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# TITLE: The impact of an injury hospital admission on childhood academic performance: a Welsh population-based data linkage study.

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## ABSTRACT

**Background**: While injuries can impact on children's educational achievements (with threats to their development and employment prospects), these risks are poorly quantified. This population-based longitudinal study investigated the impact of an injury related hospital admission on Welsh children's academic performance.

**Methods**: The Secure Anonymised Information Linkage (SAIL) databank, 55,587 children residing in Wales from 2006-2016 who had an injury hospital admission (58.2% males; 16.8% born in most deprived Wales area; 80.1% one injury hospital admission) were linked to data from the Wales Electronic Cohort for Children (WECC). The primary outcome was the Core Subject Indicator (CSI) reflecting educational achievement at key stages (KS) 2 (school years 3-6), 3 (school years 7-9) and 4 (school years 10-11). Covariates in models included demographic, birth, injury, and school characteristics.

**Results**: Educational achievement of children was negatively associated with: pedestrian injuries (Adjusted Risk Ratio,[95% confidence intervals]) (0.87,[0.83,0.92]), cyclist (0.96,[0.94,0.99]), high fall (0.96,[0.94,0.97]), fire/flames/smoke (0.85,[0.73,0.99]), cutting/piercing object:0.96,[0.93,0.99], intentional self-harm (0.86,[0.82,0.91]), minor TBI (0.92,[0.86, 0.99]), contusion/open wound (0.93,[0.91,0.95]), fracture of vertebral column (0.78,[0.64,0.95]), fracture of femur (0.88,[0.84,0.93]), internal abdomen/pelvic haemorrhage (0.82,[0.69, 0.97]), superficial injury 0.94,[0.92,0.96], young maternal age (<18 years: 0.91,[0.88,0.94]; 19-24 years: 0.94,[0.93,0.96]); area based socioeconomic status (0.98,[0.97,0.98]); moving to a more deprived area (0.95,[0.93,0.97]); requiring special educational needs (0.46,[0.44,0.47]). Positive associations were: being female (1.04,[1.03,1.06]); larger pupil school sizes and maternal age 30+ years.

**Conclusion**: This study highlights the importance on a child's education of preventing injuries and implementing intervention programs that support injured children. Greater attention is needed on equity-focused educational support and social policies addressing needs of children at risk of underachievement, including those from families experiencing poverty.

## WHAT IS ALREADY KNOWN ON THIS TOPIC

- The impact of an injury on educational attainment over the schooling years is important as poor educational achievement can affect a child's long-term career prospects and earnings
- The evidence base for the social consequences of injury on subsequent educational achievement is very limited, especially across all categories of hospitalised injuries in childhood

## WHAT THIS STUDY ADDS

- Childhood injury-related hospital admission has negative impacts on children's future educational achievement
- A child's likelihood of achieving the required standard at school was significantly lower among those who had been admitted to hospital for intentional self-harm (9-18% lower), pedestrian injury (8-17% lower), high fall injury (3-6% lower), or cyclist injury (1-6% lower)
- Children hospitalised with an injury in lower socioeconomic areas (2-7% lower), from mothers whose maternal age was under 18 years (6-12% lower) and/or children suffering from mental health conditions (9-18% lower) have a reduced likelihood to succeed academically at school

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- There is a need for improved educational support for children who have been hospitalised with an injury, including support for their families, and particularly for those in lower socioeconomic areas
- Multicomponent educational interventions, coupled with laws/legislation to improve safety knowledge, attitudes, and behaviours in school-aged children would benefit from targeted interventions surrounding injury prevention

**VIBES-Junior Study protocol:** http://dx.doi.org/10.1136/bmjopen-2018-024755

## MANUSCRIPT

### Introduction

Education is an important factor in determining the quality of an individual's life by expanding their knowledge, skills and employment prospects. In 2018, more than ten million 15-year-old students living in the 79 high- and middle-income countries were not able to complete even the most basic reading tasks in the OECD's Programme for International Student Assessment (PISA). [1] Research has found that the educational potential of many children may not be achieved due to exposure to adversity in childhood. [2] Childhood injury is a leading contributor to the global disease burden [3] with tens of millions of children around the world hospitalised every year for non-fatal injuries that places them at risk for adverse and lasting impacts on their development. [4] Variations in the nature and causes of injury through the phases of early childhood, early adolescence and late adolescence [5] may also differentially affect key educational milestones.

The association between education and health, and their interplay with social factors in early childhood (e.g. stresses imposed by social inequities and marginalisation effects on health over a child’s early-life course) is well established. [6] The detrimental influence of poor health on a child’s educational attainment highlights the importance of understanding all aspects of the health of individuals across life stages that determine the health trajectory. This approach has been shown to have a profound impact later into adulthood. Patterns of physical and psychosocial functioning post-injury differ according to the nature of injury sustained for children and adolescents, [7] which may limit a child’s academic performance.

Studies investigating the impacts of childhood injury hospitalisation on school academic achievement are few, with the majority related to a brain injury sustained in childhood [8] and on the adverse outcomes of burns. [9] Only one study has investigated the educational impact of all hospitalised injured children, which took place in New South Wales, Australia and reported significant increases in failure to meet national minimum standards in learning assessments.

To date, whilst studies have investigated the impact of the severity of an injury and specific injuries (e.g. burns) no study has examined the impact of all types of an injury, injury mechanism and intent on school performance. The aim of this study was to investigate the association of injury-related hospital admissions on school academic performance using population-based linked data in Wales, UK

## Methods and Analysis

### Included datasets

This study used the Secure Anonymised Information Linkage (SAIL) databank [10] linking Tagged Electronic Cohort Cymru (TECC) data from the Wales Electronic Cohort for Children (WECC) (Supplementary Table s1), with secondary healthcare data. [11] All children born in Wales between 1st January 1990 and 5th February 2018 were included in this cohort. These data were made available for the paediatric Validating Injury Burden Estimates Study (VIBES-Junior) [12] (SAIL project 0794).

The final data set used for this study consisted of 55,587 children with 105,394 hospital records (Figure 1). The large drop in cases was primarily due to three factors: 1) the non-availability of computerised educational data (i.e. no outcome data) for some of the period, 2) the requirement for exclusion of children born outside Wales and 3) the restriction to children experiencing an injury hospital admission.

