https://doi.org/10.24095/hpcdp.43.7.03

Original quantitative research

Lockdowns and cycling injuries: temporal analysis of rates in Quebec during the first year of the pandemic

Nathalie Auger, MD (1,2,3,4); Antoine Lewin, PhD (5); Émilie Brousseau, MSc (1,2); Aimina Ayoub, MSc (1,2); Christine Blaser, PhD (3); Thuy Mai Luu, MD (6)

This article has been peer reviewed.

Tweet this article

Abstract

Introduction: Cycling increased in popularity during the COVID-19 pandemic, but the impact on cycling injuries is not known. We examined the effect of lockdowns on cycling injury hospitalizations.

Methods: We identified hospitalizations for cycling injuries in Quebec, Canada, between April 2006 and March 2021. We used rate ratios (RR) and 95% confidence intervals (CI) to compare hospitalization rates by type of cycling injury and anatomical site during two waves of the pandemic. We performed interrupted time series regression to assess the effect of lockdowns on monthly cycling injury hospitalization rates, according to age, sex and other characteristics.

Results: There were 2020 hospitalizations for cycling injuries between March 2020 and March 2021, including 617 during the first lockdown and 67 during the second lockdown. Compared with the period before the pandemic, risk of cycling-related injuries during the first lockdown increased the most for fractures (RR = 1.44; 95% CI: 1.26–1.64) and head and neck injuries (RR = 1.59; 95% CI: 1.19–2.12). Cycling injury hospitalization rates increased significantly among adults, adolescents and individuals from socioeconomically advantaged neighbourhoods or those with low concentrations of racialized people every month of the first lockdown. The second lockdown was not associated with cycling injuries.

Conclusion: The first lockdown triggered a sharp increase in cycling injury hospitalizations, especially among adults, adolescents and individuals from socioeconomically advantaged and less racialized neighbourhoods.

Keywords: *bicycling, COVID-19, exercise, transportation, wounds, injuries, fracture, socioeconomic factors*

Highlights

- Cycling injuries in Quebec increased among adults and adolescents during the COVID-19 pandemic.
- Fractures and head and neck injuries increased the most.
- Most injuries were due to falls from a bicycle rather than due to collisions.
- People living in socioeconomically advantaged and less racialized neighbourhoods experienced the greatest increase in number of cycling injuries.

Introduction

Although cycling became more popular in cities around the world during the COVID-19 pandemic,[1-4] the impact of lockdowns on cycling injuries is unclear. This growth in popularity came about when lockdowns triggered a reduction in public transport and made people consider other means of transportation.[5] The closures of gyms and community centres led people to try other forms of physical activity, including cycling.[1] Many people went cycling with friends as a way to socialize while socially distancing.[4]

Cycling has numerous physical and mental health benefits,[6] but it is also associated with an estimated 3.1 injuries per 1000 hours travelled, with the greatest risk of injury occurring among less experienced cyclists.[7] Although many adults took up cycling during the pandemic, the relationship with cycling injuries has received little attention as injury research has been largely limited to children and adolescents.[8,9] A study of 1215 pediatric emergency department visits found that bicycle injuries among children and adolescents less than 18 years old increased significantly in Canada during the first eight months of the pandemic.[8] An Australian study reported a 43% increase in emergency department visits and a 49% increase in hospital admissions for bike-related injuries among children and adolescents 15 years old or younger during the first lockdown, compared with 2019.[9] The only study that examined adults' trauma-related injuries found an increase

Author references:

1. University of Montreal Hospital Research Centre, Montréal, Quebec, Canada
2. Institut national de santé publique du Québec, Montréal, Quebec, Canada
3. Department of Social and Preventive Medicine, School of Public Health, Université de Montréal, Montréal, Quebec, Canada
4. Department of Epidemiology, Biostatistics and Occupational Health, McGill University, Montréal, Quebec, Canada
5. Medical Affairs and Innovation, Hema-Quebec, Montréal, Quebec, Canada
6. Department of Pediatrics, Sainte-Justine Hospital Research Centre, Université de Montréal, Montréal, Quebec, Canada

Correspondence: Nathalie Auger, 190 Cremazie Blvd. E., Montréal, QC H2P 1E2; Tel: 514-864-1600; Fax: 514-864-1616; Email: nathalie.auger@inspq.qc.ca

in emergency orthopaedic referrals during the first lockdown in the United Kingdom among those between 19 and 65 years old, but cycling and scooter injury data were combined.[10]

Owing to the paucity of data, we assessed the effect of pandemic lockdowns on cycling injury hospitalizations in a population of children, adolescents and adults in the province of Quebec, Canada.

Methods

Study population

We carried out a natural experimental study of hospitalization rates for cycling injuries between 1 April 2006 and 31 March 2021 in Quebec. We extracted hospitalization records from the Maintenance et exploitation des données pour l'étude de la clientèle hospitalière (MED-ÉCHO) dataset, a registry of discharge abstracts for admissions throughout Quebec.[11]

We received a waiver for a full ethical review from the institutional review board of the Centre hospitalier de l'Université de Montréal. Data used in the analysis were de-identified.

