moving. The structure of the GEE included: group (cohort); pre-index date period and post-index date period ('care period');

Table 1 Descriptive characteristics of cohorts

Outcome	Injured* (n=9551)	Uninjured* (n=47 755)	P value
Age at index date (range)	10.3±4.9 (0.99–17.99)	10.2±4.9 (0.99–17.99)	0.96
Male	6145 (64.4)	30 730 (64.4)	0.98
Female	3406 (35.6)	17 025 (35.6)	0.98
Urban	4886 (53.0)	24 936 (53.0)	0.96
Rural	4342 (47.0)	22 136 (47.0)	0.96
High income†	4913 (53.2)	27 057 (57.5)	<0.0001
Low income†	4315 (46.8)	20 015 (42.5)	<0.0001

p>0.0006.
*Data shown as mean±SD. or No. (%).
†High income=highest 3 income quintiles (neighbourhood level); low income=lowest 2 quintiles (neighbourhood level) + missing.

Table 2 Injury characteristics (n=9551)

Type of injury	Value*
Falls	3799 (39.8)
Total transport	1674 (17.5)
Pedestrian	258 (2.7)
Bicycle	476 (5.0)
Other land transport	940 (9.8)
Struck by or against	1184 (12.4)
Suffocation and foreign body	684 (7.2)
Assault	443 (4.6)
Cuts and pierces	334 (3.5)
Burns	247 (2.6)
Self-harm	112 (1.2)
Overexertion	80 (0.8)
Unintentional firearm	44 (0.5)
Other	950 (9.9)
Injury severity†	
ISS >12 (major)	609 (6.4)
ISS ≤12 (minor)	8942 (93.6)
Length of stay (days)	3.3±11.2 (1–369)

p<0.0006.
*Data shown as No. (%) or mean±SD.
†ISS = Injury Severity Score.

sex (male/female); geography (rural/urban); neighbourhood income (low/high); age group (≤4 years/>4 years) and a 'group × care period' interaction term. Data analyses were performed using SAS V.9.4 (SAS Institute, Cary, North Carolina, USA).

Patient and public involvement

There was no patient or public involvement in this study.

RESULTS

Table 1 includes descriptive characteristics for the cohorts. There were no significant differences between the cohorts in the distribution of age, sex and geography. Nearly two-thirds of the sample were male and just over half were from a rural area and/or lived in a high-income neighbourhood. A larger proportion of the injured came from lower-income areas (p<0.0001). (For detailed covariates for the injured cohort, see online supplemental eTable 2.)

Table 2 shows the descriptive characteristics of the injured cohort. Falls (39.8%) and transport injuries (17.5%) were the most common mechanisms of injury. Major injuries (ISS>12) accounted for 6.4% of all hospitalisations.

Table 3 includes the URRs of pre-injury and post-injury outcome measures for both cohorts. Pre-injury, there was a higher URR (p<0.0006) for all mental and physical disorders among injured compared with uninjured. Post-injury, there was a higher URR (p<0.0006) for all mental and physical disorders for injured compared with uninjured, except for diabetes.

Table 4 includes ARRs for the pre-injury and post-injury periods. Injured individuals had increased ARRs for all mental disorders (p<0.0006) pre-injury (anxiety=1.30 (95% CI, 1.16 to 1.47); depression=2.00 (95% CI, 1.73 to 2.32); substance use=4.99 (95% CI, 3.08 to 5.20) and any mental disorder=1.50 (95% CI, 1.37 to 1.66)) and post-injury (anxiety=1.66 (95% CI, 1.51 to 1.82); depression=2.87 (95% CI, 2.57 to 3.21); substance use=3.25 (95% CI, 2.64 to 3.99) and any mental disorder=1.90 (95% CI, 1.76 to 2.04)). For physical disorders, injured individuals had increased ARRs (p<0.0006) pre-injury for arthritis (1.50 (95% CI, 1.39 to 1.60)), cancer (1.97 (95% CI, 1.35 to 2.88)), gastrointestinal (1.12 (95% CI, 1.06 to 1.18)) and any physical disorder (1.14 (95% CI, 1.11 to 1.18)). Post-injury, the injured had higher ARRs (p<0.0006) for arthritis (2.02 (95% CI, 1.91 to 2.15)), cancer (2.87 (95% CI, 2.57 to 3.21)), diabetes (1.76 (95% CI, 1.33 to 2.32)), gastrointestinal (1.19 (95% CI, 1.12 to 1.27)), hypertension (2.36 (95% CI, 1.83 to 3.06)) and any physical disorder (1.33 (95% CI, 1.29 to 1.37)). To examine the rate of change in ARRs for injured relative to uninjured over time, a 'group × care period' interaction term was used (table 4). There was a significant (p<0.0006) interaction term for anxiety, depression, any mental health disorder, arthritis, cancer, diabetes, hypertension and any physical disorder. These significant interactions indicate a greater increase in these outcomes from pre-injury to post-injury for injured relative to uninjured. In addition, for the post-injury period, those with severe injury (ISS>12) had more than two times the ARR for developing a mental disorder (2.03, 95% CI, 1.72 to 2.40, p<0.0006) and three times the ARR for death by suicide (3.05, 95% CI, 2.22 to 4.19, p<0.0006).