[FIGURE 1]

### Measures

The Core Subject Indicator (CSI) was the primary outcome for this study (Table 1). The first educational Key Stage (KS) statutory assessment 0/1 was excluded in this study due to key changes in the measurements during the time period rendering the measure potentially unstable, leaving three time points used in the longitudinal analysis. Details of the outcome, demographic and school variables are outlined in Table 1.

[TABLE 1]

An injury hospitalisation prior to KS was identified based on the age of the child at hospitalisation being less than the child's age at a KS. The most severe injury diagnosis prior to the KS and associated mechanism and intent were classified using International Classification of Diseases 10th Revision (ICD-10). Injury diagnosis was mapped to the 2013 Global Burden of Disease (GBD2013) study injury health states [13] and collapsed into 22 groups (Table 2). Injury severity was based on the GBD2013 order with the exception of moderate to severe traumatic brain injury (TBI) due to the expectation that these injury types would have a greater impact on educational trajectories in children compared with adults. The most severe injury for a child travelled with them through time to each KS, unless a more severe injury prior to the KS was sustained (Figure 2). Mechanism and intent of injury at each KS was matched to most severe injury (Table 2). The maximum number of injury-related admissions per KS was collapsed into four categories.

[FIGURE 2]

[TABLE 2]

The hospital admission status was derived from the PEDW database and children were categorised based on their interaction with inpatient services. The definition of an injury admission excluded any complications/sequelae (i.e. ICD10 T80-T98) due to the primary goal of this study being to investigate the impact on educational attainment related to the first injury presentation. The length of stay (LOS) was calculated using the minimum hospital admission date to maximum discharge date per patient and admission. This ensured there would be one overall LOS per hospital admission even if a child moved between hospitals (e.g. for treatment).

**Patient and public involvement**

This study was a population data linkage analysis with no patient/public input.

**Statistical Analysis**

Data were summarised using frequencies and percentages for categorical variables, and mean, SD and stratified distributions for continuous variables. Generalized Estimating Equations (GEE) Poisson population average models, with schools as the main clustering and an independent covariance structure, were used to account for the correlation of within-subject data (i.e. children within schools with repeated KS measures) and generated risk ratios with robust standard errors for effect sizes at the 95% confidence interval. The GEE model is a flexible approach to handle correlated data structures (i.e. repeated measures) [14] and missing data on the response variable (or unbalanced panels). The assumption that the data are missing completely at random, or that missingness depends only on the predictors and does not allow missingness on the outcome at one time to depend on observed values of the outcome at other times was checked to be valid.

It was possible that a child could not have an injury admission before a KS (e.g. KS2) but have an injury admission prior to a future KS (e.g. KS3). The most severe injury category and cause with the highest proportion across all KS were used as the base reference in the models (i.e. *Fracture of radius or ulna, Fall-low*). Detailed tables per KS are provided in Supplementary Tables s2 to s7. All analyses were performed using Stata version 17.0 (Stata Corp, College Station, TX) and 95% confidence intervals were evaluated for significance.

## Results

### Overview of injury cohort

Of the 55,587 children who had experienced an injury hospital admission there were more males (58.2%) than females (41.8%) (Table 3). Females were more likely from the most deprived Townsend decile at birth (Female 17.1%, Male 16.5%). The average maternal age was 26.71 years (SD 5.91) and gestational age was full term (39.25 weeks, SD 2.15). For those children who experienced an injury hospital admission, males were more likely to have experienced 2+ injury admissions compared to females (Male 20.8%, Female 18.2%).

[TABLE 3]

### Models of Ability to Achieve Expected Academic Standard

*Non-Injury Related Factors*

A number of demographic and school related factors affected a child's ability to achieve the expected academic standard (Table 4). Compared to KS2 the relative risk that children achieved the expected academic standard fell for each rise in the key stage. In general, females were more likely to achieve the expected academic standard than their male counterparts. Compared to the 25-29 years maternal age group, children whose mothers were <25 years of age at birth were less likely to achieve the expected academic standard, but mothers 30 plus years of age at birth were more likely to achieve the expected academic standard. There were indicators that socioeconomic status (SES) impacted children's relative risk of achieving the expected academic standard: children born in more deprived areas and/or children eligible for free school meals were less likely to achieve the expected academic standard. Children who required special educational needs were less likely to achieve the expected academic standard compared children who did not require these needs. Children at schools with >100 pupils were more likely to achieve the expected academic standard compared to schools with <=100 pupils.

[TABLE 4]

*Injury Related Factors*

Children who had sustained their most severe injury at any time due to environmental factors (e.g. temperature, pressure, electricity), minor TBI, contusion/open wound, or other injuries of muscle/tendon/other dislocations, crush injury/fracture foot/hand bones, internal haemorrhage in abdomen/pelvis, or superficial injury were less likely to achieve the expected academic standard than children who had sustained a fracture of the radius or ulna (Table 4). Children with pedestrian related injuries at any time prior to a KS were less likely to achieve the expected academic standard compared to children with low fall injuries. Children whose most severe injury was due to being a pedal cyclist-rider or passenger, high fall, fire/flames/smoke, cutting/piercing object, or animal related were less likely to achieve the expected academic standard compared to low fall injuries. Children who sustained their injury as a result of intentional self-harm were less likely to achieve the expected academic standard compared to unintentional/non-intentional harm.

## Discussion

This study found that Welsh children's educational achievement was negatively impacted by an injury hospital admission. Non-injury related factors, such as school size and circumstances at the child's birth, including socioeconomic status, also impacted a child's educational achievement.

This study is unique in its detailed investigation of the impact of a childhood injury requiring hospitalisation on educational attainment. This study distinguished over twenty ordered injury groupings based on the GBD2013, thereby providing a new level of detail surrounding the impact of a specific injury hospitalisation on educational attainment. To date, studies have contained less detail about the type of injury. One study that found injured young people less likely to meet the recommended level of educational achievement grouped injury severity as minor, moderate or serious and included only TBI. [15] Our study is broadly consistent with other research focussing on the negative impact of a specific injury warranting hospitalisation on educational attainment, many of which relate to TBI. [16] [8]

*Injury-Related Factors*

Future educational performance for children was hindered if they had been admitted due to intentional self-harm. Children who sustain an intentional injury have worse health outcomes post hospital discharge compared to those who sustain an unintentional injury. [17] Intentional self-harm tends to initially occur during adolescence [18] and is associated with increased mental illness conditions and suicidality. [19, 20] This relationship with suicidality potentially leads to a high risk for self-injurious thoughts and behaviours more generally, [21] which may be problematic in the school environment. The relationship between self-harm and sleep problems [22] could further impede on children's academic performance due to lack of sleep potentially interfering with key cognitive processes (e.g. executive functioning, attention and memory).

