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# Preterm birth and unintentional injuries: risks to children, adolescents and young adults show no consistent pattern

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## Abstract

**Aim—**Preterm birth is associated with a number of physical and mental health issues. The aim of this study was to find out if there was also any association between individuals born preterm in Sweden between 1984 and 2006 and the risk of unintentional injuries during childhood, adolescence and young adulthood.

**Methods—**The study followed 2,297,134 individuals, including 5.9% born preterm, from 1985 to 2007 for unintentional injuries leading to hospitalisation or death (n=244,021). The males and females were divided into four age groups: 1–5 years, 6–12 years, 13–18 years and 19–23 years. Hazard ratios were calculated for falls, transport injuries and other injuries.

**Results—**After adjusting for a comprehensive set of covariates, some of the preterm subgroups demonstrated slightly increased risks of unintentional injuries, while others showed slightly decreased risks. However, most of the estimates were borderline or non-significant in both males and females. In addition, the absolute risk differences between individuals born preterm and full term were small.

**Conclusion—**Despite the association between preterm birth and a variety of physical and mental health consequences, this study shows that there is no consistent risk pattern between preterm birth and unintentional injuries in childhood, adolescence and young adulthood.

### Keywords

accidents; adolescence; childhood; preterm birth; injuries

The rate of preterm birth, defined as <37 weeks of gestation, is increasing worldwide and so is the long-term survival of preterm born infants, due to significant advances in perinatal medicine (1, 2). Concerns have been raised about the long-term health issues faced by the constantly increasing number of preterm infants, as well as the economic burden on society (1, 3, 4).

Preterm birth is associated with a variety of physical and mental health consequences in childhood, adolescence and young adulthood (1, 3–5). These include specific neurobehavioural disorders, such as attention-deficit/hyperactivity disorder (ADHD), and

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impaired cognitive function (5), which may lead to unintentional injuries. Children with intellectual disabilities and ADHD may face a greater risk of unintentional injuries, due to difficulties with inhibitions, attention and planning ability. For example, previous studies have shown that ADHD is associated with an increased risk of unintentional injuries (6, 7). A study of US children with burn injuries found that children with ADHD also had a significantly greater history of other high risk behaviours than children without ADHD (8). It could therefore be hypothesised that some preterm born individuals may have a higher risk of unintentional injuries.

Unintentional injuries are particularly important to child and adolescent health, given their high incidence. However, current knowledge of the potential association between preterm birth and unintentional injuries is limited, despite the fact that such injuries are a leading cause of death and disabilities in children and adolescents worldwide. Studies have shown that unintentional injury is the leading cause of death for children and adolescents aged 10–19 years worldwide (9, 10), that injuries account for 40% of all childhood fatalities and that tens of millions of children require hospital care each year for non-fatal injuries that can lead to lifelong disabilities (9).

While earlier studies of preterm birth and unintentional injuries have suggested possible relationships, they have been compromised by limited sample sizes (11) or short follow-up periods (12), as well as a lack of data on different types of injuries. To date, no study has investigated whether individuals who are born with shorter gestational ages are more vulnerable to unintentional injury throughout childhood, adolescence and young adulthood.

The aim of the present large-scale study was to analyse the association between individuals born preterm between 1984 and 2006 in Sweden and the risk of several major types of unintentional injuries during childhood, adolescence and young adulthood. Possible confounders, such as maternal socio-demographic factors, were accounted for during the analysis.

## PATIENTS AND METHODS

### Data sources and study population

The dataset we used included information from 1973 onwards on 97.0% – 99.5% of all pregnancies, births and prenatal care in Sweden. Data were collected for individuals who were born between January 1, 1984 and December 31, 2006, and who survived their first year of life. The dataset also contained data from Statistics Sweden (population census registry) and the National Board of Health and Welfare (Swedish Hospital Discharge Register and Swedish Cause of Death Register). The Hospital Discharge Register was established in 1964, but not all hospitals in all county councils were included until 1987. By 1984, however, 24 of the 26 county councils were included, covering approximately 95% of the Swedish population at that time (13). We have, therefore, used 1984 as our starting point.

