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Systematic Review of Active Travel to School Surveillance in the United States and Canada

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Abstract

Active travel to school is one way youths can incorporate physical activity into their daily schedule. It is unclear the extent to which active travel to school is systematically monitored at local, state, or national levels. To determine the scope of active travel to school surveillance in the US and Canada and catalog the types of measures captured, we conducted a systematic review of peer-reviewed literature documenting active travel to school surveillance published from 2004 to February 2018. A study was included if it addressed children's school travel mode across two or more time periods in the US or Canada. Criteria were applied to determine whether a data source was considered an active travel to school surveillance system. We identified 15 unique data sources; 4 of these met our surveillance system criteria. One system is conducted in the US, is nationally representative, and occurs every 5-8 years. Three are conducted in Canada, are limited geographically to regions and provinces, and are administered with greater frequency (e.g., 2-year cycles). School travel mode was the primary measure assessed, most commonly through parent report. None of the systems collected data on school policies or program supports related to active travel to school. We concluded that incorporating questions related to active travel to school behaviors into existing surveillance systems, as well as maintaining them over time, would enable more consistent monitoring. Concurrently capturing behavioral information along with related environmental, policy, and program supports may inform efforts to promote active travel to school.

Keywords

active travel to school; active transportation; surveillance system; school commutes; physical activity

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Authors' contributions

Conceptualization, ENU, KBW, and SMG; Methodology, ENU, KBW, and SMG; Data curation and Investigation, MKW and NCM; Writing – Original Draft, MKW; Writing – Review & Editing, NCM, ENU, KBW, and SMG.

Introduction

Only 26% of US high school students meet the physical activity guideline of at least 60 minutes of aerobic physical activity each day (Kann et al., 2018; U.S. Department of Health and Human Services, 2018). Active travel to school – defined as walking or bicycling to get to or from school – is one way youths can incorporate physical activity into their daily schedule. A recent systematic review by the Community Preventive Services Task Force found sufficient evidence of the effectiveness of active travel to school interventions to increase walking among students (Community Preventive Services Task Force, 2018). Data to monitor active travel to school and related supports can help decision makers understand current levels of active travel to school and support decisions about strategies to implement and evaluate the effect of programs and interventions to address active travel to school.

School districts, communities, and policymakers have introduced strategies to help facilitate active travel to school (Hinckson & Badland, 2011; Mammen et al., 2014; Smith et al., 2015). Programs such as Safe Routes to School have demonstrated success in encouraging active modes of school travel (Community Preventive Services Task Force, 2018). These programs often include educational or encouragement components which may consist of walking school buses, school-wide events, or walking and cycling safety training sessions (Blomberg et al., 2009). Policies implemented at various levels can also play an important role in reducing barriers for active travel to school (Chriqui et al., 2012). Examples include school-based policies that permit students to walk or bike to school or provisions requiring sidewalks, traffic calming measures, or speed zones around schools (Chriqui et al., 2012). In addition to programs and policies, features of the environment near the home and school, such as street connectivity, land use mix, and population density, are important predictors of youth active travel to school (Carlson et al., 2014; Larsen et al., 2009; Wong et al., 2011). Physical improvements to built environment infrastructure (e.g., sidewalks, bicycle lanes) can enhance the safety and convenience of active travel and are recommended components of interventions (Community Preventive Services Task Force, 2018). Distance to school has been identified as an important correlate, given that children and adolescents are unlikely to actively commute to school if they live more than two or three miles away (McKee et al., 2007). Concurrently monitoring school travel behaviors and related policy, program, and environmental supports may support a comprehensive understanding of opportunities to improve active travel to school among youth.

It is unclear, however, how comprehensively youth active travel to school and related supports are monitored over time at local, state, or national levels in North America. To date, there has been no comprehensive review of surveillance related to active travel to school along with the features of the systems collecting these data. To address this gap, the National Collaborative on Childhood Obesity Research (NCCOR) – a public-private partnership among the National Institutes of Health, the Centers for Disease Control and Prevention (CDC), the Robert Wood Johnson Foundation, and the US Department of Agriculture – formed a scientific workgroup to investigate surveillance of youth active travel to school in North America.

For this study, we defined active travel to school surveillance as the ongoing, systematic collection, analysis, interpretation, and dissemination of data regarding non-motorized transportation (e.g., walking, biking, scooting, rolling) of children on their journey to and from school for use in the planning, implementation, and evaluation of active modes of school travel (adapted from Thacker and Berkelman's definition of public health surveillance (Thacker & Berkelman, 1988)). The study aims to (1) identify ongoing surveillance systems that measure active travel to school, (2) evaluate attributes of active travel to school surveillance systems, and (3) catalog the measure of behavior and behavior-related factors, environmental features, and policy or program supports being assessed.

