Benchmarking the Health and Public Transit Connection in the GTHA: An Analysis of Survey Microdata

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HOW TO USE THIS REPORT

For readability and accessibility by a broad variety of readers, this report has been organized with the following features:

Each section opens with short "Key Points" panel that quickly summarizes the section.

Maps draw out spatial patterns, such as the maps of transit access and level of service scores on page 23.

A graphic of a hypothetical neighbourhood of a GTHA resident (page 20) visually illustrates how transit access and level of service scores were calculated.

Step-by-step "TIP" sections explain how to interpret results, including how to interpret odds ratios, and how to read tabular results and Appendices.

Detailed statistical results are collected in Appendices, which are clearly referenced in appropriate sections throughout the main text.

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EXECUTIVE SUMMARY

Study context: where, why, and how?

The Greater Toronto and Hamilton Area (GTHA) is Ontario's economic engine, and it is growing rapidly. Within this context, transit is a vital public good that offers far-reaching economic, social and health benefits, and needs to keep pace with this growth. But the benchmarks to track transit-health connections do not exist, and our understanding of the connections between transit and health in the GTHA is limited. We address these gaps by leveraging health and social survey data from Statistics Canada and – for the first time in the GTHA – linking them with measures of transit access, level of service, and built environment conditions. This allows us to offer a novel overview of the transit-health relationships in the GTHA.

Goals

Four research goals underpin this study:

1. to benchmark the current state of the transit-health relationships in the GTHA;
2. to quantify these relationships across a large set of health outcomes;
3. to probe these relationships for vulnerable subpopulations within the GTHA;
4. to take account of possibly confounding influences (built environment but also individual-level factors) that might otherwise mask the relationships between transit and health.

Key findings

Our methodology successfully leveraged two Statistics Canada datasets that surveyed almost 13,000 GTHA respondents. These secure-access datasets, coupled with our generated transit and built environment data, were large enough to detect statistically significant relationships across nine outcomes (general health, mental health, knowing of neighbours, favours done for neighbours, life satisfaction, obesity, walking to school or work, diabetes, and asthma). Key findings include a negative relationship between bus stop proximity, obesity and diabetes, but a positive influence of streetcar and subway proximity on knowing neighbours. In particular, the positive effects of higher-order transit were felt more at 800-1200m distance to subway stations, indicating a trade-off between the positive effects of subway on walking in one's neighbourhood and the negative effect of crowdedness on wellbeing, broadly.

Future opportunities

This wide-ranging first survey of health outcomes brings to light many interesting relationships that can inform evidence-based policymaking. It also flags methodological challenges that deserve further investigation at a tightly focussed, more targeted level. Among other opportunities identified in this report, even larger datasets and individual-level data on automobile and transit use will lead to deeper understandings of the transit-health relationships identified here.

RESEARCH TEAM

Evan Castel

Evan is a senior doctoral candidate in health geography at the University of Toronto, and a Fellow in the Collaborative Program in Public Health Policy in the Dalla Lana School of Public Health at the University of Toronto. His research employs geospatial and epidemiological tools to examine connections between the built environment and human health, looking specifically at the health and social consequences of life in dense high-rise communities. Drawing on an education in health sciences, public health, and architecture, he also grounds his work in ten years of work experience in architecture and urban planning policy roles, including for Ontario's former Ministry of Public Infrastructure Renewal on the creation of the *Growth Plan for the Greater Golden Horseshoe*.

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Steven Farber is an Assistant Professor in the departments of Human Geography (University of Toronto Scarborough) and Geography and Planning (University of Toronto St. George). He is the co-director of the Spatial Analysis of Urban Systems (SAUSy) Lab where he directs research on land use and transportation planning, spatial analysis, and econometric modelling. He is author of more than 40 peer-reviewed articles appearing in top-tier international journals. His research is funded by the Social Sciences and Humanities Research Council of Canada (SSHRC), the National Science Foundation, the Ontario Ministry of Research, Innovation and Science, Metrolinx, and the National Institute for Transportation and Communities. Prior to his current position at the University of Toronto, Dr. Farber was an Assistant Professor at the University of Utah (2011-2014) and Ryerson University (2010-2011). He obtained his PhD in Geography and Spatial Analysis at McMaster University in 2010.

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1 INTRODUCTION

Key points

- Little is known about the transit-health relationship in the GTHA
- Some evidence is available from other regions, but does not always reflect GTHA conditions
- This project addresses that gap, with four goals:
  1. **benchmark** the current state of relationship, and for diverse subgroups
  2. **quantify** the strength of the transit-health relationship
  3. probe the relationship within **specific communities**, especially vulnerable ones
  4. **separate the effect** of transit from that of confounding effects – especially the built environment – to isolate the independent effect of transit on health

Accessible and inclusive transit is a core component of an equitable, productive and successful region. More than a decade of evidence has shown that such transit can promote physical activity, as well as improve air quality, decrease greenhouse gas emissions, and reduce noise and congestion. Physical activity has dominated the transit-health discussion, even though some studies have hinted that transit may also improve mental health, social support networks, access to health services, and a host of other health outcomes with substantial burdens to public health, the economy, and regional competitiveness.

Despite this, empirical evidence supporting these other health connections is scarce, and the evidence that does exist is regionally-specific, describing areas (e.g. Atlanta, Georgia) whose transit and socio-demographic conditions are not comparable to the Greater Toronto and Hamilton Area (GTHA). To the best of our knowledge, few analyses of transit-health connections have been performed for the GTHA, meaning that local conditions remain unknown.

This knowledge is even more necessary to track the GTHA as it undergoes major changes. First, the region's population is growing rapidly, up 5.7% from 6.57 million residents in 2011 to 6.95 million in 2016 (Statistics Canada, 2016). Urbanization also continues, but this is uneven, with some areas seeing growth in downtown cores while low-density suburbs grow in other municipalities. Finally, travel times and mobility costs are rising, whether measured as fuel costs for private vehicles or as transit fare prices (Glazier et al., 2014; Metrolinx, 2013). Taken together, these conditions create policy challenges for ensuring equitable and efficient transit provision. And since emerging research points to the health effects of transit provision, transit policy works as a public health lever as well, magnifying the need for evidence-informed policymaking.