Out of 2,327,943 individuals born between 1 January 1984 and 31 December 2006, 1.3% were excluded because they died or emigrated before their first birthday, had no identification number or had missing values on gestational age or sex. This resulted in a study population of 2,297,134.

### Exposure variable

All pregnant women in Sweden are offered free antenatal care and the majority undergo an ultrasound examination between gestational weeks 16–18 (14). In our data, gestational age was based on ultrasound in 68% of all pregnancies. If the ultrasound was missing, the last

menstrual period was used. Preterm birth was defined as birth before 37 completed weeks of gestation and full-term birth as 37 completed weeks or more. We also carried out an additional subsample analysis of the 1% of the cohort individuals who were born very preterm (<32 completed weeks) to see if there was any association with unintentional injuries.

Since neurological impairment might affect the risk of unintentional injuries, we also analysed a further subsample, of the preterm born individuals with neurological impairment (2.3% of the preterm individuals). This was defined using the following diagnostic codes from the International Classification of Diseases, tenth version (ICD-10): F07, F70-79, F80-F89, F90-F99, G40, G41, G80-G83, G91. These diagnostic codes were translated to the corresponding codes from ICD-9 and ICD-8.

## Strata examined

* *Age*. Studies have shown that incidence rates and types of injuries change by age (9, 15). Therefore the study population was stratified into four age groups, aligned with the Swedish school system: ages 1–5 (early childhood, preschool), 6–12 (preteen, elementary school), 13–18 (adolescence, middle and high school), 19–23 (young adulthood). In order to align the strata more closely with the school system, which changes the child's environment, the strata changed on 1 July of the year the child turned 6, 13 or 19. The only exception was for the first age group (1–5), which started when the child reached the age of one.

* *Sex*. The study population was also stratified by male (1) and female (2) because boys are injured more often than girls.

## Outcome variable

All individuals were followed from the age of one year (at the earliest 1985) until they had an unintentional injury, died or emigrated, or the study ended. The individuals were followed separately for each cause of injury (fall, transport and other) and in each age group. Only unintentional injuries that resulted in hospitalisation or death were included in the analysis. To avoid repeated registrations caused by the same unintentional injury, only the first hospitalisation in each category was counted.

Unintentional injuries were determined in accordance with earlier studies (16). Intentional injuries and self-injuries were not included. The cause of injury was defined as a case recorded in the Hospital Discharge Register and Causes of Death Register according to the World Health Organization International Classifications of Diseases (ICD) version 8, 9 or 10 as:

* *Transport injuries*. For example, the patient was involved in an accident as a pedestrian, pedal cyclist, horserider, car driver or motorcyclist or as a passenger in a car, bus, lorry, train or airplane. (E800-E807, E810-E823, E825-E827, E830-E838, E840-E845 [ICD-8], E800-E807, E810-E838, E840-E848 [ICD-9], V01-V99 [ICD-10]).

* *Falls*. The patient fell at the same level (for example due to ice/snow or pushing) or from a different level (for example from furniture, a tree, stairs or ladder). (E880-E887 [ICD-8], E880-E886, E888 [ICD-9], W00-W19 [ICD-10]).

* *Other unintentional injuries*. These injuries include, for example, exposure to living or non-living forces, drowning, suffocation, burn, unintentional poisoning or events of an undetermined intent. (E850-E877, E890-E899, E900-E929 E980-E988 [ICD-8], E850-E858, E860-E869, E890-E899, E900-E928 E980-E988 [ICD-9], W20-X59 Y10-Y34 [ICD-10]).

## Explanatory variables

A range of possible explanatory variables was defined according to previous studies (16, 17). When these variables were examined, they showed an association to unintentional injuries (data not shown). The variables were used as covariates and were determined in the year that the child entered each age group. One exception to this was maternal hospitalisation due to alcohol or drug abuse or psychiatric disease – this was estimated for the three years before entry into each age group. For categorised variables, zero (0) was used as the reference group for the following:

* *Calendar year*: Divided into five-year groups as follows: (0) 1985–1989, (1) 1990–1995, (2) 1996–2001 or (3) 2002–2007.