Table 3 Pre-injury and post-injury unadjusted relative rates (URR) of disorders for cohorts

Disorder	Injured (n=9551) No. (%)	Uninjured (n=47 755) No. (%)	URR (95% CI)
Pre-injury mental disorders			
Anxiety	567 (5.8)	1685 (3.5)	1.73 (1.56 to 1.90)*
Depression	502 (5.3)	861 (1.8)	3.02 (2.70 to 3.38)*
Substance use disorder	166 (1.7)	233 (0.5)	3.60 (2.95 to 4.40)*
Any mental disorder	922 (9.6)	2388 (5.0)	2.03 (1.88 to 2.20)*
Pre-injury physical disorders			
Arthritis	1376 (14.4)	3427 (7.2)	2.18 (2.04 to 2.33)*
Cancer	60 (0.6)	67 (0.1)	4.50 (3.17 to 6.38)*
Diabetes	74 (0.8)	198 (0.4)	1.88 (1.43 to 2.45)*
Gastrointestinal	1049 (11.0)	4282 (9.0)	1.25 (1.17 to 1.35)*
Hypertension	88 (0.9)	184 (0.4)	2.40 (1.86 to 3.10)*
Total respiratory morbidity†	1370 (14.3)	6350 (13.3)	1.09 (1.03 to 1.16)*
Any physical disorder	3298 (34.5)	12 364 (25.9)	1.51 (1.44 to 1.58)*
Post-injury mental disorders			
Anxiety	348 (3.6)	1325 (2.8)	1.33 (1.18 to 1.49)*
Depression	277 (2.9)	659 (1.4)	2.13 (1.85 to 2.46)*
Substance use disorder	119 (1.3)	138 (0.3)	4.31 (3.37 to 5.50)*
Any mental disorder	568 (6.0)	1831 (3.8)	1.59 (1.44 to 1.75)*
Post-injury physical disorders			
Arthritis	974 (10.2)	3252 (6.8)	1.55 (1.44 to 1.68)*
Cancer	37 (0.4)	95 (0.2)	1.95 (1.33 to 2.85)*
Diabetes	44 (0.5)	201 (0.4)	1.10 (0.79 to 1.52)
Gastrointestinal	1360 (14.2)	5946 (12.5)	1.16 (1.10 to 1.24)*
Hypertension	44 (0.5)	150 (0.3)	1.47 (1.05 to 2.06)*
Total respiratory morbidity†	1777 (18.6)	8028 (16.8)	1.13 (1.07 to 1.20)*
Any physical disorder	3460 (36.2)	14 931 (31.3)	1.25 (1.19 to 1.31)*

*p<0.0006.
†Total respiratory morbidity includes asthma, chronic or acute bronchitis, emphysema or chronic airway obstruction and chronic obstructive pulmonary disease.

DISCUSSION

This longitudinal population-based study found that youth hospitalised for a PTI had worse mental and physical health prior to and following injury compared with a matched uninjured cohort. In the 2-year pre-injury period, the injured had greater ARRs for all mental disorders and for arthritis, cancer, gastrointestinal and any physical disorder. For the 2-year post-injury period, the injured had greater ARRs for all mental disorders and all physical disorders except diabetes. When examining relative rates over time, adjusted models found that ARRs for anxiety, depression, any mental disorder, arthritis, cancer, diabetes, hypertension and any physical disorder increased at a greater rate for injured individuals over the same period compared with uninjured individuals. While unadjusted rates of disorders decreased in both cohorts over time, this may be due to underlying rate changes in the population and/or increasing age.[2]

