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Exploring active transportation investments and associated benefits for municipal budgets: a scoping review

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ABSTRACT

Municipalities play an important role in the planning and development of communities that support active transportation (AT), which refers to human-powered modes of travel, such as walking and cycling. Municipal-level stakeholders involved in land-use and transportation infrastructure planning consider multiple social, environmental and economic considerations to inform decision-making and investments in AT. Evidence around the fiscal benefits of AT investment for local governments has not been systematically identified. This scoping review sought to explore the existing evidence regarding investments in AT and opportunities for savings on municipal expenditures and revenue generation. In total, 7060 records were located and screened; of which 162 full-text articles were reviewed. Ultimately, 23 articles met our inclusion criteria and were included in this review. The available evidence focuses on potential economic benefits of AT in the areas of tax revenues, property values, consumer spending and employment, all of which are relevant sources of revenue generation in municipal operating budgets. An evidence gap was identified regarding AT infrastructure investments and benefits corresponding to municipal expenditures (e.g. maintenance cost savings). Notably, a large portion of literature was published after 2009, suggesting that municipal-level evidence on the fiscal benefits of AT investments may just be emerging.

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Active transportation; built environment; municipal government; benefit; investment

Introduction

The development of infrastructure and environments that support human-powered forms of travel, referred to as active transportation (AT), represents a salient component in public health recommendations aimed at promoting population increases in physical activity (Raine, Muhajarine, Spence, Neary, & Nykiforuk, 2012; World Health Organization, 2010). AT infrastructure, such as sidewalks, bike lanes and trails, and built environment characteristics, such as residential density and land-use mix, are associated with increased physical

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activity in neighbourhoods (Eriksson, 2013; McCormack & Shiell, 2011; Pucher, Dill, & Handy, 2010). Some of the health benefits corresponding with AT include risk reductions in all-cause mortality, diabetes and hypertension (Saunders, Green, Petticrew, Steinbach, & Roberts, 2013). There is widespread recognition of the effect of the built environment on public health, and a growing number of countries have developed national policies to address physical inactivity (Kohl et al., 2012).

Internationally, local governments have a critical role in implementing national physical activity strategies through local transportation planning and providing appropriate infrastructure (Edwards & Tsouros, 2006; Parker, Burns, & Sanchez, 2009). However, in designing local built environments, municipal sector employees and elected officials must balance multiple considerations that extend beyond physical activity, including, but not limited to, issues around traffic congestion, sprawl, livability and economic benefits (Dill & Howe, 2011; Maddock, Reger-Nash, Heinrich, Leyden, & Bias, 2009; Richards, Murdoch, Reeder, & Rosenby, 2010; Wang et al., 2016; Zwald et al., 2014). Whereas the economic benefits of AT that can be attributed to health, social and environmental gains have been synthesised and described in the literature (Brown, Diomedi, Moodie, Veerman, & Carter, 2016; Giles-Corti, Foster, Shilton, & Falconer, 2010; Powell, Dalton, Brand, & Ogilvie, 2010; Sallis et al., 2015), the potential fiscal (i.e. revenue generating or cost savings) benefits for local governments have not been systematically identified.

A common barrier to investing in AT, from the perspective of municipal stakeholders in several cities around the world, has been the costs associated with building, operating and maintaining appropriate infrastructure (Allender et al., 2009; Faskunger, 2011; Grant, Andrew, Edwards, Sveistrup, & Egan, 2011; Grant, MacKay, Manuel, & McHugh, 2010; Hollander, Martin, & Vehige, 2008; Richards et al., 2010). For many local governments, the planning and development of infrastructure projects are guided by strategic priorities and regulations set in policy documents (e.g. official plans, transportation master plans and AT plans), as well as assessments of operating and capital budgets which forecast how finite municipal revenues will be allocated to expenditures (Akerman, 2006; Chan, 2004; Pucher & Buehler, 2008; Steinman et al., 2010). Generally, budgetary revenues finance municipal expenditures (Guhnemann, Whiteing, Mackie, & Smith, 2006; Tassonyi, 2002). The capital budget identifies expenditures on infrastructure and construction projects, whereas the operating budget lists annual costs for salaries, utilities, materials and maintenance, as well as projected sources of revenues. Given that economic and fiscal benefits are one consideration in the planning of AT, there is a need to identify how local investments in AT infrastructure might impact the expenditures and revenues of municipal budgets.

In many countries, a large portion of local government revenues are received from property taxes, as well as taxes generated from the sale of goods and services and intergovernmental revenue transfers (Bird & Slack, 2004; Crabbe, Hiatt, Poliwka, & Wachs, 2005; Vander Ploeg, 2002). Municipalities can levy taxes from properties based on sales of property (i.e. land transfer tax) and property assessment valuations which influence the calculation of annual property taxes (Owens, 2000). Property market values are influenced by not only physical property characteristics (e.g. lot size), but also neighbourhood characteristics (e.g. amenities in the area) (Kain & Quigley, 1970). Municipal budgetary revenues are also influenced by consumer spending and jobs, especially where cities receive tax revenues from the sale of goods and services or income (Pagano, 2002). Investments in non-active forms of transportation have been shown to positively influence property values,

regional output and employment growth (Berechman, Ozmen, & Ozbay, 2006; Bhatta & Drennan, 2002; Cohen & Paul, 2007; Haider & Miller, 2000). In the context of AT investments, the present state of evidence around its impact on property values and economic outputs (i.e. consumer spending and employment) requires exploration, given that these are taxable and affect municipal revenues, particularly for local governments of several Organization for Economic Cooperation and Development (OECD) countries (Kitchen, 2004).

Accordingly, the purpose of this study was to identify and describe the existing evidence surrounding investments in AT and opportunities for savings on municipal expenditures and revenue generation, including in the areas of property values, goods and service revenue, and employment. Using a scoping review methodology, we addressed the following research question: What evidence exists on AT investments and associated municipal-level budgetary fiscal benefits?

