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Estimating walking and bicycling in Canada and their road collision fatality risks: The need for a national household travel survey

Michael Branion-Calles [a,b,*], Kay Teschke [c], Mieke Koehoorn [c], Osvaldo Espin-Garcia [d], M. Anne Harris [a,d]

[a] School of Occupational and Public Health, Ryerson University, Canada
[b] Department of Emergency Medicine, University of British Colombia, Canada
[c] School of Population and Public Health, University of British Columbia, Canada
[d] Dalla Lana School of Public Health, University of Toronto, Canada

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ABSTRACT

Canada does not conduct a national household travel survey, resulting in a data gap on walking and bicycling. These data are key to surveillance of physical activity and health, as well as in epidemiological injury risk calculations. This study explored the use of available national data sources, the Canadian census and the Canadian Community Health Survey (CCHS), to tally walking and bicycling and examine trends in fatality risk. Estimates of the percentage and number of Canadians walking or bicycling to work were calculated for 1996–2016 using the census. The CCHS was used to estimate the number and proportion of Canadians walking or bicycling for leisure (2000–2014) and to work or school (2008–2014). We combine these data with National Collision Database data on the number of pedestrian and bicyclist fatalities (1999–2017) and compare trends in fatality risk over time using each dataset. Across all data sources, walking was more common among women, while bicycling was more common among men. Men were at higher fatality risk than women. These results should be interpreted with caution given limitations this study identifies in census and CCHS data, including narrow definitions for bicycling behaviour, lack of detail regarding amount of use, and inconsistency of questions asked over time. A national household travel survey should be a priority for public health purposes in Canada.

1. Introduction

National population data on bicycling and walking in Canada would be useful for many stakeholders interested in active transportation. For injury epidemiologists these data are a necessity for comparisons of injury risk between transportation modes, regions, and time periods (Hauer, 1995; Teschke et al., 2015, 2013). Analyzing injuries or fatalities per number of people in the population (Ramage-Morin, 2017) does not consider exposure to risk, limiting any comparisons (The International Traffic Safety Data and Analysis Group, 2017).

Many countries conduct regular national household travel surveys (Kunert et al., 2002; Pucher et al., 2011). These surveys tally users, trips and kilometres (km) travelled for each transportation mode (Kunert et al., 2002). Canada does not conduct an equivalent national survey, leading to a lack of denominators to calculate injury risk for health data (compiled at the provincial and national levels in Canada), limiting inter-regional comparisons, and excluding Canada from analyses of international trends (Buehler and Pucher, 2020).

Without a national household travel survey, alternative national population data must be explored. Both the Canadian census and Canadian Community Health Survey (CCHS) have data relevant to active transportation. Previous reports have summarized trends in active transportation from census (Statistics Canada, 2017a) and CCHS data (Ramage-Morin, 2017). The purpose of this research is to examine and contrast methodological considerations and limitations of each national data source as compared to a national household travel survey by 1) estimating the number of people walking and bicycling as offered by these data sources, 2) providing descriptions of the data sources specific to generating active transportation user estimates, and 3) to use each source as a denominator to compare trends in fatality risk over time.

2. Materials and methods

Data sources (Census and CCHS) and the years included are

* Corresponding author at: School of Occupational and Public Health, Ryerson University, Canada.
E-mail address: m.bcalles@ryerson.ca (M. Branion-Calles).

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compared in Table 1. In Appendix A, we detail changing survey questions and approaches in cycles of the CCHS.

2.1. Census

Since 1996, the Canadian census has queried journey to work among employed citizens 15 years and older who performed paid work in the week before census day (Statistics Canada, 2017b). The "Journey to Work" module is included in the long form component of the census, corresponding to a 20% (1996, 2001, 2006) to 25% (2016) sample of the Canadian population. In 2011 only, the long form census was replaced with a voluntary National Household Survey that included this same query. The long form census is mandatory, resulting in a nearly complete response rate (96.9% in 2016), while the response rate for the 2011 National Household Survey was about 68.6% (Statistics Canada, 2019). In the Journey to Work module, respondents are asked to identify the mode of transport used for the greatest distance on the commute trip (Statistics Canada, 2017a), with "census day" being the reference point for data collection (a spring date, May 10 in 2016).

2.2. Canadian Community Health Survey (CCHS)

CCHS began data collection in 2000, was biennial until 2009 and annual thereafter, aiming to capture health data for Canadians 12 years and older. The target population excludes individuals living in institutions, First Nations people who live on reserve, some rural residents, and full-time armed forces personnel (Statistics Canada, 2020). The sample size is approximately 65,000 individuals per year, or 130,000 per two year data release (Statistics Canada, 2020). The CCHS uses a complex multistage sampling frame, with typical response rates of 70% or higher, intended to be representative of the Canadian population (Statistics Canada, 2017c).