Finding impaired pre-injury health and poor health outcomes following PTI has been found in the literature;[3] however, few studies have examined pre-injury rates or rate changes over time between these cohorts.[11] Zatzick and Grossman examined mental health outcomes in a population-based sample of over 20 000 youth ages 10–19 post-injury in the USA[6] and found increased odds of developing depression (OR=1.30; 95% CI, 1.10 to 1.53), anxiety (OR=1.21; 95% CI, 1.02 to 1.44) and substance use disorder (OR=1.56; 95% CI 1.21 to 2.00) within 3 years post-injury. While this study looked at injury-related outcomes, the authors examined a narrow age range, had few patients with PTI severe enough to require hospital admission (n=142) and did not investigate risk factors

Table 4 Pre-injury and post-injury adjusted rate ratios of disorders: injured cohort relative to uninjured cohort (n=57 306)

Disorder	2 years pre-injury ARR* (95% CI)† (injured/uninjured)	Group × care period interaction term (p value)	2 years post-injury ARR*(95% CI)† (injured/uninjured)
Mental disorders			
Anxiety	1.30 (1.16 to 1.47)‡	0.0004	1.66 (1.51 to 1.82)‡
Depression	2.00 (1.73 to 2.32)‡	<0.0001	2.87 (2.57 to 3.21)‡
Substance use disorder	4.99 (3.08 to 5.20)‡	0.19	3.25 (2.64 to 3.99)‡
Any mental disorder	1.50 (1.37 to 1.66)‡	<0.0001	1.90 (1.76 to 2.04)‡
Injury severity on any mental disorder§	N/A	N/A	2.03 (1.72 to 2.40)‡
Death by suicide	N/A	N/A	3.05 (2.22 to 4.19)‡
Physical disorders			
Arthritis	1.50 (1.39 to 1.60)‡	<0.0001	2.02 (1.91 to 2.15)‡
Cancer	1.97 (1.35 to 2.88)‡	0.0001	2.87 (2.57 to 3.21)‡
Diabetes	1.08 (0.77 to 1.50)	0.0016	1.76 (1.33 to 2.32)‡
Gastrointestinal	1.12 (1.06 to 1.18)‡	0.10	1.19 (1.12 to 1.27)‡
Hypertension	1.33 (0.94 to 1.89)	0.0015	2.36 (1.83 to 3.06)‡
Total respiratory morbidity	1.09 (1.04 to 1.15)	0.51	1.07 (1.01 to 1.13)
Any physical disorder	1.14 (1.11 to 1.18)‡	<0.0001	1.33 (1.29 to 1.37)‡

*ARR = adjusted rate ratio.
†Adjusted for sex, geography, income and age group.
‡p<0.0006.
§Adjusted for injury severity (>12 Injury Severity Score).

for injury outcomes. Our study also reports increased post-injury URRs for all mental disorders in those with PTI; however, differences remained after accounting for pre-existing mental disorders. In a 10-year retrospective cohort study using administrative data, Bushroe *et al* examined mental health 1 year pre-injury and post-injury in a hospitalised paediatric cohort and found an increased rate of any mental disorder (RR=1.63, 95% CI, 1.39 to 1.92) over time.[5] However, this study did not have a comparison group. Our study found an increased ARR for substance use following PTI; this has been found in other research,[6] however, in a population with less severe injuries. There was no difference over time for substance use disorders in our study, which may be attributed to the nearly five times higher pre-injury ARR when compared with the post-injury ARR. An additional finding of the current study was that injured youth had three times greater ARR for dying by suicide in the 2-year post-injury period compared with uninjured individuals, an outcome found in adult research.[29 36]

Research has found decreased physical functioning, health-related quality of life and increased disability[11] following paediatric injury, but no studies directly focus on physical disorders. While there is a dearth of studies on the development of physical disorders post-injury in youth, research on adults has found the most common new-onset disorders between 1 and 5 years post-orthopaedic injury were arthritis, cancer, cardiovascular and hypertension.[12] A growing body of research has examined physical disorders following post-traumatic stress or PTSD and found increased risk of numerous disorders including cardiovascular, gastrointestinal, asthma, arthritis and diabetes,[13 17 37] suggesting possible pathways between traumatic injury and later decreased mental and physical health.

