Ascertainment and description of pedestrian and bicycling injuries and fatalities in Ontario from administrative health records 2003–2017: contributions of non-collision falls and crashes

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ABSTRACT

Introduction Pedestrian and bicycling injuries may be less likely to be captured by traffic injury surveillance relying on police reports. Non-collision injuries, including pedestrian falls and single bicycle crashes, may be more likely than motor vehicle collisions to be missed. This study uses healthcare records to expand the ascertainment of active transportation injuries and evaluate their demographic and clinical features.

Methods We identified pedestrian and bicyclist injuries in records of deaths, hospitalisations and emergency department visits in Ontario, Canada, between 2002 and 2017. We described the most common types of clinical injury codes among these records and assessed overall counts and proportions of injury types captured by each ascertainment definition. We also ascertained relevant fall injuries where the location was indicated as 'street or highway'.

Results Pedestrian falls represented over 50% of all pedestrian injuries and affected all age groups, particularly non-fatal falls. Emergency department records indicating in-traffic bicycle injuries not involving a collision with motor vehicles increased from 14% of all bicycling injury records in 2003 to 34% in 2017. The overall number of injuries indicated by these ascertainment methods was substantially higher than official counts derived from police reports.

Conclusion The use of healthcare system records to ascertain bicyclist and pedestrian injuries, particularly to include non-collision falls, can more fully capture the burden of injury associated with these transportation modes.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Road injuries to pedestrians and bicyclists are a global public health issue.
⇒ Surveillance relying on police-reported collisions can miss any unreported crashes, including pedestrian falls and non-collision bicycle crashes.
⇒ Efforts to increase the uptake of active transportation must mitigate the risk and burden of injury, requiring a complete picture of associated injuries.

WHAT THIS STUDY ADDS

⇒ More than 50% of detected pedestrian injuries were falls in the street or roadway, missed if users of administrative data use only pedestrian external cause codes to detect injuries.
⇒ Although on-street falls were more common in people 65 and older, these falls were noted to contribute to the burden of injury requiring emergency department visits in all age groups.
⇒ An increasing per cent of bicycling injuries were 'in-traffic' but not motor vehicle collisions over the 15-year observation period.
⇒ Healthcare records provide an ability to detect these injuries likely to be missed by police reporting.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The inclusion of hospital records of non-collision pedestrian falls and bicyclist crashes may improve surveillance and intervention research on active transportation injury.

INTRODUCTION

Public and population health initiatives encourage active transportation modes to increase physical activity, reduce the risk of chronic disease and mortality[1] and offer a sustainable form of transportation reducing air and noise pollution from motor vehicles.[2] Such efforts must be accompanied by robust injury prevention initiatives and work to mitigate the deterrent effect of safety concerns.[3]

A challenge to the evaluation and surveillance of active transportation injury is the under-reporting of these crashes to official traffic incident records, particularly police. In a meta-analysis of studies from 13 countries comparing hospital data to police-reported crashes, Elvik and Mysen[4] found that police-reported data consistently underestimated road traffic injury among bicyclists and pedestrians; single-vehicle bicycle crashes were the least likely to be reported (less than 10% reported). The data are not missing at random. In an analysis of discordance between police-reported crashes and hospital records in Queensland, Australia, Watson *et al*[5] found that walking and bicycling modes, younger age, male gender, less severe injury and rurality were all independently associated with being missed by reported collisions. A biased data gap on injuries can lead to misleading conclusions: in a UK study, Lyons *et al*[6] found that a trend of decreasing road traffic injuries was apparent only in police-reported data and not in hospital visit data.

There are multiple advantages to police-reported crash data that explain heavy reliance on this source for road safety work. First, the data are available and easily accessed (including online[7]). Second, police data can be analysed in near real time, as police-reported crashes are often announced at the time of occurrence.[8] Third, the data have geographic markers: they can be mapped, a feature commonly used by researchers in assessing trends and interventions.[9–13]

But given that crashes involving pedestrians and bicyclists are less likely to be reported than those involving motor vehicles,[14 15] there is a particular impetus to evaluate injuries using other methods, including records of healthcare utilisation.[16]

While previous studies have used healthcare records to ascertain crashes among relevant subpopulations in Ontario,[17] the present study aims to investigate detailed definitions of bicyclist and pedestrian injuries that may capture active transportation injury more fully. In particular, this study responds to calls to include falls among pedestrian injuries[18] to give a fuller picture of injuries incurred by walking and to distinguish between bicycle crashes that involve collisions with motor vehicles and others that occur on-road but not direct collisions. The primary objective is to provide methodological insight into ascertainment methods to improve the future use of these healthcare databases to study the epidemiology of active transportation injury.

METHODS

Injury data sources

We analysed databases held by Ontario's population health data repository, ICES. ICES is an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyse healthcare and demographic data, without consent, for health system evaluation and improvement. This analysis included 2002–2017 records of (1) emergency department (ED) visits from the National Ambulatory Care Reporting System (NACRS); (2) hospitalisations from the Discharge Abstract Database (DAD) and (3) deaths from Ontario Registrar General's Death file. Sociodemographic information (age, sex) was provided through the linkage of the above sources to Ontario's population registry (the Registered Persons Database, RPDB). While 2002 records were extracted, the first year of complete reporting in DAD and NACRS was 2003, so this was the first year analysed for individual year analyses. These datasets were linked using unique encoded identifiers and analysed at ICES. In addition to data access approval and disclosure procedures at ICES, this project was reviewed and approved by research ethics boards at Toronto Metropolitan University (protocol number 2020–107) and the University of Toronto (protocol number 38743).