Methods

Scoping review framework

We conducted a scoping review to identify and summarise the existing evidence relative to investments in AT and fiscal benefits for municipal budgets. A scoping review seeks to capture the breadth and depth of available evidence on the topic of inquiry (Arksey & O'Malley, 2005). Unlike a review of literature but similar to a systematic review, a scoping review attempts to be exhaustive according to preset criteria. However, in doing so, it may go beyond the peer-reviewed literature to also incorporate "grey literature" or unpublished, non-vetted materials. Further, the scoping review is differentiated from both literature reviews and systematic reviews by its analysis and interpretation but not critical appraisal of the quality of the literature. The methodological framework developed by Arksey and O'Malley (2005) and advanced by Levac, Colquhoun, and O'Brien (2010), was utilised to ensure compliance with current standards for conducting a scoping review.

Scoping question

The scoping question was developed in close consultation with members of a local public health unit in Ontario, Canada. The public health unit was seeking to inform an audience of municipal planners, engineers and elected officials about the fiscal benefits of AT infrastructure investments. Accordingly, our research question was: What evidence exists on AT investments and associated fiscal benefits that are relevant to municipal-level budgets? In particular, this review operationalised benefits as the municipal budget revenues (e.g. revenue generation through property, sales and income taxes) or expenditures savings (e.g. capital or maintenance cost savings of AT infrastructure).

Search strategy

Three primary sources were searched: (1) published literature indexed in electronic databases, (2) grey literature indexed in web sources and (3) key documents selected by the

public health unit team. The search strategy was restricted to publication date (2005–2014), English language and geographic region (Canada, USA, Australia or New Zealand). Geographic restrictions were used because transportation investment decisions are considered in the context of the built environment (Hanson & Giuliano, 2004) and there are situational differences between North America/Australasia and Europe relative to land-use patterns. In particular, many European cities are dense with mixed land-uses, and have a tradition of constructing AT infrastructure (van de Coevering & Schwanen, 2006), which contrasts with the sprawled and car-dependent environments that characterise many North American cities (Pucher, Buehler, & Seinen, 2011; van de Coevering & Schwanen, 2006). The published literature was searched in February 2014 using eight electronic databases: MEDLINE, EMBASE, Cumulative Index to Nursing and Allied Health (CINAHL), Scopus, Transportation Research International Documentation (TRID), EconLit, Health Business Elite and SocINDEX. Search terms corresponding to types of AT, AT infrastructure, and budgetary revenues, expenditures and return on investment were derived from the elements of our research question; synonyms and alternative spellings were identified; and terms were linked using Boolean operators to generate search strings, all in consultation with a research librarian. The search strategy implemented in MEDLINE is given in Supplementary File 1; identical searches were customised for each of the remaining electronic databases. To capture documents not indexed in electronic databases, 11 relevant web sources were identified by the research librarian and public health team partners: Active Living Research (activelivingresearch.org), Walkable and Livable Communities Institute (walklive.org), Victoria Transport Policy Institute (vtpi.org), BikeBC Cycling Infrastructure Partnership Program (th.gov.bc./BikeBC/CIPP.html), Halton Region (halton.ca/walkable), Rails-to-trails Conservancy (railstotrails.org), New Zealand Transport Agency (nzta.govt.nz), Smart Growth BC (smartgrowth.bc.ca), Toronto Centre for Active Transportation (tcat.ca) and Custom Search engines for Canadian and Ontario Public Health Unit Websites (http://www.ophla.ca/customsearchcanada.htm; http://www.ophla.ca/customsearch.htm). Web sources were searched on 5 and 6 March 2014 by applying search strings developed by the research librarian, if supported by the website, and otherwise, by manually reviewing website pages. The search strings implemented on websites with search functionality is given in Supplementary File 1. In addition, the public health unit team, which had previously worked on projects related to AT, provided 33 potentially relevant documents to review for inclusion.

Study inclusion criteria

Documents included in this review were required to quantify AT fiscal benefits that were relevant to municipal budgets. Benefits were defined as savings on expenditures, tax revenues from property, sales or income, as well as outcomes associated with municipal tax revenues, such as property values, consumer spending or job creation. Studies reporting state or national-level findings were included if the benefits could be expected to spill over to the municipal budget; for example, in North America, some state/provincial governments may share consumer tax revenues with municipalities, whereas federal governments may share income tax revenues (Vander Ploeg, 2002). AT was operationalised as any infrastructure or physical design element that supports active travel, such as sidewalks, mixed land-use patterns or street connectivity. In line with scoping review methodology,

documents were not excluded based on research design (i.e. grey literature sources such as government reports were included). Documents reporting on benefits that would not typically be captured in a municipal budget were excluded (e.g. quantification of health, environmental or social benefits). In cases where review articles were identified, the reference lists were screened for inclusion of relevant primary source documents.

A total of 7060 documents were pre-screened by one reviewer (i.e. by scanning the title, abstract and/or executive summary) of which 162 were judged to be relevant. Following the preliminary assessment, the full text of 56 peer-reviewed documents and 106 grey literature sources were reviewed independently for inclusion by 2 reviewers. Disagreements were resolved through discussion and if uncertainty remained, a third party was consulted. After removing duplicates and documents not meeting inclusion criteria, 23 documents remained, ranging in date from 2006 to 2013. This review presents an analysis of the following documents: peer-reviewed articles ($n = 3$); reports produced by a governmental or affiliated organisation ($n = 2$); reports produced by an independent research institution ($n = 8$); reports produced by a not-for-profit organisation or consulting agency ($n = 8$) and student theses ($n = 2$). The study selection process is presented in Figure 1.