This analysis used the complete public use microdata file (PUMF) provided biennially (see Table 1 and Appendix A). We excluded CCHS sub-cycles conducted in 2002 (nutrition) and 2004 (mental health) since these did not use sampling comparable to the full cycles. We also excluded the last two available cycles (2015/16 and 2017/18) as these surveys did not differentiate between walking and bicycling in a manner consistent with previous cycles, and instead respondents reported on their use of "active ways" for transportation in the past 7-days. Each cycle of the CCHS PUMF provides person-level survey weights corresponding to the number of persons represented by the individual within the population and that takes into consideration the complex sampling design. To compare to the census journey to work target population, we limited CCHS analyses to participants 15 and older.

In the CCHS, bicycling and walking are assessed as a component of the physical activity module, with leisure activity asked in all cycles, while travel to work or school are asked starting in 2008. Data are collected year-round, with random temporal and spatial administration. Before the 2015/2016 cycle, questions asked about bicycling and walking in the previous three months. Work and school and leisure activity were queried separately (Table 1). Respondents reporting bicycling and walking were asked how many times in the past 3 months they participated in these activities.

2.3. National Collision Database (NCDB)

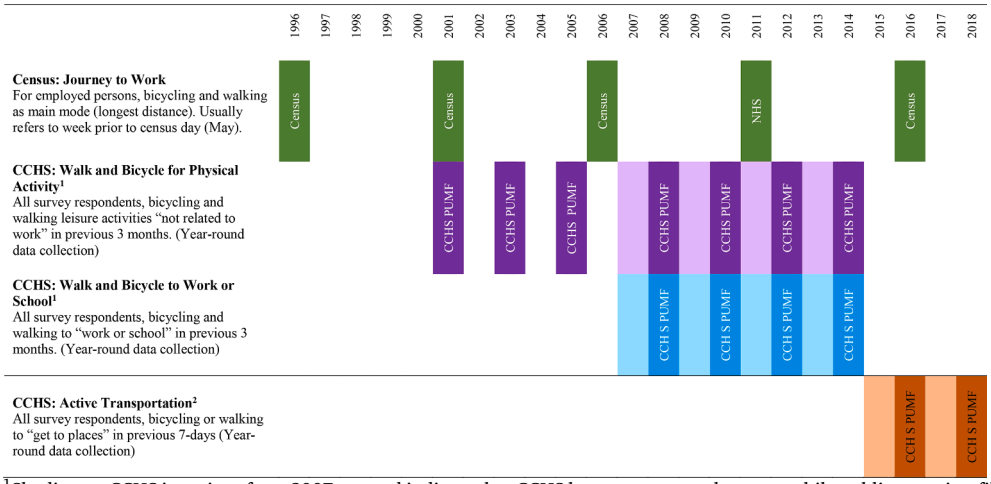
The National Collision Database (NCDB) is a publicly available national dataset of all police-reported motor-vehicle crashes that occur on public roads in Canada between 1999 and 2017 (Transport Canada, 2019). The NCDB includes information on road users involved in the crash including the gender, transportation mode and injury severity. The data are initially collected by the provinces and then shared with the federal government where it is combined to produce a national dataset. We included only fatal injuries in our analysis because these crashes are more reliably reported in police data than non-fatal crashes (Elvik and Mysen, 1999; Stutts and Hunter, 1999).

2.4. Analysis

2.4.1. Comparing CCHS and census for estimating number of Canadians walking and bicycling

The number of people who walk or bicycle for both the Census and the CCHS for each of their respective cycles were tallied, overall and by gender. Census estimates from 1996 to 2016 were based on the number of people who indicated they walk or bicycle to work as their main mode of commute. From the CCHS we produce two separate estimates of bicycling and walking based on trip purpose to ensure as consistent as possible a definition over all CCHS cycles given changes in the questions over time (Table 1 and Appendix A). Specifically, we enumerated the weighted (national, population-level) number of people who indicate they have walked and/or bicycled for leisure in the previous three

Table 1
Comparison of bicycling and walking data sources used in this study (1996–2016): Canadian census and Canadian Community Health Survey (CCHS). The census long form is the source for journey to work data, replaced by the National Household Survey (NHS) in 2011 only.



[1]Shading on CCHS iterations from 2007 onward indicate that CCHS became an annual survey, while public use microfile (PUMF) data releases are released every other year.
[2]Because of the changes to the CCHS queries in the 2015–16 and 2017–18 iteration, we did not include them in these analyses.

months and the weighted number who indicated they have walked and/or bicycled to work or school in the previous three months.

We then normalized counts of people by the weighted total number of valid respondents based on the coverage of each data source, overall and by gender. The census estimates were divided by the number of people that were employed with a workplace outside the home; CCHS queries on work or school (see Appendix A) were divided by the weighted number of people who attended work or school; and CCHS leisure physical activity queries by the weighted number of respondents. We then use simple linear regression to plot trends over time for the estimated percentage of people who walk and bicycle as defined by 1) the census and 2) the CCHS. We plot point estimates as confidence intervals around percentages were small.