Vulnerable groups in the GTHA need special consideration when considering such health implications. Inequitably distributed transit may disproportionately harm groups that are already socially and economically vulnerable in the GTHA, like our rapidly aging population, as well as new immigrants, women, and young families (Children's Aid Society of Toronto, 2016; El-Geneidy, Buliung, Diab, van

Lierop, Langlois, & Legrain, 2015; Toronto Public Health, 2013). Many of these groups already have worse health outcomes and are more transit-captive than the average GTHA resident (El-Geneidy et al., 2015; Glazier et al., 2014). A balanced and comprehensive analysis cannot ignore these populations.

Our analysis takes up the above challenges by setting out four research questions:

1. Can we **benchmark the current state of transit provision** and levels of service from the perspective of multiple populations – including vulnerable groups – categorized by health and social status?
2. Can we **quantify the health impacts** of transit access and level of service on a large selection of relevant health and social outcomes in the region?
3. How do these relationships **vary in different communities**, especially in those vulnerable groups that make up a large segment of the GTHA population?
4. How well can we **separate the effect of transit from that of confounding effects** – especially the built environment – to isolate the independent effect of transit on health?

Current obstacles to answering the above questions for the GTHA include a lack of data that simultaneously assesses transit access, built environment, and public health measures, and the insufficient dialogue and skilled partnerships between public health researchers, geospatial analysts, and transportation researchers. By bringing together a multi-disciplinary research team that has worked in tandem with Metrolinx to leverage internal expertise, we have applied an evidence-informed and rigorous analytical approach to these policy questions.

In this way, we used a two-phase strategic approach. First, we accessed and linked individual-level health and social survey data from Statistics Canada with measures that we generated of transit access, level of service, and the built environment. Following this, we analyzed the relationships between social and health outcomes and transit variables using bivariate descriptive statistics and multivariate logistic regression models.

We begin with a review of the transit-health literature in the next section. Following this is a description of the survey microdata, built environment and transit datasets used in our analyses, as well as a summary of our research approach and analytic methods. Next we report on the descriptive and multivariate results of our analysis. And finally, we conclude with a discussion of our results, a summary of relevant lessons and trends for transit planning in the GTHA, and an indication of future research directions.

2 LITERATURE REVIEW

Key points

- Using a structured search methodology, 30 key documents were identified and assessed from the past 20 years of scientific literature.
- Physical activity dominated the literature. Transit users walked more than non-users, but results varied with regions and subgroups.
- Mental health was under-examined, but suggested that longer commutes and non-social travel (driving alone, unlike transit use) was tied to worse mental health.
- Specific groups can be differentially sensitive to transit conditions (i.e. outcomes can vary with subpopulations, which need to be considered separately).
- Many studies suffered from the use of aggregate data, unlike the individual measures used in this study.

To create a solid basis for our study and to isolate knowledge gaps, we reviewed twenty years of scientific literature using a structured search methodology. Our focus of this review is specifically on *public transit* and health, and not the wider and more researched general area of *transportation* and health. Consequently, we used a semi-structured protocol to search established scholarly databases: PubMed and Google Scholar. We used the search terms *transit and health* and *transit and public health*, with some search-term supplementation (e.g. *transit and health and disadvantage*) to capture under-represented research areas. Special emphasis was given to Canadian studies, recent papers, and those deemed as very influential by their citation count. Our focus was on peer-reviewed journal articles except in cases that were particularly salient to the GTHA study area (e.g. Next Stop Health: Transit Access and Health Inequities in Toronto, Toronto Public Health, 2013).

Accordingly, we identified thirty key documents and distilled them into a literature review table using criteria and a table structure that was designed collaboratively with Metrolinx. The full table is presented in the Appendix A1.

While these documents covered a range of key health outcomes, the majority centered on physical activity and closely related outcomes such has BMI and obesity. The overall breakdown of papers reviewed are as follows: physical activity (9 studies), mental health (7), food access (4), indirect health outcomes (2), and disability (1). The remaining seven documents were peer-reviewed literature reviews or commentaries (6), and the Toronto Public Health document noted above (1).

2.1 Physical Activity

The preponderance of studies on physical activity and transit were largely in accord on certain results. Transit use was overall associated with high physical activity, whether compared against non-users (Lachapelle & Frank, 2009; Lachapelle, Frank, Saelens, Sallis, & Conway, 2011) or against minimum recommended thresholds of activity (Besser & Dannenberg, 2005; Lachapelle & Frank, 2009). The local environment tends to influence the transit-health relationship. For example, transit users walked more to services and destinations near home and workplace than transit nonusers (Lachapelle et al., 2011), and others further noted that the effect was only observed for days that transit was used (Saelens, Moudon, Kang, Hurvitz, & Zhou, 2014). Mode differences were seen as well: suburban train riders walked significantly more than other mode users (Wasfi, Ross, & El-Geneidy, 2013) and rail users surpassed bus users in this regard (Besser & Dannenberg, 2005). Differences were seen across socioeconomic and ethnic groups, though these were not always consistent. For example, non-white and low income groups walked more to and from transit (Besser & Dannenberg, 2005) while other research reported more walking among white transit users and at low and high income groups (but not middle) (Lachapelle & Frank, 2009). Some other inconsistencies were seen around neighbourhood characteristics. For instance, pedestrian-friendly environments and retail density encouraged transit and walking (Cervero & Kockelman, 1997) though others noted that neighbourhood physical characteristics played no significant role (Wasfi et al., 2013). Similarly, higher physical activity was seen in transit users in low density neighbourhoods in one study (Lachapelle & Frank, 2009), and higher density neighbourhoods in another (Besser & Dannenberg, 2005) while others saw no residential density effect at all (Cervero & Kockelman, 1997). As far as walk lengths, more seems to be better: a GPS-assisted study of Vancouver high school students reported that longer walks were correlated with a proportionately higher increase in physical activity, with transit riders achieving comparable physical activity to walkers (Voss, Winters, Frazer, & McKay, 2015).