Data extraction

The data were extracted and charted by one reviewer using standard forms developed for this protocol. The choice of fiscal outcomes for extraction was informed from the types of municipal revenues and expenses reported in municipal budgets (Tassonyi, 2002; Vander Ploeg, 2002). Specific extraction items were identified in collaboration with the public health unit team. The data were extracted in relation to the: AT setting (i.e. geographic location, development type, population size/density and AT infrastructure investment costs), study purpose and methodology (e.g. research design, data collection and analysis methods and time span of study), AT variables studied (e.g. AT infrastructure, transport mode and walkability), fiscal outcomes directly captured in municipal budgets (e.g. revenue from taxes and savings on expenditures), outcomes indirectly captured in municipal budgets (e.g. property values, consumer spending and job creation) and overall municipal-level economic impact., Information on funding disclosures and potential conflicts of interest was extracted as well. A second reviewer verified all the extracted data, and disagreements were resolved by discussion.

Synthesis

Documents were collated and summarised based on the extracted and charted data. Specifically, the general characteristics of included studies and characteristics of the AT settings were analysed and reported. All studies reported findings applicable to sources of revenue generation for municipal budgets, and none of the studies reported findings applicable to municipal expenditure benefits, for example, cost savings on initial investment or infrastructure maintenance. Thus, the findings from each document were organised thematically according to sources of revenue generation: property values, consumer spending and job creation. Data pertaining to benefits for municipal budgets were collated and summarised according to each theme.

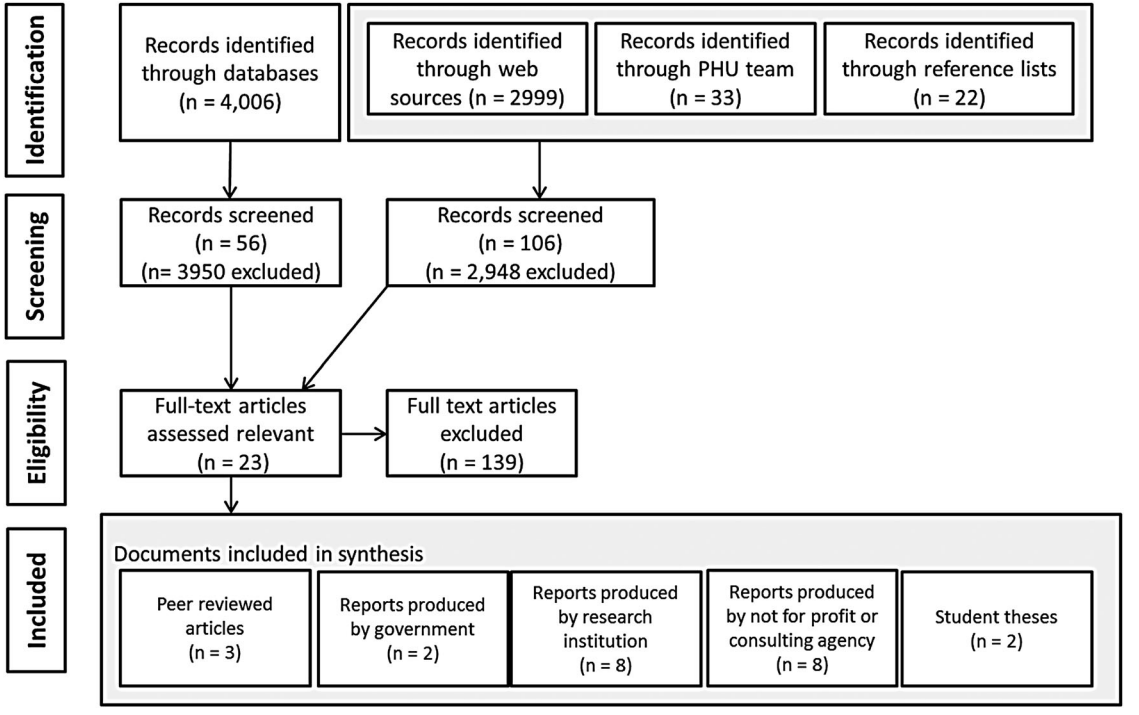

Figure 1. Study selection process flow diagram.

Results

Our review identified 23 studies that reported on AT investments and benefits for municipal budgets. All studies described municipal budgetary benefits in relation to sources of revenue generation. Specifically, nine studies quantified the role of AT infrastructure on property values, fourteen studies quantified impacts on consumer spending, six studies reported impacts on employment and four studies estimated associated tax revenues. No studies were identified reporting on AT infrastructure and benefits related to municipal expenditures, (e.g. cost savings).

Characteristics of included studies

The majority of studies were conducted in the USA ($n = 20$), and the remaining studies were carried out in Canada ($n = 1$), Australia ($n = 1$) and New Zealand ($n = 1$). Most studies ($n = 17$) were published between 2010 and 2013, and the remainder ($n = 6$) were published between 2006 and 2009. A range of study designs were employed, including economic analysis methods (i.e. hedonic regression analysis ($n = 6$) and input–output models ($n = 6$)), case studies ($n = 7$), cross-sectional surveys ($n = 3$) and longitudinal analysis ($n = 1$). Studies examined a variety of AT variables, including characteristics of the built environment (e.g. development density and measures of walkability) ($n = 6$); transport mode (e.g. cycling) ($n = 6$); proximity to AT infrastructure (e.g. bike path) ($n = 3$); cycling and pedestrian-oriented businesses and events ($n = 4$); street reconfigurations (e.g. complete streets and provision of bike lanes) ($n = 2$); and AT infrastructure capital investments ($n = 3$). A summary of the characteristics of included studies is presented in Table 1.

AT context

Most studies were conducted in urban settings ($n = 11$), suburban settings ($n = 2$), or included a mix of urban and suburban areas ($n = 4$). The remaining studies reported state-level findings ($n = 5$) or national-level findings ($n = 1$). Information on the population size or density of the geographic area under study was described in only three studies. Less than half of the studies ($n = 11$) described characteristics of the AT setting, such as, land-use allocation by type (e.g. residential, office, retail and rental), degree of walkability or types of transport infrastructure within the geographic area under study. In addition, only three studies provided information on AT infrastructure capital or maintenance costs by government at the state level ($n = 2$) or municipal level ($n = 1$). A summary of the AT setting characteristics is presented in Table 2.