2.4.2. Amount of use indicator: number of trips (CCHS)

For CCHS cycles from 2007/08 to 2013/14, participants were asked to recall the number of trips in the past three months they had made by bicycling or walking for both leisure purposes and commuting to work/school. For each of these cycles we tabulated the overall number of trips made for both leisure and to work/school for men and women. We also compared the average number of walking and bicycling trips made per person based on trip purpose.

2.4.3. Comparing risk denominators: trends in fatalities and fatality risk for women and men walking and bicycling

From the NCDB, we tallied the number of people walking and bicycling that were killed by year and gender. We then calculated

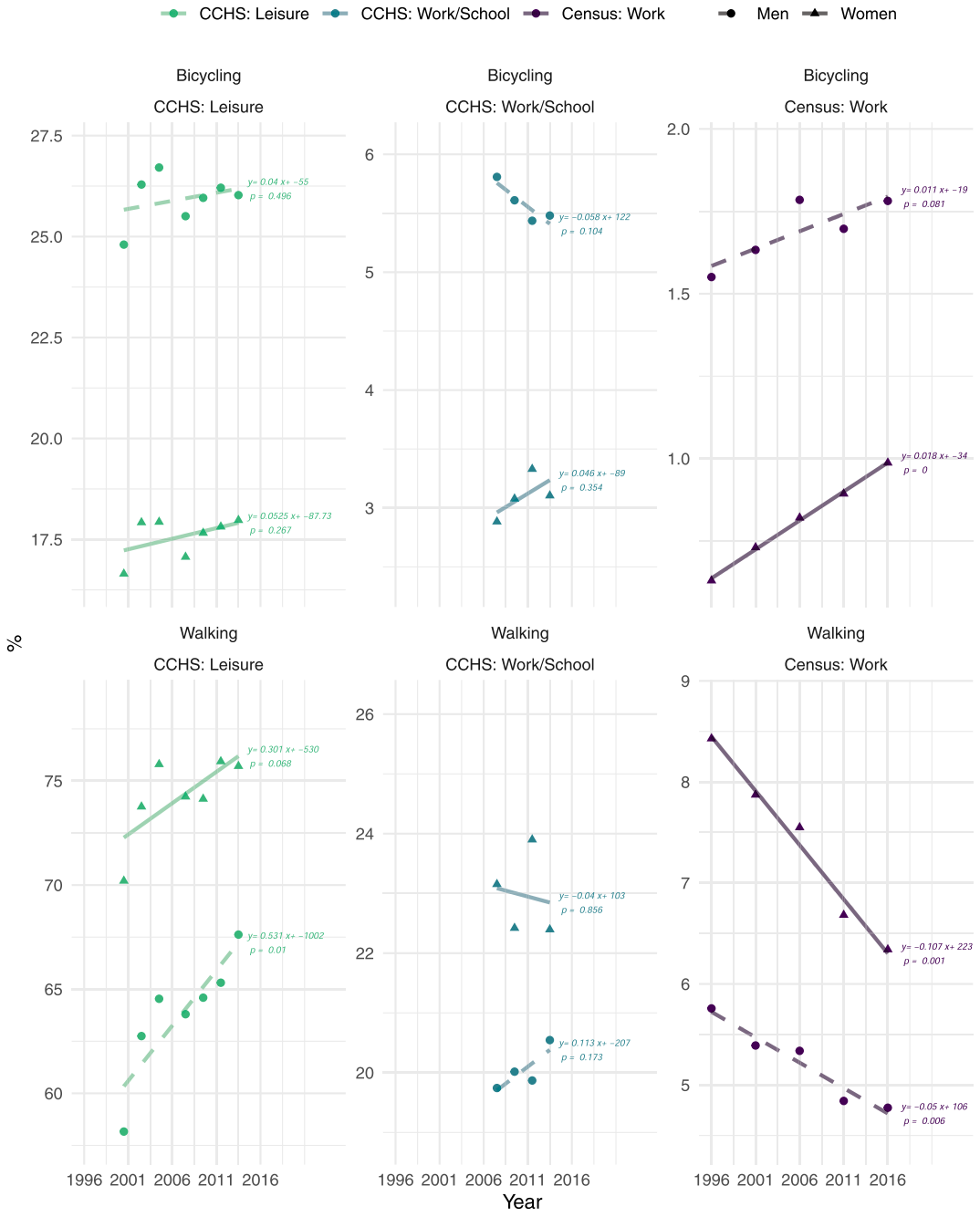


Fig. 1. Percentage of Canadian men and women aged 15 and over, walking and bicycling according to three population data sources between 1996 and 2016: Canadian Community Health Survey (CCHS) on leisure walking/bicycling; CCHS on walking/bicycling to work or school; census on walking/bicycling to work. Data points and linear trendlines with p values are shown. Note the differing scale of the y-axis in each panel.

fatality rates over time using either the census or the CCHS counts as a denominator. We conducted a sub-analysis of trip-based fatality rates using the CCHS trip data from 2008 to 2014, wherein we divided fatalities per year by the total number of trips for leisure or to work/school. We used simple linear regression to plot trends in fatality rates over time for each denominator by gender.