Case definitions

Cases were ascertained using International Classification of Disease (ICD) coding: ICD-10-CA, a Canadian version of the ICD-10, was used for ED and hospitalisation data, and ICD-10 was used for death records. Records containing ICD codes beginning with 'V0' found in any diagnostic data field were considered pedestrian injuries. Among hospitalisations and ED visits, a selection of fall codes beginning W (online supplemental appendix 1) was used to identify pedestrian falls not captured by V0 pedestrian codes. We selected fall codes that involved slips, trips and falls, and devices used for pedestrian mobility and only where a 'place of occurrence' was denoted as U984 'street or highway' (online supplemental appendix 1). Death records had less information on location of injury, and fewer informational fields in general. Vital statistics records included a 'place of injury' field (4 denoting 'street or highway') but we noted this field was not populated reliably before 2013, however, we extracted all records meeting this definition in this analysis.

Bicycling injuries were identified as ICD codes beginning 'V1' in any diagnostic field in records (including external cause fields), which we separated into five categories of bicycle crashes (online supplemental appendix 1): (1) collisions with motor vehicles occurring 'in traffic'; (2) collisions with motor vehicles 'not in traffic'; (3) injuries not involving motor vehicles but 'in traffic'; (4) injuries not involving motor vehicles and not in traffic and (5) 'other' and 'not specified' bicycle injuries.

Analyses

For ED visits and hospitalisations, we summarised numerator only frequencies to examine the percentage contribution of falls and collisions to the total ascertained pedestrian injury burden. We then examined the burden of falls versus collisions among pedestrian injuries by age categories (children of 12 years and under, adolescents and young adults 13–24, adults 25 to 64 and seniors over the age of 65) and sex (in these databases, a dichotomous male/female indicator). We examined the percentage of bicycling injury types (I–V, online supplemental appendix 1) over the follow-up period. Because deaths were too rare for subdivided analyses by sex (cell size minima were not met for data release), the overall ratio of male and female injuries was calculated for the entire follow-up period.

We assessed the top 10 clinical diagnostic codes and the ascertained health records for bicycling injuries, pedestrian collisions and pedestrian falls by examining frequency distribution of injury codes in the main diagnostic fields in these records (called 'Main Problem' in ED records, and 'Diagnosis Code' in hospitalisation records). Frequency and percentage of bicycling injuries requiring ED visits, hospitalisations and deaths were tallied by year and by each of the five categories indicating crash circumstances. In addition to examining death data from mortality records, we also examined the proportion of hospitalised and ED injuries, indicating a discharge disposition of death. Analyses were performed using SAS V.9.4 (Cary, North Carolina).

Patient and public involvement

No patients were contacted or involved in this research, so consultations were not conducted with patients. This analysis of secondary data forms part of a broader research programme in active transportation injury epidemiology, for which connections have been forged with stakeholder groups including injury prevention organisations, and public bodies charged with road safety interventions and evaluation, which have guided the motivation for improving methodology in injury surveillance.

RESULTS

Fatal pedestrian injuries and those requiring hospitalisation were more common than bicycling injuries, but for injuries requiring ED visits, bicycling injuries were more common (figure 1). For both bicycling and pedestrian injuries, an order of magnitude of difference in injury burden was observed between each severity level of injury, with hundreds of deaths, thousands of hospitalisations and tens of thousands of ED visits (figure 1).

Types of injuries among bicyclists and pedestrians

Table 1 summarises both case definitions and the top 10 clinical injury codes noted for each category of transportation injury. Head injuries were the most common injury subtype