Property values

Characteristics of AT environments and their impact on the property values of residential, retail, office or industrial properties were examined in one-third of the identified studies ($n = 9$). Studies sourced property value data from municipal property assessment records (Bliesner, Bouton, & Schultz, 2010; Karadeniz, 2008; Racca & Dhanju, 2006; Sohn, Moudon, & Lee, 2012) or real estate listing databases (Cortright, 2009; Leinberger, 2013; Leinberger & Alfonzo, 2012; Pivo & Fisher, 2011; Poindexter, Krizek, Barnes, & Thompson,

Table 1. Study characteristics.

Ref.	Country	Design/analytic approach	Active transportation variable(s) studied	Indirect benefits	Direct benefits
Sohn et al. (2012)	USA	Hedonic regression analysis	(1) Development density; (2) land-use mix; (3) public open space and (4) pedestrian infrastructure	Property values	Not measured
Pivo and Fisher (2011)	USA	Hedonic regression analysis	(1) Walk score	Property values	Not measured
Lee and March (2010)	AUS	Case study	(1) Transport mode (bike)	Consumer spending	Not measured
Poindexter et al. (2007)	USA	Matched pairs longitudinal analysis	(1) Proximity of residential properties to an on-street bike lane or off-street bike path, 3 km radius	Property values	Not measured
Leinberger and Alfonzo (2012)	USA	Hedonic regression analysis	(1) Walk score	Property values Consumer spending	Property Tax revenue
Racca and Dhanju (2006)	USA	Hedonic regression analysis	(1) Proximity of residential properties to a bike path, within 50 m	Property values	Not measured
Karadeniz (2008)	USA	Hedonic regression analysis	(1) Proximity of residential properties to a multipurpose trail, within 1.6 km	Property values	Not measured
Clifton et al. (2013)	USA	Cross-sectional survey	(1) Transport mode (bike, walk and transit)	Consumer spending	Not measured
Fleming et al. (2014)	New Zealand	Case study, cross case comparison	(1) Transport mode (bike, walk and transit)	Consumer spending	Not measured
Rowe (2013)	USA	Case study, pre–post design	(1) Case 1. Reduction in traffic lane, provision of bicycle lane and (2) Case 2. Removal of parking space, painted bike lane	Consumer spending	Not measured
Grabow et al. (2010)	USA	Input–output model, IMpact analysis for PLANning (IMPLAN)	(1) Bicycling person days on roadways, trails and cycle events/tours	Consumer spending	Not measured
Brown et al. (2013)	USA	Input–output model, Rutgers Economic forecasting model (R/ECON™)	(1) Bicycle and pedestrian Infrastructure capital costs	Consumer spending Job creation	Sales tax revenue
Leinberger (2013)	USA	Multiple case study	(1) Walk score	Property values	Not measured
Cortright (2009)	USA	Hedonic regression analysis	(1) Walk score	Property values	Not measured
Resource Systems Group, Economic and Policy Resources, & Motion (2012)	USA	Input–output model, Regional Economic Models, Inc. (REMI)	(1) Bicycle and pedestrian infrastructure capital costs; (2) cycling and pedestrian-related events and (3) cycling and pedestrian-related businesses	Consumer spending Job creation	Sales tax revenue
Garret-Peltier (2011)	USA	Input–output model, IMPLAN version 3	(1) Active transport infrastructure capital costs (bike, multi-use trails and pedestrian)	Job creation	Not measured

Bliesner et al. (2010)	USA	Multiple case study	(1) Walkability	Property values	Not measured
Venegas (2009)	USA	Input–output model, IMPLAN	(1) Walker and cyclist person days on recreational trails	Consumer spending Job creation	Sales tax revenue
Mursell (2012)	Canada	Multiple case study	(1) Bicycle trail use by cycling tourists	Consumer spending	Not measured
Bowles et al. (2011)	USA	Input–output model, IMPLAN	(1) Transport mode (bike)	Consumer spending Job creation	Not measured
McCann et al. (2012)	USA	Multiple case study	(1) Complete streets	Consumer spending Job creation	Sales tax revenue
Birk and Roberts (2008)	USA	Cross-sectional survey	(1) Cycling-related businesses and (2) Cycling-related events	Consumer spending	Not measured
Ginenthal and Birk (2006)	USA	Cross-sectional survey	(1) Cycling-related businesses and (2) Cycling-related events	Consumer spending	Not measured

Table 2. Active transportation setting characteristics.

Ref.	Geographic setting [municipality; state; country]	Devel. type	Description of AT characteristics within setting	Pop. size /density	Active transport investment costs
Sohn et al. (2012)	King County (Urban growth area); Washington; USA	Urban	Not described	Not stated	Not stated
Pivo and Fisher (2011)	USA (nationwide)	Mixed	Not described	Not stated	Not stated
Lee and March (2010)	Lygon Street, Carlton suburb; Melbourne; AUS	Suburban	Mixed land-use (shopping strip with public, retail and residential space); AT infrastructure (bike lanes, 68 bike parking spaces, pedestrian paths)	Not stated	Not stated
Poindexter et al. (2007)	Midtown Greenway, Minneapolis, St. Paul; Minnesota; USA	Urban	AT infrastructure (Midtown Greenway: off-street bike path with links to regional bicycle facility network; Minneapolis, St. Paul: combined 96 km on- street and 198 off-street bike facilities)	Not stated	Not stated
Leinberger and Alfonzo (2012)	Washington, DC; USA	Urban	Walkability (sample included all neighbourhoods with walk score of ≥90)	Not stated	Not stated
Racca and Dhanju (2006)	New Castle County; Delaware; USA	Urban	Not described	Not stated	Not stated
Karadeniz (2008)	Hamilton County, Clermont County; Ohio; USA	Suburban	AT infrastructure (70 miles of multipurpose trail; study examined 9.5 mile stretch of trail)	Not stated	Not stated
Clifton et al. (2013)	Portland; Oregon; USA	Urban and suburban	AT infrastructure (2.3 miles of bikeways, 10 bike parking spots, and 0.21 mile distance to nearest low traffic bike facility)	Pop. density within half mile buffer: 13 individuals, per acre; density not stated	Not stated

