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CONCUSSION AMONG CHILDREN & YOUTH: VANCOUVER COASTAL HEALTH AUTHORITY

BC INJURY research and
prevention unit

The British Columbia Injury Research and Prevention Unit (BCIRPU) was established by the Ministry of Health and the Minister's Injury Prevention Advisory Committee in August 1997. BCIRPU is housed in the Evidence to Innovation theme within the Child and Family Research Institute (CFRI) and supported by the Provincial Health Services Authority (PHSA) and the University of British Columbia (UBC). BCIRPU's vision is "to be a leader in the production and transfer of injury prevention knowledge and the integration of evidence-based injury prevention practices into the daily lives of those at risk, those who care for them, and those with a mandate for public health and safety in British Columbia".

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KEY HIGHLIGHTS

The purpose of this report is to provide details on the burden of concussion hospitalizations among children and youth in Vancouver Coastal Health Authority. This report is targeted to health care providers and community stakeholders in the health authority to be used to facilitate discussion of the need for standardized concussion prevention, diagnosis and management specific to children and youth.

Evidence suggests that children and youth are at greater risk of concussion and more serious head injury than the general population, take longer than adults to recover following a concussion, and that concussions can permanently change the way a child or youth talks, walks, learns, works and interacts with others.

Concussion management and appropriate return to activity is crucial, particularly in the paediatric and adolescent populations. Active and timely rehabilitation is essential for concussion patients who remain symptomatic longer than a six-week period. This may include physiotherapy, occupational therapy, educational support, neuropsychology and in some cases, neuropsychiatry.

It is important to note that an individual is 3-times more likely to sustain a second concussion while recovering from the primary concussion. Furthermore, while a rare occurrence, a condition known as second-impact syndrome (SIS) may occur if a second injury to the brain is sustained within a day or two after the first concussive event. This leads to swelling of the brain that can result in brain damage, causing severe disability and in a few cases even death.

Concussions are the most common form of head injury, yet this significant health issue is under-reported due to a lack of education and awareness among the general public and inconsistent and limited availability of data around the burden of this injury. The data presented in this report represent only a fraction of the children and youth that may have sustained a concussion, as this report does not capture concussions treated at physicians' offices, walk-in clinics, or those not recognized and treated at all.

Highlights include but are not limited to the following:

- From 2001/02 to 2013/14 there were 354 concussion hospitalizations among children and youth aged 0 to 19 years.

- Male children and youth had twice the rates of concussion hospitalizations as females (14.8/100,000 vs. 7.4/100,000).
- The leading causes of child and youth concussion hospitalizations were due to falls (52%) and transport-related events (31%).
- Among children and youth aged 0 to 19 years in Vancouver Coastal Health, those aged 1 to 4 years had the highest rates of fall-related concussion hospitalizations (10.4/100,000) and those aged 10 to 19 years had the highest rates for transport-related concussions (6.2/100,000).
- Older children in Vancouver Coastal Health experienced a larger proportion of sports-related concussion hospitalizations as compared to younger children, with a greater rate of occurrence among males rather than females.
- Cycling (36.1%), playground (12.9%), and ski and snowboard (11.6%) activities were the greatest contributors for sport and recreation-related concussion hospitalizations in Vancouver Coastal Health among children and youth 0 to 19 years old.
- Child and youth residents within North Shore/Coast Garibaldi had the highest rates of concussion hospitalizations (22.3/100,000), with 70.1 percent admitted to Vancouver Coastal Health hospitals.
- Leading causes of child and youth fall-related concussion hospitalizations in Vancouver Coastal Health were 'fall involving skates, skis and skateboards' (19.0%) and 'fall on the same level' (16.8%).
- Leading causes of child and youth transport-related concussion hospitalizations in Vancouver Coastal Health were 'pedal cyclist' (56%) and 'motor vehicle occupant' (19.3%).
- Rates of emergency department visits within Vancouver Coastal Health were highest among males and among children aged 0 to 4 years.
- Lions Gate Hospital reported the highest number of concussion emergency department visits (710 visits) within Vancouver Coastal Health from 2013/14 to 2014/15.

Concussions remain a significant health issue for children and youth in Vancouver Coastal Health, and require further attention given the potential for long-lasting effects. This may include concussion prevention, education and awareness, standardizing care, and ensuring correct treatment protocols are adhered to and appropriate concussion management is employed.

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INTRODUCTION

Children and youth are at greater risk of concussion and more serious head injury than the general population. Concussions are the most common form of head injury, yet it is believed that they are under-reported owing to both a lack of consensus in the definition of a concussion and the presence of misconceptions among the general public on the symptoms of concussion [1]. The rate of concussion hospitalization in the adult at-risk population has been measured at 1 to 3 per 1,000 in the United States, but it is estimated that the true concussion rate could be as high as 6 per 1,000 [2]. Nonetheless, concussions reportedly account for 3 to 8 percent of all sports-related injuries among youth presenting to urban emergency departments in Canada, which is expected to increase as public awareness rises [1, 3]. Furthermore, studies using national injury reporting databases in the United States indicate that sports-related injuries are responsible for 46 to 58 percent of all concussions suffered by youth between the ages of 8 and 19 years [1, 4]. Comparable Canadian data are not available.

Concussion, also known as mild traumatic brain injury (mTBI), occurs as a result of an impact to or forceful motion of the head, resulting in a jarring of the brain. This may lead to a brief alteration of mental status, which may include: confusion, loss of memory directly preceding the event, sensitivity to light, slurred speech, dizziness, emotional changes, and may or may not be accompanied by loss of consciousness or seizures [1, 5, 6].

Evidence exists that children and youth take longer than adults to recover following a concussion [1], and that concussion can permanently change the way a child or youth talks, walks, learns, works and interacts with others. Therefore, concussion management and appropriate return to activity protocol are crucial, particularly in the paediatric and adolescent populations.

Active and timely rehabilitation is essential for concussion patients who remain symptomatic longer than a six-week period. This may include physiotherapy, occupational therapy, educational support, neuropsychology and in some cases neuropsychiatry. It is important to note that an individual is 3-times more likely to sustain a second concussion while in recovery from a concussion [7]. Also, while rare, a condition known as second-impact syndrome (SIS) may occur if a second injury to the brain is sustained within a day or two of the first concussion event, where swelling of the brain that can result in brain damage causing severe disability or even death [8].

Purpose

The purpose of this report is to provide details on the burden of unintentional concussion hospitalizations and emergency department visits among children and youth living within or attending any of the hospitals in the Vancouver Coastal Health Authority. This report will be used to facilitate discussion of the need for standardized concussion prevention, diagnosis and management specific to children and youth.

Concussion as a health event is recognized to be under-reported and inconsistently coded. Concussion may also be labelled as a minor traumatic brain injury (mTBI), or sometimes as a 'head injury', which may include other injuries not involving the brain.

METHODOLOGY

Data Sources

Hospitalization Data: The Discharge Abstract Database (DAD) obtained from the BC Ministry of Health was used to provide information on concussion hospitalizations for the fiscal years 2001/02 to 2013/14. The data include external causes of injury classified according to *International Classification of Disease (ICD)-10 CA*. In 2001, injury hospitalization data coding switched from ICD-9 to ICD-10 CA. By 2002, all hospitals in BC reported using ICD-10 CA for their Discharge Abstract Data. Differences in numbers between 2001 and 2002 may be attributed to some hospitals still converting to the new coding structure. Unintentional concussion hospitalizations were also extracted separately using ICD-10 CA code S06. The hospitalization data include all acute, rehab and day surgery cases. The data are based on hospital separations rather than on patient, therefore multiple admissions of the same patient for the same injury would be counted as separate cases.

Emergency Department Visit Data: Emergency department visit data are reported in two segments. The first is using all emergency department visits from hospitals within Vancouver Coastal Health, and the second is emergency department visits to the BC Children's Hospital by residents of Vancouver Coastal Health. Data were obtained from Decision Support Services, Provincial Health Services Authority (PHSA). The emergency department data are part of the National Ambulatory Care Reporting System (NACRS). Data were available for fiscal years 2012/13 to 2013/14 by age, sex and type of injury. Unintentional concussion emergency department visits were extracted separately using ICD-10 CA code S06. External codes for injury were not available and data by cause of injury are therefore not presented for emergency department visits. Data for emergency department visits to BC Children's Hospital by residents of Vancouver Coastal Health were

extracted using postal code information that represented the residence of the patient. Data for BC Children's hospital was available from April 1, 2012 to May 21, 2015.

Analysis

Hospitalization rates were calculated per 100,000 population for age, sex, year and leading cause of injury. Age-specific and crude rates are used in the report to describe actual burden rather than comparative rates across time and regions (where age-standardized rates would normally be used). The age-specific rates were calculated by dividing the number of cases in each age group by the population of that specific age group within Vancouver Coastal Health. Rates presented by region are based on the patients' residence and not the location of injury occurrence.

Emergency department rates for Vancouver Coastal Health residents were calculated per 100,000 population for the region and rates for each hospital were calculated per 100,000 emergency department visits for all diagnoses.

Population data were obtained from BC Vital Statistics Agency.

Trend analyses were conducted using a linear regression model to test the statistical significance of the association between injuries over time. This test appraises the linear component of the relationship between injury rates and scores allocated to the categories of time (calendar years). In addition, Z tests for proportions were conducted to test significance between age groups and region.

Definitions for leading causes of concussion:

- Transport-related events include: crashes involving cars, trucks, motorcycles, bicycles, pedestrians, etc.
- Falls include: fall on the same level, fall from a height, falls on stairs or steps, fall from a building or other structure, etc.

- Struck by/against an object includes: forceful contact with a falling object, striking against or struck accidentally by objects or persons, and caught between objects, depending on the coding system, struck by/against an object involving sport may be captured by *sports and recreation activities*. This category does not include assault.
- Sports and recreational activities include: falls on same level from collision, pushing or shoving by or with other person in sports; striking against or struck accidentally by objects or persons in sports; and object in sports with subsequent fall.

Data Limitations

Concussion as a health event is recognized to be under-reported and inconsistently coded.

Concussion is often not clearly defined and may also be labelled as a minor traumatic brain injury (mTBI), or sometimes as a ‘head injury’ that may include other injuries not involving the brain.

The data presented in this report represent only a fraction of the children and youth that may have sustained a concussion. This report does not capture concussions treated at physician offices, medical clinics, or not treated at all.

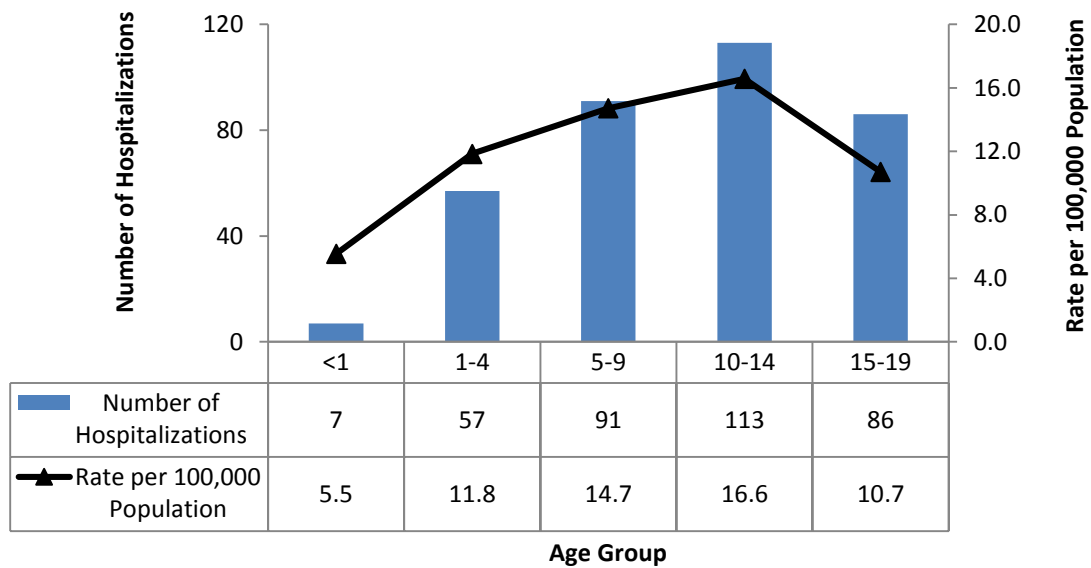
Hospitalization data can vary over time and between areas for factors not related to health, such as accessibility of treatment, and medical or administrative decisions that may affect the number of hospitalizations and lengths of hospital stay [9, 10].

CONCUSSION HOSPITALIZATION

There were 354 hospitalizations among children and youth aged 0 to 19 years resulting from concussion within Vancouver Coastal Health over the 13-year period from 2001/02 to 2013/14.