2.2 Mental Health

Although far fewer studies looked beyond physical activity to other outcomes, those centring on mental health and transit showed some clear trends, as well as some of the inconsistencies seen with physical activity research above. Commute length was associated with poorer mental health, especially stress, and more felt among women than men (Feng & Boyle, 2013; Legrain, Eluru, & El-Geneidy, 2015; Roberts, Hodgson, & Dolan, 2011), though number of children was not significant (Roberts et al., 2011). The effect of the built environment on the transit-health relationship was not uniform, with one study finding that higher quality housing reinforced the beneficial effect of less stressful transit commuting (Roberts et al., 2011) while another found that density or green space had no significant effect (van den Berg, Kemperman, de Kleijn, & Borgers, 2016). Social forms of transportation, like carpooling and public transit, were associated with better mental health while the opposite was seen for driving alone (Ferenchak N & Katirai, 2015). This negative effect of driving was found in several papers, so it may be that the positive effect of transit is merely because it replaces the known negative effect of driving (Ferenchak N & Katirai, 2015; van den Berg et al., 2016).

The sole study examining disability and public transit (Blais & El-Geneidy, 2014) reinforced the value of transit to mental health, noting that disabled people without access to public transit have a lower sense of well-being, particularly those with mental/cognitive disabilities.

2.3 Food Access

Like mental health, food access and its relationship to transit was also under-examined. One Seattle-area study pointed to many poor areas with very low transit access to low-cost supermarkets, though use of differing access and deprivation measures greatly influenced these estimates of under-served population numbers (Jiao, Moudon, Ulmer, Hurvitz, & Drewnowski, 2012). In Baltimore, however, some of these transit food deserts affect upper and lower income groups, though poorer areas showed some very low access scores and have less options to ameliorate this deficit than wealthier ones (Plano, Darby, Shaffer, & Jadud, 2015). Two Cincinnati studies concluded that drivers had greater access to supermarkets – as well as flexibility – than transit users (Farber, Morang, & Widener, 2014; Widener, Farber, Neutens, & Horner, 2015). While no systematic inequities by race or income were noted, hot spots of poor access did exist, especially by race. Moreover, in noting the effects of the changing transit conditions by time of day, Farber et al. illustrate that these temporal variations need more attention in future studies (Farber et al., 2014). Widener et al. also extended the literature by applying an "interaction potential" measure to reflect the amount of time a resident has to "interact" with food stores given a time budget, the transit network, and the transit schedule, and noted that origin (whether from home or work) needs consideration. Both of these studies were constrained by data limitations; the lack of vehicle ownership data for the transit commuters, and by the need for more disaggregate data, ideally at the individual level.

2.4 Methodological Trends

Across all of the empirical studies, several methodological trends were evident. Use of individual-level data, especially collected by the researchers (primary data) was not commonplace. Instead, aggregate data was often used, often from government surveys, which allows convenience, speed, affordability and use of larger geographies, including nation-wide studies (Ferenchak N & Katirai, 2015; Jiao et al., 2012). By contrast, access to individual-level data can offer greater robustness by avoiding ecological bias – "lumping" individuals together and incorrectly assigning area characteristics to individuals who do not resemble the area average. Such studies offer further advantages when precise locations of respondents are known, allowing walk distances to stops or commute lengths to be objectively calculated (Wasfi et al., 2013). A rare few studies went even further via primary data collection, whereby researchers collect information firsthand from respondents, which allows use of customized questionnaires and sometimes travel evaluation through GPS units and accelerometers, where both independent variables (travel) and health outcome (physical activity) are simultaneously measured (Brown et al., 2016; Miller et al., 2015; Voss et al., 2015). Since such studies are generally time-consuming, resource-intensive and costly, fewer respondents can be followed, reducing the statistical power of the study as a necessary trade-off. Lastly, though similarly complex and problem-prone, several studies used before-and-after measurements to track travel behaviours and associated health outcomes as a transit intervention was occurring, such as the rollout of an Light Rail Transit (LRT) line (Brown, Werner, Tribby, Miller, & Smith, 2015). These "natural experiments" allow a rare look into the temporality of health outcomes around transit changes, albeit at the limited geography of the specific area of the intervention.

2.5 Dominance of Physical Activity

Another trend was the clear dominance of physical activity over other important health outcomes, whether via period of study (it was among the earliest outcomes studied in this review) or by number of studies. Several factors might be driving this over-emphasis. For one, travel is by nature a kinetic activity, and public transit even more so, with "first and last mile" gaps often requiring physical exertion to reach origin stops and destinations. Studies of physical activity are an obvious and fitting way to capture this effect. Second, physical activity can be relatively easily objectively measured (walk distances, and accelerometer or GPS measures) unlike more complex health outcomes like mental health. Third, physical activity and its ties to obesity and cardiovascular disease is currently highly topical, relatively universal across sociodemographic groups, and has very visible social and economic costs. Together this may attract research interest that is denied to more complex, stigmatized health outcomes such as depression or those that centre on particular groups such as disadvantaged communities (Plano et al., 2015) or disability (Blais & El-Geneidy, 2014). Finally, less tangible outcomes, especially regarding social well-being, can be problematic in measurement and in systematizing cause and effect. Examples include social capital, social support or isolation, which researchers may be interested in their own right, or due to their downstream effect on classical health outcomes. But these social factors can be complex to study, especially objectively. Perhaps for that reason, only one such study (van den Berg et al., 2016) linking transit to isolation was identified in this review, leaving a large knowledge gap that deserves examination.

2.6 Policy Papers and Commentaries

Other gaps were identified by authors of the seven commentary and policy pieces, which made their own selective survey of the scientific literature, often enhanced by examination of policy initiatives aimed at addressing health inequities in transit provision and access. Jones et al. noted that economic, environmental and 'distributional issues' of transit dominate current empirical research, while social consequences -- including health – need more work (Jones & Lucas, 2012). However, their team did cite some promising explorations of social exclusion, social networks, social capital, and residential relocation due to transit investment. Litman offered a more planning-centric survey of the transportation and health relationship. Although transit was only one facet of his review, he concluded that transit-health studies need to examine overlooked outcomes, including mental health and access to health-related goods and services (Litman, 2013). The review also provided a good summary of policy measures including smart growth, "complete streets" policy, transport pricing reforms, and mobility management marketing. Two other documents are particularly relevant because of their GTHA focus. A 2012 commentary by Topalovic et al. offers a health, environmental and economic impact assessment of LRT development for Hamilton (Topalovic, Carter, Topalovic, & Krantzberg, 2012). While their discussion of health impacts is relatively minor, they conclude that an LRT would serve as a catalyst for social change, improving the health, environment and connectivity of the community. The final document, *Next Stop Health*, is grounded on the centrality of affordable, available and inclusive transit to the success of an equitable city (Toronto Public Health, 2013). When transit fails to meet these goals, access to four important categories of goods and services (food, health care, education and employment, and recreation) is compromised. Lower income communities are especially vulnerable, and the report specifically cites how implementation of *The Big Move* will address availability of transit in low income areas.