Mechanisms

A possible mechanism for the link between PTI and post-injury mental and physical disorders is post-traumatic stress and the allostatic load. Stress from the injury can contribute to biological alterations, inadequate health behaviours and dysfunctional coping post-traumatic injury,[10 38] which may precipitate or worsen mental and physical disease. Post-traumatic stress may mediate the relationship between traumatic injury and physical disorders in adults[17] and youth.[39] Traumatic injury itself precipitates a host of physiological changes in the body's immune and inflammatory responses[40 41] that may be a link between paediatric injury and the development of physical disorders.[42] In addition, particular conditions may increase a child's susceptibility to injury. Children living with psychiatric disorders[43] or neurodiverse conditions such as attention deficit hyperactivity disorder (ADHD) or autism[43 44] may have an increased risk of injury and present with more severe injuries.[43] Another possible mechanism for increased rates of mental and physical disorders in both the pre-injury and post-injury periods includes the social determinants of child health (SDoCH). These social and economic factors influence child health[45] and subsequent outcomes for paediatric

injury patients.[46–48] Although SDoCH are important predictors of injury and indicators of social inequality, these factors are not typically included in injury prevention programmes.[47 49]

Strengths

To the best of our knowledge, this study includes the largest longitudinal single-centre paediatric trauma population to date and is the first to measure a wide range of mental and physical disorders in a paediatric population-based sample over time. Matching injured patients with an uninjured general population reduced bias and the effect of confounding variables. Propensity scores and IPTW were utilised in the multivariate analysis to adjust for correlations between the cohorts and to further reduce the selection bias that exists in observational data. This creates an observational study that simulates a randomised control trial, reducing bias and the possibility of type I error.[50] A wide range of injuries were included in this study, and the large sample size increases generalisability to other contexts.

Limitations

A limitation of this study is that health diagnoses were dependent on the patient receiving medical treatment in an outpatient or hospital setting. As a result, individuals who sought healthcare in other settings or did not seek medical intervention would not be included in our study. In addition, we had no way of identifying whether an individual moved out of the region before the end of the 2-year follow-up period, so there may be some loss to follow-up. A further limitation of administrative data is that physician billing claims may not reflect the entire clinical picture. First, administrative data diagnoses do not reflect patient symptomatology, including PTSS. Second, at the time of this study, physicians could only report one ICD code in outpatient and clinic settings. A patient's medical history may be more complex, and certain illnesses may be prioritised. Third, while some injuries were coded as 'assault', we were unable to distinguish between intentional and unintentional injuries and potentially different outcomes between these groups. Fourth, this study was unable to distinguish diagnoses of PTSD from other anxiety disorders due to limitations in the number of decimal places in ICD codes available in the datasets. Another limitation is that we were unable to include variables such as ethnicity and gender. While we reported on neighbourhood income, data on individual-level social determinants of health were not available. A final limitation pertains to the study follow-up period. Two years was chosen as a time frame based on previous research by our team[51 52] and to allow for the development of disorders due to the exposure but not so long that they could be due to other causes. However, it may be possible that disorders were more likely to be detected in injured youth due to increased post-injury follow-up. Conversely, undetected mental illnesses (or unmeasured conditions such as ADHD) may have contributed to the risk of injury in the pre-index period rather than being outcomes of injury.

Study implications

Despite injury prevention strategies, PTI remains a leading cause of morbidity and mortality in children.[1] The findings from this study are clinically relevant in the context of injury prevention and management. Increased understanding of the relationship between PTI and mental and physical disorders can inform the development of multidisciplinary teams and provision of care at multiple intervention points prior to and following PTI. Elevated rates of pre-injury mental and physical disorders and post-injury suicides in the injured population suggest prevention supports prior to injury and routine screening post-injury are imperative for children with mental disorders.[53] Post-injury follow-up and monitoring can increase detection and diagnoses of mental and physical disorders and reduce crisis and death by suicide.[29] Further, earlier intervention and supports may reduce the burden of mental and physical disorders on the long-term health and social development of youth and on healthcare resources.[1] Next, findings can be used to improve the quality of care for survivors of PTI. This study found the two most common mechanisms of injury were falls and transport injuries.[1] Prevention and management resources should be made available to support the mental and physical health of youth following these common injuries. In addition, hospitalisation indicates greater injury severity, which is associated with increased risk of mental disorders[54] and reduced quality of life up to 1 year post hospitalisation.[22] Being hospitalised poses a potential additional risk of mental disorders following paediatric hospitalisation[21] (due to the stresses of being away from home and family and the associated interventions with being hospitalised), and this risk increases with time.[3] Future studies can expand our current knowledge by assessing sex differences and inclusion of additional mental disorders to assess the relationship between injury and these disorders. Finally, given the connection between traumatic injury, adverse childhood experiences and mental and physical disorders in adults,[18] a greater understanding of social determinants of health and other factors that place children at risk for poor health and injury is warranted.

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