Measures

We considered three exposure periods in the analysis: two lockdown periods and a reopening period between them. In Quebec, the government declared COVID-19 a public health emergency on 13 March 2020.[12] The province was marked by two major lockdowns over the course of one year.[12] The first lockdown lasted from 13 March 2020 to 23 June 2020, and was followed by a period of partial reopening between 24 June 2020 and 14 December 2020. The second lockdown began on 15 December 2020 and continued past the end of the study on 31 March 2021. The lockdowns were characterized by stay-at-home orders, curfews and widespread closures of non-essential businesses and schools.[12] Restrictions eased during reopening.[12]

We used three periods from before the pandemic as comparison groups. The comparison period for the first lockdown extended from 13 March 2019 to 23 June 2019, for the reopening from 24 June 2019 to 14 December 2019, and for the second lockdown from 15 December 2019 to 12 March 2020. These comparison periods match the calendar dates of the pandemic, to take into account, in part, effects of seasonality.

The outcome measure was cycling injury hospitalization. We used accident codes from the *International Classification of Diseases, 10th Revision* (ICD-10), to capture cycling injuries. We assessed the type (fracture, superficial wound, open wound, other), anatomical site (head and neck, spine/thorax/pelvis, upper limb, lower limb), place (roadway, other location, unspecified) and mechanism of injury (collision, fall, unspecified).

We accounted for patient characteristics that were potential determinants of cycling injury: age (< 10, 10–19, 20–39, 40–59, ≥60 years), sex (male, female), neighbourhood socioeconomic disadvantage (very high, high, moderate, low, or very low) and racialized group concentration within neighbourhoods (very high, high, moderate, low, or very low). Both socioeconomic disadvantage and racialized group concentration were measured as composite indices, with socioeconomic disadvantage accounting for median income, education and unemployment, and racialized group concentration accounting for the proportion of racialized people, recent immigrants and refugees within local neighbourhoods.[13]

The indices are representative of the population, as they were developed from census data[13] and mapped to postal codes covering small areas with an average of 500 residents. Very high socioeconomic disadvantage and racialized group concentration represented the most deprived quintile of each index.

Statistical analysis

We examined the characteristics of patients hospitalized for cycling injuries before and during the pandemic. Sex-specific hospitalization rates for cycling injuries were computed using population estimates from the Institut de la statistique du Québec.[14] We estimated rate ratios (RR) and 95% confidence intervals (CI) for the first lockdown, reopening and second lockdown compared with their respective pre-pandemic periods.

We assessed trends over time using an interrupted time series analysis of monthly cycling injury hospitalization rates. Interrupted time series analysis is a quasi-experimental method designed to estimate the effect of a sudden intervention, such as a lockdown, on an outcome.[15] This method relies on the regression of a time series, while including an interaction term between time and the onset of each interruption (first lockdown, reopening, second lockdown).[15]

For this analysis, we used an autoregressive time series model to remove the effect of seasonal patterns in bike injuries, and to account for rates that may be correlated from month to month.[15] We stratified the time series by age, sex, socioeconomic disadvantage and racialized group concentration. In sensitivity analyses, weekly hospitalization rates were used in the time series to ensure that monthly rates did not mask week-to-week trends during the pandemic.

We carried out data analyses using statistical package SAS version 9.4 (SAS Institute Inc., Cary, NC, US). We assessed statistical significance through p values and 95% CIs.

Results

There were 2020 cycling injury hospitalizations between 13 March 2020 and 31 March 2021. Of these injury hospitalizations, 617 occurred during the first lockdown, 1336 during reopening and 67 during the second lockdown (see Table 1). The majority of patients hospitalized for cycling injuries before and during the pandemic were male, aged 40 to 59 years, and resided in neighbourhoods with low socioeconomic disadvantage and with low racialized group concentration. The proportion of patients aged 10 to 19 years who were hospitalized for cycling injuries increased during each phase of the pandemic compared with the corresponding pre-pandemic period.

Hospitalization rates for cycling-related fractures increased considerably during the first lockdown (RR = 1.44; 95% CI: 1.26–1.64) and in the reopening period (RR = 1.16; 95% CI: 1.06–1.26), compared with their respective pre-pandemic comparison periods (see Table 2). The rates for head and neck injuries increased the most, followed by spine/thorax/pelvis, lower limb and upper limb injuries. Both upper limb and spine/thorax/pelvis injuries remained elevated during reopening. The first lockdown and reopening were marked by a rise in cycling-related falls and injuries on roadways. There was

TABLE 1
Characteristics of patients hospitalized for cycling injuries before and during COVID-19 lockdowns, March 2020–March 2021, Quebec, Canada