Concussion hospitalization rates were lowest among infants less than one year of age (5.5/100,000), and highest among 10 to 14 year olds (16.6/100,000), followed by teens 15 to 19 years of age (10.7/100,000) (Figure 1).

Figure 1: Concussion hospitalization counts and rates by age group, ages 0-19 years, Vancouver Coastal Health, 2001/02 - 2013/14.



Concussion hospitalization rates among children and youth were seen to vary from 2001/02 to 2013/14 (Figure 2). Rates peaked in 2006/07 at 20.6 per 100,000 and were lowest in 2010/11 at 6.3 per 100,000. Concussion hospitalization rates were consistently higher among males than females from 2001/02 to 2013/14.

Concussion hospitalization rates peaked for males aged 0 to 19 years in 2006/07 at 31.5 per

100,000, and were lowest in 2012/13 at 8.4 per 100,000 (Figure 2). Rates peaked for females in 2001/02 at 15.6 per 100,000 and were lowest in 2008/09 at 2.0 per 100,000.

Males accounted for 72.3 percent (n=256) of all concussion hospitalizations among children and youth. Rates for males were higher than for females among all age groups, except among infants less than one year of age (Figure 3).

Figure 2: Concussion hospitalization rates by year and sex, ages 0-19 years, Vancouver Coastal Health, 2001/02 - 2013/14.

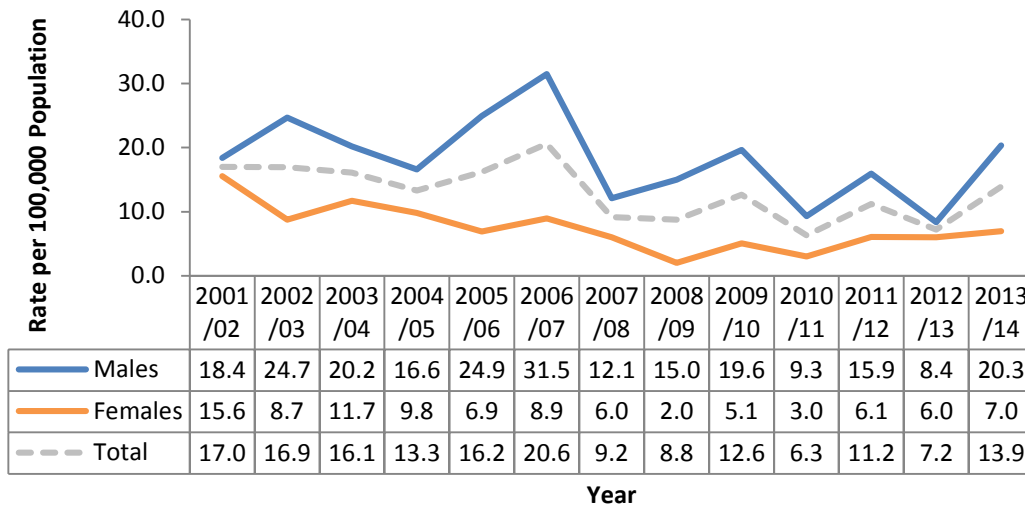
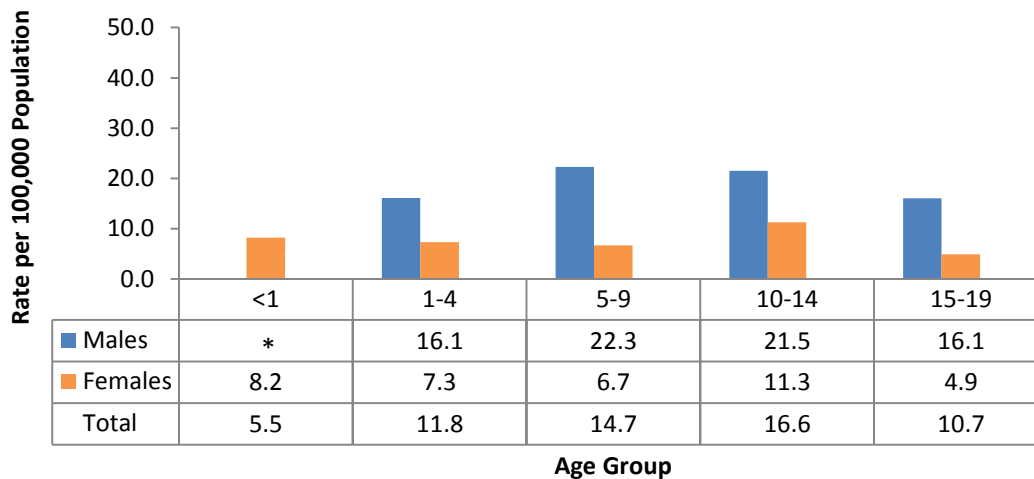


Figure 3: Concussion hospitalization rates by age group and sex, ages 0-19 years, Vancouver Coastal Health, 2001/02 - 2013/14.

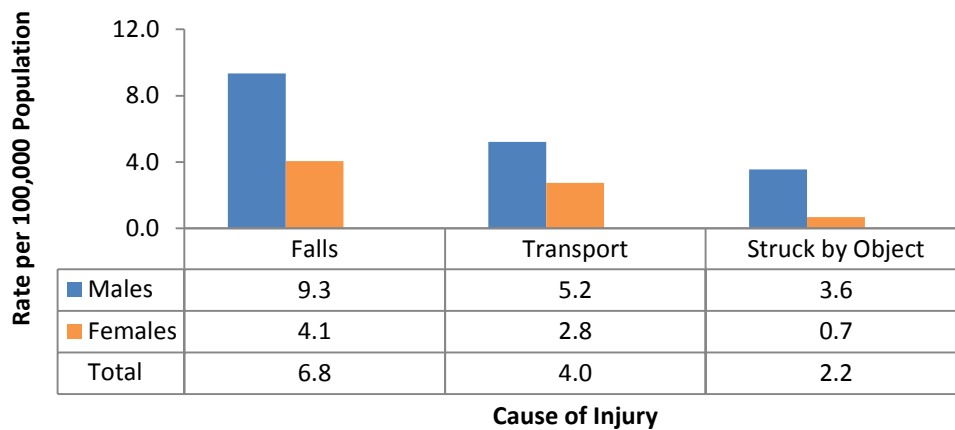


Note: * Represents fewer than 5 cases

Leading causes of concussion hospitalization among children and youth included falls, transport-related events and struck by/against an object (Figure 4). Fall-related concussion hospitalization was the leading cause for both males and females at 9.3 per 100,000 and 4.1 per 100,000, respectively. Of those concussions caused by struck by/against an object, 62.7 percent occurred during sport and recreation activities.

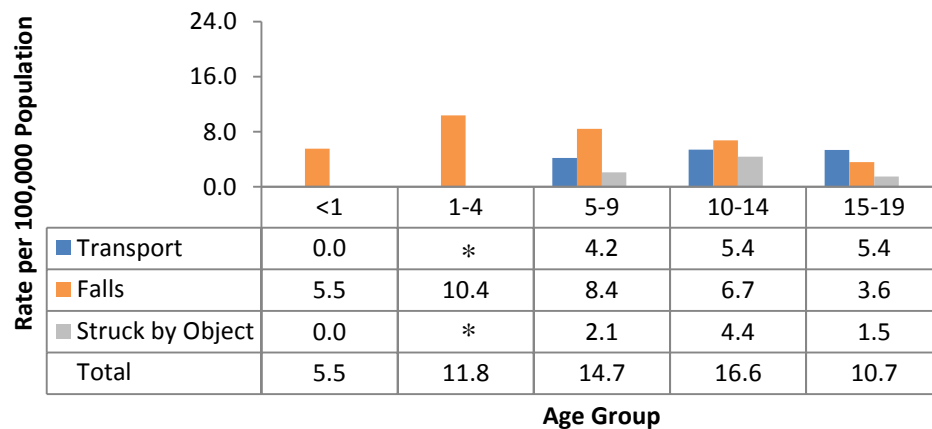
Leading causes varied by age group, with falls being the leading cause for 0 to 14 year olds, while transport-related events were the leading cause of concussion hospitalizations for 15 to 19 year olds (Figure 5). Concussion hospitalization rates for falls were highest among 1 to 4 year olds (10.4/100,000), while transport-related concussion rates were highest among both 10 to 14 and 15 to 19 year olds (both at 5.4/100,000) (Figure 5).

Figure 4: Concussion hospitalization rates by cause and sex, ages 0-19 years, Vancouver Coastal Health, 2001/02 - 2013/14.



Note: Total also includes other causes of concussion hospitalizations which are not shown as there are no or fewer than 5 cases.

Figure 5: Concussion hospitalization rates by cause and age group, ages 0-19 years, Vancouver Coastal Health, 2001/02 - 2013/14.



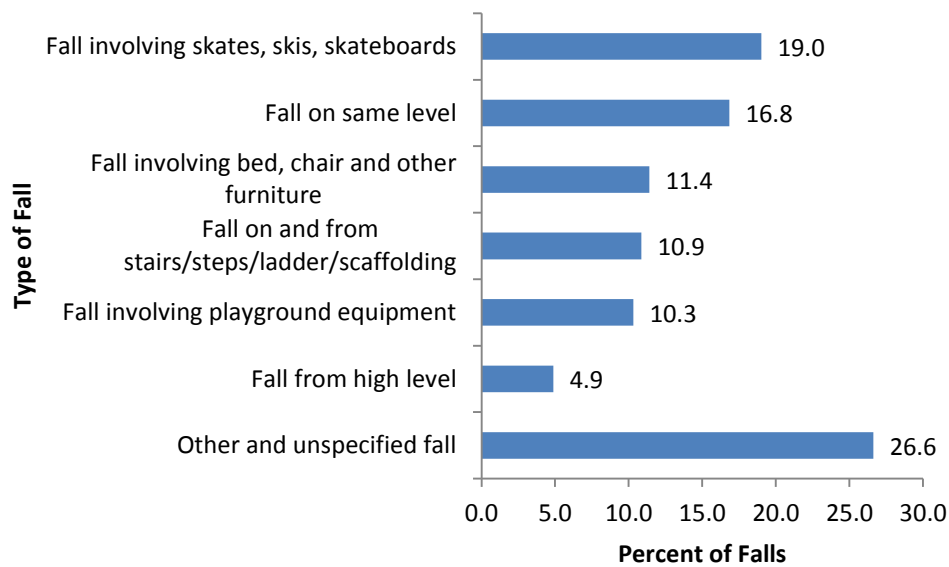
Note: * Represents fewer than 5 cases; Total also includes other causes of concussion hospitalizations that are not shown as there are fewer than 5 cases.

Fall-related Concussion Hospitalization

Concussion hospitalizations among children and youth resulting from a fall were primarily the result of a fall involving skates, skis and skateboards (19.0%, n=35) and falls on the same level (16.8%, n=31) (Figure 6). Over a quarter of cases were classified as “other and unspecified” falls (26.6%, n=49).