2.4.4. Comparing characteristics and coverage of the CCHS and the census to a hypothetical national household travel survey

Finally, we summarized characteristics and coverage of the census and CCHS for counting walking and bicycling, contrasting their attributes with data that could be provided by a national household travel survey. Existing national household travel surveys in other countries vary widely in their survey design (e.g. timing, sampling, instrumentation) but here we assume a hypothetical cross-sectional travel survey similar to those conducted in the USA (Pucher et al., 2011) or the UK (Aldred, 2018). It would include a random sample of the population, sufficient to make estimates to the municipal level, with participants completing trip diaries for a recent period of time.

3. Results

3.1. Comparing CCHS and census for estimating number of Canadians walking and bicycling

Due to the question design and included destinations (Appendix B), the CCHS captures more people bicycling and walking than the census. For example, in the 2013/2014 cycle the CCHS counts of Canadians bicycling and/or walking for leisure was approximately 20.3 million walking and 6.2 million bicycling, while bicycling and/or walking to work or school was 4.5 million walking and 0.9 million bicycling. In comparison, Census commuting data is more restrictive, with 1.1 million Canadians whose main mode of commuting to work was walking or bicycling (0.9 million walking, 0.2 million bicycling). The relative differences between CCHS leisure counts, CCHS to work and school counts, and census to work counts were consistent across time periods. Note that CCHS respondents could report both walking and bicycling in the previous 3 months, whereas the census records only one mode for commuting to work at the job held the week of the census (early May) or the job held for the longest period of time since January 1.

Estimates of the percentages of Canadian men and women walking and bicycling captured by each data source between 1996 and 2016 indicate that bicycling and walking for leisure is increasing over time, while trends in commuting to work and/or school differ by source and gender (Fig. 1). The census data show that the percent of all commuters who walk to work has declined over time, whereas the percent who bicycle has increased (Fig. 1). The magnitude of the estimated change over time also varies depending on the data source, with greater relative change in the census data compared to the CCHS leisure and work/school data.

In both the census and CCHS a larger percentage of women indicated walking, while a larger percentage of men indicated bicycling (Fig. 1). Across data sources, the percentage of women who indicate that they bicycled increased at a faster rate than for men. In the census the percentage of women commuters indicating bicycle as their main mode increased from 0.63% to 0.99% between 1996 and 2016 (Fig. 1), and more than doubled in absolute count from 35,225 to 75,515 (Appendix B). As captured by the census, women represented 25.6% of bicycle commuters in 1996 and 33.9% by 2016. In the CCHS, women represented 31.0% of people bicycling to work or school in 2008, and 33.8% in 2014.

3.2. Amount of use Indicator: number of trips (CCHS)

In the CCHS data on "number of trips" from the 2007/2008 cycle to the 2013/2014 cycle, the number of trips over a 3-month period (walking or cycling for leisure or to school or work) increased from 1.13 billion to over 1.30 billion (15.8% increase). During the same time period, the number of Canadians engaging in these activities increased from just under 28.49 million to 31.92 million (12.0% increase). The