Characteristic	Number of hospitalizations, n (%)					
	First lockdown[a]		Reopening[b]		Second lockdown[c]	
	Before	During	Before	During	Before	During
Age, years						
<10	31 (7.0)	49 (7.9)	57 (5.1)	46 (3.4)	0	<5
10–19	61 (13.8)	101 (16.4)	117 (10.4)	166 (12.4)	<5	7 (10.5)
20–39	86 (19.5)	126 (20.4)	275 (24.4)	363 (27.2)	13 (23.6)	9 (13.4)
40–59	135 (30.6)	175 (28.4)	399 (35.3)	430 (32.2)	26 (47.3)	34 (50.8)
≥60	128 (29.0)	166 (26.9)	281 (24.9)	331 (24.8)	15 (27.3)	13 (19.4)
Sex						
Male	309 (70.1)	421 (68.2)	783 (69.4)	913 (68.3)	41 (74.6)	53 (79.1)
Female	132 (29.9)	196 (31.8)	346 (30.7)	423 (31.7)	14 (25.5)	14 (20.9)
Socioeconomic disadvantage						
Very low	84 (19.1)	137 (22.2)	199 (17.6)	245 (18.3)	6 (10.9)	16 (23.9)
Low	112 (25.4)	192 (31.1)	356 (31.5)	402 (30.1)	15 (27.3)	16 (23.9)
Moderate	124 (28.1)	137 (22.2)	261 (23.1)	332 (24.9)	17 (30.9)	16 (23.9)
High	74 (16.8)	99 (16.1)	185 (16.4)	211 (15.8)	13 (23.6)	9 (13.4)
Very high	34 (7.7)	37 (6.0)	93 (8.2)	107 (8.0)	<5	9 (13.4)
Racialized group concentration[d]						
Very low	164 (37.2)	265 (43.0)	412 (36.5)	498 (37.3)	20 (36.4)	25 (37.3)
Low	137 (31.1)	160 (25.9)	346 (30.7)	379 (28.4)	18 (32.7)	21 (31.3)
Moderate	71 (16.1)	99 (16.1)	193 (17.1)	209 (15.6)	10 (18.2)	12 (17.9)
High	37 (8.4)	54 (8.8)	107 (9.5)	153 (11.5)	<5	<5
Very high	19 (4.3)	24 (3.9)	36 (3.2)	58 (4.3)	<5	<5
Total	**441 (100)**	**617 (100)**	**1129 (100)**	**1336 (100)**	**55 (100)**	**67 (100)**

[a] The first lockdown lasted from 13 March 2020 to 23 June 2020, and the pre-pandemic comparison period from 13 March 2019 to 23 June 2019.

[b] Partial reopening lasted from 24 June 2020 to 14 December 2020, and the pre-pandemic comparison period from 24 June 2019 to 14 December 2019.

[c] The second lockdown lasted from 15 December 2020 and continued past the end of the study on 31 March 2021; the pre-pandemic comparison period lasted from 15 December 2019 to 12 March 2020.

[d] Racialized group concentration refers to the proportion of racialized people, recent immigrants and refugees within neighbourhoods.

no difference in the type, site, place or mechanism of cycling injuries in the second lockdown compared with the previous calendar year.

Interrupted time series analysis indicated that there was a sharp decline in cycling injuries the first month of the pandemic, with 11.4 fewer hospitalizations per 100 000 individuals in March 2020 (see Figure 1). During the remainder of the first lockdown, however, cycling injury hospitalization rates rose by 6.5 per 100 000 individuals each month. These trends were the same for both males and females.

The trends were also superimposed onto a general pattern of increasing cycling injury rates over time that began well before the start of the pandemic. Cycling injury hospitalization rates declined and gradually returned to pre-pandemic levels during the reopening period. There were too few cycling injuries to estimate trends during the second lockdown.

Trends in cycling injury hospitalizations depended on patient age (see Figure 2). Before the pandemic, the 20 to 39, 40 to 59, and 60 years and older age groups all had steady increases in hospitalization rates for cycling injuries over time. In contrast, children aged 0 to 9 and adolescents aged 10 to 19 years had a steady decrease in hospitalization rates. In March 2020, rates fell significantly for all age groups except children less than 10 years old and adolescents 10 to 19 years old. The remainder of the first lockdown was marked by a sharp rise in cycling injury hospitalization rates among individuals 10 years and over, and particularly those aged between 10 and 19 years and between 40 and 59 years. Hospitalization rates declined for most age groups during reopening.

The impact of the pandemic on cycling injury hospitalizations depended on socioeconomic status and neighbourhood racialized group concentration (see Figure 3). Hospitalization rates for cycling injuries decreased in March 2020, but increased during the remainder of the first lockdown for individuals from neighbourhoods with very low socioeconomic disadvantage and

TABLE 2
Type, site, place and mechanism of cycling injuries, before and during COVID-19 lockdowns, March 2020–March 2021, Quebec, Canada