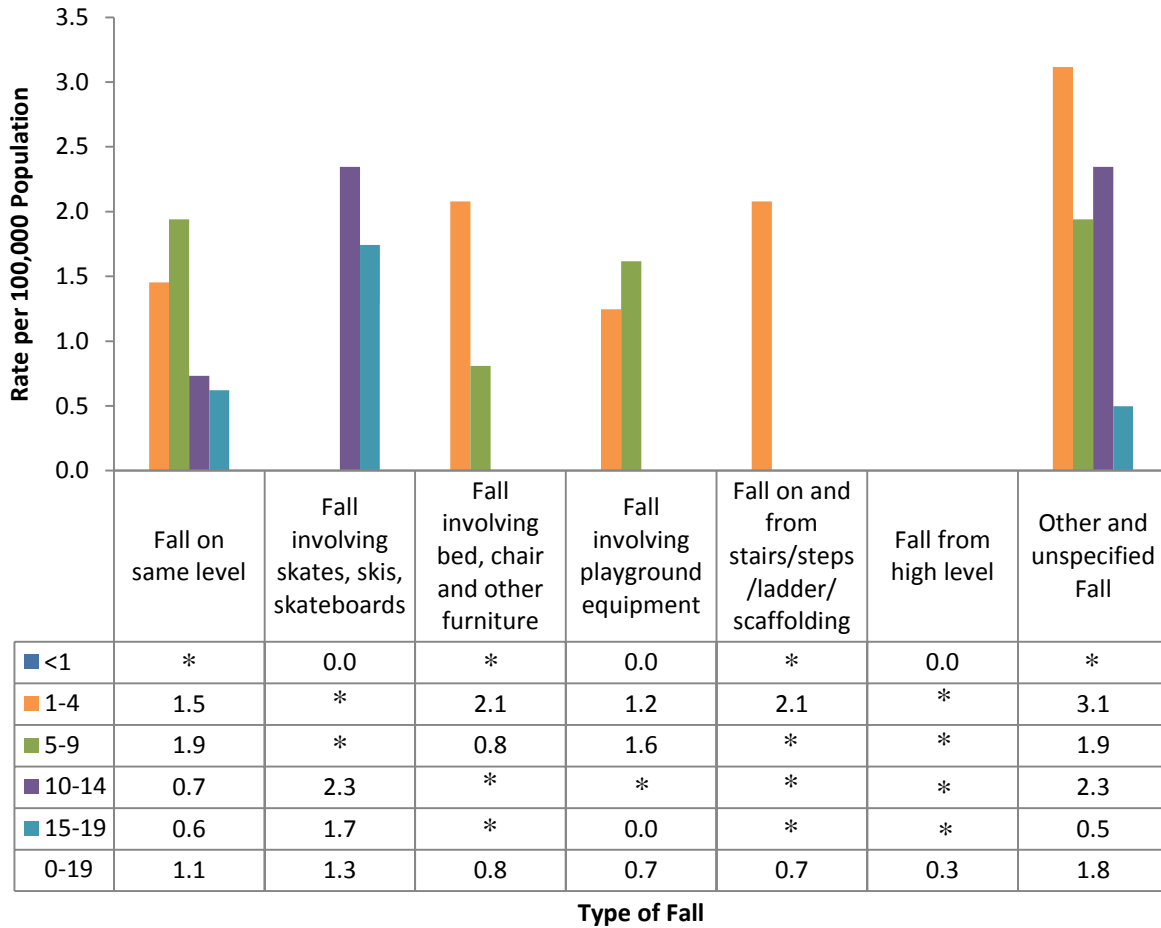
Among young children aged 1 to 4 years, falls from furniture and falls from stairs, steps, ladder and scaffolding were the leading causes of fall-related concussion (both at 2.1/100,000) (Figure 7). Falls involving skates, skis and skateboards resulting in a concussion were more common among older youth ages 10 to 14 years (2.3/100,000) and 15 to 19 years (1.7/100,000).

Figure 6: Proportion of fall-related concussion hospitalizations by type of fall, ages 0-19 years, Vancouver Coastal Health, 2001/02 - 2013/14.



Note: 'Other and unspecified falls' includes fall involving ice and snow and fall involving wheelchair.

Figure 7: Fall-related concussion hospitalization rates by type of fall and age group, ages 0-19 years, Vancouver Coastal Health, 2001/02 - 2013/14.



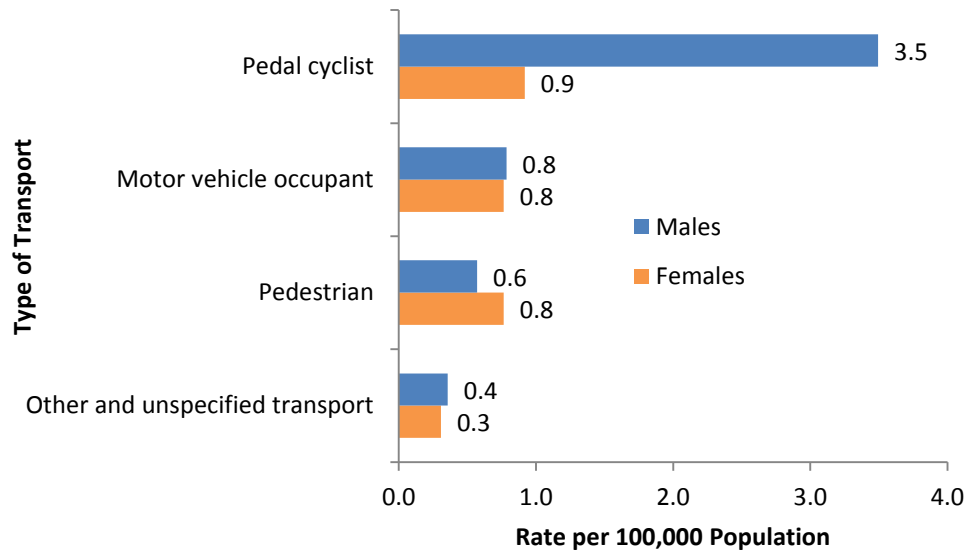
Note: *Represents fewer than 5 cases; 'Other and unspecified falls' includes fall involving ice and snow and fall involving wheelchair.

Transport-related Concussion Hospitalization

Concussion hospitalization rates from transport-related injuries among children and youth were generally higher among males than females, except for pedestrian-related (Figure 8).

Rates for both males and females were highest for pedal cyclist-related injuries (3.5/100,000 and 0.9/100,000, respectively). Rates were the same among males and females for motor vehicle occupant-related injuries (0.8/100,000) (Figure 8).

Figure 8: Transport-related concussion hospitalization rates by type of transport and sex, ages 0-19 years, Vancouver Coastal Health, 2001/02 - 2013/14.

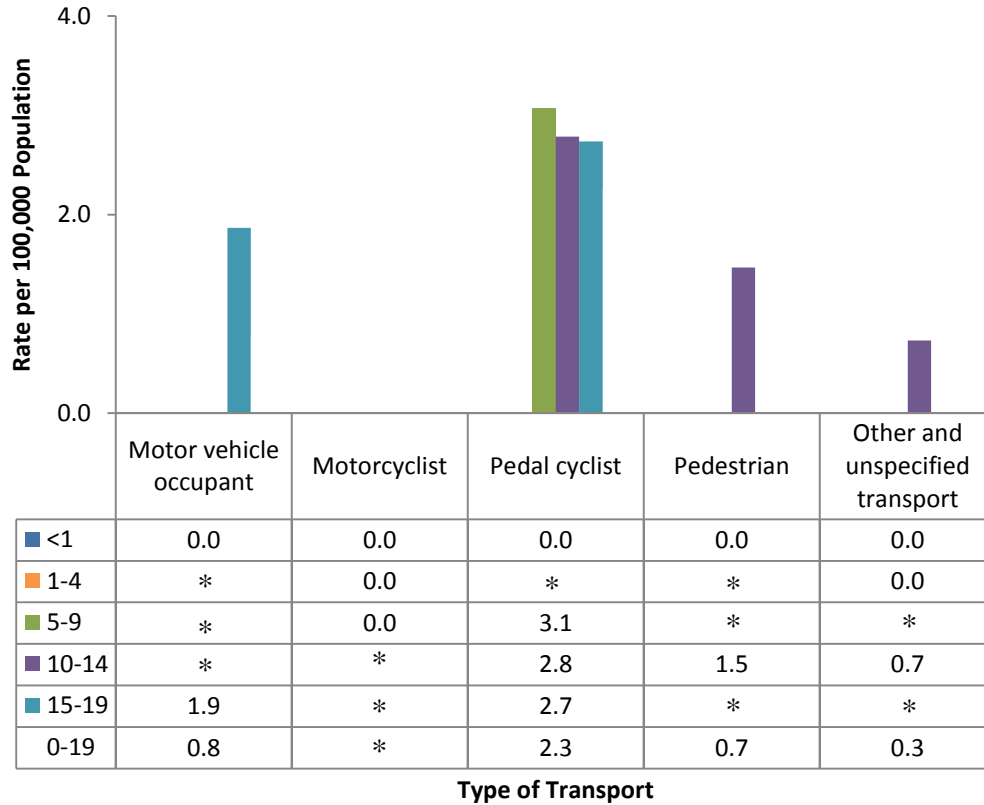


Note: 'Other transport' includes concussion hospitalizations due to off-road vehicle, motorcyclist, other land transport, and unspecified.

Across all age groups, highest rates were observed for pedal cyclist concussion hospitalizations compared to any other transport type, with highest rates among 5 to 9 year olds (3.1/100,000) (Figure 9).

Rates of motor vehicle occupant-related concussion hospitalization were highest among youth aged 15 to 19 years (1.9/100,000). Rates of pedestrian-related concussion hospitalization were highest among 10 to 14 year olds (1.5/100,000) (Figure 9).

Figure 9: Transport-related concussion hospitalization rates by type of transport and age group, ages 0-19 years, Vancouver Coastal Health, 2001/02 - 2013/14.



Note: * Represents fewer than 5 cases; 'Other transport' includes concussion hospitalizations due to off-road vehicle, other land transport, and water transport.

Sport and Recreation-related Concussion Hospitalization

Sport and recreation-related concussion hospitalization rates for children and youth were generally higher among males than females, with the highest rates being among males aged 10 to 14 years (13.3/100,000) and 5 to 9 years (9.4/100,000) (Figure 10). Rates for females were highest for ages 10 to 14 years at 4.6 per 100,000.

Cycling was the sport and recreation activity with the highest proportion of concussion hospitalizations among children and youth, at 36.1 percent (n=53) (Figure 11). Other leading types included playground (12.9%) and, skis and snowboards (11.6%).

Figure 10: Sport and recreation-related concussion hospitalization rates by age group and sex, ages 0-19 years, Vancouver Coastal Health, 2001/02 - 2013/14.

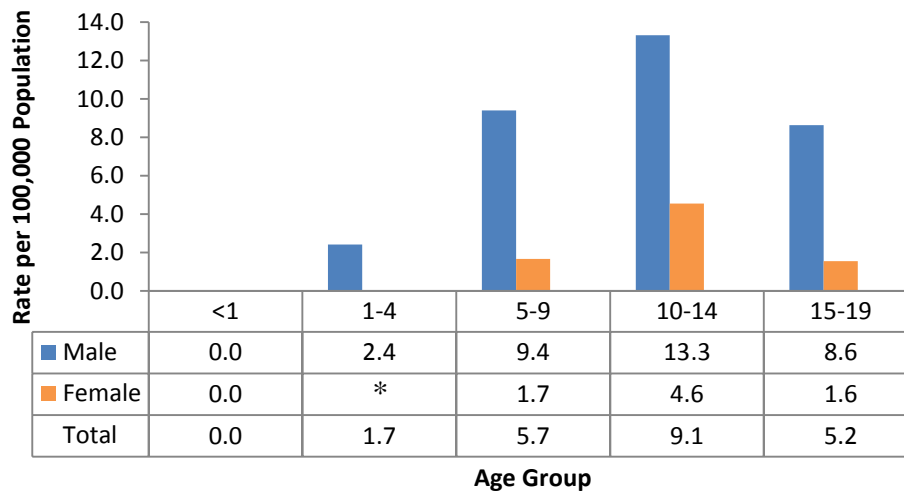
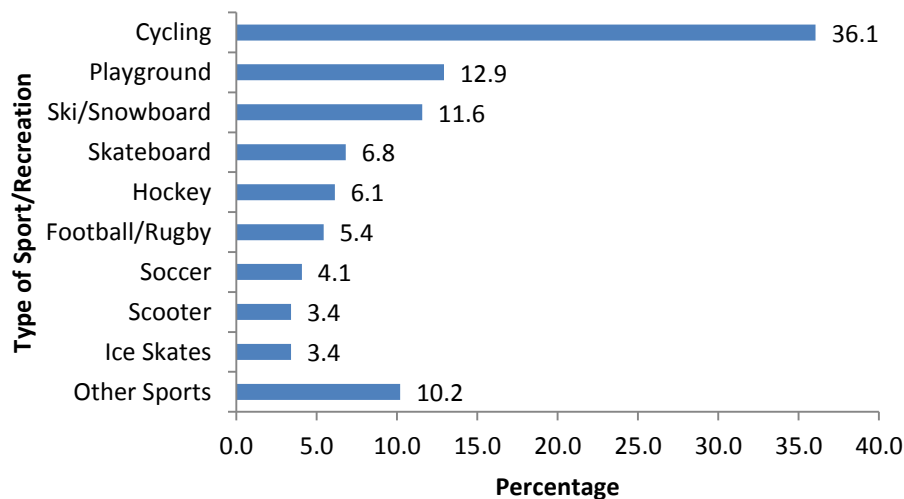


Figure 11: Sport and recreation-related concussion hospitalization rates by type of sport/recreation, ages 0-19 years, Vancouver Coastal Health, 2001/02 - 2013/14.