A childhood hospitalisation due to a pedestrian incident potentially negatively impact a child's academic standard. Research has revealed the relevance of infrastructure modification in improving pedestrian safety among children. [23] More attention is needed on risks to pedestrians, such as distracted drivers and/or pedestrians (e.g. by mobile phones) and reduced visibility during hazy weather conditions. [24] A *Safe System approach* was proposed by Cloutier et al., [25] with a focus on child pedestrians, and recommended that pedestrians be separated in time and space from motor vehicles, or capping traffic speeds to 30 km/hr should this not be the case. The physical and mental recovery from high-impact childhood pedestrian injuries may negatively affect school attendance, physical and cognitive functioning and play a role in reducing the likelihood of achieving the expected academic standard.

A childhood hospitalisation due to a pedal cycle incident potentially negatively impact a child's academic standard. These more serious injuries often relate to head injuries, hip and thigh, chest and knee and leg injuries, [26] potentially affecting the child's school life for an extended period of time (e.g. hip injuries). Multicomponent educational interventions, coupled with laws and supporting legislation to improve safety knowledge, attitudes, and behaviours in school-aged children have been shown to be effective in increasing use of an adequately sized and certified helmet to reduce head injuries and to reduce traffic-related injury rates. [23]

This study found that children admitted to hospital with minor TBI had a decreased relative risk of achieving the expected academic compared to a fracture of the radius or ulna which is consistent with past research indicating this type of injury influences the developing brain. Children with an internal abdominal or pelvic haemorrhage also had a decreased relative risk of achieving the expected academic. The abdominal wall in children is thin with less muscle and subcutaneous fat, and tends to provide reduced protection from high impact injuries such as seat-belt injuries, bicycle handlebar injuries, and penetrating injuries. Our finding reflects the more prolonged healing time, activity limitations and potential disruption to learning.

Childhood hospitalised fractures of the femur impacted on expected academic achievement compared to a fracture of the radius or ulna. These types of fractures in children often occur from traffic-related or high fall incidents. This type of break is a serious injury, treated with surgery and physical therapy to restore strength and flexibility to the leg muscles, and take months to heal. The treatment of a fractured femur considers factors such as the child's age, conformation and size, configuration of the fracture, the nature of the injury (e.g. degree of energy), and amount of soft tissue injury present. A key issue is the potential for any shortening of the femur that might occur with a fracture of a growing bone with healing time inhibiting certain physical activities.

*Non-Injury-Related Factors*

The impact of area-based SES negatively impacted on educational achievement for children who had been hospitalised with an injury: those born into more deprived areas and/or children eligible for a free school meal were less likely to achieve the expected academic standard. Children who had been hospitalised with an injury who moved to a more deprived area between key educational stages were less likely to achieve the expected academic standard compared to those who had not changed. Inequality of opportunity (i.e. family background, access to better resourced schools) has been extensively researched, [27] with the school itself found to have little effect on a student's academic outcomes over and above the individual student-centric inequalities (i.e. home, neighbourhood and peer environment). [28] This study concurs with previous research observing disparities in outcomes between advantaged and disadvantaged students. [29] A 2011 report into inspecting quality and standards in education and training in Wales cited five recommendations to tackling problems of disadvantage: improvements in planning, developing systematic approaches, ensuring the right support is available, developing appropriate partnerships, and assessing the impact of strategies to tackle disadvantage on student achievement. [30] Focus on these recommendations may assist in reducing this issue for Wales.

Maternal age at birth impacted on the likelihood for children hospitalised with an injury to achieve the expected academic standard at school. Compared with children born to mothers aged 25-29 years, maternal age under 18 years and 18-24 years were between 9-12% and 6-7% less likely to achieve academic standards respectively. This result supports research confirming a link between maternal age and child development [31] where the parent's educational experiences, maturity, experience can influence a child's development. Women who first become a mother after their teen years have more opportunity than younger mothers to complete schooling, enter the workforce and providing a financially stable home life and thereby influencing SES and the child's educational readiness. [32]

Children with special educational needs who had been hospitalised were less likely to achieve the expected academic standard. This group covers a broad range of childhood conditions such as mental disorders (e.g., Attention Deficit Hyperactivity Disorder (ADHD)), neurodevelopmental disorders (e.g. Autistic Spectrum Disorder), learning disorders (e.g. Dyslexia), physical conditions (e.g. hearing impairment), behavioural, emotional and social difficulties, and physical and medical difficulties. The heterogeneity of the children's special educational needs makes untangling specific causes difficult. However, this study reinforces the need for schools to support students with special educational needs in mainstream classrooms. Schools should consider including an array of adjustments to tailor to the student's special educational needs, establish clear measurable goals, consider alternative strategies for use of teaching assistants, and ensure adjustments are monitored. [33]

In general, children hospitalised with an injury who attended schools with >100 pupils benefitted educationally compared to children at smaller schools. However, the effect of school size on educational achievement is controversial, [34] with varying arguments regarding the explanation of its relationship and mixed research results. [35, 36] A study found an inverted U-shaped relationship between school size and achievement, where achievement falls with the larger student-sized schools. [36] The important heterogeneities in the relationship between school size and student achievement have been recognised, with specific reference to achievement of students with learning disabilities to be disproportionately harmed by increases in school size. As the size of the school influences students school and/or subjects attitudes, social behaviour, level of extracurricular activity and psychological feelings of belonging, self-concept, acceptance and completion, [37] the impact of an injury requiring hospitalisation may negatively impact these issues. A Welsh report in 2013 investigating the educational effectiveness of schools found that large primary and secondary schools tended to perform better than small and medium-sized schools, and strong evidence that secondary schools in advantaged areas tended to perform better than schools in disadvantaged areas, but the impact of disadvantage is weaker for primary schools. [38]