Methods

Search Strategy

We searched for peer-reviewed studies and reports from the grey literature addressing active travel to school in the US and Canada. We initially chose the context of North America to capture some settings outside of the US for comparison purposes while still setting a reasonable scope of analysis; however, because our search focuses on literature written in English, we limited the scope to the US and Canada so as not to inadvertently exclude evidence from Mexico. We conducted an electronic search for studies and reports, written in English, published from January 1, 2004 to February 28, 2018 in PubMed, Scopus, PsycINFO, SportDiscus, Web of Science (core collection), ERIC, Cochrane Database, the Transport Research International Documentation, the National Transportation Library, and the Grey Literature Report Database. This date range was chosen after sensitivity testing for search criteria in the selected databases at the time of the study. The title-based search included the following parameters: school AND (transport* OR travel* OR commute* OR journey OR route* OR trip OR walk OR walking OR bike OR bicycling). Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Moher et al., 2009) were used for tracking articles identified through the literature search to ensure a systematic approach to documenting the search process.

Study Selection

We searched the aforementioned databases, screened titles and abstracts of potential studies and reports, and reviewed the full texts of those meeting the inclusion criteria to determine the final sample. To be eligible for inclusion, studies had to use data which: (1) were collected in the US or Canada; (2) included some portion of children aged 5-18 in their population; (3) assessed active school travel mode; and (4) included two or more time periods (e.g., longitudinal or repeated cross-sectional). Studies were excluded during the title/abstract screening if they did not meet all of these criteria.

To apply the inclusion criteria to the studies identified by the formal electronic search, we used the systematic review software package Covidence (Covidence systematic review software, n.d.). Two reviewers screened each title and abstract using the inclusion criteria to determine whether a study would undergo full-text review. In the title and abstract screening phase there was 5% discrepancy rate among reviewers. Disagreement or discrepancy was resolved by a third researcher.

2.3 Evidence Extraction and Synthesis

We reviewed the full text of each eligible study to identify any instance of data derived from a potential active travel to school surveillance system. We systematically extracted the same data from each study using an abstraction form (see Appendix A1).

With appropriate data abstracted from each eligible study, we then determined whether the data source used in each study met our definition of active travel to school surveillance. Central to this definition is the notion of "ongoing" and "systematic." As Fulton and Carlson (2012) highlight, "ongoing" refers to the assessment of outcomes of interest over time, which differentiates surveillance from a one-time survey (Fulton & Carlson, 2012). "Systematic" refers to the use of consistent measures and methods to assess outcomes of interest over time. For this study, a data source was considered an active travel to school surveillance system if it met the following criteria: (1) mode of travel to school is measured in isolation (i.e., trips to/from school are not combined with other trips); (2) data collection is ongoing; and (3) systematic sampling, including a convenience sample followed over time, and data collection are used.

From the articles that were full-text screened, we identified unique data sources that initially appeared to meet our definition of active travel to school surveillance. To confirm these data sources were active travel to school surveillance, we accessed the website or online repository for the data guide of each source. If we could not locate a data guide (i.e., public data access was restricted), we extracted as much information as possible from the study or studies that utilized the data source. Information retrieved included: name of the data collection system; years data on youth active travel to school were collected; sampling design; geographic level; availability of the data; characteristics of the study sample; measures of active travel to school and related environmental features and policy or program supports; data collection method; and language of the survey question.

2.4 System Attributes

We adapted criteria from Thacker and Berkelman (1988) to evaluate the active travel to school surveillance systems based on four attributes (Thacker & Berkelman, 1988). *Acceptability* reflects the willingness of individuals and organizations to participate in the surveillance and could be reflected by the response rate, *representativeness* is the extent to which the system reflects the population with the event under surveillance, and *frequency* reflects how often data were collected. We also included *availability* which refers to how accessible the raw data and estimates from the raw data are to others (e.g., the public).

Results

Search Results

The initial search yielded 3,763 articles. The PRISMA flow diagram in Figure 1 illustrates the article selection process. After 1,765 duplicates were eliminated and 50 articles were excluded because the abstract could not be located, 1,948 remained. Next, 1,806 articles were excluded because they did not meet inclusion criteria. Possible reasons for exclusion were use of data from outside the US or Canada, not reporting active travel to school mode,

use of data from only one time period, or not reporting on individuals within the target age range (5-18 years old).

Complete research article reviews were attempted for the 142 remaining articles. Among these articles, 65 were excluded because the full text could not be located (n=7); they were duplicates not earlier detected (n=5); they did not meet inclusion criteria (n=16); they were conference proceedings (n=9), or they were literature reviews (n=28). Although the 28 literature reviews were excluded here, they were reviewed for any mention of active travel to school surveillance systems.