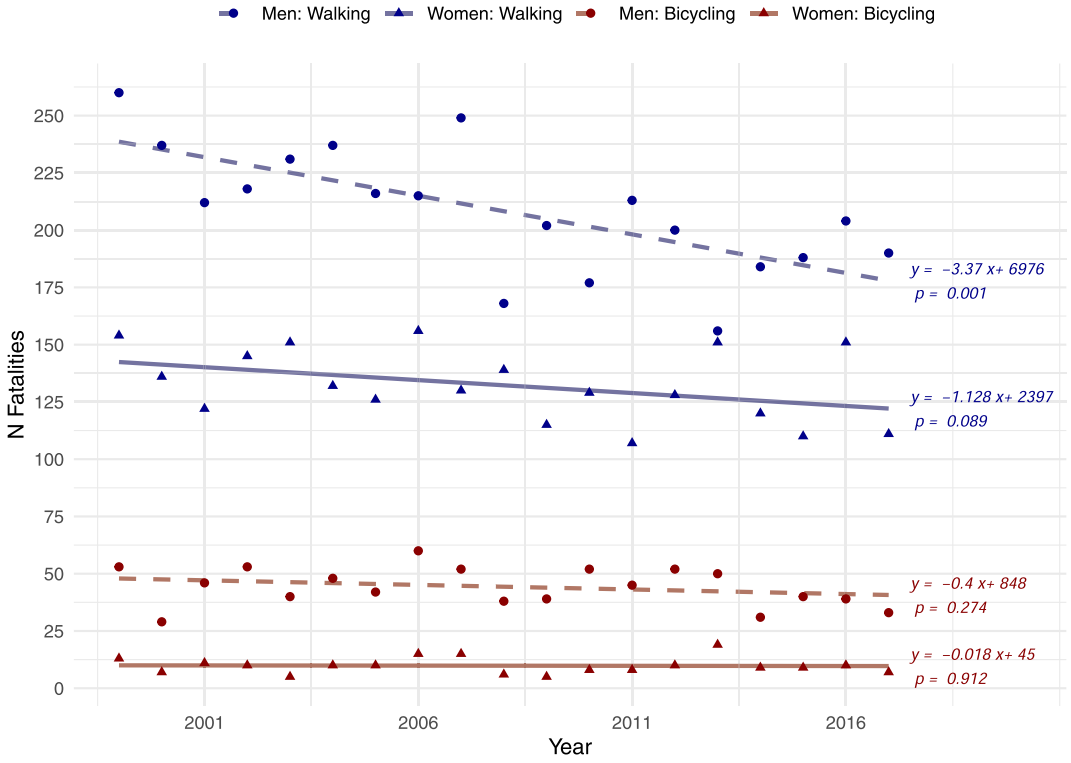


Fig. 2. The total number of fatal police-reported traffic collisions involving people walking or bicycling on public roads across all of Canada from 1999 to 2017 from the National Collision Database. Data points and linear trendlines with p values are shown.

Fig. 3. The road user fatality rates per 100,000 people who report bicycling and walking enumerated from three population data sources between 1999 and 2017: Canadian Community Health Survey (CCHS) on leisure walking/bicycling; CCHS on walking/bicycling to work or school; census on walking/bicycling to work. Note the differing scale of the y-axis for fatality rates between data sources. Data points and linear trendlines with p values are shown.

majority of trips were walking trips with 1.00 billion in 2007/2008 reported by 22.12 million Canadians, to 1.17 billion reported by 24.80 million Canadians in 2013/2014. Bicycling increased slightly over time with 123.76 million trips in 2007/2008 reported by 6.37 million Canadians and 131.16 million trips in 2013/2014 reported by 7.12 million Canadians.

Within each CCHS cycle, the frequency of trips per person was higher for walking compared to bicycling. People who bicycle to work or school, do so more often compared to those who bicycle for leisure. Results from the 2013/2014 cycle show the mean number of trips in the past 3 months was 25.4 (95% CI: 23.3–27.6) for bicycling to work or school versus 17.5 (95% CI:17.0–18.0) for leisure. Walking was about the same frequency for commuting to school or work (49.0 times in last 3 months, 95% CI: 47.8–50.3) and for leisure (47.4 times, 95% CI 46.9–47.9).

3.3. Comparing risk denominators: trends in fatalities and fatality risk for women and men walking and bicycling

Between 1999 and 2017, the number of pedestrian fatalities decreased over time, especially for men. The number of bicycling fatalities was relatively stable over time for both men and women (Fig. 2). Full counts by year and gender are included in Appendix C.

3.3.1. Fatalities per number of users: CCHS vs census

The values and trends in fatality rates vary depending on the chosen denominator for both walking and bicycling (Fig. 3). In terms of absolute risk, using census counts as the denominator produces the highest estimates of risk (due to smallest denominator), followed by CCHS counts of number of Canadians walking or bicycling to school or work and CCHS counts of number of Canadians bicycling for leisure. Between data sources and for either gender, the relationship with fatality risk and time is generally negative, with the exception of fatality rates for women who bicycle to work or school in the CCHS that is positive. The CCHS based bicycling fatality trends produce not only a lower absolute risk for both modes relative to the census-based fatality trends, but also smaller changes in risk over time for people bicycling of either gender. For walking, the fatality risk decline over time appears steeper in men compared to women, across all denominators. Regardless of denominator choice, men are consistently found to have higher fatality risks than women when either walking or bicycling.

3.3.2. Fatalities per number of person-trips: CCHS sub-analysis

Between 2007 and 2014, there was a slight decrease in fatality risk per bicycling trip over time for men, and a slight increase for women (Fig. 4). The fatality risk per walking trip decreased more rapidly over time for men compared to women.

3.4. Comparing characteristics and coverage of the CCHS and the census to a hypothetical national household travel survey