Fleming et al. (2014)	Auckland, Christchurch, Wellington; New Zealand	Urban and suburban	AT infrastructure (Auckland: 1) Balmoral, Dominion Road, arterial shopping area: pedestrian-focused lighting, mid-block crossings, and signalised intersections; two vehicle traffic lanes in both directions. (2) Eden Valley, Dominion Road, arterial shopping area: limited formal pedestrian crossing areas, flush median provided with some pedestrian islands, no dedicated bike lanes. (3) Hurstmere Road, Takupuna, central shopping area: urban design, landscaping, pedestrian-focused lighting investments; no bike lanes. Christchurch: (1) Colombo Street, central shopping area: pedestrian walkway, bus routes, no bike facilities. (2) Merivale, Papanui Road, arterial shopping area: bus lanes with painted intersection markings, dedicated painted bike lane, signalised pedestrian crossing. (3) Riccarton Road, arterial shopping area: narrow footpaths, single signalised pedestrian crossing area, dedicated painted bike lanes. Wellington: (1) Courtenay Place, central shopping area: wide footpaths, bike parking, no dedicated bike lanes, single lane two-way traffic lanes, bus lanes, on-street parking, defined pedestrian paved areas. (2) Riddiford Street, Arterial shopping area: two-way traffic, pedestrian platforms on side streets, no dedicated bike lanes. (3) The Terrace, Wellington City Centre, arterial shopping centre: single traffic lanes, signalised intersections.	Not stated.	Not stated

(*Continued*)

Table 2. Continued.

Ref.	Geographic setting [municipality; state; country]	Devel. type	Description of AT characteristics within setting	Pop. size /density	Active transport investment costs
Rowe (2013)	Seattle; Washington; USA	Urban	AT infrastructure (1) Greenwood Ave and NW 85th: centre of business district, lane reduction with addition of centre turn lane and bike lane and (2) NE 65th St. at Latona Ave NE: bike lane painted and 12 car parking spaces removed, traffic lanes not changed.	Not stated	Not stated
Grabow et al., 2010)	Wisconsin; USA	Statewide	Not described	Not stated	Not stated
Brown et al. (2013)	New Jersey; USA	Statewide	AT infrastructure (250 AT infrastructure projects implemented in 2011, including: sidewalks, curb ramps, crosswalks, bike lanes, street-scaping, way-finding, waterfront walkways, trails and boardwalks).	Not stated	Total gov't infrastructure investment of $63,170,000.
Leinberger (2013)	Atlanta; Georgia; USA	Urban and suburban	Mixed land-use (Regionally significant walkable urban places ($n = 27$) with different proportions of retail, office, rental, and for sale residential spaces were studied. Regionally significant was defined as having at least 1.4 million square feet of retail space).	Average density of the 27 walk-ups: 0.60 gross floor area ratio (FAR), ranging from 0.13 to 2.91 FAR; Pop. size not stated	Not stated
Cortright (2009)	Arlington, Austin, Bakersfield, Charlotte, Chicago, Dallas, Fresno, Jacksonville, Las Vegas, Phoenix, Sacramento, San Francisco, Seattle, Stockton, Tucson; USA	Urban and suburban	Walkability (Average walk scores of sampled properties ranged 36–79. Average distance of sampled municipality to the central business district ranged 3–13 miles).	Population size of the 15 cities ranged 800,450–9,569,624; density not stated	Not stated
Resource Systems Group, Economic and Policy Resources, & Motion (2012)	Vermont; USA	Statewide	Not described	Not stated	In 2009, AT infrastructure projects cost $9,813,206: federal government contributed $6,780,696 to infrastructure and $912,511 to recreational trail programmes; municipal sources contributed $1,300,000 for annual sidewalk/bike projects and maintenance; and private sector sources contributed $820,000 for sidewalks

Garret-Peltier (2011)	Anchorage, AL; Austin, TX; Bloomington, IN; Baltimore, MD; Concord, NH; Eugene, OR; Houston, TX; Lexington, KY; Madison, WI; Santa Cruz, CA; Seattle, WA; USA	Urban	Not described	Not stated	Not stated
Bliesner et al. (2010)	San Diego; California; USA	Urban	Not described	Not stated	Not stated
Venegas (2009)	Minnesota; USA	Statewide	Not described	Not stated	Not stated
Mursell (2012)	Ottawa, Toronto, St. Catharines-Niagara, Windsor; Ontario; CAN	Urban	Not described	Not stated	Not stated
Bowles et al. (2011)	Iowa; USA	Statewide	Not described	No stated	Not stated
McCann et al. (2012)	Santa Monica, Lancaster, San Diego, Baldwin Park, Davis, Sacramento, San Francisco; California; USA	Urban	AT infrastructure (Projects included: traffic lane reductions, bike lane construction, sidewalk widening, parking reconfiguration, roundabout/central rambla construction; revised lighting and landscaping)	Not stated	In 2010, town of Lancaster invested $10 million into new lighting, landscaping, and trees on Lancaster Boulevard
Birk and Roberts (2008)	Portland; Oregon; USA	Urban	Not described	Not stated	Not stated
Ginenthal and Birk (2006)	Portland; Oregon; USA	Urban	Not described	Not stated	Not stated

*AT = active transport.

2007). Findings focused on two main characteristics of AT environments: walkable areas (Bliesner et al., 2010; Cortright, 2009; Leinberger, 2013; Leinberger & Alfonzo, 2012; Pivo & Fisher, 2011; Sohn et al., 2012) and proximity to AT infrastructure (Karadeniz, 2008; Poindexter et al., 2007; Racca & Dhanju, 2006).