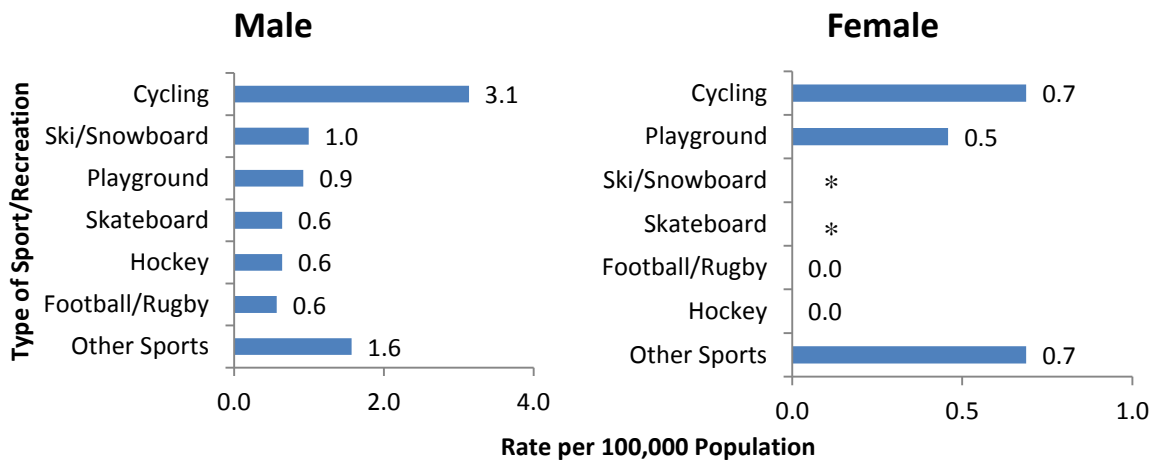


Note: 'Other sports' includes concussion hospitalizations due to all-terrain vehicle, hit by ball, baseball and tobogganing.

The rate of cycling-related concussion hospitalizations for males was 3.1 per 100,000, followed by ski and snowboard (1.0/100,000) and playground (0.9/100,000) (Figure 12). For females, highest rates were seen for cycling (0.7/100,000) and playground (0.5/100,000).

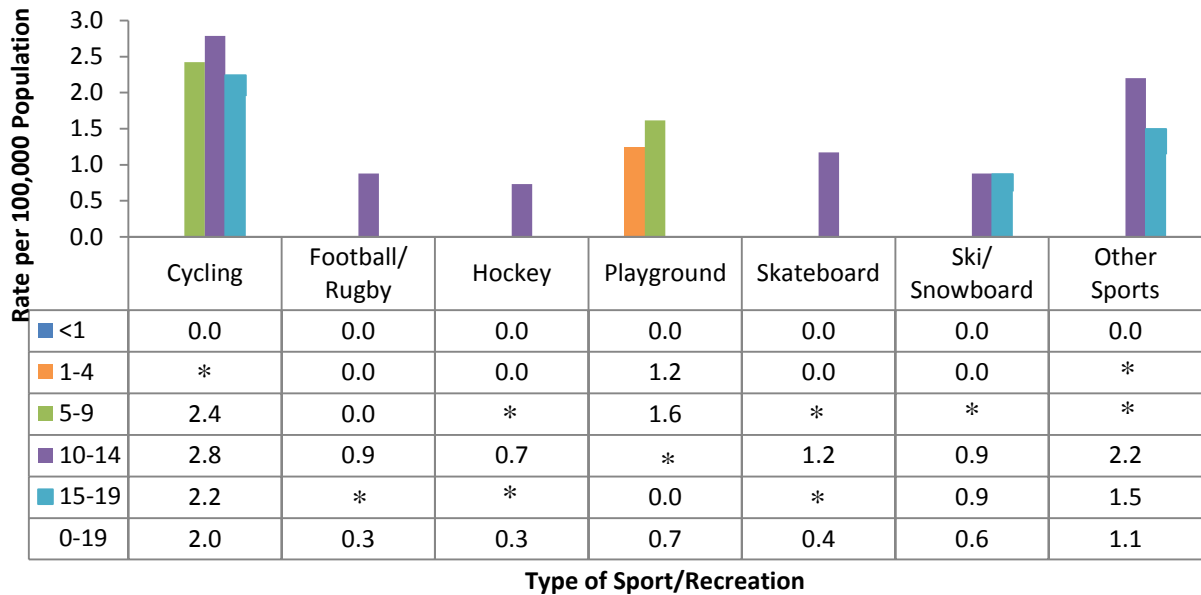
Rates of cycling-related concussion hospitalizations were highest among children aged 10 to 14 years (2.8/100,000) and 5 to 9 years (2.4/100,000) (Figure 13). Playground concussion rates were higher among younger children aged 0 to 9 years, while generally sport concussion rates were highest among the older children and youth.

Figure 12: Sport and recreation-related concussion hospitalization rates by leading type of sport/recreation and sex, ages 0-19 years, Vancouver Coastal Health, 2001/02 - 2013/14.



Note: * Represents fewer than 5 cases

Figure 13: Sport and recreation-related concussion hospitalization rates by leading type of sport/recreation and age group, ages 0-19 years, Vancouver Coastal Health, 2001/02 - 2013/14.



Note: * Represents fewer than 5 cases

Concussion Hospitalization between Health Service Delivery Areas

Vancouver Coastal Health consists of three Health Service Delivery Areas (HSDAs): Richmond, Vancouver and North Shore/Coast Garibaldi. The majority of Vancouver Coastal Health child and youth residents who were hospitalized for concussion sought treatment within the Vancouver Coastal Health Authority and Provincial Health Services Authority (PHSA) (Table 1). About 70 percent of North Shore/Coast Garibaldi residents were admitted to hospitals within Vancouver Coastal Health for concussion; this is a higher proportion than for residents of both Richmond and Vancouver (47.1% and 9.8% respectively). Over three-quarters of residents of Vancouver received hospital care from BC Children’s Hospital.

Concussion hospitalization rates were highest among residents of North Shore/Coast Garibaldi (22.3/100,000) and lowest among residents of

Richmond (6.4/100,000) (Figure 14). The highest number of concussion hospitalization cases was within North Shore/Coast Garibaldi (177 cases). Statistical testing yielded significant differences between North Shore/Coast Garibaldi and Vancouver, between North Shore/Coast Garibaldi and Richmond, and between Richmond and Vancouver (p -value <0.05).

Concussion hospitalization rates were highest in North Shore/Coast Garibaldi among all age groups (Figure 15). Highest rates for concussion hospitalization in Richmond were among 1 to 4 year olds (13.6/100,000). In both Vancouver and North Shore/Coast Garibaldi, highest concussion rates were observed among children aged 10 to 14 years (14.4/100,000 and 26.8/100,000, respectively).

Table 1: Concussion hospitalization counts by health service delivery area of patient’s residence and health authority in which treatment sought, ages 0-19 years, Vancouver Coastal Health, 2001/02-2013/14.

Health Authority in which treatment sought	Health Service Delivery Area of patient’s residence		
	Richmond	Vancouver	North Shore/Coast Garibaldi
Vancouver Coastal Health	16 (47.1%)	14 (9.8%)	124 (70.1%)
Fraser Health	*	10	6
Interior Health	*	*	*
Island Health	0	*	*
Northern Health	*	*	0
Provincial Health Services Authority ⁺	14 (41.2%)	113 (79.0%)	40 (22.6%)
Out-of-province	*	0	*
Grand Total	34	143	177

Note: * Represents fewer than 5 cases; ⁺Provincial Health Services Authority refers to BC Children’s Hospital.

Figure 14: Concussion hospitalization counts and rates by Health Service Delivery Area, ages 0-19 years, Vancouver Coastal Health, 2001/02-2013/14.

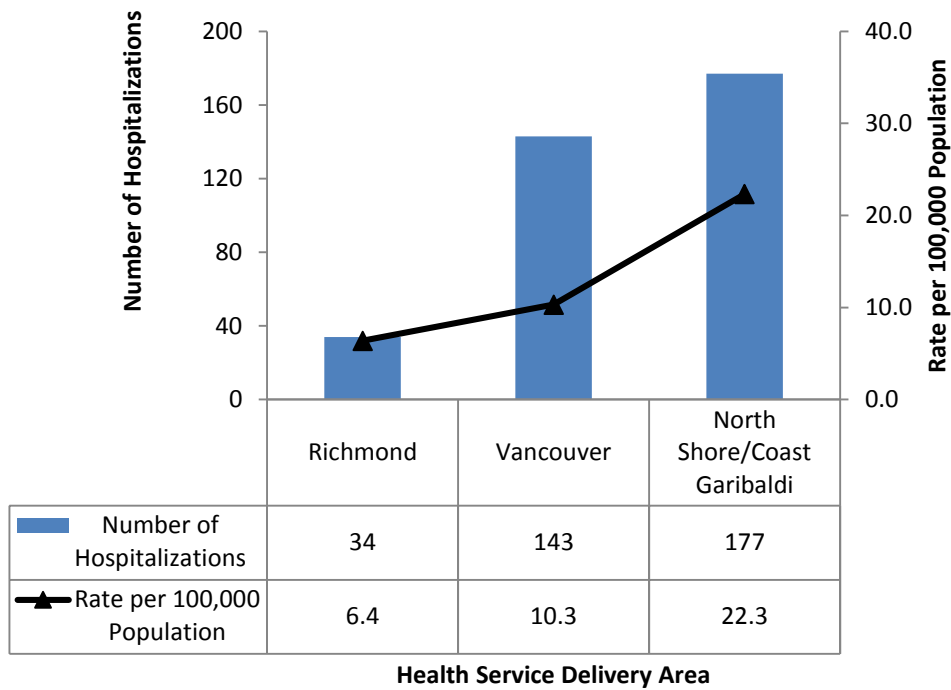
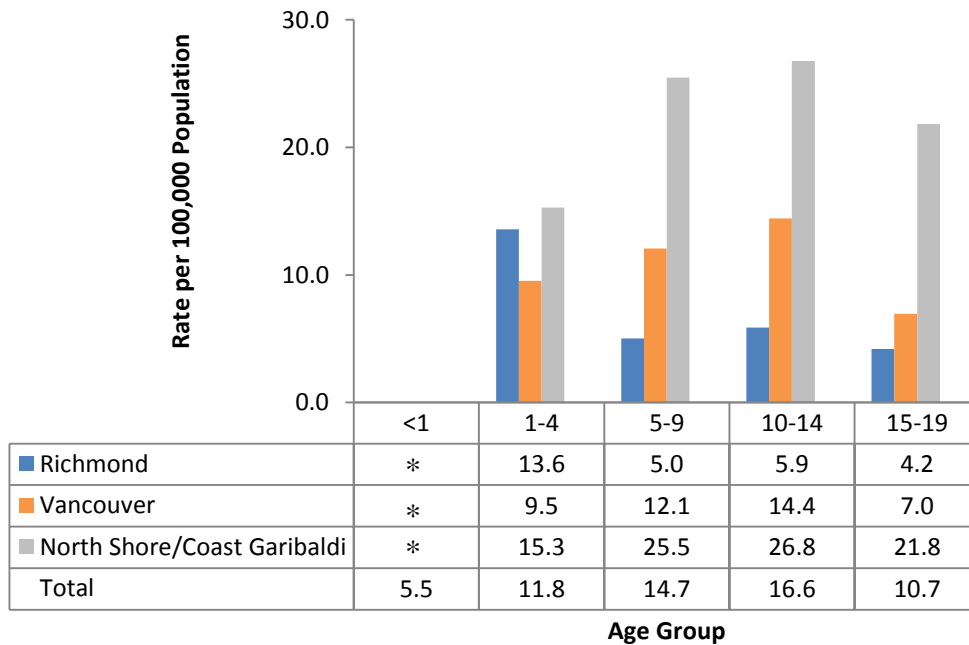


Figure 15: Concussion hospitalization rates by Health Service Delivery Area and age group, ages 0-19 years, Vancouver Coastal Health, 2001/02-2013/14.