* *Maternal age*: continuous variable, centred at its mean.

* *Maternal marital status*: (0) married, (1) never married, widowed or divorced.

* *Maternal education*: (0) college or university (> 12 years), (1) practical or theoretical high school (10–12 years) or (2) completion of compulsory school or less (≤ 9 years).

* *Maternal immigration*: (0) Mother born in Sweden, (1) mother immigrated from another country.

* *Maternal social allowance*: (0) no, (1) yes.

* *Maternal hospitalisation due to alcohol or drug abuse or psychiatric disease* within three years before entry into each age group: (0) no, (1) yes.

## Statistics

All analyses were stratified by injuries and age strata as described above. They were also conducted separately for each sex. Characteristics of the preterm and full-term individuals were estimated for each age group. Incidence rates of falls, transport injuries, other injuries and any unintentional injury were assessed per 1,000 person-years in preterm and full-term individuals. Person-years at risk were calculated from entry into each age group until first injury or death, migration, the end of the age group or the end of follow-up on December 31, 2007. Individuals suffering from one type of injury were still included in the follow-up for other types of injuries.

Time to unintentional injury in preterm versus full-term individuals was estimated using the Cox proportional hazards model, with 95% confidence intervals (CI). The first analysis was made without adjustments. Further analyses were then made for the following potential confounding variables: calendar year, maternal age, maternal marital status, maternal education, maternal immigration, maternal social allowance and maternal hospitalisation due to alcohol, drug abuse or psychiatric diseases. Preterm individuals born with neurological impairment were analysed as a single group, regardless of sex or age, and rates of any unintentional injury were compared with all preterm born individuals without neurological impairment.

We also estimated adjusted survival curves, separately for preterm and full-term individuals, using the fitted Cox regression model with all the other covariates set to zero (reference group). Similar to the other analyses, one survival curve was calculated for each of the strata described above. In an additional analysis, the Andersen-Gill proportional hazards model was used to examine repeated injuries. These were treated in the analysis as separate

observations from several individuals. A robust variance estimator was used to account for the correlation among multiple observations per individual.

The proportionality assumption was tested using Schoenfeld residuals. Cox-Snell residuals were applied to assess the goodness of fit of the model. These tests showed no violation of the proportionality assumptions (data not shown). All analyses were performed in STATA version 11 (Stata Corporation, College Station TX, 2003).

### Ethical Considerations

The study was approved by the Ethics Committee at Lund University, Sweden.

## RESULTS

Out of the 2,297,134 individuals studied, 135,762 (5.9%) were born preterm (<37 weeks of gestation), with more premature boys than girls. The mothers of the preterm born children were more likely to be unmarried, have a low level of education and/or receive social allowance. They had also been hospitalised more often due to substance abuse or psychiatric disease (Table S1).

The numbers and incidence rates of falls, transport injuries, other injuries and any injury per 1,000 person-years are shown, separately for males and females, in Table 1. During the study period, there were 8,259 unintentional injuries recorded for preterm males and 120,108 for full-term males, together with 5,010 injuries for preterm females and 80,014 for full-term females. Falls were the most common cause of injury in all male age groups, except among 19–23 years old, where other injuries and transport injuries were more common. Falls were the most common cause of injury in female age groups 1–5 and 6–12, with transport injuries more common in females aged 13–18 and 19–23. Out of all the 244,021 unintentional injuries, 1,011 (0.7%) were fatal in males and 536 (0.6%) in females.

Crude and adjusted hazard ratios with 95% CIs for falls, transport injuries and other injuries in preterm versus full-term males and females are shown in Table 2. In some of the subgroups the hazard ratio reached statistical significance for increased risk, for example the adjusted hazard ratio of 1.11 (95% CI: 1.05–1.17) for other injuries in preterm boys aged 1–5. In contrast, the risk was reduced in other subgroups, for example the adjusted hazard ratio of 0.80 (95% CI: 0.67–0.97) for transport injuries in preterm males aged 19–23. However, most of the estimates were borderline or non-significant, both in males and females. In addition, by studying the adjusted survival curves, we found that the absolute differences in injury rates between preterm and full-term individuals were very small. The largest difference was found for 1–5 year old girls: at the end of the follow-up, 4.5% of preterm girls in this age group had experienced any unintentional injury, compared to 4.1% of full-term girls. The other subgroups had even smaller absolute differences between preterm and full-term individuals (data not shown in tables).