From the 77 articles that were reviewed in full, we identified 28 articles which utilized one or more data source that appeared to meet our definition of active travel to school surveillance. Within these 28 articles, 15 unique data sources were identified (several studies used the same data sources). To determine whether these 15 sources could be classified as active travel to school surveillance, we retrieved additional information by accessing the website or online repository for the data guide of each, when available. In total, 11 data sources were excluded at this stage because it was determined that they did not meet our definition of an active travel to school surveillance system. These data sources and reasons for exclusion are summarized in Table 1. The remaining four surveillance systems met our definition of an active travel to school surveillance system in the US or Canadian context.

Description and Attributes of Surveillance Systems

Of the four systems identified as active travel to school surveillance, one is from the US (US National Household Travel Survey [NHTS]) and three are conducted in Canada (Transportation Tomorrow Survey [TTS], Québec Longitudinal Study of Child Development [QLSCD], and COMPASS Study) (Table 2). Design varied across systems; NHTS and TTS are repeated cross-sectional surveys, while COMPASS and QLSCD are cohort studies. COMPASS is a prospective cohort study designed to collect hierarchical longitudinal data from a convenience sample of secondary schools and grade 9 to 12 students attending those schools. QLSCD is a birth cohort study following Québec children (beginning when they were 5 months old) since 1998. While the NHTS and TTS collect data from youth and adults, the QLSCD and COMPASS focus data collection on youth only. Data collection methods are consistent across systems, ranging between mail-back questionnaires and telephone interviews. All systems ask a household adult to report the data except for COMPASS, which includes a student questionnaire as well as a school policies and practices questionnaire completed by school administrators.

We found acceptability, or the willingness of individuals and organizations to participate, varied across systems (Table 2). According to the most recently available reports, the overall response rate was 15.6% for NHTS in 2017 (Westat, 2018) and 49% for TTS in 2016 (Rose, 2018). Since its inception in 1998, the QLSCD maintained 64% of its original cohort through 2015 (Quebec Longitudinal Study of Child Development, 2019). At baseline school recruitment for the COMPASS study in 2012-2013, 49 of the 111 eligible schools agreed to participate, 44 declined, and 18 did not respond (Leatherdale et al., 2014).

The NHTS is the only nationally representative surveillance system we identified. In 2017, the NHTS also used stratification to produce state-level estimates with adequate precision (Westat, 2016); however, it is unclear whether all states have adequate sample size for producing statistically reliable estimates of active travel to school. Both the TTS and QLSCD are representative of specific geographic parts of Canada; TTS is representative of the Greater Golden Horseshoe area of Ontario while QLSCD represents Québec. At recruitment, the COMPASS study did not require a provincially representative sample of schools, therefore a convenience sample of Ontario and Alberta school boards was purposefully selected.

Frequency of data collection varies by system: two of the surveillance systems (NHTS and TTS) have less frequent data collection, every 5-8 years and every 5 years respectively, while the remaining two systems (QLSCD and COMPASS) have much greater frequency with data collection occurring on an annual basis. Data from two of the systems (NHTS and TTS) are publicly available, while QLSCD and COMPASS require special access and data use applications from potential users. National estimates for NHTS can be found in the form of reports (Federal Highway Administration, 2008, 2019a) and manuscripts (Ham et al., 2008; McDonald et al., 2011; McDonald, 2007a). For the most recent year of data collection, estimates can be generated through the NHTS Data - 2017 Table Designer (Federal Highway Administration, 2019b). Limited provincial, city, and municipal estimates from Canada are available in various manuscripts (Buliung et al., 2009; Pabayo et al., 2011).

Active travel to school related constructs

We examined each surveillance system to understand what active travel to school behaviors are measured and the method used (Table 3). Although all four systems measure mode of travel to school, only one (NHTS) assesses both the child's usual mode of travel to school as well as the mode of travel to school on the day the survey was administered. The TTS assesses only the mode taken on the day prior to the survey, while the QLSCD and COMPASS assess only the usual mode.

Two of the four surveillance systems measure additional constructs related to active travel to school. Although prior administrations of NHTS have recorded travel time to school as well as parental beliefs about their child's independent travel (e.g., what grade their child is allowed to walk/bike to/from school without an adult), parental beliefs were not included in the most recent survey. The COMPASS Study used accelerometers to track children's moderate-to-vigorous physical activity, which reflects the study's broader focus on youth health behaviors.