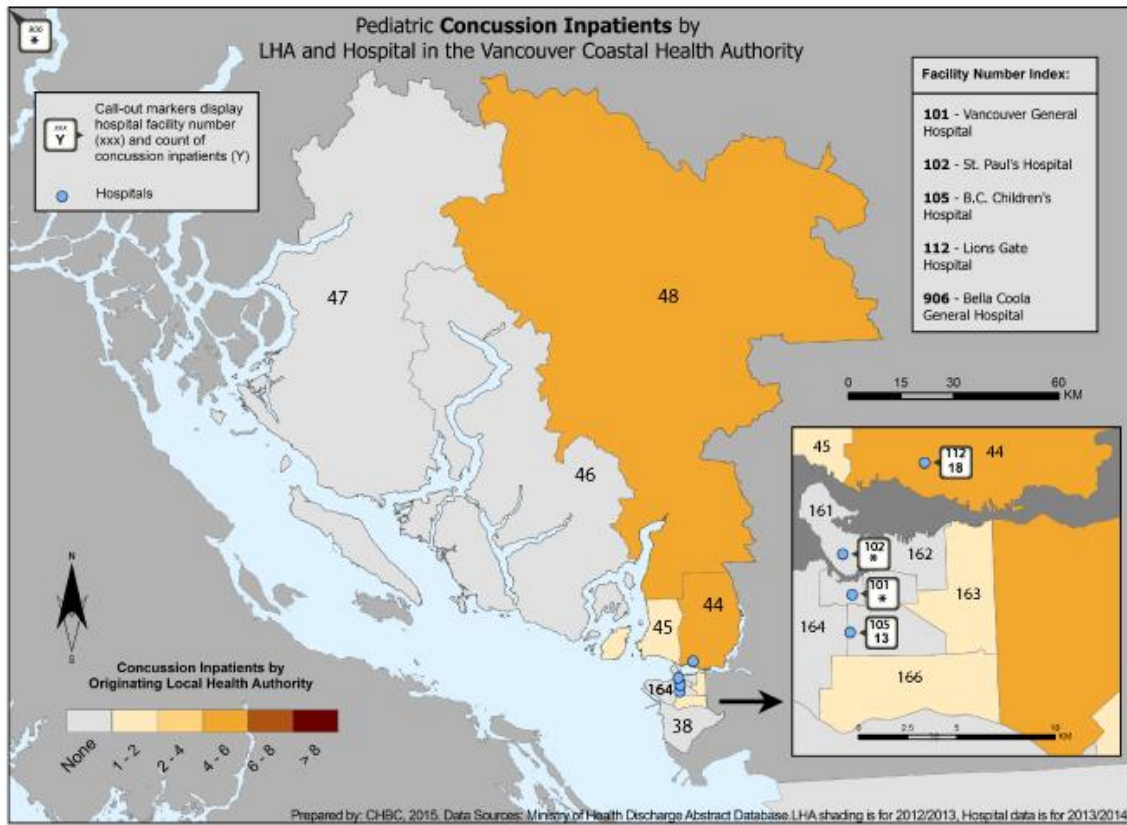


Note: * Represents fewer than 5 cases

The number of child and youth concussion inpatients was highest among residents in Howe Sound, followed by North Vancouver in 2013/14 (Figure 16).

The number of concussion inpatients was highest at Lions Gate Hospital (18 cases) in the 2013/14 year (Figure 16).

Figure 16: Pediatric Concussion Inpatients by local health area and hospital, Vancouver Coastal Health, 2013/14.



Note: * Represents fewer than 5 cases

Note: 38: Richmond, 44: North Vancouver, 45: West Vancouver-Bowen Island, 46: Sunshine Coast, 47: Powell River, 48: Howe Sound, 49: Bella Coola Valley, 83: Central Coast, 161: City Centre, 162: Downtown Eastside, 163: North East, 164: Westside, 165: Midtown, 166: South Vancouver

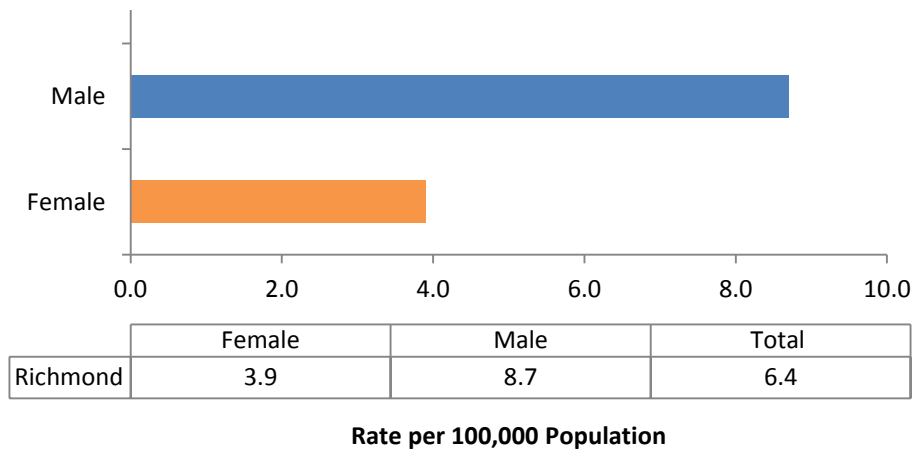
Concussion Hospitalization by Health Service Delivery Area: Richmond

A total of 34 concussion hospitalizations were reported for Richmond between 2001/02 and 2013/14. Concussion hospitalization rates in Richmond were higher among males (8.7/100,000) than females (3.9/100,000) (Figure 17).

Richmond did not exhibit total number of cases high enough to further investigate age and sex differences.

Rates of fall-related child and youth concussion hospitalization in Richmond were highest among children aged 1 to 4 years (11.3/100,000, n=10) (chart not shown).

Figure 17: Concussion hospitalization rates by sex, ages 0-19 years, Vancouver Coastal Health: Richmond, 2001/02-2013/14.



Concussion Hospitalization by Health Service Delivery Area: Vancouver

A total of 143 concussion hospitalizations were reported for Vancouver between 2001/02 and 2013/14. Among all age groups, 10 to 14 year olds had the highest rate of concussion, most of which comprised of fall-related cases.

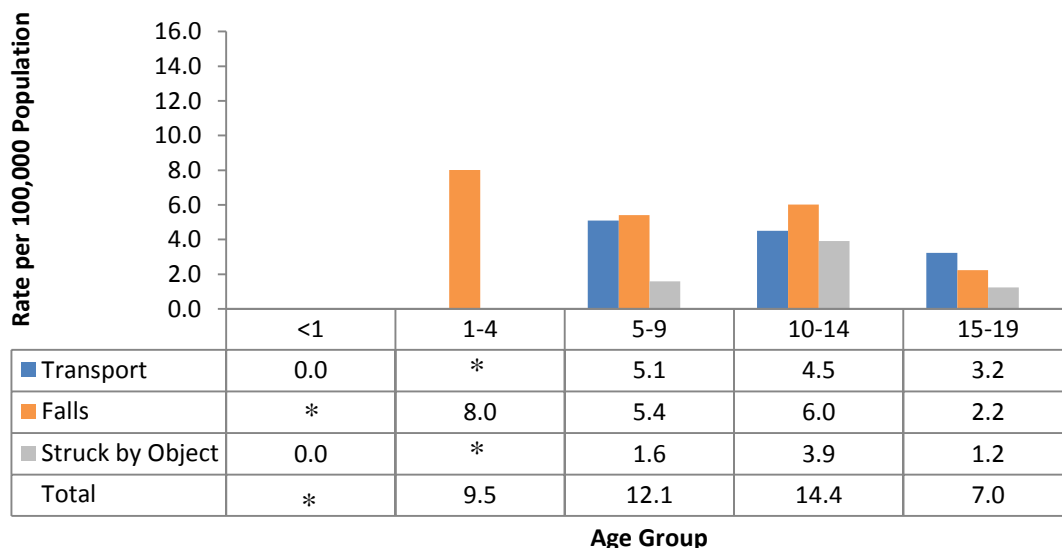
Rates of child and youth fall-related concussion hospitalizations in Vancouver were highest among children aged 1 to 4 years (8.0/100,000), while transport-related concussion hospitalization rates were highest among children aged 5 to 9 years (5.1/100,000) (Figure 18).

Vancouver is split into six LHAs: City Centre, Downtown Eastside, Midtown, North East, South Vancouver and Westside. The concussion hospitalization rate was highest in Westside (12.2/100,000) and lowest in North East (8.0/100,000). The total numbers of hospitalization cases within Vancouver Coastal were lowest in Downtown Eastside and City Centre and highest in South Vancouver (Figure 19).

Concussion hospitalization rates were higher among males than females within all Vancouver LHAs except in City Centre. The highest rates among males were in Westside (16.6/100,000) while the highest rates among females were in City Centre (14.7/ 100,000) (Figure 20).

Concussion hospitalization rates were particularly high among 10 to 14 year olds in City Centre (28.9/100,000) (Figure 21). All LHAs within Vancouver reported low rates of concussion hospitalization among infants less than one year of age, with fewer than five cases reported (Figure 21).

Figure 18: Concussion hospitalization rates by cause and age group, ages 0-19 years, Vancouver Coastal Health: Vancouver, 2001/02-2013/14.



Note: * Represents fewer than 5 cases; Total also includes other causes of concussion hospitalizations which are not shown as there are no or fewer than 5 cases.

Figure 19: Concussion hospitalization counts and rates by local health area, ages 0-19 years, Vancouver Coastal Health: Vancouver, 2001/02-2013/14.

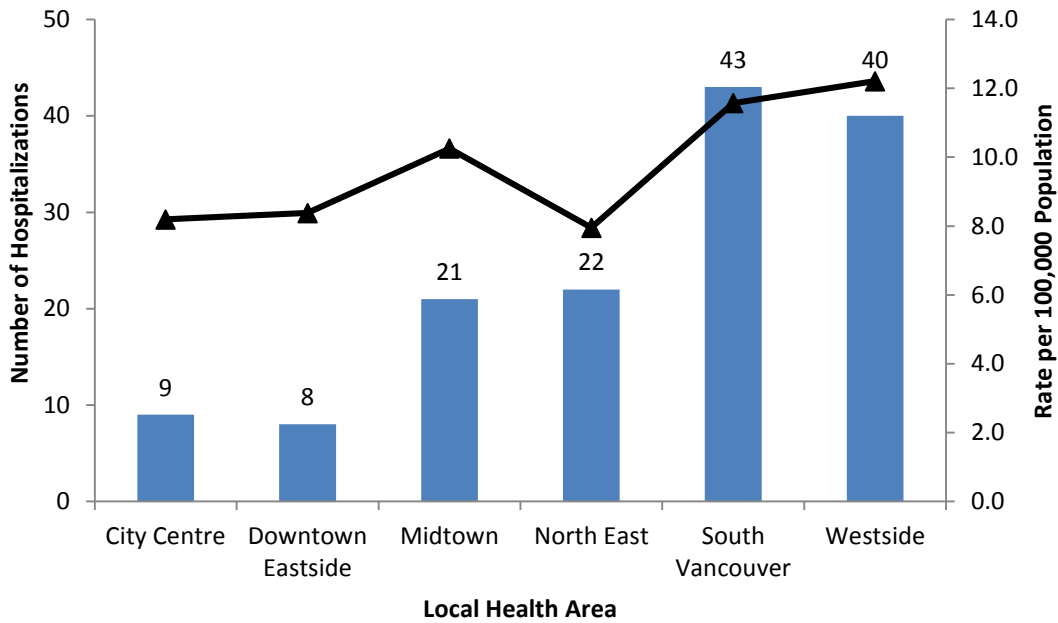
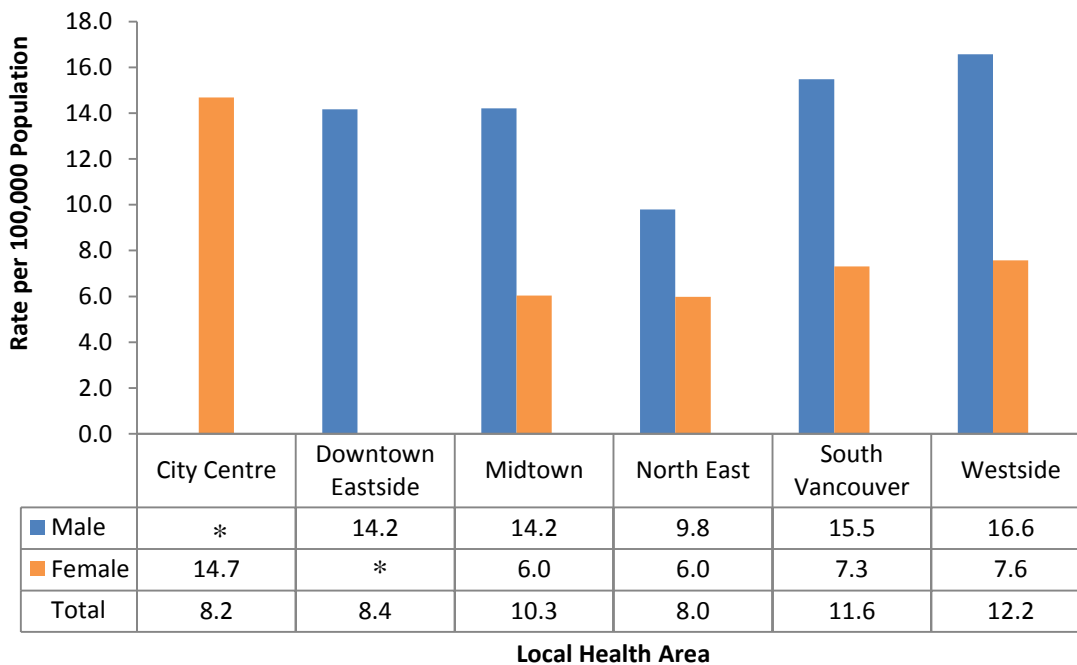
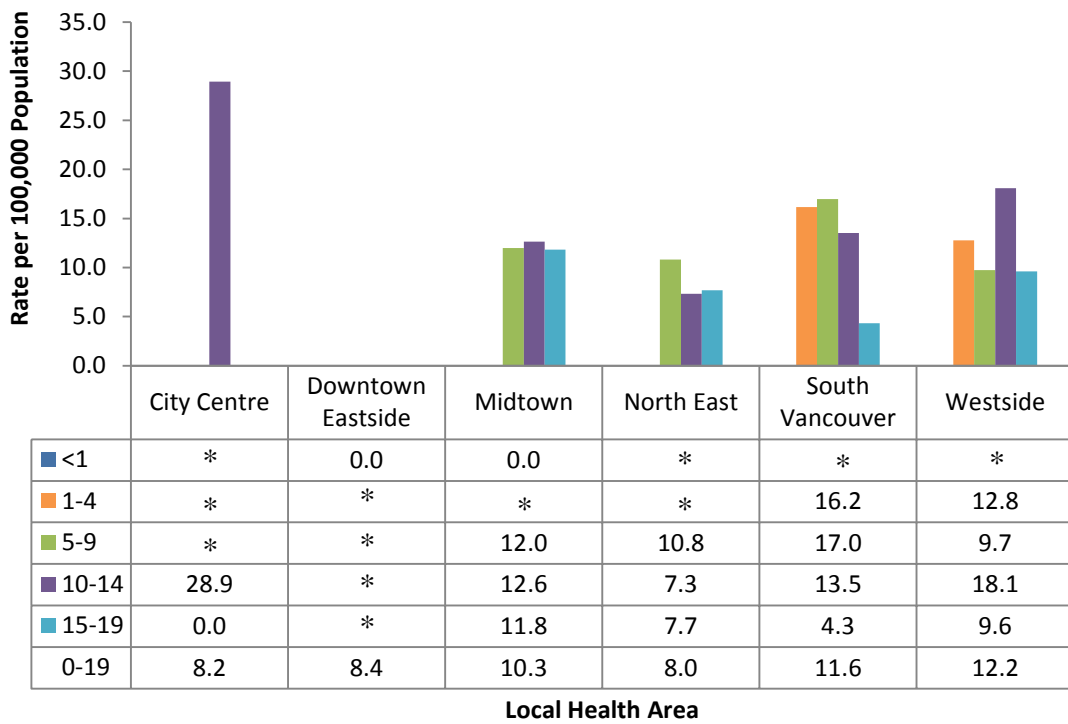