*Strengths and Limitations*

The strength of this study lies in the linked population-based data enabling the measurement of the impact of an injury hospital admission, a large range of GBD injury groups in the models and the ability to include adjustments for important non-injury confounders such as maternal and gestational age and school size. However, the linked datasets do not have information on all chronic diseases; the hospital discharge data records the reason for admission and co-morbidities that have impacted on treatment/management during the admission (not background co-morbidities). The educational data relate only to children who were assessed so excludes any home-schooled children and children who had dropped out of school. However, the proportion of home-schooled children is <0.3% and it mandatory for children in Wales to be educated until age 16. [39] The effect on achieving the academic standard of special educational needs may be the temporal association with the type of injury which was unable to be disentangled. Data related to an Injury Severity Score (ISS) were very limited so could not be included but the models controlled for injury characteristics based on GBD order of severity. The main analysis in this paper assesses the impact of the most serious injury to date at each educational key stage (KS), irrespective of the duration since injury. Injuries differ in the time-course of their effects, commonly being most severe in the weeks to a few months after onset. With this in mind, a second GEE modelling analysis was done, limiting attention to the most severe injury that had occurred only within the months prior each KS (Supplementary Table s8). In general, results were consistent with those of the main study model. Future research could expand this study to investigate the impact of a childhood injury admission on educational outcomes with the inclusion of children without an injury admission as a comparison group. This study relates to a high-income country and the patterns may differ in low- to middle-income countries due to the impact of SES, nature of injuries sustained, and constrained health systems.

To date, the study most comparable with ours is the study of hospitalised injured children in New South Wales, Australia which had some differences in design (control cohort), outcomes (different assessments) and in the ability to adjust for additional confounders (maternal age, gestation, and school size) but which reported qualitatively similar results. [40] However, our study is unique in its modelling of numerous types of injury.

## Conclusion

Childhood injury-related hospital admission has negative impacts on children's future educational achievement. Injuries sustained due to intentional self-harm, as a cyclist or pedestrian, and in high falls can have detrimental effects on a child's potential to succeed academically at school. The implementation of multicomponent educational interventions, coupled with laws/legislation to improve safety knowledge, attitudes, and behaviours in school-aged children would be beneficial to help reduce childhood injury hospitalisations and prevent detrimental educational achievement outcomes. Children in lower socioeconomic areas and/or suffering from mental health conditions require greater attention and early interventions to prevent detrimental impacts on educational outcomes.

**ABBREVIATIONS**

| | |
|---|---|
| ARR | Adjusted Relative Risk Ratio |
| CI | Confidence Interval |
| CSI | Core Subject Indicator |
| ICD-10 | International Classification of Diseases, 10th Revision |
| KS | Key Stage |
| RR | Risk Ratio |
| SAIL | Secure Anonymised Information Linkage |
| SES | Socio Economic Status |
| SD | Standard deviation |
| TECC | Tagged Electronic Cohort Cymru |
| WECC | Wales Electronic Cohort for Children |
| WHO | World Health Organization |

**DECLARATIONS**

**Ethics approval and consent to participate**

The project was approved by the Monash University Human Research Ethics Committee (project number 12311) and was conducted in compliance with the NHMRC National Statement on Ethical Conduct in Human Research (2007)-Updated 2018 [41] and the ICH Guideline for Good Clinical Practice E6(R2). The use of the de-identified data was approved by the independent Information Governance Review Panel for the Secure Anonymised Information Linkage (SAIL) databank on 22/06/2018 (Project 0794).

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**Conflict of Interest Disclosures (includes financial disclosures):** There are no competing interests to declare.

**Contributors' Statement**

All authors conceptualised and designed the study. Dr Dipnall carried out the analyses, wrote the original draft of the manuscript and reviewed and edited the final manuscript. Profs Gabbe, Lyons, and Ms Lyons verified the underlying data. Profs Gabbe, R Lyons, Ameratunga, Lecky, Harrison, Brussoni, A/Prof Beck, Dr Schneeberg, and Ms Lyons, critically reviewed the manuscript for important intellectual content. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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**Data Statement**

This study makes use of anonymised data held in the Secure Anonymised Information Linkage (SAIL) Databank. We would like to acknowledge all the data providers who make anonymised data available for research. [42-46] Data are available from the SAIL Databank at HDRUK Swansea University https://saildatabank.com/ or contact SAILDatabank@swansea.ac.uk. For further information on access including training required see website: https://saildatabank.com/data/apply-to-work-with-the-data/. We confirm that the authors did not have any special access privileges.