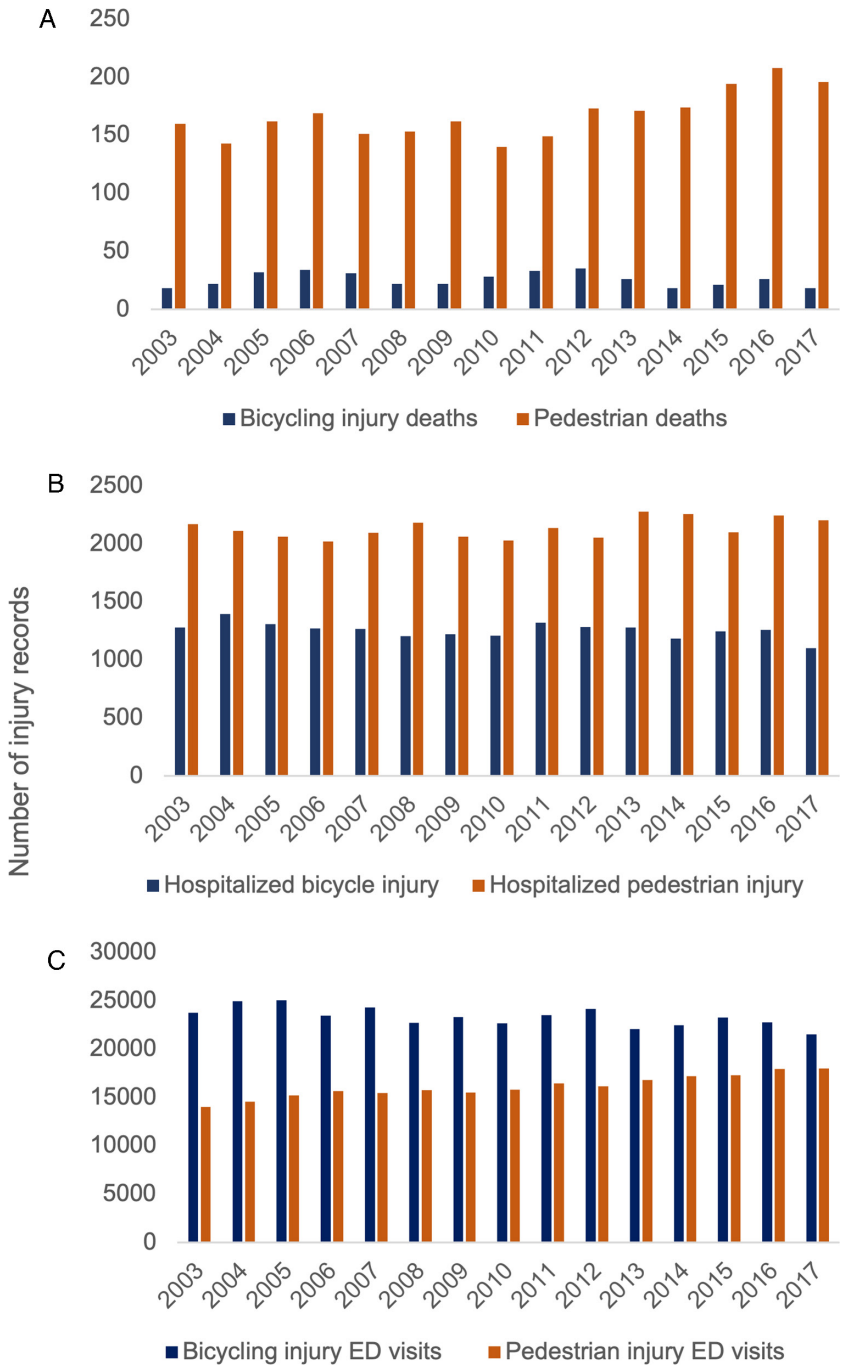

Figure 1 Number of pedestrian and bicycling injury records ascertained among databases of (A) deaths; (B) hospitalisations and (C) emergency department (ED) visits in Ontario, Canada 2003–2017.

among records of ED visits for bicycling and pedestrian injuries (table 1). Fractures were common among injuries requiring ED visits or hospitalisation, with uncomplicated wounds and lacerations more common among ED-treated injuries (table 1). Among death records, the 'underlying cause' field was not comparable to clinical codes in healthcare records, with most 'underlying' causes of death populated by the same external cause codes used in case ascertainment.

Discharge disposition for pedestrians and bicyclists visiting hospital

A higher percentage of pedestrian injuries requiring hospital visits were fatal than bicycling injuries. Among visits to EDs, 12.1% of pedestrian motor vehicle collisions and 8.7% of pedestrian fall injuries were fatal (the discharge disposition indicated 'died' or 'dead on arrival'). In comparison, 4.4% of bicycling injuries were fatal. Among hospitalisations, 4.6% of pedestrian motor vehicle collisions, 2.7% of pedestrian falls, and 0.8% of bicycling injuries resulted in recorded death in discharge records.

Men over-represented in severe road injury

A nuanced construction of gender was not available in these administrative datasets, only a binary sex indicator, which was populated for all individuals. Among bicycling injuries, men were 73% of all ED visits, 75.7% of hospitalisations and 87.4% of deaths. Among pedestrians injured by collisions, men were

Table 1 Description of 10 most common clinical diagnostic codes found in main clinical diagnosis field among emergency department and hospitalisation records of bicycling and pedestrian injuries in Ontario, Canada 2003–2017

	Bicycling injuries		%	Pedestrian collisions		%	Pedestrian falls		%
Emergency department visits	S099	Unspecified injury of head	5.5	S099	Unspecified injury of head	5.4	S099	Unspecified injury of head	8.0
	S0180	Open wounds of other parts of head, uncomplicated	5.1	S809	Superficial injury of lower leg, unspecified	3.1	S0180	Open wounds of other parts of head, uncomplicated	5.9
	S52590	Unspecified fracture of lower end of radius, closed	2.0	S899	Unspecified injury of lower leg	2.4	S9349	Sprain and strain of ankle, unspecified	3.3
	S699	Unspecified injury of wrist and hand	1.9	S909	Superficial injury of ankle and foot, unspecified	2.4	S008	Superficial injury of other parts of head	2.6
	S52100	Fracture of head of radius, closed	1.8	T009	Multiple superficial injuries, unspecified	2.1	S0100	Open wound of scalp, uncomplicated	1.8
	S52580	Other fracture of lower end of radius, closed	1.7	S999	Unspecified injury of ankle and foot	2.0	S52590	Unspecified fracture of lower end of radius, closed	1.7
	S42090	Fracture of unspecified part of clavicle, closed	1.6	S800	Contusion of knee	1.9	S809	Superficial injury of lower leg, unspecified	1.5
	S809	Superficial injury of lower leg, unspecified	1.6	S903	Contusion of other and unspecified parts of foot	1.7	S0110	Open wound of eyelid and periocular area, uncomplicated	1.4
	S42010	Fracture of shaft of clavicle, closed	1.6	S82100	Fracture of upper (proximal) end of tibia with or without fibula, closed	1.7	S92300	Fracture of metatarsal bone, closed	1.3
	S8100	Open wound of knee, uncomplicated	1.5	T140	Superficial injury of unspecified body region	1.4	S52580	Other fracture of lower end of radius, closed	1.3
Hospitalisations	S42400	Supracondylar fracture of humerus, closed	3.9	S82100	Fracture of upper (proximal) end of tibia with or without fibula, closed	9.2	S72080	Other fracture of femoral neck, closed	9.9
	S82100	Fracture of upper (proximal) end of tibia with or without fibula, closed	3.1	S82200	Fracture of shaft of tibia with or without fibula, closed	4.1	S72100	Intertrochanteric fracture, closed	8.9
	S72080	Other fracture of femoral neck, closed	3.1	S065	Traumatic subdural haemorrhage	3.7	S82800	Bimalleolar fracture of ankle, closed	5.1
	S52000	Fracture of olecranon process of ulna, closed	3.0	S32500	Fracture of pubis, closed	3.6	S82000	Fracture of patella, closed	3.3
	S72100	Intertrochanteric fracture, closed	2.7	S066	Traumatic subarachnoid haemorrhage	3.0	S32500	Fracture of pubis, closed	2.9
	S52600	Fracture of lower end of both ulna and radius, closed	2.2	S82201	Fracture of shaft of tibia with or without fibula, open	2.3	S065	Traumatic subdural haemorrhage	2.7
	S42010	Fracture of shaft of clavicle, closed	2.0	S82300	Fracture of lower (distal) end of tibia with or without fibula, closed	2.0	S82300	Fracture of lower (distal) end of tibia with or without fibula, closed	2.6
	S099	Unspecified injury of head	1.8	S72100	Intertrochanteric fracture, closed	1.9	S82600	Fracture of lateral malleolus, closed	2.4
	S27000	Traumatic pneumothorax, without open wound into thoracic cavity	1.8	S72300	Fracture of shaft of femur, closed	1.9	S42200	Fracture of surgical neck of humerus, closed	2.1
	S52580	Other fracture of lower end of radius, closed	1.8	S82800	Bimalleolar fracture of ankle, closed	1.8	S52000	Fracture of olecranon process of ulna, closed	1.9