When comparing characteristics of the Census, CCHS, and a potential

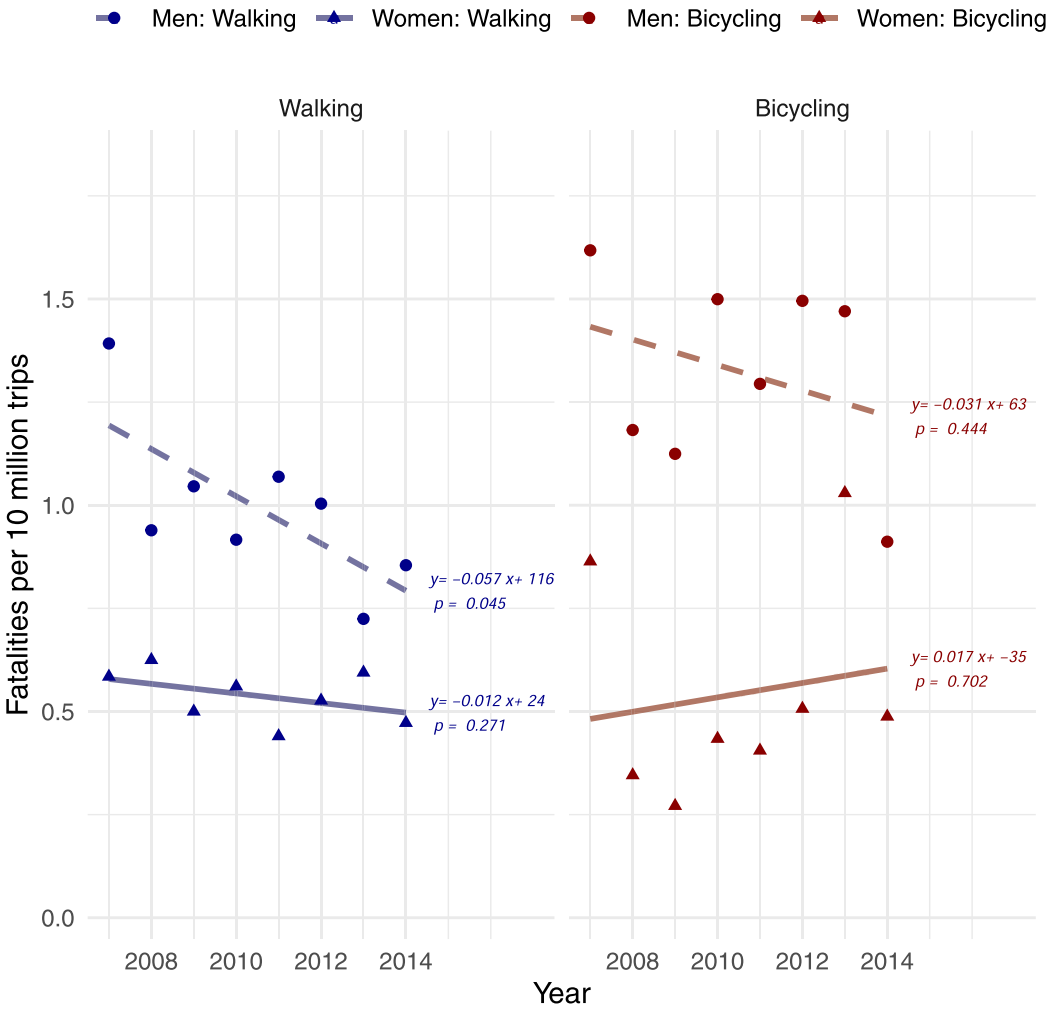


Fig. 4. The fatality rates per 10 million trips per year based on combined number of self-reported trips for leisure or to work or school as enumerated from the Canadian Community Health Survey between 2007 and 2014. Data points and linear trendlines with p values are shown.

Table 2
Summary of Census and Canadian Community Health Survey (CCHS) Canadian national data sources for bicycling and walking, compared to features of a national household travel surveys.

	Census	CCHS		Comparison: design features of a national household travel survey
	Journey to Work	Physical activity	Work or School	
Data collection timing	Spring Census date	Year-roundYear-round	Year-round Include month indicator to enable study of seasonal trends	
Frequency	Every 5 years	Annual	Annual	If modeled on UK benchmark, annual
How is transportation queried?	Main mode of commute to work on census day or previous week	Leisure activities in previous 3 months	Walking or bicycling to work or school in previous 3 months	All modes of transport Trip type indicator to distinguish work, school and other destinations All modes of transport included so trips using multiple modes tally every mode used, rather than mode used for greatest distance
Destinations included	Work only	Leisure only (work excluded)	Work or school (combined)	All
Specific origin and destination points	Yes Work commute only	No	No	Yes
Distance travelled	Yes Work commute only	No	No	Yes, for all trips and all modes
Sample size	Approximately 20–25% sample of Canadian population	Approximately 65,000	Sample size sufficient for data stratification to provincial and municipal levels	
Age coverage	15 + Only if employed outside the home	12+	12 +	All Surveillance of healthy physical activity and childhood injury epidemiology requires data on travel patterns among people of all ages
Covariates Available	Demographics, employment, education, household structure, costs and income	Demographics, wide range of self-reported health behaviours and health status indicators	Demographics (age, sex, ethnicity, education, income), reasons for modal choice on trips (e.g. cost, health status, etc.), can enable linkage to health/injury databases	
Spatial data (trip locations)	Average coordinates for census geography of home and work location	No	No	Emerging smartphone technology (mobile applications) can enable subsets of participants to record and submit spatially referenced trip location data. Historically not available.

national travel survey, we note constraints on existing data from the Census and CCHS including either narrow definitions for bicycling behaviour, a lack of detail regarding amount of use, and/or inconsistency of questions asked over time (Tables 1 and 2) that could be addressed by a national survey.