In the additional analysis of very preterm individuals (<32 completed weeks), most of the estimates were borderline or non-significant in both males and females. However, some categories had significantly decreased or increased risks. The highest significant risk (hazard ratio 1.20 [95% CI:1.03–1.40]) was for fall injuries in females aged 1–5 years (data not shown in tables).

In the additional analysis of preterm born individuals with neurological impairment, the risk of any unintentional injury did not differ from the risk in preterm born individuals without neurological impairment. The hazard ratio was 1.06 (95% CI: 0.97–1.16) (data not shown in tables).

## DISCUSSION

The main finding of this study is that some subgroups of preterm born individuals had a slightly increased risk of unintentional injuries, whereas others had slightly decreased risks, after adjustments for a comprehensive set of covariates. In addition, the absolute risk differences between preterm and full-term individuals were very small. This implies that preterm birth is not a strong predictor for injuries in childhood, adolescence and young adulthood.

To the best of our knowledge, this is the first study that has examined the risk of different types of unintentional injuries in preterm born boys and girls throughout childhood, adolescence, and young adulthood. The findings of this study are important, because concerns have been raised about the long-term health consequences in these infants, as well as the economic burden on society. Although injuries represent a leading cause of death and disabilities in children and adolescents worldwide, our findings show that infants who are born preterm and survive the first year, do not cause an additional economic burden on society due to unintentional injuries.

Previous studies of the potential association between preterm birth and unintentional injuries are scarce. A 1989 UK study that examined 18 preterm and 18 full-term children, showed an increased risk of unintentional injuries for three-year-old children born preterm (11). A 2001 US study of more than 10 million births, reported that low birth weight is associated with increased mortality due to unintentional injury in infants. However, it did not include data on gestational length (12). Also, the US study examined fatal unintentional injuries during the infant's first year of life, whereas we studied fatal and non-fatal injuries from one year of age. This means that the US study and our study are not directly comparable.

The findings of our study are of clinical importance. During the last few decades, the rate of preterm births has increased worldwide and advances in perinatal medicine have increased the survival of these infants (3, 18, 19). This increases the importance of information about how these infants manage later in life (4). Earlier studies on preterm children have shown continued sequelae, such as cerebral palsy, mental disorders, neurobehavioral developmental disorders and more subtle cognitive impairments, such as learning disabilities, behavioural problems and social disabilities (1, 4, 20–22). Some of these conditions may also be related to unintentional injuries (15–17, 23, 24).

### Strengths and limitations

The major advantages of the present study are: 1) its use of national data registers, which make it possible to conduct a longitudinal study on a large population without selection bias, 2) a comprehensive set of potential covariates and highly complete data and 3) use of hospitalisation and death records, which are not subject to self-reporting bias from parents. Being able to access data for more than two million individuals made it possible to study an uncommon outcome such as injuries leading to hospitalisation. And the long follow-up enabled us to study the risk of unintentional injuries during the entire period of childhood, adolescence and early adulthood. This is in contrast to earlier studies that have been limited to health effects during childhood and unable to evaluate long-term morbidity and mortality (25).

Preterm born children are also associated with less favourable socio-economic and socio-demographic parameters, which are also related to unintentional injuries (1, 24). In this study, we were able to include a number of socio-economic and socio-demographic covariates that could provide potential confounding factors. We believe this makes our conclusions more accurate (16, 17). Furthermore, we chose to estimate the risk of

unintentional injury from the age of one, rather than from birth, as injury is considered to be a significant cause of death and morbidity from this age (9). This is also the age when many children begin to walk.