Cycling injury characteristic	First lockdown[a]			Reopening[b]			Second lockdown[c]		
	Hospitalization rate per 100 000		RR (95% CI)[d]	Hospitalization rate per 100 000		RR (95% CI)[d]	Hospitalization rate per 100 000		RR (95% CI)[d]
	Before	During		Before	During		Before	During	
Type of injury									
Any	18.4	25.6	1.39 (1.23–1.57)	27.9	32.8	1.18 (1.09–1.27)	2.6	2.7	1.01 (0.71–1.44)
Fracture	15.3	22.1	1.44 (1.26–1.64)	23.9	27.7	1.16 (1.06–1.26)	2.1	1.5	0.73 (0.47–1.13)
Superficial wound	1.6	2.3	1.43 (0.95–2.15)	2.3	2.7	1.17 (0.89–1.54)	0.0	0.1	1.65 (0.15–18.24)
Open wound	1.3	1.3	1.06 (0.64–1.74)	1.8	1.8	0.98 (0.71–1.36)	0.0	0.2	4.13 (0.48–35.39)
Other	5.6	7.5	1.33 (1.07–1.67)	8.2	9.8	1.20 (1.04–1.39)	0.8	1.1	1.45 (0.78–2.67)
Anatomical site									
Head and neck	3.1	4.9	1.59 (1.19–2.12)	5.2	5.7	1.09 (0.90–1.31)	0.2	0.4	1.49 (0.50–4.44)
Spine, thorax, pelvis	3.5	4.9	1.39 (1.05–1.84)	4.9	6.0	1.23 (1.02–1.48)	0.2	0.2	0.99 (0.30–3.25)
Upper limb	11.1	14.7	1.33 (1.13–1.55)	17.8	20.5	1.16 (1.05–1.28)	1.0	1.4	1.42 (0.83–2.43)
Lower limb	5.0	6.8	1.35 (1.07–1.71)	6.6	7.6	1.16 (0.98–1.36)	1.2	0.9	0.73 (0.41–1.29)
Place of injury									
Roadway	11.8	16.1	1.37 (1.17–1.59)	17.0	19.0	1.12 (1.01–1.24)	1.6	1.7	1.05 (0.67–1.64)
Other location	1.8	3.4	1.85 (1.28–2.67)	4.4	5.6	1.27 (1.05–1.55)	0.7	0.3	0.41 (0.17–1.02)
Unspecified	4.5	5.8	1.29 (1.00–1.65)	5.9	7.9	1.32 (1.12–1.56)	0.3	0.6	2.20 (0.86–5.63)
Mechanism									
Collision	3.0	3.5	1.16 (0.85–1.59)	4.4	5.3	1.21 (0.99–1.48)	0.4	0.5	1.34 (0.56–3.24)
Fall	14.2	20.8	1.47 (1.28–1.68)	21.9	25.5	1.16 (1.06–1.27)	2.1	2.1	1.00 (0.67–1.50)
Unspecified	1.2	1.2	1.06 (0.64–1.78)	1.6	2.0	1.26 (0.91–1.76)	0.2	0.1	0.41 (0.08–2.26)

Abbreviations: CI, confidence interval; RR, rate ratio.

[a] The first lockdown lasted from 13 March 2020 to 23 June 2020, and the pre-pandemic comparison period from 13 March 2019 to 23 June 2019.

[b] The reopening lasted from 24 June 2020 to 14 December 2020, and the pre-pandemic comparison period from 24 June 2019 to 14 December 2019.

[c] The second lockdown lasted from 15 December 2020 and continued past the end of the study on 31 March 2021; the pre-pandemic comparison period lasted from 15 December 2019 to 12 March 2020.

[d] Rate ratio is for the first lockdown, reopening or second lockdown vs. the corresponding pre-pandemic comparison period for each type, site, place and mechanism of injury.

racialized group concentration. Individuals from neighbourhoods with very low socioeconomic disadvantage had 9.6 additional hospitalizations per 100 000 each month, and individuals living in neighbourhoods with very low racialized group concentration had 19.2 additional hospitalizations per 100 000 each month. In contrast, rates increased only slightly for patients from socioeconomically disadvantaged neighbourhoods and those with very high racialized group concentration. During reopening, rates returned to pre-pandemic levels in all groups. In sensitivity analyses of weekly rates, trends resembled monthly rates.

Discussion

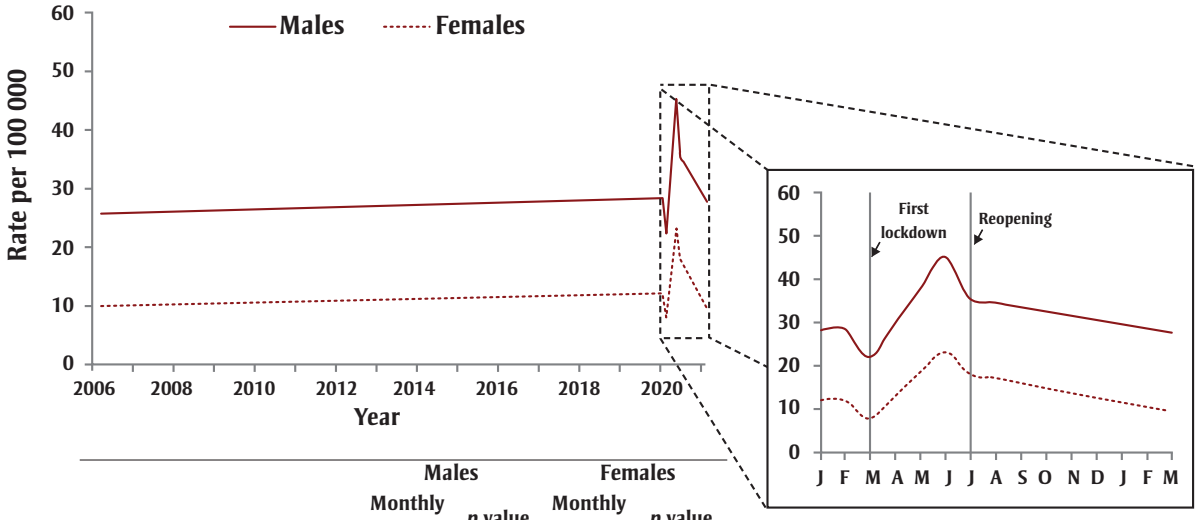
In this study of data from Quebec, hospitalization rates for cycling injuries increased significantly during the first COVID-19 lockdown. The increase in cycling injury hospitalizations was highest among adolescents and adults, and among individuals from socioeconomically advantaged neighbourhoods with low racialized group concentration.

The lockdown was marked by a predominance of cycling-related fractures and injuries to the head and neck. Most of the increase in the number of cycling injuries was due to falls rather than collisions. The findings suggest that cycling behaviours and associated injuries changed considerably during the pandemic, and that cycling should be included in injury prevention policies to reduce morbidity during lockdowns.