Among studies that examined walkable areas, various measures were used to define walkable and non-walkable places, including measures of walk score developed by Front Seat, Inc. (Cortright, 2009; Leinberger, 2013; Pivo & Fisher, 2011), or Irvine Minnesota Inventory (Leinberger & Alfonzo, 2012), measures of the correlates of walking (i.e. development density, land-use mix, public open space and pedestrian infrastructure) (Sohn et al., 2012) and self-reported measures based on the common consensus by people travelling to the study areas (Bliesner et al., 2010). Studies consistently reported that residential, office and retail properties were associated with higher property values when located in areas defined as walkable compared to areas defined as not walkable (Bliesner et al., 2010; Cortright, 2009; Leinberger, 2013; Leinberger & Alfonzo, 2012; Pivo & Fisher, 2011; Sohn et al., 2012). There was no difference reported in industrial property values in relation to walkable and non-walkable areas (Pivo & Fisher, 2011).

The proximity of residential properties to a multipurpose trail (within 1.6 km) or a bike trail (within 50 m) was associated with higher property values, for each foot closer to the trail (Karadeniz, 2008; Racca & Dhanju, 2006). Conversely, one study that compared residential homes located within and beyond 3 km of a bike trail found no significant difference on property values (Poindexter et al., 2007).

Consumer spending

The majority of the identified literature ($n = 14$) examined economic activity within AT supportive environments. The review captured economic findings in the context of land-use reallocation and walkability (Lee & March, 2010; Leinberger & Alfonzo, 2012; McCann, Meyer, Woods, & Morfas, 2012; Rowe, 2013), travel mode (Birk & Roberts, 2008; Bowles, Fleming, Fuller, Lankford, & Printz, 2011; Clifton et al., 2013; Fleming, Turner, & Tarjomi, 2014; Ginenthal & Birk, 2006), and AT events and tourism (Brown, Hawkins, Lahr, & Bodnar, 2013; Grabow, Hahn, & Whited, 2010; Mursell, 2012; Resource Systems Group, Economic and Policy Resources, & Motion, 2012; Venegas, 2009).

Three case studies examined consumer spending after reallocating existing street space to incorporate bike parking, a dedicated bike lane or pedestrian infrastructure (Lee & March, 2010; McCann et al., 2012; Rowe, 2013). All three case studies reported no negative impact on retail revenues of businesses located near the project site after the streets were redesigned to support cycling or pedestrian infrastructure. Positive impacts of neighbourhood walkability on consumer spending were reported by one study that used a hedonic regression analysis, in that a 20-point increase in area walkability was associated with an 80% increase in retail revenue (Leinberger & Alfonzo, 2012; McCann et al., 2012).

A subset of studies examined the impact of AT mode on consumer spending. Of this literature, two studies included a comparison of active (i.e. pedestrian, cyclist and transit) and non-active (i.e. car) travel modes (Clifton et al., 2013; Fleming et al., 2014), while the remaining three studies examined consumer spending by cyclists only (Birk & Roberts, 2008; Bowles et al., 2011; Ginenthal & Birk, 2006). The comparative studies reported mixed results in that one study found higher spending rates at supermarkets

by automobile users versus AT-mode users (Clifton et al., 2013), whereas another study reported higher spending rates among AT users in shopping areas relative to their modal share (Fleming et al., 2014). Studies exploring the impact of cycling on consumer spending revealed that the cycling industries in Portland, Oregon (Birk & Roberts, 2008; Ginenthal & Birk, 2006) and the state of Iowa (Bowles et al., 2011) contributed significant annual economic activity to both regions (approximately $90 million and $52 million, respectively).

Estimates of economic activity associated with AT events and tourism were reported in five studies. Annual spending by visitors at running and cycling events in the states of Vermont and New Jersey was reported to total $6.2 million and $35 million, respectively (Brown et al., 2013; Resource Systems Group, Economic and Policy Resources, & Motion, 2012). Annual spending related to cycle tourism and recreation was estimated to total $391 million in the province of Ontario (Mursell, 2012) and $533 million in the state of Wisconsin (Grabow et al., 2010). Finally, annual spending by walkers, cyclists and runners on multipurpose trails in Wisconsin was estimated to produce a total economic impact of $2.4 billion (Venegas, 2009). The contribution of AT event and tourism spending relative to total visitor expenditures was estimated to be 0.7% in New Jersey (Resource Systems Group, Economic and Policy Resources, & Motion, 2012) and 3% in Ontario (Mursell, 2012); the remaining studies did not estimate the proportion of total event and visitor expenditures that can be attributed to AT.

Job creation

The number of jobs generated or supported by AT-related spending was examined in six studies. Specifically, studies examined job creation relative to capital investments in AT infrastructure (Brown et al., 2013; Garret-Peltier, 2011; McCann et al., 2012; Resource Systems Group, Economic and Policy Resources, & Motion, 2012) or relative to consumer spending on AT-related goods and services (Bowles et al., 2011; Brown et al., 2013; Resource Systems Group, Economic and Policy Resources, & Motion, 2012; Venegas, 2009).

Almost all studies measured employment attributed to AT investment and spending using an economic impact analysis model tailored for the region under study (Bowles et al., 2011; Brown et al., 2013; Garret-Peltier, 2011; Resource Systems Group, Economic and Policy Resources, & Motion, 2012; Venegas, 2009); one study did not describe how jobs were measured (McCann et al., 2012). In addition, most studies estimated state-level employment (Bowles et al., 2011; Brown et al., 2013; Resource Systems Group, Economic and Policy Resources, & Motion, 2012; Venegas, 2009) as opposed to employment at the municipal level (Garret-Peltier, 2011; McCann et al., 2012).