Our predictor variable was based on gestational length, which is a major strength. Earlier studies have often used low birth weight (LBW) as the predictor variable. However, LBW may be an unreliable predictor because it is determined by both duration of gestation and the rate of foetal growth. Consequently, LBW may occur because an infant is born either preterm or is small for gestational age (2, 26).

The present study also had some limitations. We needed to restrict injuries to unique ICD codes to avoid analysing repeated hospitalisations caused by the same unintentional injury. As a result, we may have missed some injuries or counted the same injury repeatedly if the ICD code was changed during the course of the illness. However, this type of bias would occur in both the preterm and full-term infants. Furthermore, we only present the first unintentional injury of each type in each age stratum, rather than repeated injuries. A previous study reported a history of injury as a risk factor for future injury (15). We performed an additional analysis with repeated injuries and the results were almost identical to our analysis of the first unintentional injury. A certain proportion of children born preterm may be neurologically handicapped and rarely engage in sports, drive a car or be at risk from other kinds of unintentional injury. The measure of time at risk may not be representative for these children, which may constitute a limitation of this study. This is particularly salient, as previous studies have shown that preterm born individuals are less likely to be involved in risky behaviour. For example, two studies on the same cohort of preterm born women aged 20 years demonstrated lower risks of substance abuse (27) and lower overall risk taking, including individual risk factors (smoking, alcohol and drugs) and associating with delinquent peers (28). Similar findings were recently found among preterm born individuals aged 14 years in a 1992–1995 cohort (29). In addition, it would have been desirable to adjust the risk of transport injuries by whether the individual held a driver's licence. However, we do not have access to such data. Another limitation is that we only had access to data on unintentional injuries leading to hospitalisation or death. A study on Canadian children aged 0–9 years showed that most non-fatal injuries did not require hospitalisation (30). However, injuries requiring hospitalisation represent more serious injuries, which are of larger clinical relevance. In addition, they are also associated with higher costs for society and are therefore of more concern than minor injuries treated in outpatient clinics or at home.

In conclusion, this study suggests that there is no consistent risk pattern between preterm birth and unintentional injuries in childhood, adolescence and young adulthood.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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## REFERENCES

1. Moster D, Lie RT, Markestad T. Long-term medical and social consequences of preterm birth. N Engl J Med. 2008; 359:262–273. [PubMed: 18635431]