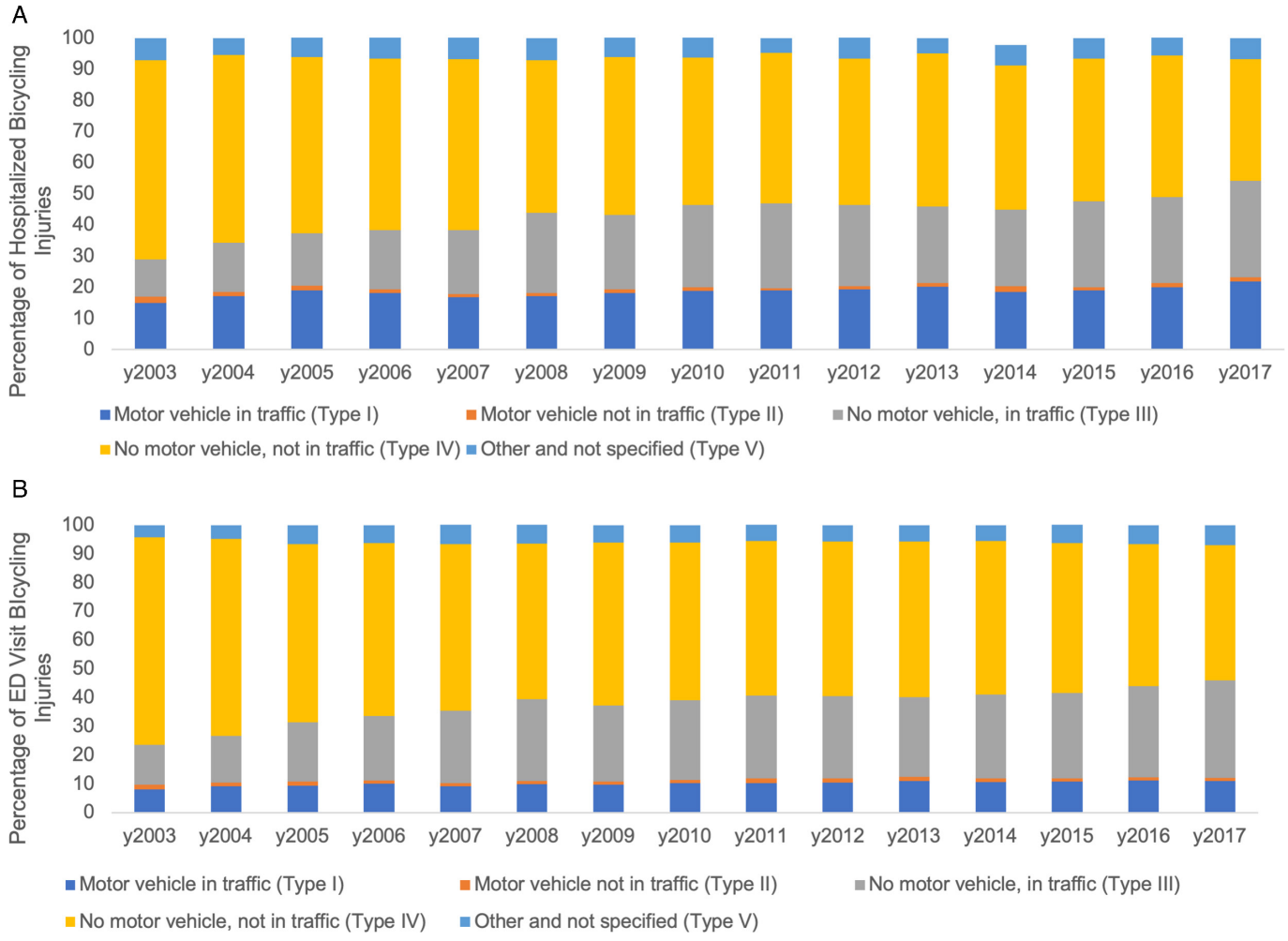

Figure 2 Types of bicycling injuries observed among 2003–2017 records of (A) hospitalisations (B) emergency department (ED) visits by year in Ontario, Canada.

51.3% of ED visits, 52.8% of hospitalisations and 63.0% of deaths. Among pedestrian street or roadway falls, men represented 41.0% of ED visits, 41.7% of hospitalisations and 69.5% of deaths.

Increasing percentage of in-traffic, non-collision bicycling injuries

We observed an increase in the percentage of bicycling injuries recorded as occurring 'in traffic' but without a motor vehicle collision in records of both hospitalisations and ED visits, from 14% in 2003 to 34% in 2017 for ED visits (figure 2). There was an attendant decrease in the percentage of ED-recorded injuries occurring 'not in traffic' and not involving a motor vehicle collision, from 72% in 2003 to 47% in 2017, while the percentage of injuries attributed to in-traffic motor vehicle collisions increased slightly from 10% in 2003 to 12% in 2017 (figure 2). A similar pattern was observed among hospitalisation records for bicycling injuries (figure 2).