## REFERENCES:


1. Schleicher, A., *PISA 2018: Insights and Interpretations.* oecd Publishing, 2019.
2. Evans, A., et al., *Adverse childhood experiences during childhood and academic attainment at age 7 and 11 years: an electronic birth cohort study.* Public Health, 2020. **189**: p. 37-47.
3. Collaboration, G.B.o.D.P., *Global and national burden of diseases and injuries among children and adolescents between 1990 and 2013: Findings from the Global Burden of Disease 2013 study.* JAMA Pediatrics, 2016. **170**(3): p. 267-287.
4. Rivara, F. and K. Oldham, *Pediatric trauma care: Defining a research agenda.* Journal of Trauma, 2007. **63**: p. S52-S53.
5. Peclet, M.H., et al., *Patterns of injury in children.* Journal of pediatric surgery, 1990. **25**(1): p. 85-91.
6. Bhatta, T.R., *Intercohort variations in the education–health gradient: Sociohistorical changes in early-life selection mechanisms in the United States.* The Journals of Gerontology: Series B, 2021. **76**(2): p. 330-342.
7. Dipnall, J.F., et al., *Health-related quality of life (HRQoL) outcomes following injury in childhood and adolescence using EuroQol (EQ-5D) responses with pooled longitudinal data.* International journal of environmental research and public health, 2021. **18**(19): p. 10156.
8. Gabbe, B.J., et al., *The association between hospitalisation for childhood head injury and academic performance: evidence from a population e-cohort study.* J Epidemiol Community Health, 2014. **68**(5): p. 466-70.
9. Azzam, N., et al., *Influence of early childhood burns on school performance: an Australian population study.* Archives of disease in childhood, 2018. **103**(5): p. 444-451.
10. Ford, D.V., et al., *The SAIL Databank: building a national architecture for e-health research and evaluation.* BMC health services research, 2009. **9**(1): p. 1-12.
11. Lyons, R.A., et al., *The SAIL databank: linking multiple health and social care datasets.* BMC medical informatics and decision making, 2009. **9**(1): p. 1-8.
12. Gabbe, B.J., et al., *Validating injury burden estimates using population birth cohorts and longitudinal cohort studies of injury outcomes: the VIBES-Junior study protocol.* BMJ open, 2018. **8**(8): p. e024755.
13. Haagsma, J.A., et al., *The global burden of injury: incidence, mortality, disability-adjusted life years and time trends from the Global Burden of Disease study 2013.* Injury prevention, 2016. **22**(1): p. 3-18.
14. Liang, K.-Y. and S.L. Zeger, *Regression analysis for correlated data.* Annual review of public health, 1993. **14**(1): p. 43-68.
15. Mitchell, R.J., et al., *The impact of childhood asthma on academic performance: A matched population-based cohort study.* Clinical & Experimental Allergy, 2022. **52**(2): p. 286-296.
16. Visnick, M.J., et al., *Educational and employment outcomes associated with childhood traumatic brain injury in Scotland: A population-based record-linkage cohort study.* PLoS Medicine, 2023. **20**(3): p. e1004204.
17. Dipnall, J.F., et al., *Predictors of health-related quality of life following injury in childhood and adolescence: a pooled analysis.* Injury Prevention, 2021: p. injuryprev-2021-044309.
18. Nock, M.K., *Self-injury.* Annual review of clinical psychology, 2010. **6**(1): p. 339-363.
19. Muehlenkamp, J.J. and P.L. Kerr, *Untangling a complex web: how non-suicidal self-injury and suicide attempts differ.* The Prevention Researcher, 2010. **17**(1): p. 8-11.
20. Whitlock, J., et al., *Nonsuicidal self-injury as a gateway to suicide in young adults.* Journal of adolescent health, 2013. **52**(4): p. 486-492.
21. Cipriano, A., S. Cella, and P. Cotrufo, *Nonsuicidal self-injury: A systematic review.* Frontiers in psychology, 2017. **8**: p. 1946.
22. Hysing, M., et al., *Sleep problems and self-harm in adolescence.* The British Journal of Psychiatry, 2015. **207**(4): p. 306-312.
23. Bou-Karroum, L., et al., *Preventing unintentional injuries in school-aged children: a systematic review.* Pediatrics, 2022. **149**(Supplement 6).

24. Gao, K., et al., *Impacts of reduced visibility under hazy weather condition on collision risk and car-following behavior: Implications for traffic control and management.* International journal of sustainable transportation, 2020. **14**(8): p. 635-642.
25. Cloutier, M.-S., et al., *State-of-the-art review: preventing child and youth pedestrian motor vehicle collisions: critical issues and future directions.* Injury prevention, 2021. **27**(1): p. 77-84.
26. Airaksinen, N., P. Lüthje, and I. Nurmi-Lüthje. *Cyclist injuries treated in emergency department (ED): consequences and costs in south-eastern Finland in an area of 100 000 inhabitants*. in *Annals of Advances in Automotive Medicine/Annual Scientific Conference*. 2010. Association for the Advancement of Automotive Medicine.
27. Broer, M., Y. Bai, and F. Fonseca, *A review of the literature on socioeconomic status and educational achievement.* Socioeconomic inequality and educational outcomes, 2019: p. 7-17.
28. Coleman, J.S., *Equality of educational opportunity [summary report*. Vol. 1. 1966: US Department of Health, Education, and Welfare, Office of Education.
29. Thomson, S., *Achievement at school and socioeconomic background—an educational perspective*. 2018, Nature Publishing Group. p. 1-2.
30. Estyn, *Thematic Report: Tackling poverty and disadvantage in schools: working with the community and other services July 2011.* 2011.
31. Duncan, G.J., et al., *Maternal age and child development.* Demography, 2018. **55**(6): p. 2229-2255.
32. Augustine, J.M., et al., *Maternal education and the link between birth timing and children's school readiness.* Social Science Quarterly, 2015. **96**(4): p. 970-984.
33. Carter, M., et al., *The nature of adjustments and monitoring for students with special educational needs in mainstream schools.* Australasian Journal of Special and Inclusive Education, 2022. **46**(1): p. 1-18.
34. McGuire, K., *School size: The continuing controversy.* Education and Urban Society, 1989. **21**(2): p. 164-174.
35. Egalite, A.J. and B. Kisida, *School size and student achievement: A longitudinal analysis.* School Effectiveness and School Improvement, 2016. **27**(3): p. 406-417.
36. Giambona, F. and M. Porcu, *School size and students' achievement. Empirical evidences from PISA survey data.* Socio-Economic Planning Sciences, 2018. **64**: p. 66-77.
37. Cotton, K., *School size, school climate, and student performance*. 1996, Citeseer.
38. Estyn, *Thematic Report: School size and educational effectiveness - December 2013.* 2013.
39. Vine, S.H. *Pupils educated other than at school: September 2021 to August 2022. Data relating to pupils known by local authorities to be receiving education outside of school from September 2021 to August 2022.* 2022 8 September 2022 [cited 2023 1/02/2023]; Available from: https://www.gov.wales/pupils-educated-other-school-september-2021-august-2022-html.
40. Mitchell, R.J., et al., *The impact of childhood injury and injury severity on school performance and high school completion in Australia: a matched population-based retrospective cohort study.* BMC pediatrics, 2021. **21**(1): p. 1-14.
41. NHMRC, A., *National Statement on Ethical Conduct in Human Research (2007) - Updated 2018.* Canberra, NHMRC, 2018.
42. Jones, K.H., et al., *A case study of the Secure Anonymous Information Linkage (SAIL) Gateway: a privacy-protecting remote access system for health-related research and evaluation.* Journal of biomedical informatics, 2014. **50**: p. 196-204.
43. Ford, D.V., et al., *The SAIL Databank: building a national architecture for e-health research and evaluation.* BMC health services research, 2009. **9**: p. 1-12.
44. Lyons, R.A., et al., *The SAIL databank: linking multiple health and social care datasets.* BMC medical informatics and decision making, 2009. **9**: p. 1-8.
45. Rodgers, S.E., et al., *Protecting health data privacy while using residence-based environment and demographic data.* Health & place, 2012. **18**(2): p. 209-217.
46. Rodgers, S.E., et al., *Residential Anonymous Linking Fields (RALFs): a novel information infrastructure to study the interaction between the environment and individuals' health.* Journal of Public Health, 2009. **31**(4): p. 582-588.