2. Tucker J, McGuire W. Epidemiology of preterm birth. BMJ. 2004; 329:675–678. [PubMed: 15374920]
3. Fellman V, Hellstrom-Westas L, Norman M, Westgren M, Kallen K, Lagercrantz H, et al. One-year survival of extremely preterm infants after active perinatal care in Sweden. JAMA. 2009; 301:2225–2233. [PubMed: 19491184]
4. Saigal S, Doyle LW. An overview of mortality and sequelae of preterm birth from infancy to adulthood. Lancet. 2008; 371:261–269. [PubMed: 18207020]
5. Bhutta AT, Cleves MA, Casey PH, Cradock MM, Anand KJ. Cognitive and behavioral outcomes of school-aged children who were born preterm: a meta-analysis. JAMA. 2002; 288:728–737. [PubMed: 12169077]
6. Pastor PN, Reuben CA. Identified attention-deficit/hyperactivity disorder and medically attended, nonfatal injuries: US school-age children, 1997–2002. Ambul Pediatr. 2006; 6:38–44. [PubMed: 16443182]
7. Sabuncuoglu O. Traumatic dental injuries and attention-deficit/hyperactivity disorder: is there a link? Dent Traumatol. 2007; 23:137–142. [PubMed: 17511834]
8. Badger K, Anderson L, Kagan RJ. Attention deficit-hyperactivity disorder in children with burn injuries. J Burn Care Res. 2008; 29:724–729. [PubMed: 18695621]
9. World Health Organization & United Nations Children's Fund. Geneva: 2008. World report on child injury prevention.
10. Harvey A, Towner E, Peden M, Soori H, Bartolomeos K. Injury prevention and the attainment of child and adolescent health. Bull World Health Organ. 2009; 87:390–394. [PubMed: 19551258]
11. Walker J. The behaviour of 3-year-old children who were born preterm. Child Care Health Dev. 1989; 15:297–313. [PubMed: 2805237]
12. Jain A, Khoshnood B, Lee KS, Concato J. Injury related infant death: the impact of race and birth weight. Inj Prev. 2001; 7:135–140. [PubMed: 11428561]
13. Ludvigsson JF, Andersson E, Ekbom A, Feychting M, Kim JL, Reuterwall C, et al. External review and validation of the Swedish national inpatient register. BMC Public Health. 2011; 11:450. [PubMed: 21658213]
14. SBU. Reports from the Swedish Council on Technology Assessment in Health Care. Int J Technol Assess Health Care. 1999; 15:424–436. [PubMed: 10507199]
15. Mytton J, Towner E, Brussoni M, Gray S. Unintentional injuries in school-aged children and adolescents: lessons from a systematic review of cohort studies. Inj Prev. 2009; 15:111–124. [PubMed: 19346424]
16. Li X, Sundquist S, Johansson SE. Effects of neighbourhood and individual factors on injury risk in the entire Swedish population: a 12-month multilevel follow-up study. Eur J Epidemiol. 2008; 23:191–203. [PubMed: 18193169]
17. Schwebel DC, Gaines J. Pediatric unintentional injury: behavioral risk factors and implications for prevention. J Dev Behav Pediatr. 2007; 28:245–254. [PubMed: 17565295]
18. Draper ES, Zeitlin J, Fenton AC, Weber T, Gerrits J, Martens G, et al. Investigating the variations in survival rates for very preterm infants in 10 European regions: the MOSAIC birth cohort. Arch Dis Child Fetal Neonatal Ed. 2009; 94:F158–F163. [PubMed: 18805823]
19. Martin JA, Kung HC, Mathews TJ, Hoyert DL, Strobino DM, Guyer B, et al. Annual summary of vital statistics: 2006. Pediatrics. 2008; 121:788–801. [PubMed: 18381544]
20. Arpino C, Compagnone E, Montanaro ML, Cacciatore D, De Luca A, Cerulli A, et al. Preterm birth and neurodevelopmental outcome: a review. Childs Nerv Syst. 26:1139–1149. [PubMed: 20349187]
21. Aylward GP. Cognitive function in preterm infants: no simple answers. JAMA. 2003; 289:752–753. [PubMed: 12585955]
22. Lindstrom K, Winbladh B, Haglund B, Hjern A. Preterm infants as young adults: a Swedish national cohort study. Pediatrics. 2007; 120:70–77. [PubMed: 17606563]
23. Brehaut JC, Miller A, Raina P, McGrail KM. Childhood behavior disorders and injuries among children and youth: a population-based study. Pediatrics. 2003; 111:262–269. [PubMed: 12563049]

24. Laflamme L, Hasselberg M, Burrows S. 20 Years of Research on Socioeconomic Inequality and Children's-Unintentional Injuries Understanding the Cause-Specific Evidence at Hand. Int J Pediatr. 2010

25. Swamy GK, Ostbye T, Skjaerven R. Association of preterm birth with long-term survival, reproduction, and next-generation preterm birth. JAMA. 2008; 299:1429–1436. [PubMed: 18364485]

26. Kramer MS. Determinants of low birth weight: methodological assessment and meta-analysis. Bull World Health Organ. 1987; 65:663–737. [PubMed: 3322602]

27. Hack M, Flannery DJ, Schluchter M, Cartar L, Borawski E, Klein N. Outcomes in young adulthood for very-low-birth-weight infants. N Engl J Med. 2002; 346:149–157. [PubMed: 11796848]

28. Hack M, Cartar L, Schluchter M, Klein N, Forrest CB. Self-perceived health, functioning and well-being of very low birth weight infants at age 20 years. J Pediatr. 2007; 151:635–641. 41 e1–41 e2. [PubMed: 18035144]

29. Hack M, Schluchter M, Forrest CB, Taylor HG, Drotar D, Holmbeck G, et al. Self-reported adolescent health status of extremely low birth weight children born 1992–1995. Pediatrics. 2012; 130:46–53. [PubMed: 22665412]

30. Spady DW, Saunders DL, Schopflocher DP, Svenson LW. Patterns of injury in children: a population-based approach. Pediatrics. 2004; 113:522–529. [PubMed: 14993544]

**Key notes**

- Preterm birth is associated with a variety of physical and mental health consequences.
- However, this study showed no consistent risk pattern between preterm birth and unintentional injuries in childhood, adolescence and young adulthood.
- The results imply that preterm birth is not a strong predictor for injuries in these age groups.