Three systems (NHTS, TTS, and QLSCD) assess the distance from a child or adolescent's home to school. While the NHTS collects this information in both the questionnaire and trip diary, TTS and QLSCD approximate distance to school using geographic identifiers of the home and school locations. Two systems (NHTS and COMPASS) include additional aspects of the built environment as it relates to active travel to school. In NHTS, the respondent's home address is geocoded, and individual-level data are linked with environmental features from existing data sources, including population density, housing density, and urbanicity. COMPASS includes information about environmental features related to active travel to

school, collected via direct observation and linkage with geospatial data. Study staff collect observational data about the schools' indoor and outdoor facilities that relate to physical activity, including bicycle racks, sports fields, and gymnasiums. COMPASS also includes measures of environmental features around the school, which were derived by linking school geocodes with various geospatial data layers. Available measures include macro-scale environmental features (e.g., street networks and land use) and nearby points of interest (e.g., grocery stores, fast food restaurants, and parks). The TTS and QLSCD do not monitor additional environmental features related to active travel to school.

None of the surveillance systems identified in this review monitor policy or program supports for active travel to school. COMPASS tracks information about a school's health policies and programs over time in the areas of physical activity, healthy eating, tobacco use, alcohol and other drug use, mental health, and bullying via a questionnaire administered to school administrators; however, this questionnaire does not include any measures that ask specifically about school programs or policies related to active travel to school.

Discussion

This review identified limited ongoing surveillance of active travel to school by youth in the US and Canada. In the US, we found only one currently active system with infrequent survey administration. In Canada, we found three currently active systems limited geographically to regions and provinces. Improving active travel to school surveillance systems could enable more consistent monitoring and could help inform efforts by public health, transportation planning, and education professionals to increase active travel to school.

Mode of travel to school was the primary measure assessed in active travel to school surveillance; published findings demonstrate the variability in representativeness and prevalence estimates across systems. For example, the 2017 US National Household Travel Survey (NHTS) reported that 10.4% of trips to school were made by walking or bicycling in US children aged 5-17 years (Federal Highway Administration, 2019a). The Québec Longitudinal Study of Child Development (QLSCD) study reported 17.6% children between the ages of 6 and 8 years, or between grades kindergarten and second, engaged in active travel to school in Québec in 2003-2006 (Pabayo et al., 2011). In the provinces of Alberta and Ontario, Canada, the COMPASS study reported 15% of youth in grades 9-12 engaged in active travel to school in 2012-2015 (Lau et al., 2017). When limiting the sample based on distance to school, the Transportation Tomorrow Survey (TTS) study reported 57.4% of 11-year old children living within 3.2 kilometers of their school in Toronto, Canada engaged in active travel to school in 2006 (Mitra et al., 2016). The wide variation in estimates may be partially explained by geographic coverage, differences in age ranges targeted by each system, designated unit of analysis, and limiting the sample based on proximity to school.

Attributes of the active travel to school surveillance systems varied. Although NHTS was nationally representative, acceptability, based on a response rate of 16%, was low. Acceptability was better for the three Canadian systems, but the systems were, at most, representative of specific locales. Data collection occurred on a more frequent basis for

QLSCD and COMPASS compared to NTHS and TTS. The difference in frequency may be related to the funding mechanisms behind each system: the NHTS and TTS are government agency-funded while QLSCD and COMPASS are grant-funded and largely run by researchers. Data collection for the QLSCD is ongoing while COMPASS is a 9-year study slated to end in 2021-2022. None of the surveillance systems excelled across all four attributes assessed.

The surveillance systems varied on the availability of the raw data and of estimates from the raw data. Although the raw data from the four systems are potentially available, only the data from two systems are publicly available (NHTS, https://nhts.ornl.gov/; TTS, http://dmg.utoronto.ca/). Additionally, to our knowledge, the availability of more granular estimates derived from the raw data were limited. Stakeholders may rely on the availability of estimates from surveillance systems to inform strategies to increase active travel to school. For example, built environment improvements that make routes safer for children to actively travel to school and encouragement strategies to support more children to actively travel to school may rely on support from different stakeholders, such as state departments of health, parks and recreation, and educators. These stakeholders may not have the resources to obtain the estimates from the raw data; thus, improving the availability of estimates calculated from these data may help promote use.

To evaluate the impacts of strategies to promote active travel to school it would be advantageous for systems to concurrently capture information about supports and behavior. This can include information about built environment features (e.g., active travel to school infrastructure at the school site) and active travel to school policies and programs (e.g., presence of Safe Routes to School education and encouragement programs). Concurrent monitoring of mode of travel to school and potential contributing factors in surveillance systems could help decision makers identify existing resources and needs for increasing opportunities for active school travel.