Falls account for a high proportion of pedestrian injury burden

Among pedestrian collision injuries, 96.8% were recorded with codes indicating collision with motor vehicles. After the exclusion of 'other and unspecified' pedestrian collision codes, cell sizes were too small for a detailed analysis of collisions with non-motor vehicles. However, injuries ascertained as falls in the street or roadway were 60.1% of total pedestrian injuries requiring ED visits, 54.8% of hospitalisations and 14% of pedestrian deaths. A comparison of pedestrian injuries attributed to falls versus collisions indicated that falls represented a large proportion of injury burden for those aged 65 and older, but, among non-fatal injuries in particular, a substantial proportion of the burden of injury among children and working-age adults (figure 3).

DISCUSSION

We noted considerably higher counts and burdens of pedestrian and bicycling injuries than data summarised from police-reported crashes for the province of Ontario.[19] Overall, our observed injury counts are several times those assessed from police-reported crashes. This is consistent with a pattern observed in multiple jurisdictions of police-reported crashes undercounting road injuries, particularly those involving vulnerable road users such as bicyclists and pedestrians.[8 14 20–22] Despite healthcare utilisation records being more sensitive than police report, the injuries detected by healthcare records will under-represent the overall traffic injury burden as less severe injuries may be managed without visiting the hospital. While it is assumed that injuries requiring treatment at EDs without admission represent 'minor' injuries, head injury was the leading clinical code

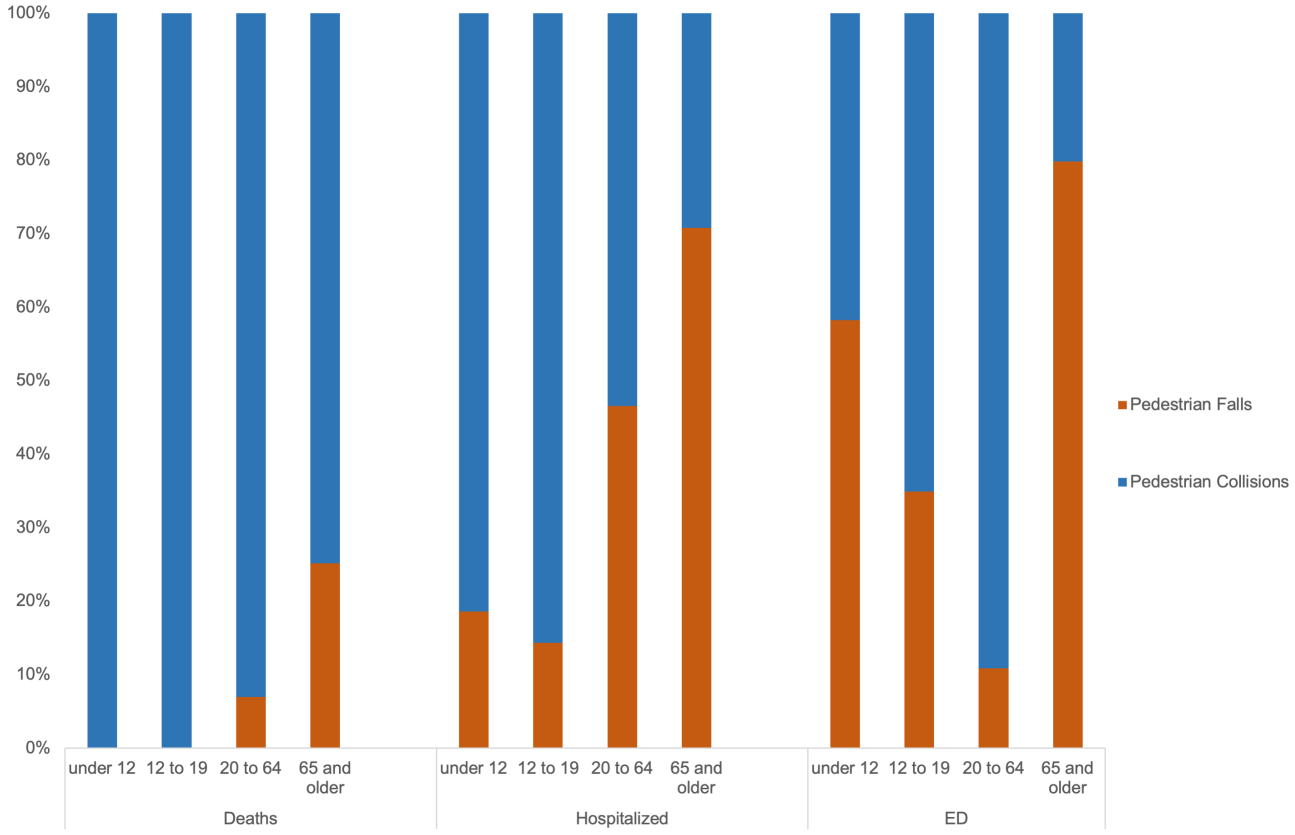

Figure 3 Percentage of total pedestrian injuries represented by falls (ascertained in records of deaths, hospitalisations and emergency department (ED) visits) across age groups in Ontario, Canada 2002–2017.

on these records; this is similar to a previous study in Belgium by Dhont *et al*.[23] Because head injuries can be associated with significant acute[24] and longer term[25–28] impacts, even the least severe injuries detected by these healthcare utilisation records can represent significant morbidity.