**Table 1**

Numbers and incidence rates of unintentional injuries per 1,000 person-years (p-yrs) among males and females in each age group

| | Cause of injury | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Falls | | | Transport injuries | | | Other injuries | | | Any injury | | |
| Age group | Cases | P-yrs | Rate | Cases | P-yrs | Rate | Cases | P-yrs | Rate | Cases | P-yrs | Rate |
| *Males* | | | | | | | | | | | | |
| 1–5 | | | | | | | | | | | | |
| Preterm | 1860 | 319515 | 5.82 | 226 | 323553 | 0.70 | 1447 | 319650 | 4.53 | 3460 | 315042 | 10.98 |
| Full-term | 26068 | 4850007 | 5.37 | 3697 | 4905284 | 0.75 | 19708 | 4853059 | 4.06 | 48409 | 4787394 | 10.11 |
| 6–12 | | | | | | | | | | | | |
| Preterm | 2058 | 319842 | 6.43 | 549 | 325182 | 1.69 | 707 | 324494 | 2.18 | 3213 | 316041 | 10.17 |
| Full-term | 29078 | 4861614 | 5.98 | 8382 | 4932237 | 1.70 | 9947 | 4924597 | 2.02 | 45875 | 4808846 | 9.54 |
| 13–18 | | | | | | | | | | | | |
| Preterm | 853 | 155491 | 5.49 | 560 | 156460 | 3.58 | 487 | 156764 | 3.11 | 1824 | 152988 | 11.92 |
| Full-term | 12903 | 2331656 | 5.53 | 9386 | 2346152 | 4.00 | 7680 | 2350949 | 3.27 | 28725 | 2292121 | 12.53 |
| 19–23 | | | | | | | | | | | | |
| Preterm | 117 | 37573 | 3.11 | 125 | 37545 | 3.33 | 192 | 37462 | 5.13 | 420 | 37089 | 11.32 |
| Full-term | 1816 | 552823 | 3.28 | 2184 | 552155 | 3.96 | 2344 | 552253 | 4.24 | 6134 | 545743 | 11.24 |
| 1–23 | | | | | | | | | | | | |
| Preterm | 4696 | 809365 | 5.80 | 1422 | 837900 | 1.70 | 2753 | 823766 | 3.34 | 8259 | 781618 | 10.57 |
| Full-term | 67239 | 12270124 | 5.48 | 23045 | 12657716 | 1.82 | 38752 | 12476815 | 3.11 | 120108 | 11866795 | 10.12 |
| *Females* | | | | | | | | | | | | |
| 1–5 | | | | | | | | | | | | |
| Preterm | 1274 | 275187 | 4.63 | 165 | 278066 | 0.59 | 898 | 275736 | 3.26 | 2293 | 272356 | 8.42 |
| Full-term | 19911 | 4630676 | 4.30 | 2626 | 4675744 | 0.56 | 13093 | 4641571 | 2.82 | 35003 | 4588833 | 7.63 |
| 6–12 | | | | | | | | | | | | |
| Preterm | 1141 | 275127 | 4.15 | 409 | 277826 | 1.47 | 393 | 277717 | 1.42 | 1896 | 272806 | 6.95 |
| Full-term | 18271 | 4668704 | 3.91 | 6630 | 4710474 | 1.41 | 5618 | 4711175 | 1.19 | 29773 | 4634108 | 6.42 |
| 13–18 | | | | | | | | | | | | |
| Preterm | 319 | 132232 | 2.41 | 335 | 132275 | 2.53 | 269 | 132436 | 2.03 | 897 | 130728 | 6.86 |