The surveillance systems identified in this review included limited information on environmental features, and no information on policies and programs related to active travel to school. The COMPASS study was the only surveillance system identified that actively collects information about environmental features related to active school travel, although this was limited to the availability of bicycle racks at the school. NHTS and COMPASS data are linked to environmental features from existing data sources using geocoding; however, COMPASS links based only on the school address while NHTS links based only on the home address. If environmental features are to be considered for their impact on school travel decisions in population-based surveillance, it may be important to include a more comprehensive assessment of features surrounding both the home and school locations. None of the surveillance systems assessed the presence of school policies or programs that encourage active travel to school, such as Safe Routes to School. Understanding what constructs are most important to capture and the best ways to measure them may be an important first step in developing questions for future surveillance of environmental, policy, and programmatic supports for active travel to school.

No surveillance system routinely includes assessment of environmental, policy, and programmatic supports, either through the surveillance system or through linkage to existing sources, to comprehensively monitor active travel to school in the US at state and local levels. While several location-specific estimates are available for Canada, US estimates of active travel to school are available at the national level and potentially at the state-level, although it is unknown if stable estimates can be produced for all states. To help address the lack of surveillance at more granular levels, it may be beneficial to create a brief set of survey items to assess active travel to school (including the behavior and key indicators of supports) and make these tools available for state and local use (Pate et al., 2018).

Incorporating questions related to active travel to school into existing surveillance systems, and maintaining them across multiple waves of data collection, would enable more consistent monitoring and an understanding of changes over time. Of course, this approach presents challenges due to space limitations on existing surveys; potential to increase respondent burden; small sample sizes of the target population in larger-scale surveys; and the surveillance systems' own competing priorities. Finding ways to overcome these challenges may improve the likelihood of including assessment of active school travel on existing surveillance systems.

Limitations and Strengths

This review used a structured and well-established definition of public health surveillance to evaluate the current state of active travel to school monitoring in the US and Canada (Thacker & Berkelman, 1988). Our findings are useful in understanding the current state of active travel to school surveillance and how it can potentially be improved.

Inherent to the nature of systematic reviews, our review is limited by the search terms we imposed and search strategy we employed. During the eligibility phase of the literature search, we were not able to locate some conference proceedings and several full-text articles. We also had to make informed decisions about what constitutes an active travel to school surveillance system; therefore, some active travel to school monitoring efforts are catalogued in Table 1 but are not examined in extensive detail. Finally, it is possible that this review did not identify all existing surveillance systems, particularly if there are systems that measure active school travel but for which estimates have not been published.

Our review reveals limited ongoing surveillance of youth active travel to school in the US and Canada. Incorporating (and maintaining) questions related to active travel to school behaviors into existing surveillance systems could facilitate more consistent monitoring. Whether accomplished through additional questions or through linkage with existing data sources, concurrently capturing information related to environmental supports and policies and programs (e.g., Safe Routes to School) with active travel to school behavior may help inform stakeholders' efforts to promote active travel to school and increase physical activity among youths.

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Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

APPENDIX

A1.

Abstraction form for full-text screening

Title	**Authors**	**Year**	**Study Type**	**Study design**	**Intervention? (0/1)**	**Age of study pop. (primary or <5 y.o.) (0/1)**	**Age of study pop. (elementary or 5-10 y.o.) (0/1)**	**Age of study pop. (middle school or 11-13 y.o.) (0/1)**	**Age of study pop. (high school or 14-18 y.o.) (0/1)**	**Population sampled/ targeted**
Years of data used	Sample size used	Ongoing surveillance (0/1)	Name of surveillance system	Data Collection Method	Measure of Interest	Question format	Who answers question?	Study area	Rep. of study area (0/1)	Findings

LIST OF ABBREVIATIONS

CDC	Centers for Disease Control and Prevention
CPSTF	Community Preventive Services Task Force
NCCOR	National Collaborative on Childhood Obesity Research
NHTSA	National Highway Traffic Safety Administration
NHTS	National Household Travel Survey
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analysis
QLSCD	Quebec Longitudinal Study of Child Development
TTS	Transportation Tomorrow Survey