A number of studies have examined bike injuries experienced by children and adolescents less than 18 years old during the pandemic, as this group was thought to be most at risk of sustaining cycling accidents.[8,9] Between March and October 2020, the average number of emergency department visits for cycling injuries in this population reached 84.5 per month in Canada, an amount considerably greater than the average of 33.7 visits per month seen in the two years preceding the pandemic.[8] Children aged 6 to 10 years were more likely to present to emergency rooms for bike injuries than younger children (0–5 years) or older children and adolescents (11–18 years).[8]

In Australia, pediatric emergency department visits and hospital admissions for cycling-related injuries among individuals younger than 16 went up by 43% and 49%, respectively, during the first lockdown compared with the previous year.[9] We found that cycling injury hospitalization rates increased primarily for adolescents aged 10 to 19 years.

FIGURE 1
Interrupted time series of monthly hospitalization rates for cycling injuries before and during the first COVID-19 lockdown and during reopening, 2006–2021, Quebec, Canada[a,b]



	Males		Females	
	Monthly change	*p* value	Monthly change	*p* value
Pre-pandemic	0.016	0.15	0.012	0.10
First month of lockdown	−13.93	0.02	−9.45	0.01
Remainder of first lockdown	7.70	<0.01	5.15	<0.01
First month of reopening	−8.59	0.14	−3.92	0.25
Remainder of follow-up	−0.98	0.29	−1.08	0.03

[a] The left vertical line corresponds to start of first lockdown in March 2020; the right vertical line corresponds to start of reopening in July 2020. As hospitalization rates are monthly, the interruptions are set as the first of the month.

[b] There were too few cycling injuries to estimate trends during the second lockdown (15 December 2020–31 March 2021).

Adults' cycling injuries have received less attention. A multicentre study from the United Kingdom found that emergency referrals for scooter and bike injuries increased for patients aged 19 to 65 years between March and June 2020.[10] Bike injuries, however, were not specifically examined.[10] Rajput et al.[16] observed a significant increase in bike injuries during lockdown among adults, but examined only road traffic collisions. In Ireland, Foley et al.[17] reported no difference in emergency room visits for cycling injuries during the first lockdown compared with 2019, although the data combined adults and adolescents. Other studies of cycling injuries in the general population did not report rates separately for adults and adolescents.[18,19]

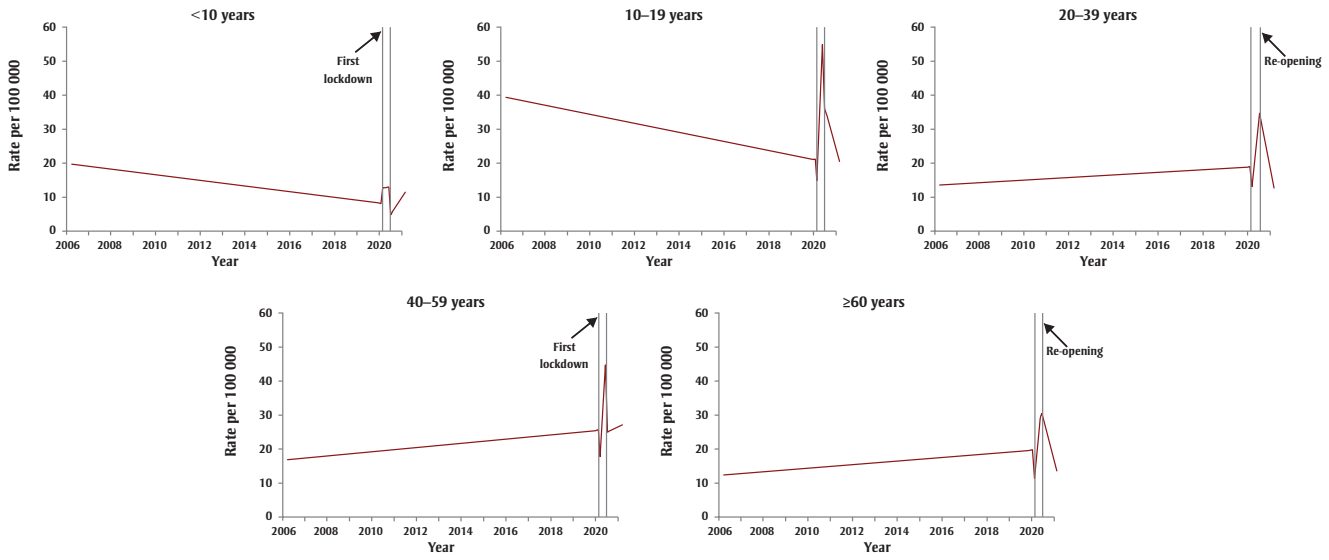
Our data show that adults' cycling injury hospitalization rates increased considerably during the first lockdown. As exercise facilities were closed during lockdowns,[1] cycling may have been the sport of choice for many adults as a way of complying with social distancing measures.[4] Adults may also have used bikes to ride to work or to run errands as a way of avoiding public transportation.