| | Cause of injury | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Falls | | | Transport injuries | | | Other injuries | | | Any injury | | |
| Age group | Cases | P-yrs | Rate | Cases | P-yrs | Rate | Cases | P-yrs | Rate | Cases | P-yrs | Rate |
| Full-term | 6068 | 2241935 | 2.71 | 6350 | 2242684 | 2.83 | 4443 | 2247932 | 1.98 | 16259 | 2216130 | 7.34 |
| 19–23 | | | | | | | | | | | | |
| Preterm | 60 | 31284 | 1.92 | 68 | 31273 | 2.17 | 72 | 31280 | 2.30 | 189 | 31069 | 6.08 |
| Full-term | 921 | 525083 | 1.75 | 1208 | 524583 | 2.30 | 1029 | 525144 | 1.96 | 3068 | 521588 | 5.88 |
| 1–23 | | | | | | | | | | | | |
| Preterm | 2715 | 699853 | 3.88 | 965 | 715922 | 1.35 | 1607 | 708274 | 2.27 | 5010 | 681930 | 7.35 |
| Full-term | 43957 | 11838846 | 3.71 | 16559 | 12094562 | 1.37 | 23779 | 11997352 | 1.98 | 80014 | 11565878 | 6.92 |

**Table 2**

Crude and adjusted hazard ratios (HR) for unintentional injuries with 95% confidence intervals (CI) for preterm males and females (full-term males or females used as reference)

| | Cause of injury | | | | | |
|---|---|---|---|---|---|---|
| | Falls | | Transport injuries | | Other injuries | |
| Age group | Crude HR (95% CI) | Adjusted HR (95% CI) | Crude HR (95% CI) | Adjusted HR (95% CI) | Crude HR (95% CI) | Adjusted HR (95% CI) |
| *Males* | | | | | | |
| 1–5 | 1.08 (1.03–1.14) | 1.07 (1.02–1.13) | 0.93 (0.81–1.06) | 0.92 (0.80–1.05) | 1.11 (1.06–1.18) | 1.11 (1.05–1.17) |
| 6–12 | 1.08 (1.03–1.12) | 1.07 (1.02–1.12) | 0.99 (0.91–1.08) | 0.98 (0.90–1.07) | 1.08 (1.00–1.16) | 1.06 (0.99–1.15) |
| 13–18 | 0.99 (0.93–1.06) | 0.99 (0.93–1.06) | 0.89 (0.82–0.97) | 0.88 (0.81–0.96) | 0.95 (0.87–1.04) | 0.94 (0.85–1.03) |
| 19–23 | 0.95 (0.79–1.14) | 0.95 (0.79–1.15) | 0.84 (0.70–1.01) | 0.80 (0.67–0.97) | 1.21 (1.04–1.40) | 1.15 (0.99–1.33) |
| *Females* | | | | | | |
| 1–5 | 1.08 (1.02–1.14) | 1.07 (1.01–1.13) | 1.06 (0.90–1.24) | 1.02 (0.86–1.19) | 1.15 (1.08–1.23) | 1.14 (1.06–1.22) |
| 6–12 | 1.06 (1.00–1.12) | 1.06 (1.00–1.12) | 1.05 (0.95–1.16) | 1.04 (0.94–1.15) | 1.19 (1.07–1.31) | 1.19 (1.07–1.31) |
| 13–18 | 0.89 (0.80–1.00) | 0.89 (0.80–1.00) | 0.89 (0.80–1.00) | 0.88 (0.79–0.99) | 1.03 (0.91–1.16) | 1.01 (0.89–1.15) |
| 19–23 | 1.09 (0.84–1.42) | 1.08 (0.83–1.41) | 0.95 (0.74–1.21) | 0.95 (0.74–1.21) | 1.18 (0.93–1.49) | 1.16 (0.91–1.47) |

*Adjusted for calendar year, maternal age, maternal marital status, maternal education, maternal immigration, maternal social allowance and maternal hospitalisation due to alcohol, drug abuse or psychiatric diseases.