**Figure 1***:* Flowchart of inclusions/exclusions

**Figure 2:** Examples of Injury Classification Through Time

**Table 1:** Outcome, Time, Demographic and School Measures

| Variable | Description | Coding |
|---|---|---|
| Core Subject Indicator (CSI) (Outcome) | This binary measure, if the child achieved expected academic standard, was derived from teacher assessments in the three core subjects of language, mathematics and science. | 0=No, 1=Yes. |
| Educational Key Stage (KS) (Time) | Three time points were used in the longitudinal analysis based on the educational KS statutory assessments: KS2 represents school years 3 to 6 (children aged 7-11 years), KS3 represents school years 7 to 9 (children aged 11-14 years), and KS4 represents school years 10 to 11 (children aged 14-16 years). | KS2, KS3, KS4 |
| CSI count | The number of CSI scores per child across KS2 to KS4 were counted and summarised to indicate the proportion of children with one, two or three CSI outcomes over time. | Numeric |
| Sex | Sex of patient. | Male, Female |
| Age group | Age of patient at injury | 0-4 years,5-9 years,10-14 years,15-17 years |
| Townsend decile at birth | The Townsend decile at birth and at each KS was included as covariates. This measure is an area-based measure representing socioeconomic status (SES) in the United Kingdom (UK) where the higher the score the more a deprived area. Refer Yousaf S, Bonsall A. UK Townsend Deprivation Scores from 2011 census data. Colchester, UK: UK Data Service 2017. This measure was included as a continuous covariate in the models after finding the categorical covariate represented | 1 to 10 deciles |

| | | |
|---|---|---|
| | a general linear trend. Missing Townsend decile scores were replaced with carry forward values from the previous KS period. | |
| Change in Townsend | Change in Townsend between a KS. | No change, changed to less deprived area, changed to more deprived area |
| Caesarean section | If mother had a caesarean at birth. | No, Yes. |
| Maternal age group at birth | Age of mother at birth | <18 years, 18-24 years, 25-29 years, 30-34 years, 35+ years |
| Gestational age group | Gestational age group was informed by the World Health Organisation preterm definition, The American College of Obstetricians and Gynaecologists (ACOG) and the Society for Maternal–Foetal Medicine (SMFM) definitions of term pregnancy. | Extreme preterm (<28 weeks), Very preterm (28-32 weeks), Moderate or late preterm (33-36 weeks)/Early term (37-38 weeks)/Full term (39-40 weeks)/Later term (41-42 weeks)/Post term (43+ weeks). |
| Calendar year | The KS calendar school year, school pupil size group. | Numeric year. |
| School pupil size | Number of pupils per school. | <=100 pupils, >100-150 pupils, >150-200 pupils, >200-300 pupils, >300 pupils. |
| Free school Meal | Measure of free school meal eligibility included as indicative measures of disadvantage. Refer Gorard S. Who is eligible for free school meals? Characterising free school meals as a measure of | No, Yes. |

| | | |
|---|---|---|
| | disadvantage in England. British Educational Research Journal 2012; 38(6): 1003-17. | |
| Special educational needs | Any mention of any special educational needs was included as indicative measures of disadvantage and potential learning disabilities respectively. Refer Wearmouth J. A beginning teacher's guide to special educational needs: McGraw-Hill Education (UK); 2008. | No, Yes. |
| Maximum number of injuries | The maximum number of injury-related admissions per KS for a child was collapsed. It was possible that at KS2 and KS3 a child had not sustained an injury prior to the KS so would have a count of zero. | No injury related admissions, Total 1 injury related admission, Total 2 injury related admissions, Total 3+ injury related admissions. |

**Table 2:** Key Stage GBD 2013 Injury, Mechanism and Intent Groups

| **KS GBD 2013 Most Severe Injury Group** | **KS Most Severe Injury Mechanism** | **KS Most Severe Injury Intent** |
|---|---|---|
| N33, N34 Spinal cord lesion | Motor vehicle driver/passenger | Unintentional/non-intentional harm |
| N28 Moderate to severe traumatic brain injury | Motorcycle driver/passenger | Intentional self-harm |
| N19, N26 Fracture of femur | Pedal cyclist-rider or passenger | Intentional assault |
| N45 Environmental factors (e.g. temperature, pressure, electricity) | Pedestrian | Adverse effect or complication of medical or surgical care |
| N20 Fracture of patella, tibia, fibula, or ankle | Other transport related circumstance | Intent not specified/cannot be determined |
| N37, N17, N18 Crush injury, fracture foot/hand bones | Fall-low | |
| N43 Internal haemorrhage in abdomen or pelvis | Fall-high | |
| N27 Minor traumatic brain injury | Submersion / drowning / Other threat to breathing | |
| N21 Fracture of pelvis | Fire, flames, smoke | |
| N42 Severe chest Injury | Scalds | |
| N8, N9, N10 Burns (including lower airways) | Contact burn | |
| N25 Fracture of vertebral column | Poisoning | |
| N40, N44 Contusion, open wound | Cutting, piercing object | |
| | Animal related | |

| | |
|---|---|
| N35, N36 Asphyxiation, Non-fatal submersion | Struck by or collision with person/object |
| N14 Other injuries of muscle & tendon and other dislocations | Other cause |
| N16 Fracture of face bone | |
| N41 Poisoning | |
| N15 Fracture of clavicle, scapula, or humerus | |
| N22 Fracture of radius or ulna | |
| N47 Superficial | |
| Other | |