During the pandemic, many cities promoted cycling by closing streets to motor vehicle traffic.[4] This, together with an expanded network of bike paths, as documented in Montréal,[4] the largest city in Quebec, may have enticed more people to try cycling. Bicycle sales increased by 39%,[4] and it is possible that many individuals took up cycling for the first time or after a long break. One study found that less experienced cyclists were 69% more likely to sustain injuries requiring medical attention.[7] These factors together may have resulted in a higher number of inexperienced cyclists and exacerbated cycling injury hospitalizations, particularly among adults.

Increased availability of bike lanes along with reduced motor vehicle traffic may have led to more fall-related injuries rather than collisions. A study in Ireland found that emergency department visits decreased for injuries due to motor vehicle collisions, while those due to isolated cycling crashes increased substantially.[17] Similarly, a multicentre study from Scotland reported a decrease in the number of cycling injuries involving car collisions, while the number of orthopaedic interventions for falls from bikes increased compared with the period preceding the pandemic.[18] Our study found that patients admitted to hospital for cycling injuries during the first lockdown were 47% more likely to have had isolated falls; collisions were rare. Efforts to increase the safety of bike paths may be needed to decrease the burden of injury not due to collisions.

Other factors may have contributed to the overall increase in cycling hospitalizations, as the risk of injury was not evenly distributed across racialized and socioeconomic backgrounds at the neighbourhood level. The first lockdown was marked by an increase in cycling injuries in neighbourhoods with low racialized group

FIGURE 2
Interrupted time series of age-specific hospitalization rates for cycling injuries, 2006–2021, Quebec, Canada[a,b]



	<10 years		10–19 years		20–39 years		40–59 years		≥60 years	
	Monthly change	*p* value	Monthly change	*p* value	Monthly change	*p* value	Monthly change	*p* value	Monthly change	*p* value
Pre-pandemic	−0.069	0.04	−0.108	<0.01	0.032	0.04	0.052	<0.01	0.045	<0.01
First month of lockdown	4.33	0.51	−19.46	0.06	−10.96	0.04	−16.90	<0.01	−14.44	0.02
Remainder of first lockdown	0.08	0.97	13.30	<0.01	5.07	0.01	8.94	<0.01	5.89	0.01
First month of reopening	−8.83	0.16	−16.57	0.10	9.12	0.08	−19.70	<0.01	3.43	0.58
Remainder of follow-up	0.82	0.36	−1.95	0.19	−2.72	<0.01	0.27	0.76	−2.09	0.06

[a] The left vertical line corresponds to start of first lockdown in March 2020; the right vertical line corresponds to start of reopening in July 2020. As hospitalization rates are monthly, the interruptions are set as the first of the month.

[b] There were too few cycling injuries to estimate trends during the second lockdown (15 December 2020–31 March 2021).

concentration and high socioeconomic advantage. A recent study of 22 major American cities found that the presence of dedicated cycling lanes correlated strongly with bike commuting in neighbourhoods with high socioeconomic status and few Hispanic residents.[20] Remote work during lockdowns was more prevalent among individuals with high socioeconomic status and may have increased the leisure time available for cycling,[21] as commuting was no longer needed. Thus, cycling routes may have benefited socioeconomically advantaged groups during the pandemic, but also led to more injuries in this population. Individuals in socioeconomically disadvantaged neighbourhoods with high concentrations of racialized people may have been less likely to cycle, despite the overall greater availability of bike paths during the pandemic.[4]

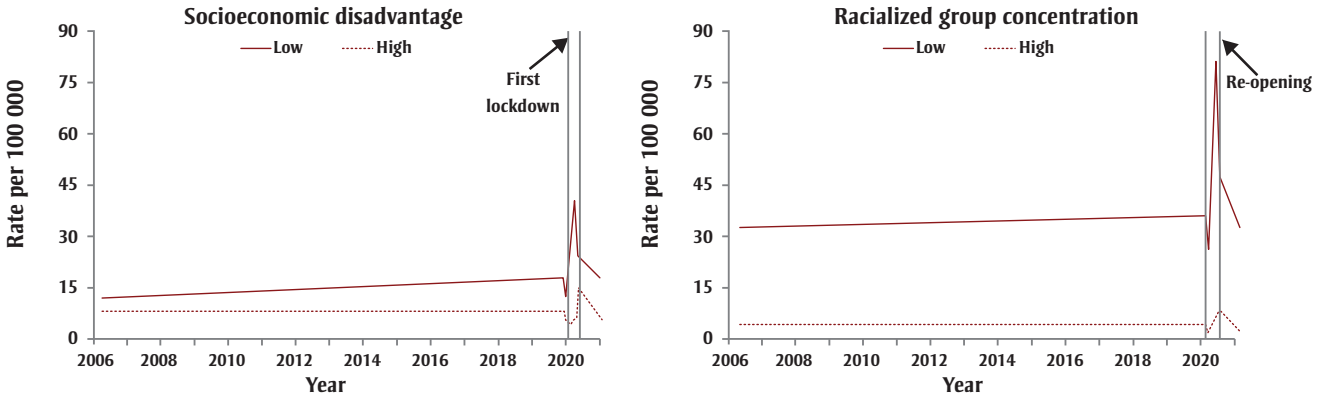
The type and anatomical site of cycling injuries during the pandemic appears to have changed. A single-centre study from the U.S. found that fractures from pediatric bike accidents increased during the first month of the pandemic,[22] while other Canadian and Australian investigations found no difference.[8,9] In Scotland, the proportion of cycling injuries requiring surgery for fractures increased in the general population.[18] The first lockdown also led to an increase in fractures in our study population. However, head and neck injuries increased more than those of spine/thorax/pelvis, lower limb and upper limb. This differs from Ireland, where head injuries decreased.[17] In both Ireland and Scotland, upper limb injuries increased more.[17,18] Some of the difference may be due to helmet laws in Quebec, where cyclists are not required to wear helmets except while using electric bikes.[23] Greater emphasis on use of helmets and other safety equipment while cycling may be beneficial.