We were directly able to include injuries that may go unreported to law enforcement, and, therefore, missed in police records, including those not involving collisions with motor vehicles.[20] While the proportion of bicycling injuries involving in-traffic collisions with motor vehicles remained relatively consistent during the observation period, we noted an increasing contribution of in-traffic injuries not involving motor vehicles, which seemed to accompany a decreasing proportion of non-traffic injuries not involving motor vehicle collision. This could represent an underlying change in bicycle usage in Ontario—with a changing proportion of injuries occurring among recreational bicyclists travelling off-road and an increasing proportion of injuries occurring among utilitarian cyclists using roads for transportation.[29 30] This is consistent with the observed pattern occurring in both ED visits and hospitalisations. However, it is critical that we are not able to exclude changing applications and interpretations of external cause codes among hospital record coders. A primary collection interview study of ED visits for utilitarian (non-recreational) bicycle injury in Toronto, Ontario (2008–2009) found that approximately one-third of utilitarian bicycling injuries involved motor vehicles,[31] in contrast with the approximately 11%–12% estimated here from province-wide administrative data in the same years. These figures are not directly comparable due to a focus on different study populations: excluding exclusively recreational bicycling injuries would likely increase the proportion of motor vehicle involved injuries. However, this primary collection study noted reports of indirect motor vehicle involvement (eg, swerving to avoid a motor vehicle crash) in an additional 15% of injuries,[31] suggesting that it is possible that the involvement of motor vehicles could be assessed differently by coders as compared with those who can provide first-hand reports of crash circumstances.

Our inclusion of falls with a place of occurrence as street or highway addresses two concerns. The first is the potential for miscoding of pedestrian collision injuries as falls, found in another Canadian jurisdiction.[32] But inclusion of these injuries may also improve our overall surveillance and conceptualisation of transportation injury by addressing the omission of the equivalent of 'single vehicle crashes' among pedestrians from traditional ascertainment methods. We found that falls occurring on the street or highway could contribute substantially to pedestrian injury burden. These are not reportable to police, and missed if only collision-based external cause codes are used to ascertain injury from administrative data.[18] Falls have been long understood as a major contributor to injury burden in older

ages[33] and carry a high economic and health burden within this population,[34] suggesting falls will be an increasingly critical concern in ageing populations. However, we observed that falls on road represented a substantial non-fatal injury burden among younger age groups. Even these non-fatal injuries can be linked to substantial quality of life and economic impacts.[35]

We note that by excluding pedestrian injuries that do not entail collisions from surveillance and prevention assessment, transportation injury prevention may inadvertently discount interventions that could substantially reduce injury burden. The inclusion of falls in the ascertainment of pedestrian injury when using healthcare data could affect priorities for intervention initiatives, including snow and ice clearing to prevent slips and sidewalk and curb maintenance to prevent tripping.[36] While non-fatal pedestrian falls were ascertained clearly in the included databases, a limitation in the ascertainment of fatal pedestrian falls was inconsistency in the availability of a location of injury field in death records captured by external cause codes, so fatalities resulting from pedestrian falls may not be easily ascertained compared with those requiring ED visits or hospitalisation. An alternative may be to examine and compare ED visits or hospitalisations associated with fatal discharge disposition to determine overlap on captured fatal pedestrian falls. A case review of on-street (or on-sidewalk) fatal falls may also contribute to insight into the ability of general death records to ascertain these injuries.

Overall, a chart review or primary collection study conducted in Ontario would be a useful supplement to these analyses to help interpret the contribution of falls to pedestrian injuries, and non-motor vehicle bicycling injuries. A chart review and linkage study to examine how injuries are coded by their observed circumstances would be costly and could face critical privacy challenges associated with data linkage in this jurisdiction. However, a primary data collection study examining injury circumstances, possible precipitating medical events[37] or infrastructural risk factors[38] could present a critical addition to our understanding of active transportation injury aetiology and help identify targets for prevention.

Two additional limitations on interpreting these data are the potential for repeat visits (double counting) and a lack of denominator data to contextualise counts. We did not attempt in these analyses to restrict repeated visits to unique individuals, given the aim to capture the overall burden represented by these injuries. However, this does mean that these numbers of injuries may not represent the absolute prevalence of injury in the population during this time. We did perform an analysis of the proportion of unique individuals among all records, finding that ED visits had the highest number of multiple records per individual: 16.2% of bicycling injury records, 9.2% of pedestrian collisions, 5.7% may be repeated events or repeat visits attributable the same incident. Hospitalisations had considerably fewer repeat records and deaths none. We note that these potential repeated visits alone can not explain the gap in estimate between police-reported[19] and healthcare detected injuries.

It is challenging to interpret sex and gender differences in pedestrian and bicycling injury burden without a complete picture of exposure to these travel modes. Denominators are a longstanding challenge to the interpretation of traffic injury patterns in Canada, in particular, because Canada lacks a national household transportation survey to estimate kilometres or trips travelled by different modes.[30] In available national data, women contribute more walking trips than men, and men more bicycling trips than women,[29 30] such that our finding that men are over-represented in pedestrian injury may particularly reflect an underlying risk difference rather than merely greater exposure to risk.

These analyses include injuries recorded in databases up to 2017, the most recent complete data year for all three databases at the time of analysis commencement in 2021. There is a challenge of the timeliness of the use of healthcare secondary data. We analysed complete years for all three databases. While all administrative databases are lagged, death data are considerably lagged in Canada. By contrast, some local jurisdictions make police-reported traffic injury data available in near-real time.[8] This can encourage reliance on incomplete police-reported data by policy-makers and researchers, while administrative data represents a more complete, but much more slowly available picture, particularly when death records are included. Analyses of healthcare system administrative data and police reported crashes focused on traffic injury during the pandemic period address the balance between timeliness and completeness of data.[8] Therefore, these analyses can form a critical historical context in which to compare pandemic and postpandemic injury patterns and provide insight into the methodological impact of including non-collision falls in active transportation injury surveillance.

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Contributors MAH conceived the study and designed in consultation with LR. All authors contributed to the methodolgical approaches. MAH and TW conducted data analyses. All authors contributed to interpretation. MAH wrote the manuscript with input from all authors. MAH is guarantor of the overall content of the work and conduct of the study.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer-reviewed.