Capital investments in the context of bike, pedestrian and trail infrastructure were examined in four studies (Brown et al., 2013; Garret-Peltier, 2011; McCann et al., 2012; Resource Systems Group, Economic and Policy Resources, & Motion, 2012). Data on infrastructure investment costs were obtained from government-sourced budgets, annual reports or construction bid sheets (Brown et al., 2013; Garret-Peltier, 2011; Resource Systems Group, Economic and Policy Resources, & Motion, 2012); one study did not describe the source of infrastructure cost data (McCann et al., 2012). Studies ranged at the level of AT infrastructure investments examined, from total annual capital investments of $9.8 million to $63 million at the state level (Brown et al., 2013; Resource Systems Group,

Economic and Policy Resources, & Motion, 2012), to a municipal-level investment of $10 million for a single street reconstruction project (McCann et al., 2012); one study did not report the costs of infrastructure projects under study (Garret-Peltier, 2011). Findings from the three studies that conducted an economic input–output analysis estimated a range of 10–23 jobs generated statewide and between 8 and 11 jobs generated municipally, for each one million dollars spent on a bicycling or pedestrian infrastructure project (Brown et al., 2013; Garret-Peltier, 2011; Resource Systems Group, Economic and Policy Resources, & Motion, 2012). Of these three studies, one estimated the number of jobs generated by type of infrastructure project, and reported that in comparison to road, pedestrian or trail projects, investments in bicycling infrastructure generated the most jobs per one million dollars invested (Garret-Peltier, 2011). The case study reported that an investment of $10 million in AT infrastructure generated 800 new jobs between 2006 and 2010 (McCann et al., 2012).

State-level employment from consumer spending on AT-related goods, services or events was examined in four studies (Bowles et al., 2011; Brown et al., 2013; Resource Systems Group, Economic and Policy Resources, & Motion, 2012; Venegas, 2009). Measures of business revenues and event spending were self-reported through surveys with AT businesses or patrons (Bowles et al., 2011; Brown et al., 2013; Resource Systems Group, Economic and Policy Resources, & Motion, 2012; Venegas, 2009). AT-oriented businesses included those that provided equipment or services related to bicycling, walking and running. Studies reported a range of 11–26 jobs generated statewide for every one million dollars of revenue received from spending at AT-related businesses (Brown et al., 2013; Resource Systems Group, Economic and Policy Resources, & Motion, 2012; Venegas, 2009). One study reported that consumer spending by recreational and commuter cyclists generated about 7000 jobs within Iowa State, however, the total expenditures of cyclists on which these estimates are based were not reported (Bowles et al., 2011). Two studies examined annual spending on registration fees and travel expenses at cycling, running and walking events and reported a range of 11–27 jobs generated statewide for every one million dollars received from AT event revenue (Brown et al., 2013; Resource Systems Group, Economic and Policy Resources, & Motion, 2012).

Tax revenue

For single sources of municipal tax revenues, one study reported findings on property taxes (Leinberger & Alfonzo, 2012) and reported no differences in the assessed taxes of properties located within an area defined as a walkable standalone place and areas that were defined as walkable and clustered with other walkable places (Leinberger & Alfonzo, 2012). No studies compared tax revenues of properties located in areas defined as walkable and non-walkable, or for properties located in close and distant proximity to AT infrastructure. In addition, one study reported that sales tax revenue increased by 26% in the downtown area of Lancaster, Los Angeles, following the adoption of a complete streets policy and investment of $10 million to redesign Lancaster Boulevard (McCann et al., 2012).

Three studies provided estimates of total tax revenues generated by AT-related spending; however, the reporting of these revenues varied across studies. In 2011, for each one million dollar investment made by the State of New Jersey on AT-related businesses,

events, and capital infrastructure projects, the state saw a return in local tax revenues of $30,742 for AT-related businesses, $50,787 for AT-related events and $85,971 for AT-related capital infrastructure projects (Brown et al., 2013). Spending at trails used by walkers, cyclists and runners was reported to generate a combined $179,100 in state and local taxes for Minnesota in 2007 (Venegas, 2009). Consumer spending on cycling and walking events in 2009 was reported to generate a net positive of $1.6 million dollars of state revenue in Vermont (Resource Systems Group, Economic and Policy Resources, & Motion, 2012).

Discussion

This scoping review has demonstrated that there are limited studies on the benefits of AT investment for local governments. Specifically, our review found 23 studies that examined potential benefits in the areas of tax revenues, property values, consumer spending and employment, all of which are relevant sources of revenue generation in municipal operating budgets. However, the available evidence was concentrated in the non-peer-reviewed grey literature, results varied, as did measures and methods used across studies. Most studies reported incomplete descriptions of the AT setting and infrastructure investment, and lacked comparisons between different types of transport modes and infrastructure. Moreover, the review has highlighted information gaps in the available literature concerning local-level fiscal benefits that could otherwise be integrated into comprehensive arguments around the value of AT investments for local government budgets. A prominent evidence gap was identified in relation to AT infrastructure investments and benefits corresponding to municipal expenditures, such as savings on maintenance costs. Notably, a large portion of the identified literature was published after 2009, suggesting that municipal-level evidence on the fiscal benefits of AT investments may just be emerging.

The types of municipal budgetary benefits identified in this review were largely based on studies originating in the USA, and mainly in the context of urban and suburban developments; however, none of the identified studies included a focus on rural areas or mixed urban–rural settings. Notably, the majority of studies in this review did not report initial capital investment costs or operating expenditures relative to AT infrastructure, which is of interest to municipal sector decision-makers (Clark et al., 2010). The review revealed that the present state of literature provides limited information about the context surrounding AT investments, which can present a challenge for discerning the relevance of reported budgetary benefits in relation to the costs of AT investments to other municipal settings, particularly those outside of the USA or in rural areas.

The review identified several studies that reported on characteristics of AT environments and property valuations, which are used to levy municipal property taxes. Generally, the literature suggested that properties located within walkable areas or within close proximity to AT infrastructure were associated with higher property values; these findings align with research showing increased property valuations as a result of proximity to public transit (Haider & Miller, 2000). However, the identified research does not isolate the effects of walkable areas and AT infrastructure, relative to other factors that are known to influence property valuations, such as gentrification, proximity to a central business district or green space (Atkinson, 2004; Crompton, 2001; Irwin, 2002; Waddell, Berry, & Hoch, 1993). In addition, the degree to which property valuation differences

impacted property taxes, specifically in comparison of areas with and without AT investments, was not reported. Further research is required to determine whether local governments can capture property tax returns on their AT infrastructure investments through sustained or increased property values.