Figure 20: Concussion hospitalization rates by local health area and sex, ages 0-19 years, Vancouver Coastal Health: Vancouver, 2001/02-2013/14.



Note: * Represents fewer than 5 cases

Figure 21: Concussion hospitalization rates by local health area and age group, ages 0-19 years, Vancouver Coastal Health: Vancouver, 2001/02-2013/14.



Note: * Represents fewer than 5 cases

Concussion Hospitalization by Health Service Delivery Area: North Shore/Coast Garibaldi

A total of 177 concussion hospitalizations were reported for North Shore/Coast Garibaldi between 2001/02 and 2013/14. Among all age groups, 10 to 14 year olds had the highest rate of concussion, most of which comprised of fall-related cases.

Child and youth fall-related concussion hospitalization rates in North Shore/Coast Garibaldi were highest among children aged 5 to 9 years (16.2/100,000), while transport-related concussion hospitalization rates were highest among youth aged 15 to 19 years (11.6/100,000) (Figure 22).

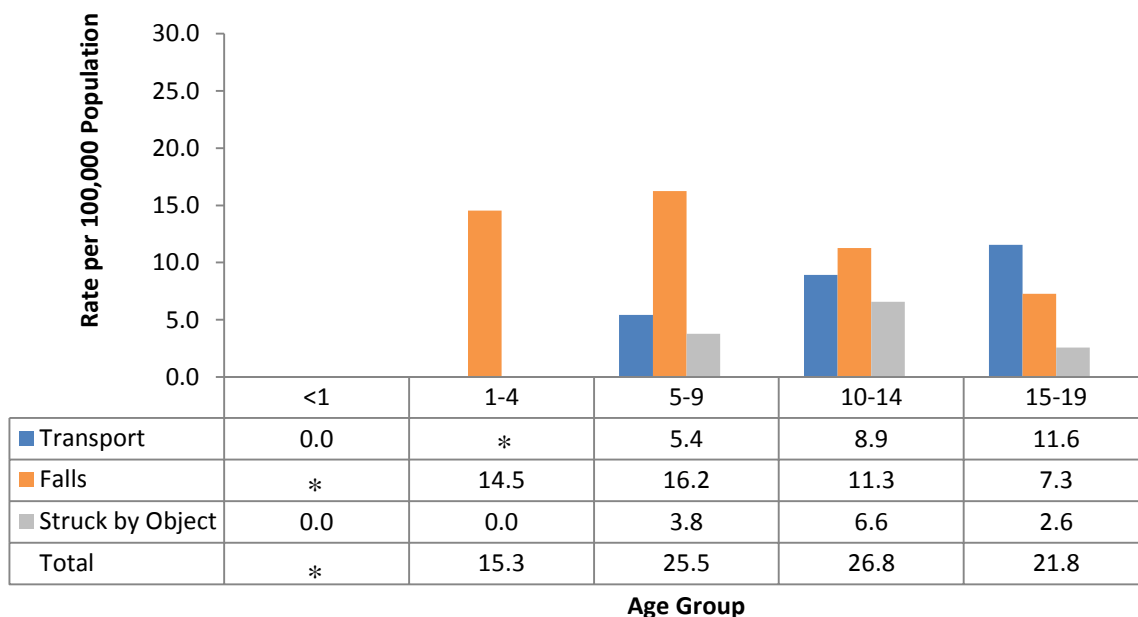
North Shore/Coast Garibaldi is split into seven LHAs: Bella Coola Valley, Central Coast, Howe Sound, North Vancouver, Powell River, Sunshine Coast and West Vancouver-Bowen Island. The number of concussion hospitalizations was

highest in North Vancouver (73 cases) and lowest in Central Coast and Bella Coola, each with fewer than 5 cases (Figure 23).

Concussion hospitalization rates were higher among males than females for all LHAs of North Shore/Coast Garibaldi. High rates among males and females were found in Howe Sound (48.7/100,000 and 25.0/100,000, respectively) (Figure 24).

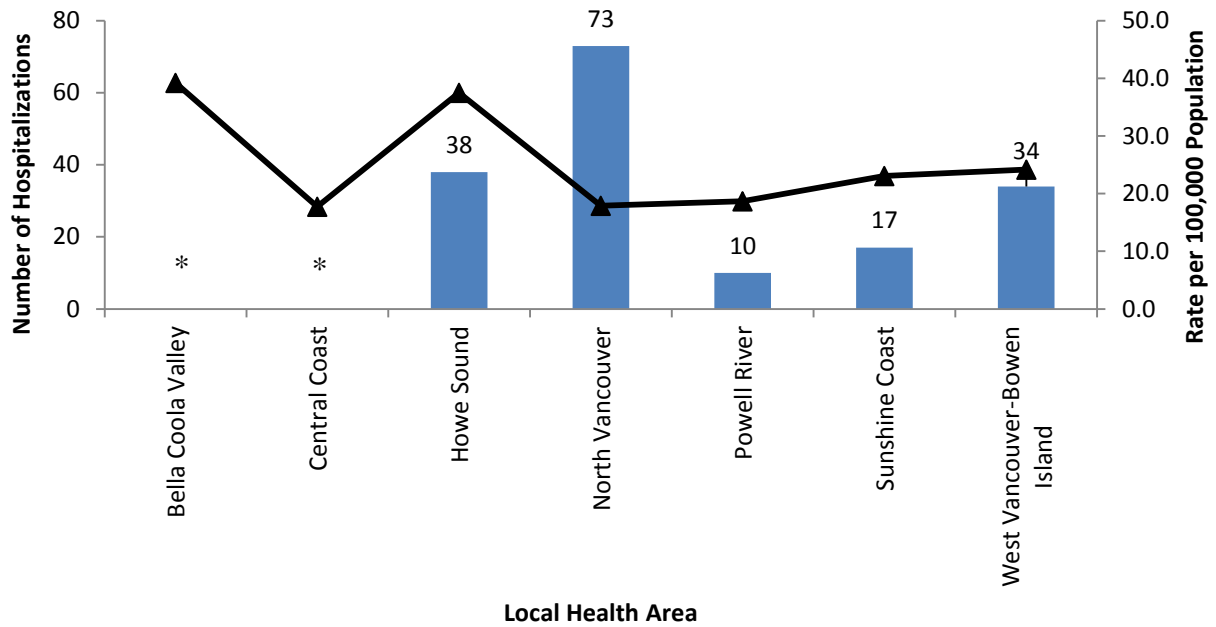
Concussion hospitalization rates among infants less than one year of age were lowest across all LHAs in North Shore/Coast Garibaldi, with fewer than five cases reported. Howe Sound had high rates of concussion hospitalizations among children aged 10 to 14 years and among youth 15 to 19 years (56.8/100,000 and 51.1/100,000, respectively) (Figure 25).

Figure 22: Concussion hospitalization rates by cause and age group, ages 0-19 years, Vancouver Coastal Health: North Shore/Coast Garibaldi, 2001/02-2013/14.



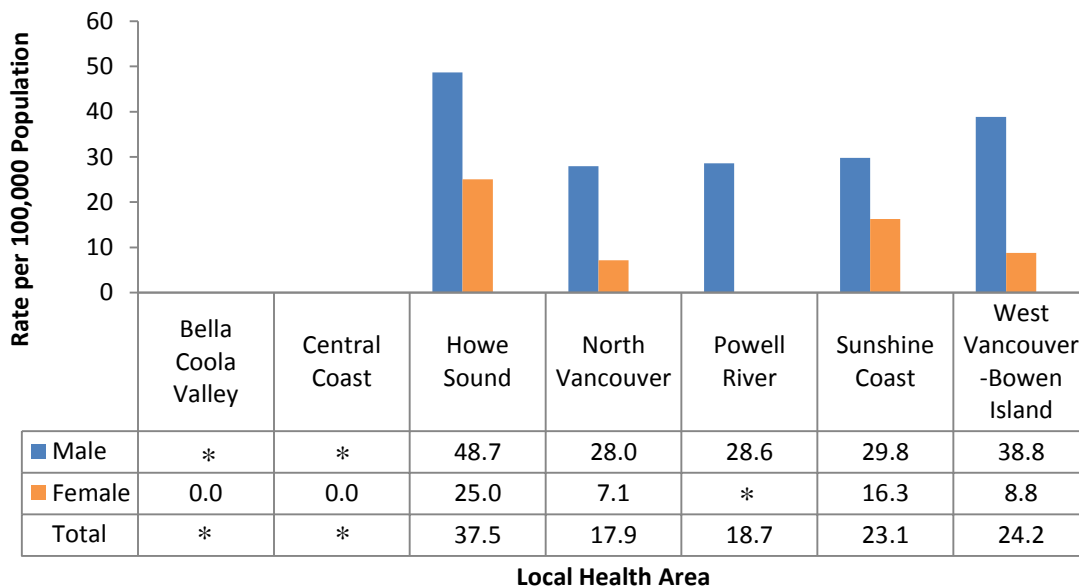
Note: * Represents fewer than 5 cases; Total also includes other causes of concussion hospitalizations that are not shown as there are no or fewer than 5 cases.

Figure 23: Concussion hospitalization counts and rates by local health area, ages 0-19 years, Vancouver Coastal Health: North Shore/Coast Garibaldi, 2001/02-2013/14.