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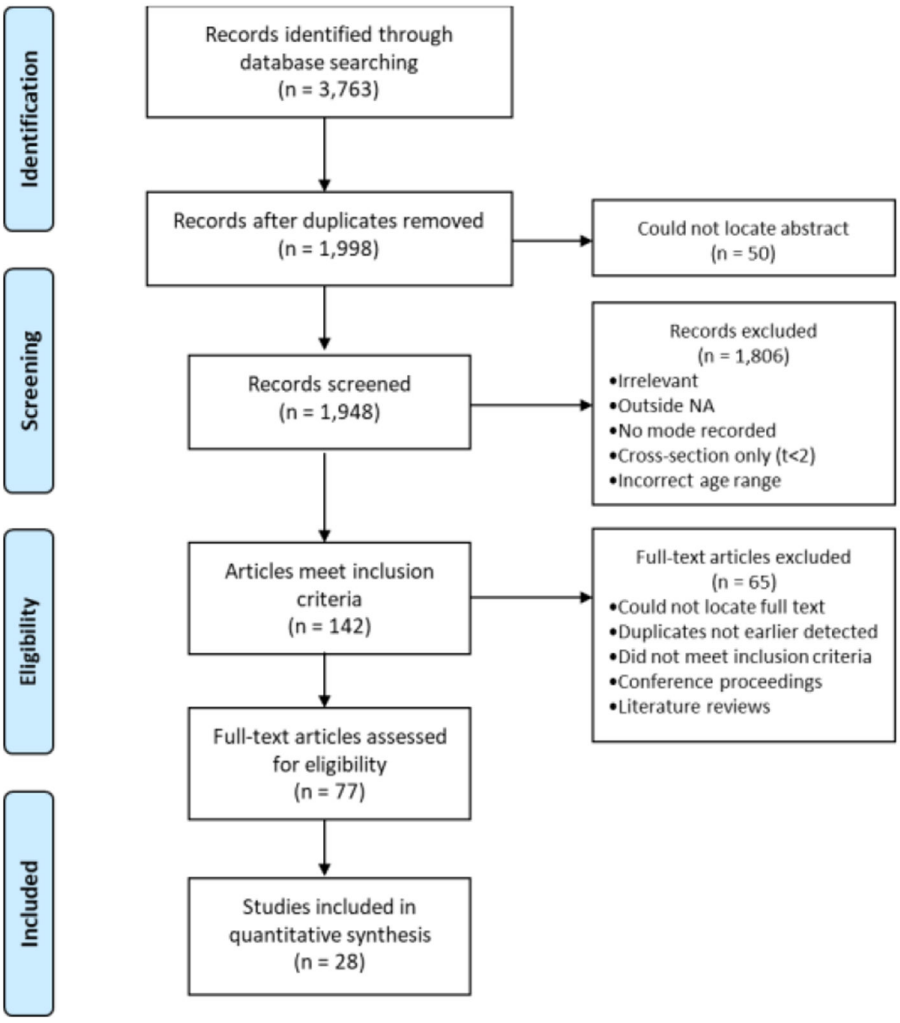

Figure 1.

PRISMA diagram of literature search and selection through February 2018. *Note:* Based on systematic literature review of peer-reviewed studies from January 2004 through February 2018 that utilized active travel to school data over time for children ages 5-18 in the United States and Canada.

Table 1.

Unique active travel to school data sources identified in evidence synthesis (n=15)

Data source	Deemed active travel to school surveillance?	Reason for exclusion, if applicable	Active travel to school and related outcomes	Paper (s) in which data source was utilized
National Household Travel Survey (NHTS)	Yes	n/a	Mode to school Distance to school	(Ham et al., 2008 [20]; McDonald et al., 2011 [19]; McDonald, 2007 [18]; McDonald, 2012 [35]; McDonald et al., 2014 [34])
Transportation Tomorrow Survey (TTS)	Yes	n/a	Mode to school	(Buliung et al., 2009 [22]; Colley & Buliung, 2016 [36]; Mitra et al., 2016 [25])
Quebec Longitudinal Study of Child Development (QLSCD)	Yes	n/a	Mode to school	(Pabayo, 2010 [38]; Pabayo et al., 2010 [39]; Pabayo et al., 2012 [37])
COMPASS study funded by the Canadian Institutes of Health Research and Health Canada	Yes	n/a	Mode to school	(Lau et al., 2017 [24])
US Department of Transportation National Highway Traffic and Safety Administration State Data Systems	No	No school mode (safety-focused outcome)	Crash-involved pedestrians and bicyclists†	(Blomberg et al., 2008 [31]; DiMaggio et al., 2016 [40])
California Statewide Integrated Traffic Records System	No	No school mode (safety-focused outcome)	Crash-involved pedestrians and bicyclists Pedestrian and bicyclist injuries	(Gutierrez et al., 2008 [42]; Ragland et al., 2014 [41])
New York City Department of Transportation Office of Research, Implementation, and Safety Motor Vehicle Crash data	No	No school mode (safety-focused outcome)	Pedestrian injury during school travel hours	(Dimaggio & Li, 2013 [43])
Quebec Road Vehicle Accident Reports	No	No school mode (safety-focused outcome)	Collision victim by mode	(Lavoie et al., 2014 [44])
Texas Department of Transportation Crash Records Information System	No	No school mode (safety-focused outcome)	Bicycle and pedestrian crashes	(DiMaggio et al., 2015 [45])
School Health Policies & Practices Questionnaire	No	Not ongoing	School permits active travel	(Chriqui et al., 2012 [46])
Porter Novelli's ConsumerStyles Survey	No	Questions not consistent; Not ongoing	School travel mode	(Martin & Carlson, 2005 [47]; Beck & Nguyen, 2017 [48])
US National Health and Nutrition Examination Survey	No	Active travel origin/ destination not specific to school	Active travel	(Mendoza et al., 2011 [49])
Centralized Data Collection and Reporting System through the National Center for Safe Routes to School	No	Data collection is voluntary; Does not use a systematic sampling approach	Mode to school Distance and travel time from school Parent and school encouragement for active travel	(McDonald et al., 2013 [52]; The National Center for Safe Routes to School, 2013 [51]; McDonald et al., 2014 [50]; Ragland et al., 2014 [41])
Canadian National Longitudinal Study of Children and Youth	No	Not ongoing (2008-2009 last cycle)	Mode to school	(Pabayo, 2010 [38]; Pabayo et al., 2011 [23])
Centre for Hip Health & Mobility Active Streets, Active People - Junior	No	Not ongoing (2012 data collection)	Moderate- to vigorous-intensity physical activity School trip speed	(Voss et al., 2015 [53])