4. Discussion

Each exposure data source yielded different estimates of absolute counts and percentages of Canadians walking and bicycling, reflecting differences in how questions were asked, and the type of behaviour being captured (e.g. leisure versus commuting, or *main* mode of commute, or work versus work and school commute). As a result, the choice of denominator data makes a difference to interpretation of fatality risk and resulting trends.

We found that population data on commuting yields different estimates than leisure use. In the CCHS dataset, more people bicycle for leisure than for commuting, a result consistent with a study in the UK (Sahlqvist et al., 2012). Though analyses of leisure-only use in the CCHS yielded the highest estimates, these are an incomplete assessment of physical activity without inclusion of travel to work or school or other utilitarian purposes (e.g., shopping). The census, in contrast, yields the smallest estimates, consistent with its narrow definition of walking or bicycling as a work commuting mode for the majority of a commute. In sum, neither of the current sources of Canadian data provide a complete picture of all modes and amount of active travel during a defined period of time, and a national travel survey is recommended.

Across all data sources we found that bicycling is more common among men and walking more common among women. That men are more likely to bicycle than women is a finding consistent with previously reported analyses in Canada (Ramage-Morin, 2017; Winters et al., 2011) and the United States (Buehler et al., 2020). Women being more likely to walk than men is a finding that has also been reported in the United States (Buehler et al., 2020). Over 20 years, we note an approximate doubling of the number of Canadian women who report commuting by bicycle in the census (equivalent to about 6% growth per year), outstripping estimated population growth of 1 to 2% per year (Statistics Canada, 2012). Gender differences in bicycling tend to attenuate where safe bicycling infrastructure is available and more people bicycle overall (Garrard et al., 2008; Teschke et al., 2017).

In general, the CCHS data are limited by inconsistencies in how queries regarding walking and bicycling were asked over cycle iterations (Appendix A). Before the 2007/2008 cycle the CCHS only queried bicycling and walking for leisure, excluding utilitarian purposes that are an important subset of active transportation users and trips. While the CCHS did ask questions regarding bicycling and walking to work or school between the 2007/2008 and 2013/2014 cycles, a complete definition of utilitarian bicycling and walking requires inclusion of destinations other than work (e.g. shopping, appointments), and both on- and off-street routes used for such trips. Cycles in 2000/01, 2003 and 2005 included queries about the time spent in a typical week bicycling and walking to work, school or while doing errands. Beginning with the 2007/08 iteration, the query was modified to specifically assess bicycling and walking to work or school. We did not find the estimates generated by these two questions comparable, so we limited our analyses to 2008 onward. The CCHS again overhauled queries of walking and bicycling in their 2015/16 iteration, rendering them incomparable to previous cycles. This underscores that incomplete coverage and changes to queries are pitfalls of data sources focused on employment, health or physical activity rather than transportation (see Table 2 and Appendix B).

Though previous iterations of the CCHS are limited, they are an improvement on the census for enumerating differences in bicycling behaviour. The census is quite restrictive in that it only includes people

bicycling and walking if they use that mode as their main mode of commuting. Furthermore, for certain cycles the CCHS directly queries differences in the frequency of bicycling and walking by asking for the number of times a trip is made in the past three months. This trip data is limited by several factors. Travel to work and school is queried as "both to and from school" so each time could be considered two trips. Number of times queried in leisure activity may, by contrast, indicate a single trip, but there is a potential for reporting error depending on how respondents interpret "number of times". Reporting error in the number of bicycling and walking trips is also likely an issue due to the long length of time participants are asked to recall (Branion-Calles et al., 2019).

The census could potentially be used to estimate the number of trips by examining the number of days per week worked and assuming two trips per working day. This, however, requires the assumption that the transport mode is used a certain amount of days of the week. Our analyses of the CCHS trip data showed that bicycling respondents indicated commuting to work or school an average of 25.4 times in the previous 3 months (~2 times a week). The census also queries commuting distance (in km), but these data are not released in public user microdata files (PUMFs) except in broad categories (travel distances less than 5 km from a single category).

Our analyses included a broad age range (all Canadians 15 and older) to capture as close to total counts as possible, while incorporating comparable age limits between sources. However, as age is strongly related to both the underlying activities being queried (e.g. working full time) and physical activity participation, individual studies must match age restrictions to analysis purpose. Information on children's travel could be a vital contribution of a national household travel survey and an important input to public health planning in support of establishing early physical activity pattern. The US National Household Travel Survey collects trip data for persons aged 5 and up (Pucher et al., 2011).