It should be considered that across studies, various measures of property values were used. Namely, studies used property value assessments prepared for government (appraised values) or property real estate listing data. Real estate listings should be interpreted with caution in the context of municipal budgets, in particular because market values in real estate data are more sensitive to changing market conditions, such as consumer demand, which are not immediately captured in property valuations (Owens, 2000). One interpretation that can be drawn of the impact on property values is that residents have higher demand to live in areas with AT infrastructure that supports connectivity to places where individuals live, work and play. This would be consistent with the strong neighbourhood preferences for walkable environments that have been reported across various cities around the world (Badland et al., 2012; Frank, Kershaw, Chapman, Campbell, & Swinkels, 2015; Handy, Sallis, Weber, Malibach, & Hallander, 2008). However, these interpretations should be tested in future studies.

The majority of the identified literature focused on AT and impacts on economic activity (i.e. consumer spending and employment), which also benefits municipalities that receive a portion of their revenues from sales and income taxes (Kitchen, 2004; Pagano, 2002). A subset of studies contained findings that lend insights on the potential implications of travel mode choice for local government tax revenues; however, more research is needed to discern how AT investment impacts the distribution of consumer expenditures by travel mode, including considerations for modal shifts, frequency of trips and multimodal trips taken. The review also identified a body of literature that described AT-related employment, events and tourism as a potential contributor to state or provincial level tax revenues, which can be allocated to local governments via intergovernmental revenue transfers. However, the portion of AT event and tourism revenues that may have been generated by or shared with municipalities was not reported, and is an identified research gap in this review. The state-level findings should be considered as a secondary source of revenue for local governments, and interpreted as evidence of opportunities for intergovernmental transfers of AT-generated tax revenues between senior and local-level governments. At the local level, walking and cycling events can generate direct revenue for municipalities through user fees that are charged for the use of municipal facilities or services (Vander Ploeg, 2002); this area can be explored further in future studies.

Findings in the identified literature surrounding consumer spending and job creation showed that walkable areas contributed to business revenues, that AT users spent money at local businesses, and that AT consumer spending and investments supported jobs. One interpretation that can be drawn is that investing in AT may encourage cyclists and pedestrians to support local businesses, thus positively impacting business revenues and employment. This would be consistent with economic development impacts that have been observed by investments and improvements in other transportation infrastructure, such as highways (Bhatta & Drennan, 2002). The existing research base can be built on by discerning the magnitude of business revenues and jobs generated through AT infrastructure relative to other types of infrastructure investments, as well as the degree

to which these economic benefits expand or contract the municipal tax base. Our review has identified and synthesised a body of peer-reviewed and grey literature that may be a useful starting point for researchers who wish to conduct a comparative analysis of the economic and fiscal benefits of alternative AT investments for local government.

The scoping research methodology used in this study has some limitations. First, although a comprehensive approach was taken in scoping a variety of sources to synthesise existing evidence on AT investments and municipal budgetary benefits, some relevant documents may have not been captured by the search strategy due to variations in terminology used in the transportation, planning and engineering sectors. Further, the review focused on available evidence from North America and Australasia; nonetheless, the findings may be relevant for European countries that also receive municipal revenues from property, income and consumer taxes (Taxation and Customs Union, 2014). Extending the review to other countries may provide valuable insights on the role of different built environments and municipal budgetary benefits of AT investments. Second, the review focused on benefits that could be directly captured in municipal budgets (e.g. tax revenues); there are opportunities to quantify health, environmental, social and other benefits using economic valuation methods (Giles-Corti et al., 2010), the scope and potential relevance of such benefits to municipal budgets can be explored in future studies. Third, it is important to note that the body of literature in this area represents a wide range of methodological approaches, and research was conducted by diverse authors, including organisations with potential vested interests in promoting AT investments. In addition, the scoping review does not present a comparative effectiveness of the benefits generated through AT infrastructure investments relative to other types of transportation investments. In line with scoping review methodology, this review did not include a critical appraisal of the evidence, which would be a considerable challenge given the diversity of the studies. The findings should be interpreted with caution given that no assessment of the quality of the studies in the review was completed, and that the majority of documents that met inclusion criteria were identified from non-peer-reviewed grey literature sources. Nonetheless, this review offers a comprehensive overview of the state of the literature and has systematically identified the types of municipal budgetary benefits generated by AT investments that have been examined to date. This fills an important gap in synthesising the research and providing an evidentiary basis to support municipal decision-makers.

Conclusions

Municipalities have a significant role in the planning and development of communities that support active living (Zwald et al., 2014), which aligns with health sector priorities to promote physical activity and reduce the burden of chronic diseases (World Health Organization, 2010). For many local governments, fiscal evidence on the benefits relative to the costs of investment is one consideration in financing AT infrastructure. This scoping review illustrated that the present state of evidence in relation to AT investments and municipal budgetary benefits is scarce, located in diverse sources (e.g. peer-reviewed journals, government and not-for-profit organisational reports), and focused in areas of potential revenue generation and economic development (i.e. property values, consumer spending, job creation and tax revenue). A prominent evidence gap was identified in

areas that could inform the incurred municipal expenditures to be expected, such as the costs of maintaining and replacing types of AT infrastructure. Ultimately, the lack of synthesised evidence on potential local budgetary benefits may inhibit decision-maker buy-in and subsequent investments in AT, which could support a population-based approach for chronic disease prevention. The review demonstrates the need for more research and synthesised evidence around the fiscal benefits of AT, which in combination with evidence on other co-benefits of AT, can inform decisions about AT investments at the local level.

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