Table 2.

Attributes of surveillance systems collecting active travel to school data (n=4)

Surveillance System	Location	Attributes of the surveillance system			
		Acceptability	Representativeness	Frequency	Availability
National Household Travel Survey (NHTS)	US	2017: 15.6% overall weighted response rate	Nationally representative State-level representativeness *	Sporadic (1969, 1977, 1983, 1990, 2001, 2009, 2017) NHTS: 2001, 2009, 2017; (formerly) NPTS: 1969, 1977, 1983, 1990, 1995	Raw data publicly available † Some estimates available via online tool (Federal Highway Administration, 2019b), reports (Federal Highway Administration, 2008, 2019a), and peer-reviewed manuscripts (Ham et al., 2008; McDonald et al., 2011; McDonald, 2007a)
Transportation Tomorrow Survey (TTS)	Canada	2016: 16% response rate	Representative of the Greater Golden Horseshoe area Greater Golden Horseshoe city and municipality representativeness	Every 5 years (1986, 1991, 1996, 2001, 2006, 2011, 2016)	Raw data publicly available ‡ Some estimates available via peer-reviewed manuscripts (Buliung et al., 2009)
Quebec Longitudinal Study of Child Development (QLSCD)	Canada	1998-2015: 64% longitudinal response rate	Representative of birth cohort of babies born in 1997-1998 in the province of Quebec	Annual follow-up from 5 mos. to 19 years of age. Phase 1 (1998, 1999, 2000, 2001, 2002); Phase 2 (2003, 2004, 2005, 2006, 2008, 2008-2009, 2010); Phase 3 (2011, 2013, 2015); future Phase 4 (2016-2023)	Raw data are private – must qualify to obtain this data § Some estimates available via peer-reviewed manuscripts (Pabayo et al., 2012)
COMPASS Study	Canada	Year 1 (2012-2013): 80.2% response rate Year 2 (2013-2014): 80.1% participation rate Year 3 (2014-2015): 79.3% participation rate	Not regionally representative - convenience sample of secondary schools in Ontario and Alberta	Annual academic years (2012-13; 2013-14; 2014-15; 2015-16; 2016-17; 2017-18) 9-year study started in 2012; Baseline (2012-13), Year 2 (2013-14), Year 3 (2014-15), Year 4 (2015-16), Year 5 (2016-17), Year 6 (2017-18)	Raw data are private – data usage application is required ** Some estimates available via peer-reviewed manuscripts (Lau et al., 2017)

* Although NHTS collects state-level data, some states may not have an adequate sample size for statistically reliable estimates for estimating children's mode of travel to school, especially when limiting estimates to children and adolescents who live 3 miles or less from school.

† Available at https://nhts.ornl.gov/.

‡ Available after account registration at http://dmg.utoronto.ca/drs-access.

§ QLSCD data are accessible to researchers at the laboratory of the Research Data Access Centre of the Institut de la statistique du Québec Centre d'accès aux données de recherche de l'Institut (CADRISQ) located in Montréal and in Québec City. Outside researchers are directed to contact the QLSCD surveys program coordinator as outlined here: http://www.iamillbe.stat.gouv.qc.ca/informations_chercheurs/acces_an.html.

** Data are stored at the University of Waterloo on a secure server. The principal investigator of COMPASS maintains ownership of all COMPASS data. Access may be granted to all COMPASS project collaborators and/or their research teams and students as well as external researchers/teams and students. The data usage application can be accessed here: https://uwaterloo.ca/compass-system/information-researchers/data-usage-application.

Table 3.