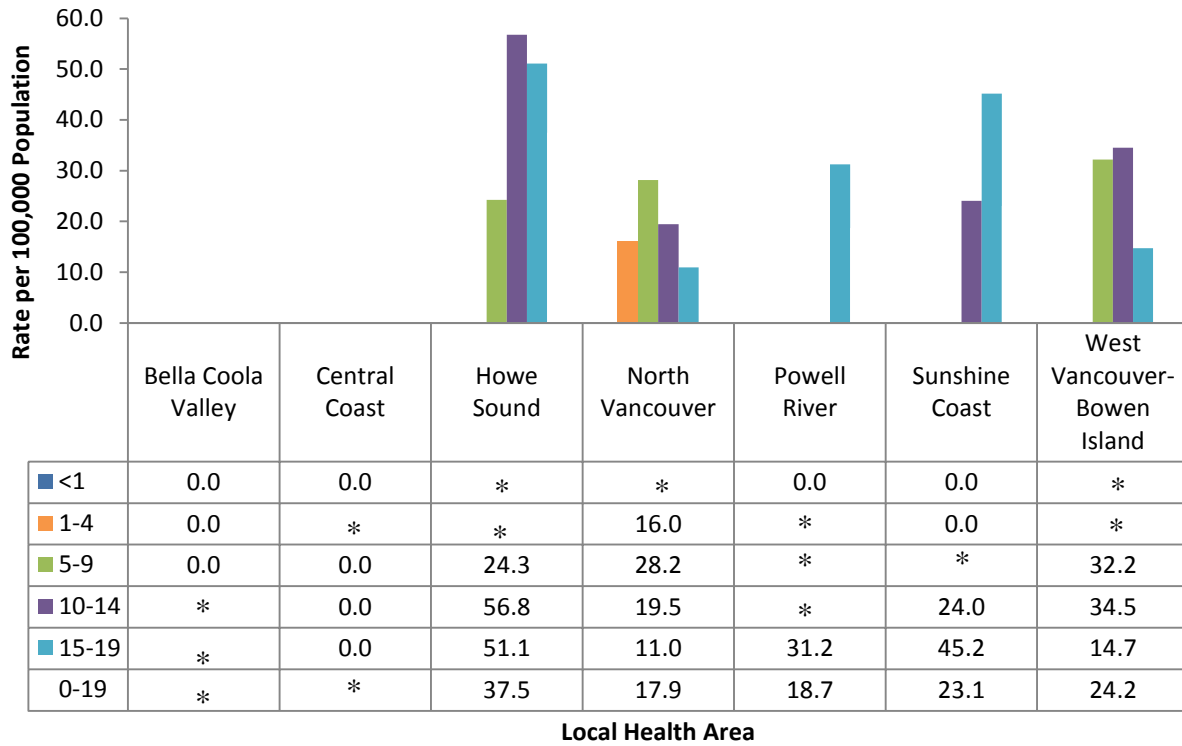
Note: * Represents fewer than 5 cases

Figure 24: Concussion hospitalization rates by local health area and sex, ages 0-19 years, Vancouver Coastal Health: North Shore/Coast Garibaldi, 2001/02-2013/14.



Note: * Represents fewer than 5 cases

Figure 25: Concussion hospitalization rates by local health area and age group, ages 0-19 years, Vancouver Coastal Health: North Shore/Coast Garibaldi, 2001/02-2013/14.



Note: * Represents fewer than 5 cases

CONCUSSION EMERGENCY DEPARTMENT VISIT RATES

There were a total of 3,994 concussion emergency department visits by child and youth residents of Vancouver Coastal Health for the 2-year period of 2013/14 and 2014/15. Emergency department visit rates for Vancouver Coastal Health residents were calculated per 100,000 population for the region. Rates of emergency department visits for concussion were highest in Vancouver (1,152.2/100,000), which also had the highest rates for both males (1,358.5/100,000) and females (931.2/100,000)

(Figure 26). Lowest rates of concussion emergency department visits were seen in North Shore/Coast Garibaldi (657.5/100,000) (Figure 26). Concussion emergency department visits within Vancouver Coastal Health were highest among children under the age of five years. Rates within Richmond, Vancouver and North Shore/Coast Garibaldi were highest among infants less than one year (2,157.4/100,000, 3,352.2/100,000 and 1,447.9/100,000, respectively) (Figure 27).

Figure 26: Concussion emergency department visit rates by health service delivery area and sex, ages 0-19 years, residents of Vancouver Coastal Health, NACRS, April 1, 2013 - March 31, 2015

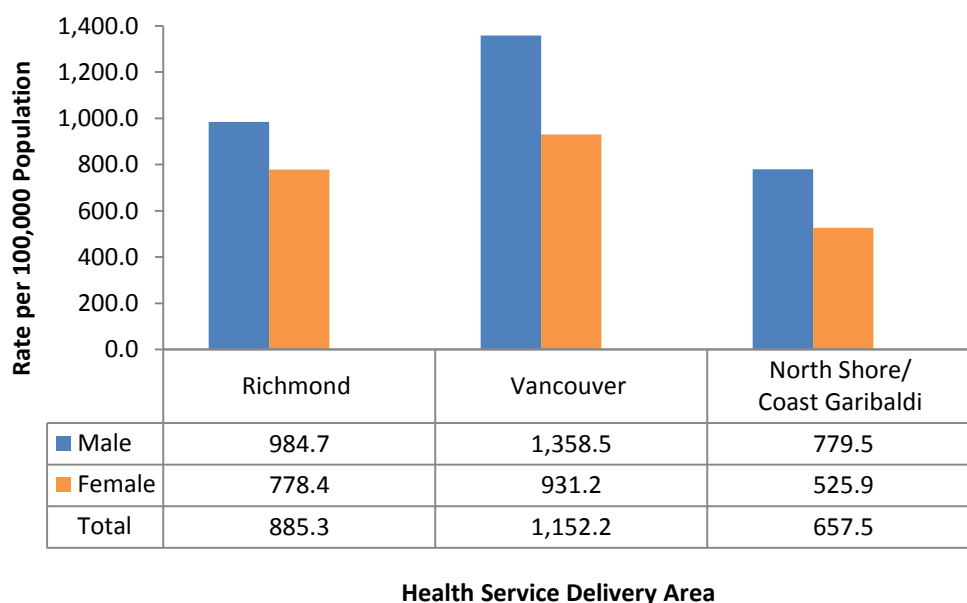
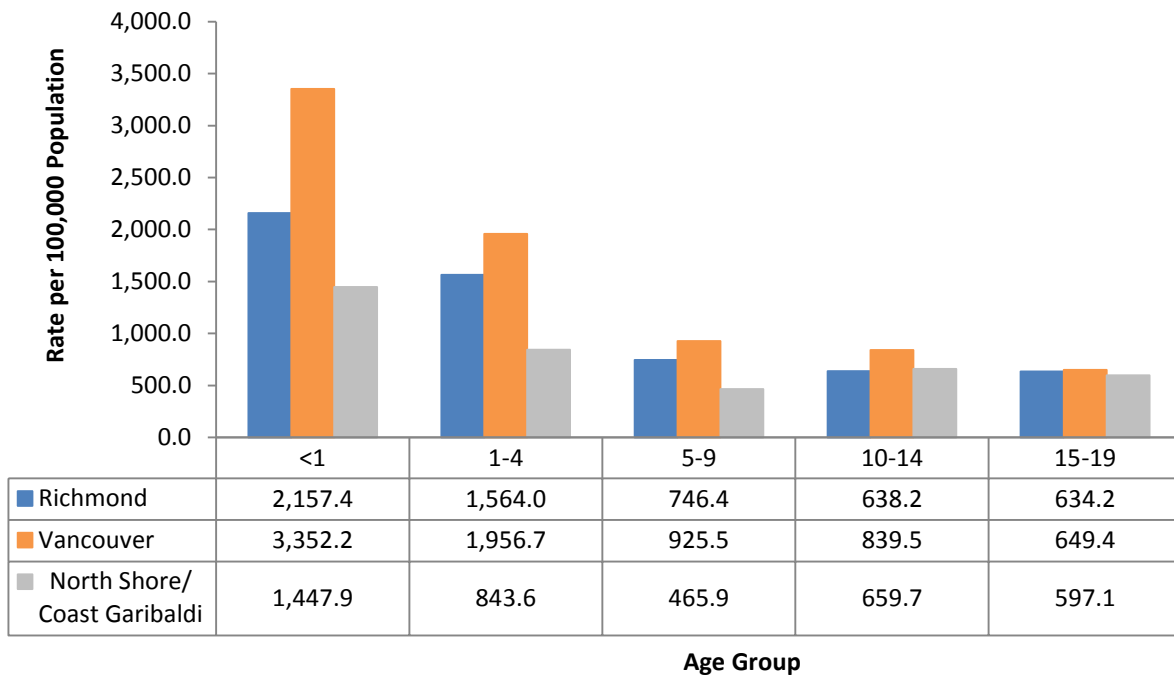


Figure 27: Concussion emergency department visit rates by health service delivery area residence and age group, ages 0-19 years, residents of Vancouver Coastal Health, NACRS, April 1, 2013 - March 31, 2015



Vancouver Coastal Health has six principal hospitals with recorded concussion emergency department visits: Lions Gate Hospital, Mount Saint Joseph Hospital, St. Paul’s Hospital, Richmond Hospital, UBC Hospital and Vancouver General Hospital. Rates for each hospital were calculated per 100,000 emergency department visits for all diagnoses.

There were a total of 1,833 child and youth concussion emergency department visits to these hospitals during the 2-year period of 2013/14 and 2014/15 (Table 2). During this period, Mount Saint Joseph Hospital saw the highest rate of concussion emergency department visits per 100,000 visits among all hospitals in Vancouver Coastal Health (4,054.9/100,000) (Figure 28). Lowest rates of emergency department visits due to concussion within the Vancouver Coastal Health region were seen at UBC Hospital (2,389.0/100,000). Mount Saint Joseph Hospital reported the highest rates of concussion emergency department visits among

males (4,997.3/100,000) and Lions Gate Hospital reported the highest rates among females (3,122.8/100,000). Males exhibited higher rates than females among all Vancouver Coastal Health hospitals. Lowest rates among males were reported at UBC Hospital, and lowest rates among females were reported at Vancouver General Hospital (2,712.1/100,000 and 1,664.8/100,000, respectively) (Figure 28).

When looking at emergency department visits from concussions by month between April 1, 2013 and March 31, 2015, the number of cases presented was highest during the months of November (182 visits), March (172 visits) and May (170 visits). Rates of concussion emergency department visits per 100,000 visits peaked during November (4,113.9/100,000). The number of concussion emergency department visits was lowest during August (118 visits), December (131 visits) and July (136 visits). Lowest rates were reported during December (2,688.8/100,000) (Figure 29).

Figure 28: Concussion emergency department visit rates by hospital and sex, ages 0-19 years, Vancouver Coastal Health, NACRS, April 1, 2013 - March 31, 2015

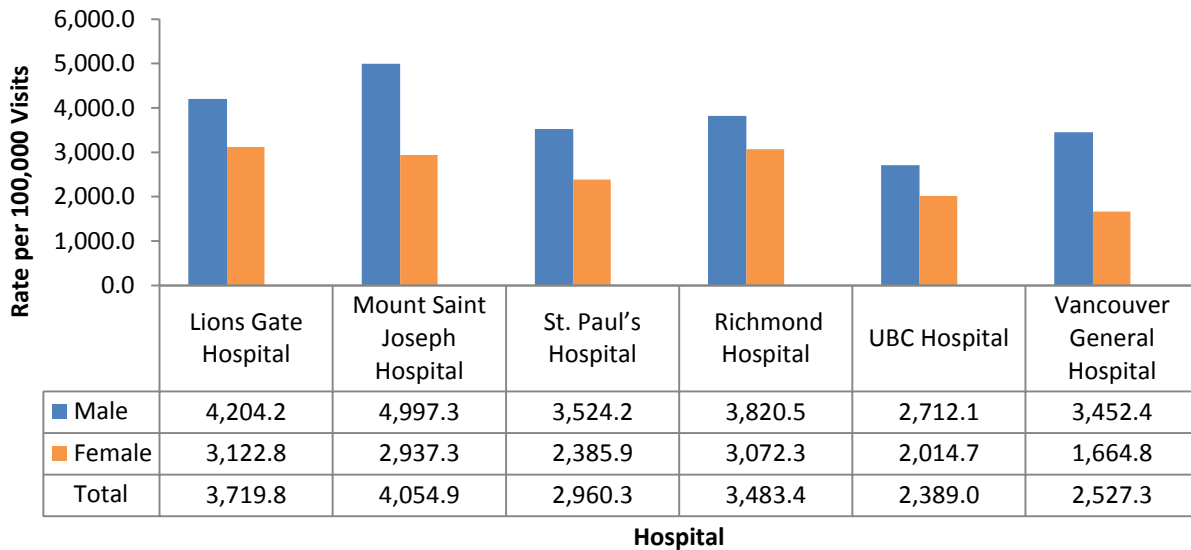
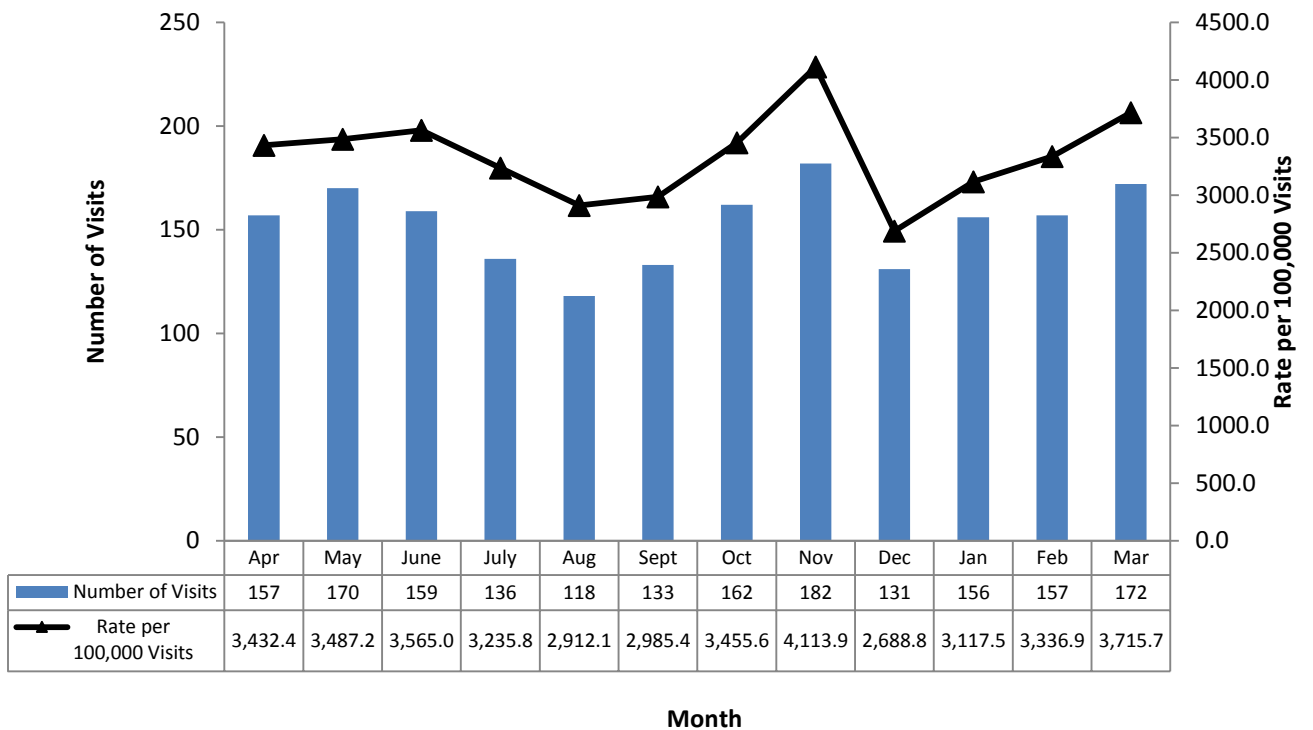