2.7 Summary: Building On the Literature

Taken together, this review sets the course for our analysis by identifying knowledge gaps and flagging potential methodological considerations from past studies. It also helps situate the GTHA, with its specific economic, social and cultural makeup, in the research landscape. This allows us to construct a customized and regionally-specific research methodology that leverages available datasets like Statistics Canada health and social surveys. We can also take three cautions from this review. First, we see that specific groups can be differentially sensitive to transit conditions (i.e. outcomes can vary with subpopulations), especially between modes of transit. Second, authors have noted contradictory results across studies and even within the same study, so careful methodological planning and use of sufficiently large and well-sampled datasets are key. Finally, the moderating effect of local built environment seems to matter, at least for some groups and under some conditions. We need to bear these learnings – and their own specific contexts – in mind and tailor our research plan accordingly. Our datasets and research approach are outlined in the next two sections.

3 DATA

Key points

- Data was obtained via special access to two well-established Statistics Canada surveys.
- Individual-level data was used, allowing fine-grained analyses at small geographic scales.
- These data were linked to GTHA transit data (both transit accessibility and levels of service) computed specifically for this study for all four transit modes (bus, streetcar, subway, and commuter rail) in the region.
- Together, this survey data linked to transit data supported a wide range of transit-health analyses never performed before for the region.

3.1 Study Area

The study area consists of the Greater Toronto and Hamilton Area (GTHA), a region under the transportation planning jurisdiction of Metrolinx. The GTHA consists of the six municipalities of the City of Toronto, Durham Region, Peel Region, York Region, Halton, and the City of Hamilton. It is the largest urban agglomeration in Canada with a population of 6.95 million (in 2016). The region is served by nine local public transportation agencies and one regional agency offering inter-municipality commuting services. Transit plays an important role in the region, especially during peak-hour commuting into its major employment centres, and for other daily trips amongst captive riders who are often in households without cars and with below average income.

3.2 Datasets

Multiple datasets are used in this study. They can be categorized into a) survey microdata pertaining to individual residents in the GTHA, b) measures of transit accessibility and levels of service (LOS), and c) controls for neighbourhood-level urban form.

3.2.1 General Social Survey of Canada (GSS)

The General Social Survey has collected data from telephone surveys across Canada since 1985. It is part of a library of such interview-based surveys where respondents self-report data to a trained phone interviewer. Each annual cycle collects information from non-institutionalized Canadians age 15 and over, and uses a combination of questions common to each cycle and themed modules that repeat on a rotating basis. As a result of this reach and regularity, the GSS is "recognized for its regular collection of cross-sectional data that allows for trend analysis and its capacity to test and develop new concepts that address current or emerging issues" (Statistics Canada, 2012).Though focussing primarily on social outcomes, some health outcomes are included. When researchers require fine-grain geographic details like full postal codes at the level of the individual in the GSS – microdata – access is only granted via application to Statistics Canada's stringent review process. Once approved, such GSS microdata is only accessible in supervised and secure Research Data Centres across Canada, where all analyses must be completed. Results are vetted by Statistics Canada before release to ensure that sufficient aggregation has occurred to protect the identities of individual respondents. Our study obtained access to microdata from GSS cycles 26 (2012) and 27 (2013), selected because they were the most recent cycles available at the time of this work and that captured the social outcomes of interest. We selected only residents of the GTHA using Census Division codes in the survey.

To allow these residents to statistically represent the entire population of the GTHA (i.e. as if every resident was surveyed), Statistics Canada relies on sophisticated sampling methodologies. These methods assign each respondent with a weight that "scales up" their response to represent their specific target population. Specific details of these sampling and weighting methods are available elsewhere (Statistics Canada, 2012), but the result is that the number of persons represented by a given person in the sample is the "weight' of that sampled person. For confidentiality, Statistics Canada favours the reporting of such weighted results only, a format we follow in this report.

Finally, we standardized the independent variables in the GSS as much as possible with those in the second survey (the Canadian Community Health Survey, or CCHS). For instance, we harmonized the size of the age categories in the two surveys to ensure comparability. Some differences in independent variables between the surveys were notable and were preserved. In particular, the GSS features two variables not available in the CCHS (length of time respondent has lived in current dwelling, and dwelling type). We felt these were relevant to our outcomes so we included them in the GSS analyses.

A description of the socioeconomic characteristics of the survey respondents appears in Table 1, below.

Table 1: Socioeconomic Characteristics of GSS Respondents in the GTHA

		Rounded Weighted Count	Percent
GSS cycle	26 (2012)	2,874,950	49.8%
	27 (2013)	2,896,100	50.2%
Census division code of the respondent's residence	Durham	525,750	9.1%
	York	1,000,050	17.3%
	Toronto	2,146,150	37.2%
	Peel	1,169,350	20.3%
	Halton	499,950	8.7%
	Hamilton	429,800	7.4%
Sex of respondent	Female	2,958,700	51.3%
	Male	2,812,350	48.7%
Age group of the respondent	15 to 24	1,003,750	17.4%
	25 to 34	1,007,200	17.5%
	35 to 44	997,350	17.3%
	45 to 54	1,097,750	19.0%
	55 to 64	801,500	13.9%
	65 to 74	480,500	8.3%
	75 years and over	383,050	6.6%
Total household income	None to $19,999	242,900	4.2%
	$20,000 to $39,999	484,450	8.4%
	$40,000 to $59,999	636,400	11.0%
	$60,000 to $79,999	586,200	10.2%