Prior studies have not considered long-term trends in cycling injuries. The pandemic has only been compared with the period immediately preceding it.[8-10,16-19] Yet, our data suggest that cycling injuries began increasing many years prior to the pandemic. As a result, it is not clear if some of the increase reported in other studies reflects secular trends in cycling injuries,[15] rather than the pandemic itself. We eliminated the effect of secular trends by using an autoregressive interrupted time series,[15] allowing us to attribute the increase in cycling injuries seen at the beginning of the pandemic to the first lockdown.

Strengths and limitations

This study has a number of limitations. The data we used are rigorously validated,[11] but coding errors can occur, resulting in misclassification of outcomes or other characteristics. We could not identify minor cycling injuries that did not require hospital admission, and we did not have information on the number of hours spent cycling per day, the types of roads used for travel, the use of reserved bike lanes and the extent to which cycling

FIGURE 3
Interrupted time series of cycling injury hospitalization rates according to neighbourhood socioeconomic status and racialized group concentration, 2006–2021, Quebec, Canada[a,b]



	Low disadvantage		High disadvantage		Nonracialized		Racialized	
	Monthly change	*p* value	Monthly change	*p* value	Monthly change	*p* value	Monthly change	*p* value
Pre-pandemic	0.035	0.07	0.000	0.98	0.023	0.36	−0.003	0.71
First month of lockdown	−15.19	<0.01	−4.28	0.24	−31.90	<0.01	−3.89	0.15
Remainder of first lockdown	9.60	<0.01	0.56	0.68	19.22	<0.01	1.57	0.12
First month of reopening	−15.77	<0.01	10.32	<0.01	−29.36	<0.01	3.43	0.18
Remainder of follow-up	−0.85	0.28	−1.19	0.03	−2.13	0.12	−0.85	0.02

[a] The left vertical line corresponds to start of first lockdown in March 2020; the right vertical line corresponds to start of reopening in July 2020.

[b] There were too few cycling injuries to estimate trends during the second lockdown (15 December 2020–31 March 2021).

routes were expanded during the pandemic. Data on helmet use or other protective equipment were also not available.

Statistical power was limited for the second lockdown, although this limitation may be because winter conditions decreased the number of cyclists. Our study reflects the situation in the population of Quebec, where cycling is a common means of transportation.[24] Data from other provinces were not available. It remains unclear whether our findings can be applied to regions where cycling is less prevalent.

Conclusion

The first COVID-19 lockdown led to a significant rise in cycling injury hospitalizations among adolescents and adults in Quebec, while the reopening period and second lockdown had a more limited effect. Individuals from socioeconomically advantaged and less racialized neighbourhoods were most affected by cycling injuries. Falls not involving a collision were the principal mechanism of injury. Fractures and injuries to the head and neck also increased. Awareness campaigns promoting bike safety and helmet use to prevent severe cycling injuries should be ongoing, even during public health crises such as a pandemic.

Acknowledgements

This work was supported by the Canadian Institutes of Health Research (WI2-179928) and the Fonds de recherche du Québec – Santé (296785). The study sponsors had no role in the study design, collection, analysis and interpretation of data, writing of the report, or decision to submit the report for publication.

Conflicts of interest

The authors have no conflicts of interest to declare.

Authors' contributions and statement

NA – Conceptualization, Study design, Writing – Original Draft; AL – Conceptualization, Writing – Review & Editing; ÉB – Conceptualization, Study design, Formal analysis, Visualization, Writing – Original Draft; AA – Conceptualization, Study design, Writing – Review & Editing; CB – Conceptualization, Writing – Review & Editing; TML – Conceptualization, Writing – Review & Editing.

All authors read and approved the final manuscript.

The content and views expressed herein are those of the authors and do not necessarily reflect those of the Government of Canada.

References

1. Schweizer AM, Leiderer A, Mitterwallner V, Walentowitz A, Mathes GH, Steinbauer MJ. Outdoor cycling activity affected by COVID-19 related epidemic-control-decisions. PLoS One. 2021;16(5):e0249268. https://doi.org/10.1371/journal.pone.0249268

2. Doubleday A, Choe Y, Busch Isaksen T, Miles S, Errett NA. How did outdoor biking and walking change during COVID-19?: A case study of three U.S. cities. PLoS One. 2021; 16(1):e0245514. https://doi.org/10.1371/journal.pone.0245514

3. Fuller G, McGuinness K, Waitt G, Buchanan I, Lea T. The reactivated bike: self-reported cycling activity during the 2020 COVID-19 pandemic in Australia. Transp Res Interdiscip Perspect. 2021;10:100377. https://doi.org/10.1016/j.trip.2021.100377

4. Buehler R, Pucher J. COVID-19 impacts on cycling, 2019–2020. Transp Rev. 2021;41(4):393-400. https://doi.org/10.1080/01441647.2021.1914900