**Table 3** Overall patient characteristics

| | Total N=55587 | Male N=32379 | Female N=23208 | p-value |
|---|---|---|---|---|
| **Gender** | | | | <0.001 |
| Male | 32379 (58.2%) | 32379 (100.0%) | 0 (0.0%) | |
| Female | 23208 (41.8%) | 0 (0.0%) | 23208 (100.0%) | |
| **Townsend decile at birth** | | | | 0.012 |
| 1 - Least deprived | 3517 (6.3%) | 2072 (6.4%) | 1445 (6.2%) | |
| 2 | 3699 (6.7%) | 2206 (6.8%) | 1493 (6.4%) | |
| 3 | 4223 (7.6%) | 2529 (7.8%) | 1694 (7.3%) | |
| 4 | 4480 (8.1%) | 2607 (8.1%) | 1873 (8.1%) | |
| 5 | 4939 (8.9%) | 2881 (8.9%) | 2058 (8.9%) | |
| 6 | 5392 (9.7%) | 3196 (9.9%) | 2196 (9.5%) | |
| 7 | 6031 (10.8%) | 3529 (10.9%) | 2502 (10.8%) | |
| 8 | 6255 (11.3%) | 3557 (11.0%) | 2698 (11.6%) | |
| 9 | 7042 (12.7%) | 4042 (12.5%) | 3000 (12.9%) | |
| 10 - Most deprived | 9323 (16.8%) | 5343 (16.5%) | 3980 (17.1%) | |
| Missing | 686 (1.2%) | 417 (1.3%) | 269 (1.2%) | |
| **Maternal age (Mean, SD)** | 26.71 (5.91) | 26.75 (5.87) | 26.64 (5.97) | 0.021 |
| **Maternal age (Median, IQR)** | 27.00 (22.00-31.00) | 27.00 (22.00-31.00) | 26.00 (22.00-31.00) | 0.007 |
| **Maternal age group** | | | | 0.10 |
| <18 years | 2431 (4.4%) | 1399 (4.3%) | 1032 (4.4%) | |
| 18-24 years | 18788 (33.8%) | 10813 (33.4%) | 7975 (34.4%) | |
| 25-29 years | 16136 (29.0%) | 9496 (29.3%) | 6640 (28.6%) | |
| 30-34 years | 12269 (22.1%) | 7205 (22.3%) | 5064 (21.8%) | |
| 35+ years | 5852 (10.5%) | 3406 (10.5%) | 2446 (10.5%) | |
| Missing | 111 (0.2%) | 60 (0.2%) | 51 (0.2%) | |
| **Gestational age (Mean, SD)** | 39.25 (2.15) | 39.23 (2.16) | 39.27 (2.12) | 0.067 |
| **Gestational age (Median, IQR)** | 40.00 (38.00-41.00) | 40.00 (38.00-41.00) | 40.00 (38.00-41.00) | 0.21 |
| **Gestational age group** | | | | 0.016 |
| Extreme preterm (<28 weeks) | 134 (0.2%) | 68 (0.2%) | 66 (0.3%) | |
| Very preterm (28-32 weeks) | 766 (1.4%) | 477 (1.5%) | 289 (1.2%) | |
| Moderate or late preterm (33-36 weeks) | 3413 (6.1%) | 2048 (6.3%) | 1365 (5.9%) | |

| | | | | |
|---|---|---|---|---|
| Early term (37-38 weeks) | 10424 (18.8%) | 6097 (18.8%) | 4327 (18.6%) | |
| Full term (39-40 weeks) | 26018 (46.8%) | 15026 (46.4%) | 10992 (47.4%) | |
| Later term (41-42 weeks) | 13397 (24.1%) | 7828 (24.2%) | 5569 (24.0%) | |
| Post term (43+ weeks) | 679 (1.2%) | 395 (1.2%) | 284 (1.2%) | |
| Missing | 756 (1.4%) | 440 (1.4%) | 316 (1.4%) | |
| **Cesarean section** | | | | 0.019 |
| No | 47770 (85.9%) | 27731 (85.6%) | 20039 (86.3%) | |
| Yes | 7817 (14.1%) | 4648 (14.4%) | 3169 (13.7%) | |
| **Maximum number of injuries** | | | | <0.001 |
| Total 1 injury related admission^ | 44539 (80.1%) | 25608 (79.1%) | 18931 (81.6%) | |
| Total 2 injury related admissions | 8453 (15.2%) | 5300 (16.4%) | 3153 (13.6%) | |
| Total 3+ injury related admissions | 2503 (4.5%) | 1428 (4.4%) | 1075 (4.6%) | |
| Injury related admission undefined | 92 (0.2%) | 43 (0.1%) | 49 (0.2%) | |
| **Number of educational attainment scores across key stages** | | | | <0.001 |
| One CSI score | 9336 (16.8%) | 5684 (17.6%) | 3652 (15.7%) | |
| Two CSI scores | 28352 (51.0%) | 16550 (51.1%) | 11802 (50.9%) | |
| Three CSI scores | 17899 (32.2%) | 10145 (31.3%) | 7754 (33.4%) | |

Note: SD = Standard deviation. CSI = Core Subject Indicator. Max no = Maximum number. - = Not applicable. ^Same day admissions anomalies but injury was recorded and children were included in analysis (n=28).

**Table 4:** Model Results

| | ARR | 95% CI | p-value |
|---|---|---|---|
| **Key stage (KS)** | | | |
| *Stage 2* | *Reference* | | |
| Stage 3 | **0.821** | **(0.80, 0.84)** | **<0.001** |
| Stage 4 | **0.508** | **(0.49, 0.53)** | **<0.001** |
| **Gender** | | | |
| *Male* | *Reference* | | |
| Female | **1.043** | **(1.03, 1.06)** | **<0.001** |
| **Age group** | | | |
| *0-4 years* | *Reference* | | |
| 5-9 years | **0.971** | **(0.96, 0.98)** | **<0.001** |
| 10-14 years | **0.979** | **(0.96, 1.00)** | **0.014** |
| 15-17 years | **0.896** | **(0.85, 0.94)** | **<0.001** |
| **Caesarean Section** | | | |
| *No* | *Reference* | | |
| Yes | 1.011 | (1.00, 1.02) | 0.121 |
| **Townsend decile at birth** | **0.975** | **(0.97, 0.98)** | **<0.001** |
| **Maternal age group** | | | |
| <18 years | **0.909** | **(0.88, 0.94)** | **<0.001** |
| 18-24 years | **0.942** | **(0.93, 0.96)** | **<0.001** |
| *25-29 years* | *Reference* | | |
| 30-34 years | **1.019** | **(1.00, 1.03)** | **0.010** |
| 35+ years | **1.027** | **(1.01, 1.05)** | **0.005** |
| **Year** | **1.049** | **(1.05, 1.05)** | **<0.001** |
| **Gestational age group** | | | |
| Extreme preterm (<28 weeks) | **0.823** | **(0.68, 1.00)** | **0.048** |
| Very preterm (28-32 weeks) | 0.951 | (0.89, 1.02) | 0.133 |
| Moderate or late preterm (33-36 weeks) | **0.960** | **(0.94, 0.98)** | **0.001** |
| Early term (37-38 weeks) | **0.982** | **(0.97, 1.00)** | **0.025** |
| *Full term (39-40 weeks)* | *Reference* | | |
| Later term (41-42 weeks) | 1.013 | (1.00, 1.03) | 0.079 |
| Post term (43+ weeks) | 1.009 | (0.95, 1.08) | 0.778 |