		Rounded Weighted Count	Percent
	$80,000 to $99,999	560,050	9.7%
	over $100,000	1,820,200	31.5%
	Don’t know/Refusal	1,440,900	25.0%
Education - highest degree	Less than high school diploma or its equivalent	727,400	12.6%
	High school diploma or equivalency certificate	1,486,950	25.8%
	Certificate or diploma from trade, community college or CEGEP, or university certificate below the bachelors level	1,505,750	26.1%
	Bachelor's degree	1,353,450	23.5%
	University certificate, diploma, degree above the BA level	654,400	11.3%
	Don’t know/Refusal	43,150	0.7%
Employed last week	No	2,117,900	36.7%
	Yes	3,636,400	63.0%
	Don’t know/Refusal	16,750	0.3%
Language first spoken in childhood - English	No	2,252,700	39.0%
	Yes	3,374,100	58.5%
	Don’t know/Refusal	144,300	2.5%
Home is owned by a household member	No	1,102,600	19.1%
	Yes	4,558,500	79.0%
	Don’t know/Refusal	110,000	1.9%
Single child(ren) 0-4 living in the household	0	5,124,250	88.8%
	1 or more	646,850	11.2%
Single child(ren) 5-14 in household	0	4,726,350	81.9%
	1 or more	1,044,700	18.1%
Single child(ren) 15-18 in household	0	5,201,400	90.1%
	1 or more	569,700	9.9%
Household size of respondent	1	513,700	8.9%
	2	1,441,700	25.0%
	3	1,214,300	21.0%
	4	1,534,850	26.6%
	5 or more	1,066,500	18.5%
Marital status	Married or common-law	3,401,800	58.9%
	Divorced/separated/widowed	568,150	9.8%
	Single	1,795,450	31.1%
	Don’t know/Refusal or other	5,700	0.1%
Main activity in past 3 months	Working at a paid job or business	3,236,350	56.1%
	Looking for paid work	154,100	2.7%
	Going to school	896,950	15.5%
	Caring for children, household work, or parental leave	439,450	7.6%
	Retired	836,850	14.5%
	Long term illness	114,250	2.0%
	Don’t know/Refusal or other	93,100	1.6%

		Rounded Weighted Count	Percent
Born outside of Canada	Born in Canada	3,073,550	53.3%
	Born outside of Canada	2,586,500	44.8%
	Don't know/Refusal or other	111,100	1.9%
Ethnic background of the respondent	European	2,587,250	44.8%
	Chinese only	341,100	5.9%
	South Asian only (East Indian, Sri Lankan, Pakistani, Punjab)	723,550	12.5%
	Other	1,869,150	32.4%
	Don't know/Refusal or other	250,050	4.3%
Length of time respondent has lived in current dwelling *	Less than 1 year	429,000	7.4%
	1year to less than 5 years	1,471,500	25.5%
	5year to less than 10years	1,210,050	21.0%
	10years and over	2,561,800	44.4%
	Don't know/Refusal	98,750	1.7%
Dwelling type *	Single detached house	3,407,950	59.1%
	Semi-detached, double, garden, town-house, row house, duplex	1,148,800	19.9%
	Low-rise apartment (less than 5 stories)	267,900	4.6%
	High-rise apartment (5 or more stories)	793,200	13.7%
	Mobile home, trailer or other	57,400	1.0%
	Don't know/Refusal	95,850	1.7%

Notes:
* Not available in CCHS

3.2.2 Canadian Community Health Survey (CCHS)

The CCHS is the second of the two core datasets used in this study, and it provides the self-reported health outcomes of interest in the GTHA. The CCHS is an annual cross-sectional survey that gathers information related to health status, health-care utilization, and social determinants of health for all Canadians 12 years of age and over using telephone surveys. Like the GSS, this scope and regularity allows for powerful surveillance of changes in health-related outcomes over time. Less than 3% of the Canadian population is excluded from sampling each year, namely persons living on reserves and other Aboriginal settlements, full-time members of the Canadian Forces, the institutionalized population, and more remote Quebec health regions (Statistics Canada, 2014). As with the GSS, CCHS microdata (with postal codes) can only be accessed via application, with all analyses confined to the Research Data Centres. Sampling, weighting and vetting processes differ in some aspects from the GSS (Statistics Canada, 2014) but the overall concepts and rationales are the same. For comparability with the GSS sample and with other studies, in the 2014 cycle of the CCHS we selected respondents who were age 15 years and over, and who lived within the GTHA. By the same logic, we standardized the CCHS variables as much as possible with those in the GSS, as noted in the GSS section. But the CCHS included one variable not available in the GSS: a leisure physical activity index. This index offered the possibility for controlling for non-transit-related physical activity, thus improving our focus on transit-related physical activity. Since we theorized that this would be relevant to physical activity-related outcomes such as obesity and diabetes, we included this index in the CCHS analyses.

A tabular description of the CCHS sample is found in **Table 2** below.

Table 2: Socioeconomic Characteristics of CCHS Respondents in the GTHA

		Weighted Count	Percent
Census division code of the respondent's residence	Durham	543,635	9.2%
	York	933,783	15.8%
	Toronto	2,391,679	40.4%
	Peel	1,148,923	19.4%
	Halton	442,025	7.5%
	Hamilton	452,814	7.7%
Sex of respondent	Female	3,028,333	51.2%
	Male	2,884,525	48.8%
Age group of the respondent	15 to 24	1,019,781	17.2%
	25 to 34	977,702	16.5%
	35 to 44	1,026,405	17.4%
	45 to 54	1,020,861	17.3%
	55 to 64	914,592	15.5%
	65 to 74	565,915	9.6%
	75 years and over	387,601	6.6%
Total household income	None to $19,999	386,401	6.5%
	$20,000 to $39,999	1,022,093	17.3%
	$40,000 to $59,999	1,033,847	17.5%
	$60,000 to $79,999	819,463	13.9%
	$80,000 to $99,999	564,538	9.5%
	over $100,000	2,086,517	35.3%
Education - Highest degree	Less than high school diploma or its equivalent	854,540	14.5%
	High school diploma or equivalency certificate	1,145,323	19.4%
	Certificate or diploma from trade, community college or CEGEP, or university certificate below the bachelors level	1,888,759	31.9%
	Bachelor's degree	1,312,668	22.2%
	University certificate, diploma, degree above the BA level	604,311	10.2%
	Don't know/Refusal	107,257	1.8%
Employed last week	No	2,378,850	40.2%
	Yes	3,406,105	57.6%
	Don't know/Refusal	127,904	2.2%
Language first spoken in childhood - English	No	2,759,854	46.7%
	Yes	2,980,172	50.4%
	Don't know/Refusal	172,832	2.9%
Home is owned by a household member	No	1,685,313	28.5%
	Yes	4,058,438	68.6%