Measures for active travel to school behavior and behavior-related factors, environmental features, and policy or program supports used in active travel to school surveillance

Surveillance System	Behavior	Mode Operationalization	Distance to school captured?	Environmental features *(if applicable)*	Policy or program supports *(if applicable)*	Data Collection Method	Age of Target Population	Who reports?	Most recent year data collected	Active travel behavior question (if available)
National Household Travel Survey (NHTS; Retrieval questionnaire)	Mode to school; Mode from school	Usual mode to and from school	Yes, with survey question	Linked data: Population density, housing density, and urbanicity (for home address) Survey: None	None reported	Questionnaire	Children ages 5 years and older	Household representative; Adult proxy-report for children under 14 years	2017	On most school days, how do you usually get to school? *Active travel response options are bicycle or walk*[1] On most school days, do you usually leave school? *Active travel response options are bicycle or walk*[1]
National Household Travel Survey (NHTS; Trip diary)	Mode to school Minutes to school Mode from school Minutes from school	Mode on day of trip diary	Yes, with survey question	Linked data: Population density, housing density, and urbanicity (for home address) Survey: None	None reported	Trip diary	Children ages 5 years and older	Household representative; Adult proxy-report for children under 14 years	2017	For each trip, respondent reports trip purpose, mode of transportation, time of day of trip, day of the week, and vehicle occupancy
Transportation Tomorrow Survey (TTS)	Mode to school	Mode on day before travel survey	Yes, by linking household geocode and school location (except for children aged 6-10 years)	None	None reported	Trip diary	Children ages 6 years and older in 1986; children ages 11 years and older since 1991	Household representative	2016	For each trip, respondent reports origin and destination (street address preferred), trip purpose, start time, and primary mode of trip *Active travel response options are bicycle or walk*[2]
Quebec Longitudinal Study of Child Development (QLSCD)	Mode to school[3]	Usual mode to school	Yes, by linking postal codes of residence and school	None	None reported	Structured interviews	Children born in Quebec in 1997-1998[3]	Adults most knowledgeable about child	2015	Adults asked how their child usually gets to school[4] *Response options include school*

Surveillance System	Behavior	Mode Operationalization	Distance to school captured?	Environmental features *(if applicable)*	Policy or program supports *(if applicable)*	Data Collection Method	Age of Target Population	Who reports?	Most recent year data collected	Active travel behavior question (if available)
										bus, public transit, walking/bicycling, driven, multiple modes
COMPASS Study	Mode to and from school[5]	Usual mode to and from school	No	Linked data: Macro-scale environmental features (e.g., street networks and land use) and nearby points of interest (e.g., grocery stores, fast food restaurants, and parks) Direct observation: Observations of the school's built environment and existing indoor and outdoor facilities related to physical activity, including the presence of bicycle racks.[6] Survey: None	None reported	Student questionnaire; School policies and practices questionnaire; Direct observation tool utilized by COMPASS staff to record school environment	Students in grades 9 to12	Students (student questionnaire); school administrators (school policies and practices questionnaire); COMPASS staff (school's indoor and outdoor observations)	2018	How do you usually travel to school? (If you use two or more modes of travel, choose the one that you spend most time doing). How do you usually travel from school? (If you use two or more modes or travel, choose the one that you spend most time doing). *Response options include car (as passenger), car (as driver), school bus, public bus/subway/ streetcar, walking, bicycling, or other.*

[1] Responses options include the following: Walk, Bicycle, Car, SUV, Van, Pickup truck, Golf cart/Segway, Motorcycle/Moped, RV (motor home, ATV, snowmobile), School bus, Public or commuter bus, Paratransit/Dial-a-ride, Private/Charter/Tour/Shuttle bus, City-to-city bus (Greyhound, Megabus), Amtrak/Commuter rail, Subway/Elevated/Light rail/Street car, Taxi/Limo (including Uber/Lyft), Rental car (including Zipcar/Car2Go), Airplane, Boat/Ferry/Water taxi, Something Else, I prefer not to answer, I don't know.

[2] Response options include the following: Public Transit (excluding GO Rail); Bicycle; Auto Driver; GO Rail; Joint GO Rail and Public Transit; Motorcycle; Other; Auto Passenger; School Bus; Taxi; Paid rideshare (Uber, Lyft, Driver, or other paid rideshare app) (since 2016); Walk; Unknown

[3] Yearly follow-up from 5 mos. to 19 years of age (with breaks at ages 9, 11, 14, 16 and 18)

[4] Technical data documentation is only available in French

[5] Moderate-to-vigorous physical activity was gathered via accelerometers, but this was part of the larger study and not reflective of mode choice; Behavioral-related factors include obesity, fitness levels, awareness of school policies about physical activity.

[6] Presence of specific facilities include the following: bike racks, football/soccer fields, gymnasiums, cafeterias, vending machines, public parks, fast-food outlets, sports arenas, and convenience stores