| | | | |
|---|---|---|---|
| **Change in Townsend** | | | |
| *No change in Townsend* | *Reference* | | |
| Changed to less deprived area | 1.012 | (0.99, 1.03) | 0.171 |
| Changed to more deprived area | **0.952** | **(0.93, 0.97)** | **<0.001** |
| **Eligible for a free school meal** | | | |
| *No* | *Reference* | | |
| Yes | **0.799** | **(0.78, 0.82)** | **<0.001** |
| **Any special educational needs** | | | |
| *No* | *Reference* | | |
| Yes | **0.456** | **(0.44, 0.47)** | **<0.001** |
| **School pupil size** | | | |
| *<=100 pupils* | *Reference* | | |
| >100-150 pupils | **1.098** | **(1.04, 1.16)** | **<0.001** |
| >150-200 pupils | **1.122** | **(1.07, 1.18)** | **<0.001** |
| >200-300 pupils | **1.100** | **(1.05, 1.15)** | **<0.001** |
| >300 pupils | **1.138** | **(1.09, 1.19)** | **<0.001** |
| **Maximum number of injuries** | | | |
| *No injuries^* | *Reference* | | |
| 1 injury | 1.049 | (0.92, 1.20) | 0.491 |
| 2 injuries | 1.018 | (0.89, 1.17) | 0.798 |
| 3+ injuries | 0.930 | (0.80, 1.08) | 0.340 |
| **Length of stay (LOS)** | 1.001 | (1.00, 1.00) | 0.099 |
| **GBD Injury Group (most severe prior to KS)** | | | |
| N34 Spinal cord lesion | 1.181 | (0.83, 1.68) | 0.356 |
| N28 Moderate to severe traumatic brain injury | 0.977 | (0.91, 1.04) | 0.482 |
| N19, N26 Fracture of femur | **0.883** | **(0.84, 0.93)** | **<0.001** |
| N45 Environmental factors (e.g. temperature, pressure, electricity) | 1.014 | (0.86, 1.20) | 0.867 |
| N20 Fracture of patella, tibia, fibula, or ankle | 0.974 | (0.95, 1.00) | 0.058 |
| N37, N17, N18 Crush injury, fracture foot/hand bones | **0.962** | **(0.93, 0.99)** | **0.021** |
| N43 Internal hemorrhage in abdomen or pelvis | **0.820** | **(0.69, 0.97)** | **0.021** |
| N27 Minor traumatic brain injury | **0.924** | **(0.86, 0.99)** | **0.033** |
| N21 Fracture of pelvis | 0.941 | (0.78, 1.13) | 0.514 |
| N42 Severe chest Injury | 1.232 | (0.88, 1.73) | 0.228 |

| | | | |
|---|---|---|---|
| N8, N9, N10 Burns (including lower airways) | 0.939 | (0.85, 1.04) | 0.209 |
| N25 Fracture of vertebral column | **0.779** | **(0.64, 0.95)** | **0.016** |
| N40, N44 Contusion, open wound | **0.930** | **(0.91, 0.95)** | **<0.001** |
| N35, N36 Asphyxiation, Non-fatal submersion | 0.825 | (0.64, 1.06) | 0.137 |
| N14 Other injuries of muscle & tendon and other dislocations | **0.953** | **(0.91, 0.99)** | **0.021** |
| N16 Fracture of face bone | 0.951 | (0.88, 1.03) | 0.195 |
| N41 Poisoning | 0.930 | (0.83, 1.05) | 0.225 |
| N15 Fracture of clavicle, scapula, or humerus | 0.990 | (0.97, 1.01) | 0.425 |
| *N22 Fracture of radius or ulna* | *Reference* | | |
| N47 Superficial | **0.942** | **(0.92, 0.97)** | **<0.001** |
| Other | **0.950** | **(0.93, 0.97)** | **<0.001** |
| **Cause** | | | |
| Motor vehicle driver/passenger | 0.979 | (0.93, 1.03) | 0.428 |
| Motorcycle driver/passenger | 0.924 | (0.84, 1.01) | 0.097 |
| Pedal cyclist-rider or passenger | **0.965** | **(0.94, 0.99)** | **0.007** |
| Pedestrian | **0.873** | **(0.83, 0.92)** | **<0.001** |
| Other transport related circumstance | 0.991 | (0.94, 1.05) | 0.733 |
| *Fall-low* | *Reference* | | |
| Fall-high | **0.956** | **(0.94, 0.97)** | **<0.001** |
| Submersion / drowning / Other threat to breathing | 0.881 | (0.77, 1.00) | 0.055 |
| Fire, flames, smoke | **0.849** | **(0.73, 0.99)** | **0.042** |
| Scalds | 0.984 | (0.89, 1.09) | 0.763 |
| Contact burn | 0.976 | (0.88, 1.09) | 0.660 |
| Poisoning | 0.993 | (0.88, 1.12) | 0.910 |
| Cutting, piercing object | **0.960** | **(0.93, 0.99)** | **0.003** |
| Animal related | 0.958 | (0.91, 1.00) | 0.065 |
| Struck by or collision with person/object | 1.001 | (0.98, 1.03) | 0.964 |
| Other cause | **0.961** | **(0.94, 0.98)** | **<0.001** |
| **Intent** | | | |
| *Unintentional/non-intentional harm* | *Reference* | | |
| Intentional self-harm | **0.863** | **(0.82, 0.91)** | **<0.001** |
| Intentional assault | 0.968 | (0.93, 1.01) | 0.157 |
| Adverse effect or complication of medical or surgical care | 0.980 | (0.57, 1.67) | 0.939 |

| | | | |
|---|---|---|---|
| Intent not specified/cannot be determined | 0.895 | (0.80, 1.00) | 0.059 |

Note: ARR = Adjusted relative risk, CI = Confidence interval. KS = Academic key stage. LOS = Length of stay. Bold represents significant at $\alpha = 0.05$. Number of observations across all KS = 62,871, Number of schools = 1,652. ^ Some children had no injury prior to a KS, then injured.