		Weighted Count	Percent
	Don't know/Refusal	169,107	2.9%
Single child(ren) 0-5 living in the household**	0	5,055,332	85.5%
	1 or more	857,526	14.5%
Single child(ren) 6-15 in household*	0	4,481,893	75.8%
	1 or more	1,430,965	24.2%
Single child(ren) 16-17 in household *	0	5,278,966	89.3%
	1 or more	633,892	10.7%
Household size of respondent	1	649,092	11.0%
	2	1,596,538	27.0%
	3	1,224,907	20.7%
	4	1,279,481	21.6%
	5 or more	1,162,840	19.7%
Marital status	Married or common-law	3,421,198	57.9%
	Divorced/separated/widowed	674,135	11.4%
	Single	1,800,002	30.4%
	Don't know/Refusal or other	17,523	0.3%
Main activity in past 3 months	Working at a paid job or business	3,800,411	64.3%
	Going to school	373,777	6.3%
	Caring for children, household work, or parental leave	191,948	3.2%
	Retired	495,743	8.4%
	Long term illness	257,127	4.3%
	Don't know/Refusal or other	793,853	13.4%
Born outside of Canada	Born in Canada	2,843,925	48.1%
	Born outside of Canada	2,829,749	47.9%
	Don't know/Refusal or other	239,184	4.0%
Ethnic background of the respondent	European	2,312,206	39.1%
	Chinese only	415,830	7.0%
	South Asian only (East Indian, Sri Lankan, Pakistani, Punjab)	609,299	10.3%
	Other single	2,358,790	39.9%
	Don't know/Refusal or other	216,732	3.7%
Leisure physical activity index **	Active	1,553,298	26.3%
	Moderate active	1,270,899	21.5%
	Inactive	2,963,716	50.1%
	Don't know/Refusal	0	0.0%
	Not stated	124,945	2.1%

Notes:

* Slightly different age ranges than GSS.

** Not available in GSS.

Comparing the socioeconomic characteristics of the GSS versus CCHS samples, we find the distributions of variables to be very similar except in a few cases. The income variable for the GSS showed a 25% refusal rate, whereas all respondents in the CCHS provided income information. The GSS sample is also composed of more individuals with English as a first language and who are students, and fewer people who stated that they went to work at a paid job as their main activity. Despite these slight differences between surveys, we do not anticipate the differences in sample composition to have a major bearing on our findings because we are not attempting to pool the samples from each survey together, nor are we investigating outcomes that are common to both surveys.

3.2.3 Transit Accessibility and Levels of Service

Two transit variables are central to the current research questions: transit access and level of service (LOS). We operationalized these using accepted methodologies from the research literature:

1. Transit access: For each mode of transit (bus, streetcar, subway and GO rail), we use binary variables to indicate whether the closest access stop, platform or station, is within a 400 meter walk, a 400-800 meter walk, or a 800-1200 meter walk from the respondent's home postal code (6 digit FSALDU). We calculated these ranges – or bands – by measuring distance along the actual street network, thus capturing pedestrian network conditions that would be missed with a cruder Euclidean (as-the-crow-flies) distance measure.

TIP: Visual Guide to Transit Access Measures

Below, **Figure 1: Schematic Illustration of Transit Access and** Level of Service Measures illustrates how we calculated transit access measures for a hypothetical GTHA resident living at the home postal code shown as "FSALDU centroid". Since their closest bus stop was found at a 250m walk along the street network from their home, our analysis treats them as living in the closest band of bus access, the 0-400m band. By the same logic, this diagram shows that they are in the 400-800m band for streetcar access, and 800-1200m band for subway.