Data availability statement Data may be obtained from a third party and are not publicly available. The accessed databases used data adapted from the Statistics Canada Postal Code OM Conversion File, which is based on data licensed from Canada Post Corporation, and/or data adapted from the Ontario Ministry of Health Postal Code Conversion File, which contains data copied under license from ©Canada Post Corporation and Statistics Canada. Parts of this material are based on data and/or information compiled and provided by: MOH, the Canadian Institute for Health Information (CIHI). The analyses, conclusions, opinions and statements expressed herein are solely those of the authors and do not reflect those of the funding or data sources; no endorsement is intended or should be inferred. Parts of this report are based on Ontario Registrar General (ORG) information on deaths, the original source of which is ServiceOntario. The views expressed therein are those of the author and do not necessarily reflect those of ORG or the Ministry of Public and Business Service Delivery. The dataset from this study is held securely in coded form at ICES. While legal data sharing agreements between ICES and data providers (eg, healthcare organisations and government) prohibit ICES from making the dataset publicly available, access may be granted to those who meet pre-specified criteria for confidential access, available at www.ices.on.ca/DAS (email: das@ices.on.ca). The

full dataset creation plan and underlying analytic code are available from the authors upon request, understanding that the computer programs may rely upon coding templates or macros that are unique to ICES and are therefore either inaccessible or may require modification.

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Appendix 1: Case definitions and code descriptions

Case definitions

Bicycling Injuries

I: Motor vehicle collisions, in traffic	**II:** Motor vehicle collisions, non-traffic	**III:** No motor vehicle, in traffic	**IV:** No motor vehicle, non-traffic	**V:** Other and not specified
V123-125, V129 V133-135, V139 V143-145, V149 V153-155, V159 V194-196	V120-122 V130-132 V140-142 V150-152 V190-192	V103-105, V109 V113-115, V119 V163-165, V169 V173-175, V179 V183-185, V189	V100-102 V110-112 V160-162 V170-172 V180-182 V193	V198-199

Pedestrian Injuries

Collisions	**Falls**	
All codes beginning V0*	W00, W01, W0208, W03, W04, W05, W10, W17, W18, W19	**and** designated location U984 (Street and Highway)

Excerpt of ICD-10-CA code descriptions

V010	Pedestrian injured in collision with pedal cycle, nontraffic accident
V011	Pedestrian injured in collision with pedal cycle, traffic accident
V019	Pedestrian injured in collision with pedal cycle, unspecified whether traffic or nontraffic accident
V020	Pedestrian injured in collision with two- or three-wheeled motor vehicle, nontraffic accident
V021	Pedestrian injured in collision with two- or three-wheeled motor vehicle, traffic accident
V029	Pedestrian injured in collision with two- or three-wheeled motor vehicle, unspecified whether traffic or nontraffic accident
V030	Pedestrian injured in collision with car, pick-up truck or van, nontraffic accident
V031	Pedestrian injured in collision with car, pick-up truck or van, traffic accident
V039	Pedestrian injured in collision with car, pick-up truck or van, unspecified whether traffic or nontraffic accident
V040	Pedestrian injured in collision with heavy transport vehicle or bus, nontraffic accident
V041	Pedestrian injured in collision with heavy transport vehicle or bus, traffic accident
V049	Pedestrian injured in collision with heavy transport vehicle or bus, unspecified whether traffic or nontraffic accident
V050	Pedestrian injured in collision with railway train or railway vehicle, nontraffic accident
V051	Pedestrian injured in collision with railway train or railway vehicle, traffic accident
V059	Pedestrian injured in collision with railway train or railway vehicle, unspecified whether traffic or nontraffic accident

V060	Pedestrian injured in collision with other nonmotor vehicle, nontraffic accident
V061	Pedestrian injured in collision with other nonmotor vehicle, traffic accident
V069	Pedestrian injured in collision with other nonmotor vehicle, unspecified whether traffic or nontraffic accident
V090	Pedestrian injured in nontraffic accident involving other and unspecified motor vehicles
V091	Pedestrian injured in unspecified nontraffic accident
V092	Pedestrian injured in traffic accident involving other and unspecified motor vehicles
V093	Pedestrian injured in unspecified traffic accident
V099	Pedestrian injured in unspecified transport accident
V100	Pedal cyclist injured in collision with pedestrian or animal, driver, nontraffic accident
V101	Pedal cyclist injured in collision with pedestrian or animal, passenger, nontraffic accident
V102	Pedal cyclist injured in collision with pedestrian or animal, unspecified pedal cyclist, nontraffic accident
V103	Pedal cyclist injured in collision with pedestrian or animal, while boarding or alighting
V104	Pedal cyclist injured in collision with pedestrian or animal, driver, traffic accident
V105	Pedal cyclist injured in collision with pedestrian or animal, passenger, traffic accident
V109	Pedal cyclist injured in collision with pedestrian or animal, unspecified pedal cyclist, traffic accident
V110	Pedal cyclist injured in collision with other pedal cycle, driver, nontraffic accident
V111	Pedal cyclist injured in collision with other pedal cycle, passenger, nontraffic accident
V112	Pedal cyclist injured in collision with other pedal cycle, unspecified pedal cyclist, nontraffic accident
V113	Pedal cyclist injured in collision with other pedal cycle, while boarding or alighting
V114	Pedal cyclist injured in collision with other pedal cycle, driver, traffic accident
V115	Pedal cyclist injured in collision with other pedal cycle, passenger, traffic accident
V119	Pedal cyclist injured in collision with other pedal cycle, unspecified pedal cyclist, traffic accident
V120	Pedal cyclist injured in collision with two- or three-wheeled motor vehicle, driver, nontraffic accident
V121	Pedal cyclist injured in collision with two- or three-wheeled motor vehicle, passenger, nontraffic accident
V122	Pedal cyclist injured in collision with two- or three-wheeled motor vehicle, unspecified pedal cyclist, nontraffic accident
V123	Pedal cyclist injured in collision with two- or three-wheeled motor vehicle, while boarding or alighting
V124	Pedal cyclist injured in collision with two- or three-wheeled motor vehicle, driver, traffic accident