Figure 29: Concussion emergency department visit rates and number of cases by month, ages 0-19 years, Vancouver Coastal Health Hospitals, NACRS, April 1, 2013 - March 31, 2015



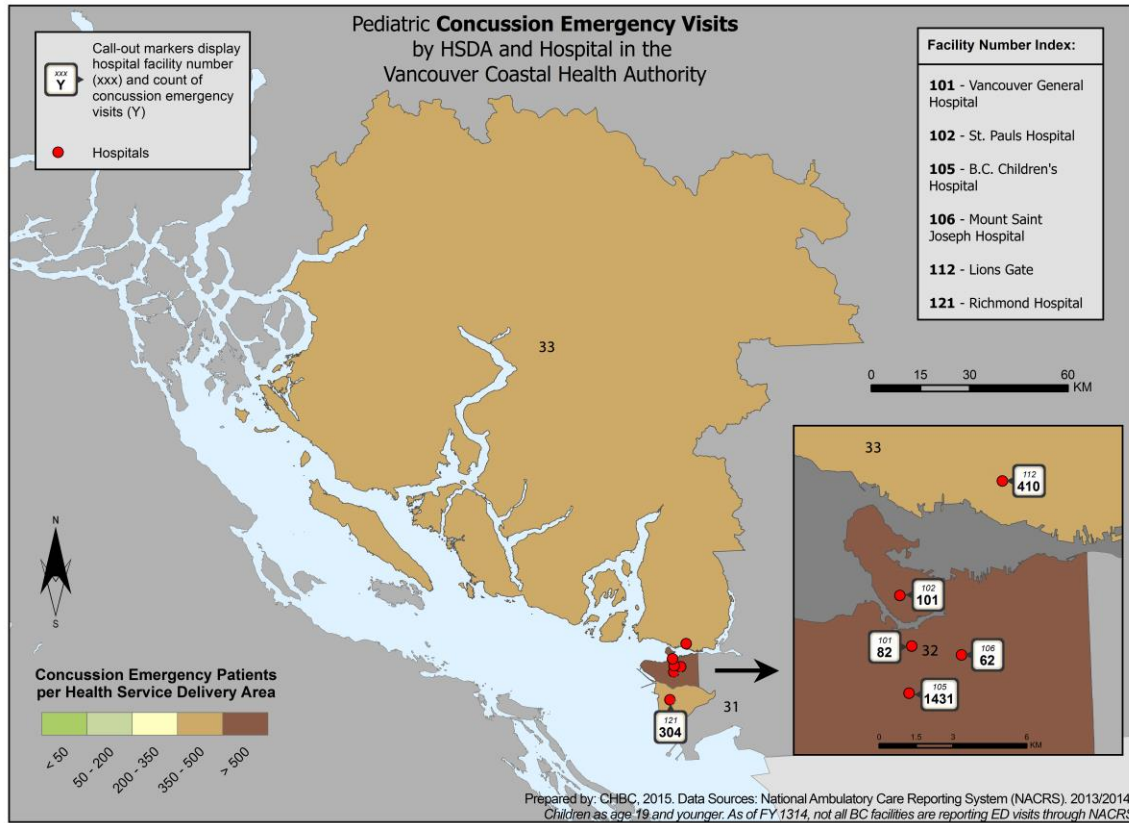
The total number of child and youth emergency department visits for concussion at Vancouver Coastal Health treating hospital facilities was highest for Lions Gate Hospital during 2013/14 and 2014/15 (710 cases). The highest proportions of emergency department visits attributed to child and youth concussion were seen at Mount Saint Joseph and Lions Gate Hospitals (4.1% and 3.7%, respectively). Low numbers of visits were seen at Mount Saint Joseph Hospital (136 cases) and Vancouver General Hospital (132 cases). Vancouver General Hospital also reported the second lowest proportion of concussion emergency visits as a proportion of overall emergency department visits (2.5%) and UBC Hospital reported the lowest (2.4%). Across all treating hospitals, Vancouver Coastal Health saw an average 3.3% of all child and youth emergency departments visits attributed to concussion-related injury (Table 2).

During the 2013/14 year alone, emergency department visits occurring at hospitals located within the region of Vancouver Coastal Health were highest at BC Children’s Hospital (PHSA) with 1,431 reported cases (Figure 30). Lions Gate Hospital saw 410 concussion emergency visits during the same year. The lowest numbers of child and youth emergency visits recorded in 2013/14 were seen at Mount Saint Joseph Hospital (62 visits) and Vancouver General Hospital (82 visits) (Figure 30).

Table 2: Concussion emergency department visit rates by hospital, ages 0-19 years, Vancouver Coastal Health, NACRS, April 1, 2013 - March 31, 2015

	Number of ER concussion visits	Total ER visits	% of concussion ER visits
Mount Saint Joseph Hospital	136	3,354	4.05
Lions Gate Hospital	710	19,087	3.72
Richmond Hospital	541	15,531	3.48
St. Paul’s Hospital	173	5,844	2.96
Vancouver General Hospital	132	5,223	2.53
UBC Hospital	141	5,902	2.39
Grand Total	1,833	54,941	3.34

Figure 30: Pediatric concussion emergency visits by local health area and hospital, Vancouver Coastal Health Authority, NACRS, 2013/14



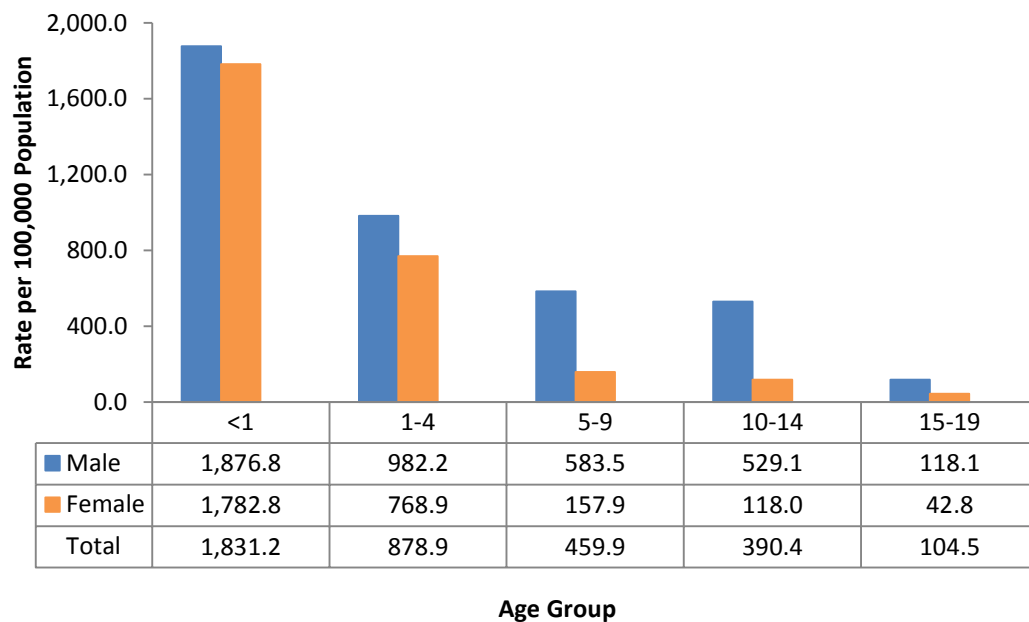
Note: 31: Richmond, 32: Vancouver, 33: North Shore/Coast Garibaldi

EMERGENCY DEPARTMENT VISITS AT BC CHILDREN'S HOSPITAL

Among child and youth residents of Vancouver Coastal Health, rates of emergency department visits to BC Children's Hospital for concussion were highest among males and females less than one year of age (Figure 31). Rates were lowest among males and females 15 to 19 years of age (118.1/100,000 and 42.8/100,000,

respectively). Overall concussion emergency department visit rates at BC Children's Hospital among children residing in Vancouver Coastal Health were highest for infants less than one year of age (1,831.2/100,000) and children 1 to 4 years old (878.9/100,000) (Figure 31).

Figure 31: Concussion emergency department visit rates at BC Children's Hospital by age group and sex, ages 0-19 years, residents of Vancouver Coastal Health, NACRS, April 1, 2012 - May 21, 2015



CONCLUSION

Vancouver Coastal Health exhibited low overall rates of child and youth concussion hospitalization. The highest rates of concussion hospitalizations were seen among 10 to 14 year olds, largely due to transport-related causes. The majority of these hospitalizations were due to the involvement of pedal-cyclists and motor vehicle occupants. Falls were the leading cause of concussion hospitalization among children under the age of 14 years, where the leading cause of falls involved skates, skis and skateboards.

Males within Vancouver Coastal Health exhibited higher rates of concussion hospitalizations than females across all ages between 0 to 19 years. Sport and recreation-related concussion hospitalizations were mostly observed among males between the ages of 5 and 19 years.

Of all the HSDAs in Vancouver Coastal Health, North Shore/Coast Garibaldi displayed the highest rates of transport-related concussion hospitalization across all age groups, while Richmond displayed the lowest rates.

Fall-related concussion hospitalization rates varied with age within each HSDA. Children aged 1 to 4 years displayed the highest rates of fall-related concussion hospitalization in Richmond and Vancouver, while in North Shore/Coast Garibaldi, rates were highest among children aged 5 to 9 years. Richmond had the highest rate of fall-related concussion hospitalization for the 1 to 4 years age category.

Fewer than five cases of fall-related concussion hospitalization among infants less than one year of age were experienced in all three HSDAs.

There was a large discrepancy in rates among LHAs. Bella Coola Valley, Howe Sound and West Vancouver-Bowen Island exhibited much higher rates of concussion hospitalizations than most regions in Vancouver Coastal Health, while Richmond, North East and City Centre reported low rates of child and youth concussion hospitalizations.

Concussion emergency department visits rates were higher among males than females residing within Vancouver Coastal Health. Rates were also higher among children less than 5 years of age. Overall, concussion emergency department visit rates among 0 to 19 year olds were highest among Vancouver residents.

Between April 1, 2013 and March 31, 2015, Mount Saint Joseph Hospital had the highest rate of child and youth concussion emergency department visits per 100,000 visits among all hospitals within Vancouver Coastal Health, while UBC Hospital had the lowest rate.

The months of November and March reported the highest rates per 100,000 visits and numbers of concussion emergency department visits, while the months of August and December recorded the lowest rates and numbers of concussion emergency department visits.

This report provides a comprehensive glance at the burden of concussion among children and youth within Vancouver Coastal Health, both at a regional and hospital level. With this information, Vancouver Coastal Health can work towards reducing the occurrence and burden of concussions among children and youth in BC.

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