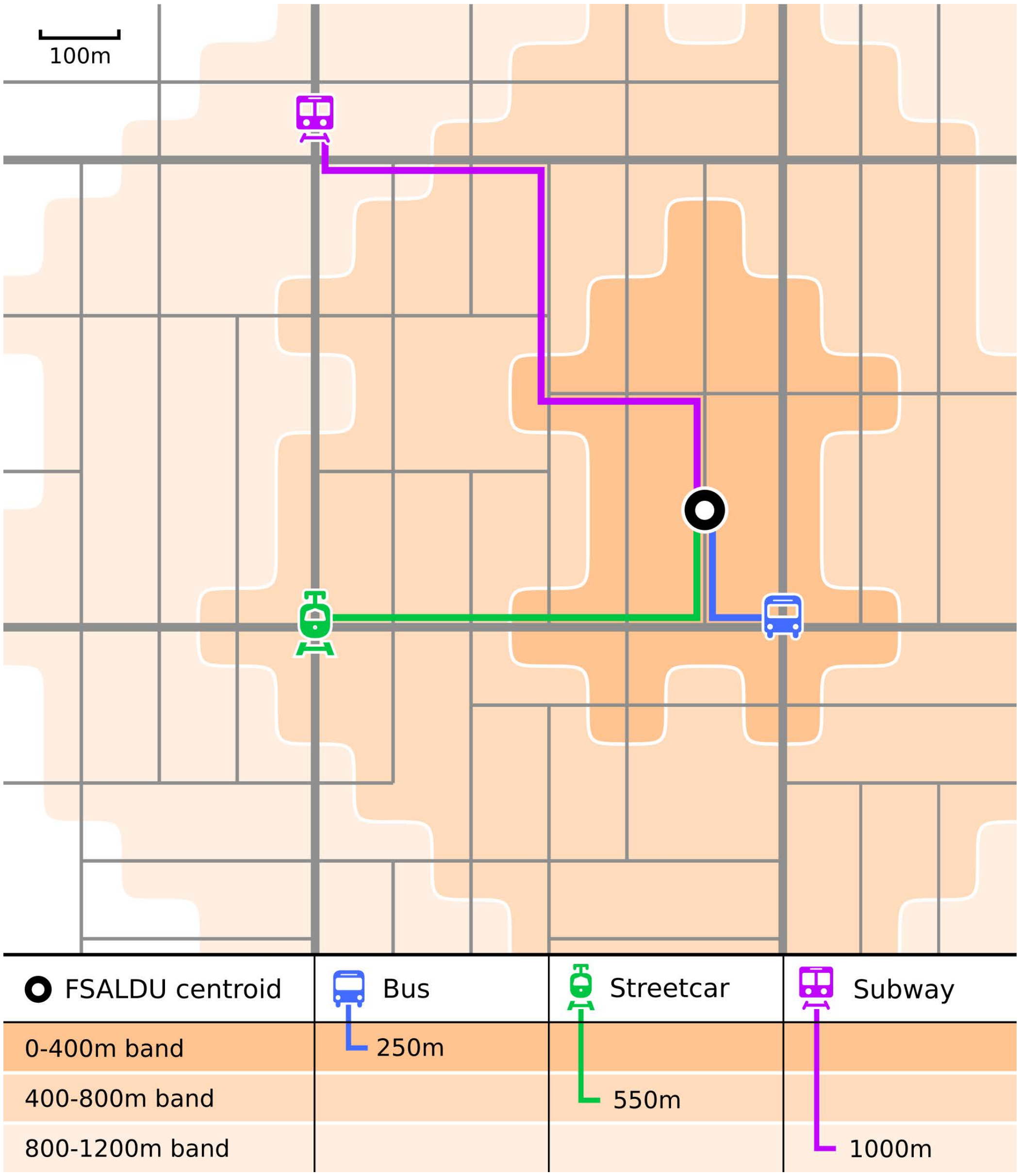

Figure 1: Schematic Illustration of Transit Access and Level of Service Measures

In this way, maps of the transit access scores were generated for the entire GTHA, and can be found in **Figure 2-Figure 5**. Data for the approximately 126,000 FSALDU points have been aggregated into a regular tessellation of hex bins for easier visualization. The density of postal codes in the northern Peel Region is reflective of the true distribution of unique postal codes, in comparison to other rural areas that rely on larger postal code areas in rural areas. This does introduce a higher degree of spatial accuracy for respondents in rural areas of Peel as compared to, for example, Durham Region. But, since population densities, and hence sampling probabilities, are so low in these rural areas, we do not expect this to have much effect in our overall analysis.

2. Level of Service (LOS): The *Better Bus Buffers* GIS tool is used to count the number of unique transit trips reachable within a 400 meter walk, 400-800 meter walk, and 800-1200 meter walk over a typical 24 hour period (Morang, n.d.). Results constrained to the AM peak period were also computed, but these were excluded from the analysis because, within the GTHA, they were nearly collinear with the measures for the entire day.

TIP: Visual Guide to Level of Service Measures

As an example of computing level of service, let us return to **Figure 1: Schematic Illustration of Transit Access and Level of Service Measures**, above. If 48 unique bus trips passed through the bus stop shown over each typical 24-hour period, that resident would be assigned a LOS score of 48 for their 0-400m band.

Using this method, to provide a snapshot of the variables computed to measure LOS, **Figure 6** displays the total number of trips reachable within an 800m walk from FSALDU centroids for the whole GTHA. As before, data for the approximately 126,000 FSALDU points have been aggregated into a regular tessellation of hex bins for easier visualization.

The transit access and LOS measures were derived from General Transit Feed Specification (GTFS) packages and GIS shapefiles defining transit routes. These were either publically available on the internet, or else were provided by Metrolinx and its partner transit agencies. The complete set of agencies were: GO Transit, Toronto Transit Commission, York Region Transit, Brampton Transit, MiWay, Burlington Transit, Oakville Transit, Milton Transit, Hamilton Street Railway, UP Express, and Durham Region Transit.

Accessibility and LOS statistics for the survey respondents in our study appear in **Table 3** and **Table 4**, respectively. There are remarkable similarities between surveys, indicating that the spatial distributions of respondents follow a similar pattern across the two samples. As a brief overview, we are impressed by the broad coverage of bus access at the 400m threshold (71.5%-72.5%). But observe that 89%-95% of the regions' population lives more than 1200m walking distance to their nearest streetcar, subway and GO rail stations. Of course, these networks are far more spatially concentrated, as is evident in the maps.

Table 3: Transit Accessibility Characteristics for the GSS and CCHS Respondents

	GSS		CCHS	
Distance from home to first stop:	**Count (rounded)**	**%**	**Count**	**%**
Bus:				
0 to 400m	4,082,150	71.5%	4,259,386	72.5%
400 to 800m	1,209,750	21.2%	1,242,186	21.2%
800 to 1200m	138,050	2.4%	110,207	1.9%
more than 1200m	278,800	4.9%	260,683	4.4%
Streetcar:				

0 to 400m	269,150	4.7%	308,306	5.3%
400 to 800m	129,850	2.3%	152,096	2.6%
800 to 1200m	91,700	1.6%	106,673	1.8%
more than 1200m	5,218,050	91.4%	5,305,387	90.3%
Subway:				
0 to 400m	130,200	2.3%	100,732	1.7%
400 to 800m	265,700	4.7%	331,431	5.6%
800 to 1200m	232,450	4.1%	219,934	3.7%
more than 1200m	5,080,400	88.9%	5,220,365	89.0%
Rail:				
0 to 400m	25,500	0.4%	18,589	0.3%
400 to 800m	101,850	1.8%	94,456	1.6%
800 to 1200m	175,450	3.1%	184,671	3.1%
more than 1200m	5,405,950	94.7%	5,574,746	95.0%

Table 4: Transit Level of Service Characteristics for the GSS and CCHS Respondents

# of Transit Trips Reachable over a Typical 24 Hour Period	**GSS**				**CCHS**			
	Mean	**Standard Deviation**	**5th Percentile**	**95th Percentile**	**Mean**	**Standard Deviation**	**5th Percentile**	**95th Percentile**
0-400m walk from home	289	528	0	1269	313	533	0	1149
400-800m walk from home	411	650	0	1591	445	685	0	1664
800-1200m walk from home	424	720	0	1692	433	641	0	1737

Maps of Transit Access and Level of Service Scores (Figure 2-Figure 5)