A Canadian national household travel survey would provide consistent estimates of all travel by bicycling and walking, (as well as other modes of travel including multimodal trips) and would consider destinations other than work or school (Pucher et al., 2011). Such a travel survey is needed for the collection of more consistent, accurate and expansive estimates of: (i) the number of citizens using different modes of travel, (ii) the number of trips by mode and (iii) the amount of time and/or distance travelled by mode. Information around time/distance travelled is key to accurate characterizations of crash/injury risk by mode (Aldred, 2018; Teschke et al., 2013) and would allow for Canada to be included in international comparisons of risk (Buehler and Pucher, 2020; Castro et al., 2018). If such a travel diary also included questions regarding self-reported crashes (including information on severity such as physician or hospital visits), or was linked to injury datasets (e.g. hospitalization data compiled at the provincial and national levels in Canada), it would enable crash risk analyses that would provide more detailed insight into crash risk factors beyond simply gender or age strata (Aldred, 2018; Branion-Calles et al., 2020).

Our analysis of road safety reveals that the magnitude of absolute risk for both walking and bicycling varies substantially based on which surrogate dataset is used as a denominator. The fatality rate based on census data suggests much higher risk per 100,000 road users than rates based on the CCHS data, due to the more expansive definition of bicycling and walking in the CCHS. On average, the census-based bicycling fatality rate was ~24 times higher than the CCHS leisure-based fatality rate for men, and ~39 times higher for women. Similar differences were found for walking, with the census-based pedestrian fatality rate being ~20 times higher than the CCHS leisured-based fatality rate for men and ~19 times higher for women. Even with ideal denominator data such as that provided by national travel surveys, estimates of absolute injury risk for people walking and bicycling based on police data would be underestimates due to under-reporting (Elvik and Mysen, 1999; Langley et al., 2003; Stutts and Hunter, 1998). Crashes that result in a fatality have a much higher likelihood of being captured in police databases compared to crashes that result in injuries of lower severity (Elvik and Mysen, 1999; Stutts and Hunter, 1998).

In addition to variation in absolute risk, we also found that trends in fatality risk varied depending on the denominator dataset. For example, census-based bicycling fatality risk fell over time for both men and women, while CCHS leisure data showed risk falling slightly for men but staying stable for women. Within datasets, we found consistent patterns such as men having a higher fatality risk for both walking and bicycling. That men are at higher risk of fatality is a finding is consistent with previous analyses of transportation fatalities in other countries including the United States (Beck et al., 2007), and the United Kingdom (Mindell et al., 2012; Scholes et al., 2018). Regardless of denominator, the fatality rates did not increase significantly over time in the current analysis of Canadian data, a trend consistent with those in western European nations and in contrast to the United States (Buehler and Pucher, 2020).

One of the main limiting factors for the safety analysis is that the numerator data (fatalities) and denominator data (counts of people bicycling or walking) do not necessarily match. The matching denominator for the fatality data from the NCDB would be limited to bicycling/walking on public roads. Note that this means that the NCDB does not capture fatal incidents off public roads and will underestimate the total number of fatalities. Our sub-analysis of bicycling trips made in Canada, combining the leisure and utilitarian trips from the CCHS is the best estimate of the appropriate denominator for the NCDB data, but still falls short relative to what a travel survey would provide, namely reliable estimates of number of trips, distance and/or time travelled. Unfortunately, the latest two iterations of the CCHS has eliminated even this option – trip data is no longer recorded separately by mode.

Overall, our study shows that population data from the CCHS and census can capture different aspects of active transportation and leisure walking and bicycling in Canada. However, these surrogate data sources present considerable limitations in how these activities are queried. To support the development of a national household travel survey, a next step would be a methodological comparison of regional household travel surveys conducted in Canada. To fill the national household travel data gap, several municipal or metropolitan regions in Canada have developed and conducted regular or ad-hoc household travel surveys (e.g. Buliung et al., 2009; Teschke et al., 2013). Regions have undertaken significant expense and expertise to conduct these surveys, which should be considered and consulted in a national survey development process to preclude any duplication of effort. Academically, an analysis of best practices used in regional household travel surveys to elicit complete travel data will be a crucial next step.

As Canada experiences potential transportation upheaval in the wake of the COVID-19 pandemic (Harris and Branion-Calles, 2021), national data on transportation are crucially needed to understand national, provincial and sub-provincial impacts. A national household travel survey is a vital research need for Canadian public health, transportation, and injury epidemiology.

CRediT authorship contribution statement

Michael Branion-Calles: Conceptualization, Methodology, Writing - original draft, Visualization, Formal analysis. **Kay Teschke:** Conceptualization, Methodology, Writing - review & editing. **Mieke Koehoorn:** Conceptualization, Methodology, Writing - review & editing. **Osvaldo Espin-Garcia:** Methodology, Formal analysis, Writing - review & editing. **M. Anne Harris:** Conceptualization, Methodology, Writing - original draft, Formal analysis, Funding acquisition, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2021.101366.

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