5. Büchel B, Marra AD, Corman F. COVID-19 as a window of opportunity for cycling: evidence from the first wave. Transp Policy (Oxf). 2022; 116:144-56. https://doi.org/10.1016/j.tranpol.2021.12.003

6. Green S, Sakuls P, Levitt S. Cycling for health: improving health and mitigating the climate crisis. Can Fam Physician. 2021;67(10):739-42. https://doi.org/10.46747/cfp.6710739

7. Poulos RG, Hatfield J, Rissel C, et al. An exposure based study of crash and injury rates in a cohort of transport and recreational cyclists in New South Wales, Australia. Accid Anal Prev. 2015;78:29-38. https://doi.org/10.1016/j.aap.2015.02.009

8. Shack M, Davis AL, Zhang EW, Rosenfield D. Bicycle injuries presenting to the emergency department during COVID-19 lockdown. J Paediatr Child Health. 2022;58(4):600-3. https://doi.org/10.1111/jpc.15775

9. van Oudtshoorn S, Chiu KYC, Khosa J. Beware of the bicycle! An increase in paediatric bicycle related injuries during the COVID-19 period in Western Australia. ANZ J Surg. 2021;91(6): 1154-8. https://doi.org/10.1111/ans.16918

10. Sephton BM, Mahapatra P, Shenouda M, et al. The effect of COVID-19 on a major trauma network. An analysis of mechanism of injury pattern, referral load and operative case-mix. Injury. 2021;52(3):395-401. https://doi.org/10.1016/j.injury.2021.02.035

11. Ministère de la Santé et des Services sociaux. Cadre normatif du système MED-ÉCHO [Internet]. Quebec (QC): Government of Quebec; 1987 Oct [revised 2022 Apr; cited 2022 Jul 26]. Available from: https://publications.msss.gouv.qc.ca/msss/fichiers/2000/00-601.pdf

12. Institut national de santé publique du Québec. Timeline of COVID-19 in Quebec [Internet]. Quebec (QC): INSPQ; [cited 2022 Jul 26]. Available from: https://www.inspq.qc.ca/covid-19/donnees/ligne-du-temps

13. CDC Agency for Toxic Substances and Disease Registry (ATSDR). CDC Social Vulnerability Index (SVI) Documentation 2018 [Internet]. 2020 [cited 2022 Sep 9]. Available from: https://www.atsdr.cdc.gov/placeandhealth/svi/documentation/SVI_documentation_2018.html

14. Institut de la statistique du Québec. Population of Québec by age and sex, 1971-2021 (in French only) [Internet]. Quebec (QC): Institut de la statistique du Québec; 2022 Sep 28 [cited 2022 Jul 07]. Available from: https://statistique.quebec.ca/en/document/population-and-age-and-sex-structure-quebec/tableau/population-of-quebec-by-age-and-sex

15. Penfold RB, Zhang F. Use of interrupted time series analysis in evaluating health care quality improvements. Acad Pediatr. 2013;13(6 Suppl):S38-44. https://doi.org/10.1016/j.acap.2013.08.002

16. Rajput K, Sud A, Rees M, Rutka O. Epidemiology of trauma presentations to a major trauma centre in the North West of England during the COVID-19 level 4 lockdown. Eur J Trauma Emerg Surg. 2021;47(3):631-6. https://doi.org/10.1007/s00068-020-01507-w

17. Foley J, Robinson M, Ryan J, Cronin J. Impact of a national lockdown on cycling injuries. Ir Med J. 2021; 114(7):412.

18. Faulkner A, MacDonald DR, Neilly DW, et al. Cycling injuries requiring orthopaedic intervention during the first COVID-19 lockdown period: a multicentre SCottish Orthopaedic Research collaborativE (SCORE) study. Surgeon. 2022:20(4):252-7. https://doi.org/10.1016/j.surge.2021.05.003

19. Probert AC, Sivakumar BS, An V, et al. Impact of COVID-19-related social restrictions on orthopaedic trauma in a level 1 trauma centre in Sydney: the first wave. ANZ J Surg. 2021;91(1-2): 68-72. https://doi.org/10.1111/ans.16375

20. Braun LM. Disparities in bicycle commuting: could bike lane investment widen the gap? J Plan Educ Res. Published online February 23, 2021: 0739456X21993905. https://doi.org/10.1177/0739456X21993905

21. Statistics Canada. Working from home during the COVID-19 pandemic, April 2020 to June 2021 [Internet]. Ottawa (ON); 2021 Aug 04 [cited 2022 Nov 07]. Available from: https://www150.statcan.gc.ca/n1/daily-quotidien/210804/dq210804b-info-eng.htm

22. Bram JT, Johnson MA, Magee LC, et al. Where have all the fractures gone? The epidemiology of pediatric fractures during the COVID-19 pandemic. J Pediatr Orthop. 2020;40(8):373-9. https://doi.org/10.1097/BPO.0000000000001600

23. Société de l'assurance automobile du Québec. Modes of transportation: Bicycles and accessories: visibility and safety [Internet]. Quebec City (QC): SAAQ; 2022 [cited 2022 Oct 03]. Available from: https://saaq.gouv.qc.ca/en/road-safety/modes-transportation/bicycle/accessories

24. Vélo Québec. Cycling in Québec in 2020 [Internet]. Montréal (QC): Vélo Québec; 2021 [cited 2022 Sep 16]. Available from: https://www.velo.qc.ca/wp-content/uploads/2021/06/vq-edv2020-en.pdf