V125	Pedal cyclist injured in collision with two- or three-wheeled motor vehicle, passenger, traffic accident
V129	Pedal cyclist injured in collision with two- or three-wheeled motor vehicle, unspecified pedal cyclist, traffic accident
V130	Pedal cyclist injured in collision with car, pick-up truck or van, driver, nontraffic accident
V131	Pedal cyclist injured in collision with car, pick-up truck or van, passenger, nontraffic accident
V132	Pedal cyclist injured in collision with car, pick-up truck or van, unspecified pedal cyclist, nontraffic accident
V133	Pedal cyclist injured in collision with car, pick-up truck or van, while boarding or alighting
V134	Pedal cyclist injured in collision with car, pick-up truck or van, driver, traffic accident
V135	Pedal cyclist injured in collision with car, pick-up truck or van, passenger, traffic accident
V139	Pedal cyclist injured in collision with car, pick-up truck or van, unspecified pedal cyclist, traffic accident
V140	Pedal cyclist injured in collision with heavy transport vehicle or bus, driver, nontraffic accident
V141	Pedal cyclist injured in collision with heavy transport vehicle or bus, passenger, nontraffic accident
V142	Pedal cyclist injured in collision with heavy transport vehicle or bus, unspecified pedal cyclist, nontraffic accident
V143	Pedal cyclist injured in collision with heavy transport vehicle or bus, while boarding or alighting
V144	Pedal cyclist injured in collision with heavy transport vehicle or bus, driver, traffic accident
V145	Pedal cyclist injured in collision with heavy transport vehicle or bus, passenger, traffic accident
V149	Pedal cyclist injured in collision with heavy transport vehicle or bus, unspecified pedal cyclist, traffic accident
V150	Pedal cyclist injured in collision with railway train or railway vehicle, driver, nontraffic accident
V151	Pedal cyclist injured in collision with railway train or railway vehicle, passenger, nontraffic accident
V152	Pedal cyclist injured in collision with railway train or railway vehicle, unspecified pedal cyclist, nontraffic accident
V153	Pedal cyclist injured in collision with railway train or railway vehicle, while boarding or alighting
V154	Pedal cyclist injured in collision with railway train or railway vehicle, driver, traffic accident
V155	Pedal cyclist injured in collision with railway train or railway vehicle, passenger, traffic accident
V159	Pedal cyclist injured in collision with railway train or railway vehicle, unspecified pedal cyclist, traffic accident
V160	Pedal cyclist injured in collision with other nonmotor vehicle, driver, nontraffic accident
V161	Pedal cyclist injured in collision with other nonmotor vehicle, passenger, nontraffic accident

V162	Pedal cyclist injured in collision with other nonmotor vehicle, unspecified pedal cyclist, nontraffic accident
V163	Pedal cyclist injured in collision with other nonmotor vehicle, while boarding or alighting
V164	Pedal cyclist injured in collision with other nonmotor vehicle, driver, traffic accident
V165	Pedal cyclist injured in collision with other nonmotor vehicle, passenger, traffic accident
V169	Pedal cyclist injured in collision with other nonmotor vehicle, unspecified pedal cyclist, traffic accident
V170	Pedal cyclist injured in collision with fixed or stationary object, driver, nontraffic accident
V171	Pedal cyclist injured in collision with fixed or stationary object, passenger, nontraffic accident
V172	Pedal cyclist injured in collision with fixed or stationary object, unspecified pedal cyclist, nontraffic accident
V173	Pedal cyclist injured in collision with fixed or stationary object, while boarding or alighting
V174	Pedal cyclist injured in collision with fixed or stationary object, driver, traffic accident
V175	Pedal cyclist injured in collision with fixed or stationary object, passenger, traffic accident
V179	Pedal cyclist injured in collision with fixed or stationary object, unspecified pedal cyclist, traffic accident
V180	Pedal cyclist injured in noncollision transport accident, driver, nontraffic accident
V181	Pedal cyclist injured in noncollision transport accident, passenger, nontraffic accident
V182	Pedal cyclist injured in noncollision transport accident, unspecified pedal cyclist, nontraffic accident
V183	Pedal cyclist injured in noncollision transport accident, while boarding or alighting
V184	Pedal cyclist injured in noncollision transport accident, driver, traffic accident
V185	Pedal cyclist injured in noncollision transport accident, passenger, traffic accident
V189	Pedal cyclist injured in collision with fixed or stationary object, unspecified pedal cyclist, traffic accident
V190	Driver of pedal cycle injured in collision with other and unspecified motor vehicles in nontraffic accident
V191	Passenger of pedal cycle injured in collision with other and unspecified motor vehicles in nontraffic accident
V192	Unspecified pedal cyclist injured in collision with other and unspecified motor vehicles in nontraffic accident
V193	Pedal cyclist [any] injured in unspecified nontraffic accident
V194	Driver of pedal cycle injured in collision with other and unspecified motor vehicles in traffic accident
V195	Passenger of pedal cycle injured in collision with other and unspecified motor vehicles in traffic accident
V196	Unspecified pedal cyclist injured in collision with other and unspecified motor vehicles in traffic accident

V198	Pedal cyclist [any] injured in other specified transport accident
V199	Pedal cyclist [any] injured in unspecified traffic accident
W00	Fall on same level involving ice and snow
W01	Fall on same level from slipping, tripping and stumbling
W0208	Fall other specified
W03	Other fall on same level due to collision with, or pushing by, another person
W04	Fall while being carried or supported by other persons
W0500	Fall involving wheelchair
W0501	Fall involving adult walker
W0502	Fall involving baby walker
W0503	Fall involving stroller/carriage
W0508	Fall involving other specified walking devices
W0509	Fall involving unspecified walking devices
W10	Fall on and from stairs and steps
W17	Other fall from one level to another
W18	Other fall on same level
W19	Unspecified fall