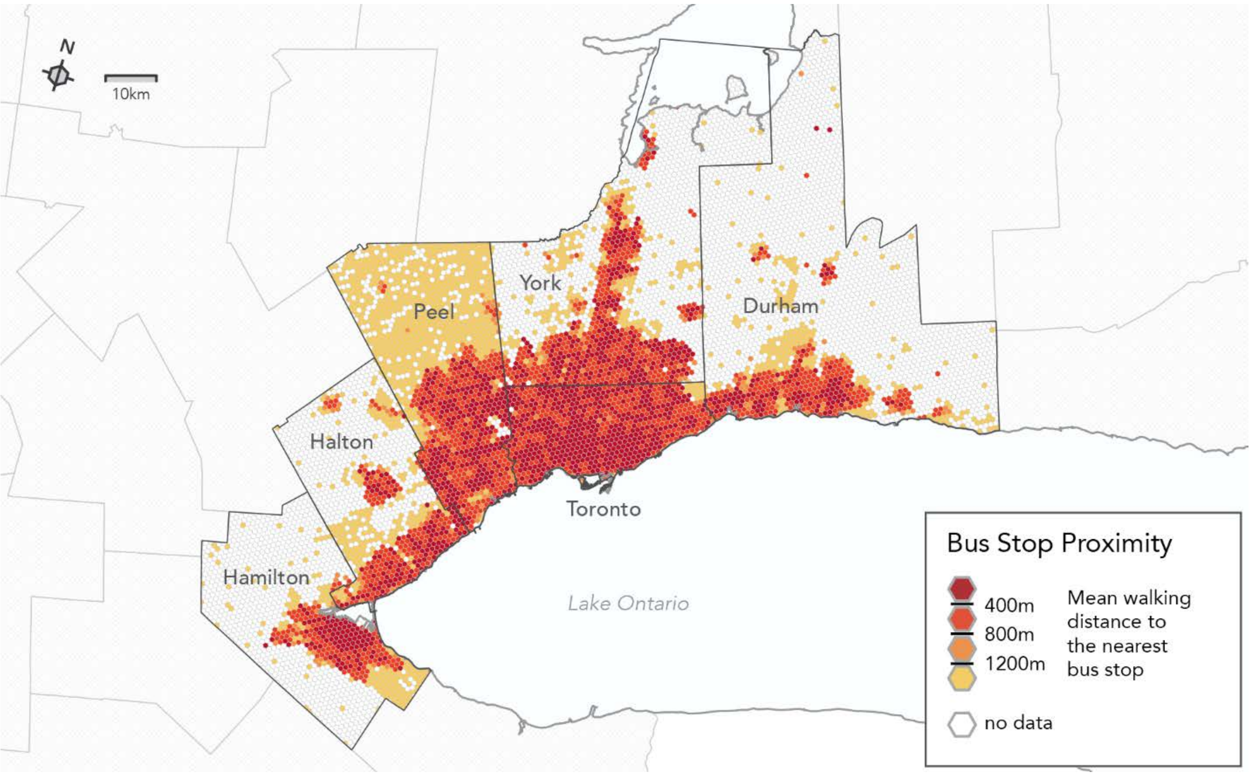

Figure 2: Walking Distance from FSALDU Centroid to Nearest Bus Stop

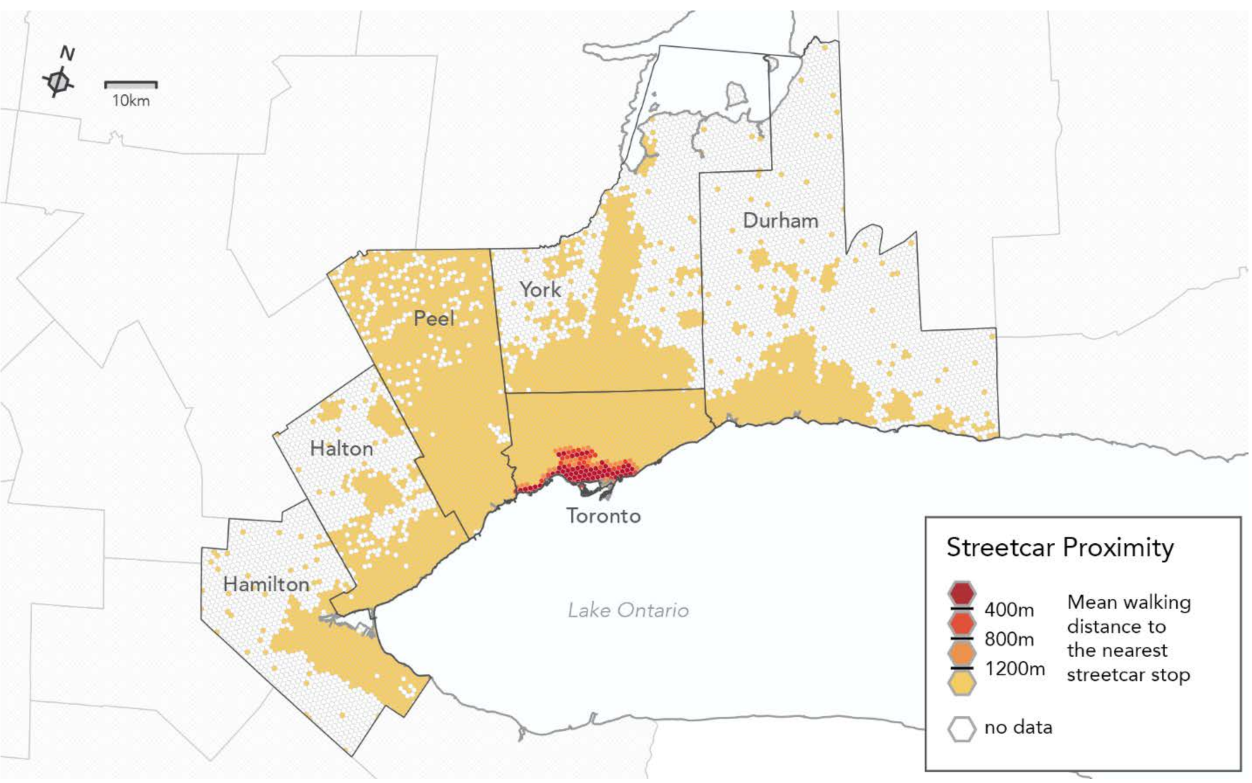

Figure 3: Walking Distance from FSALDU Centroid to Nearest Streetcar Stop

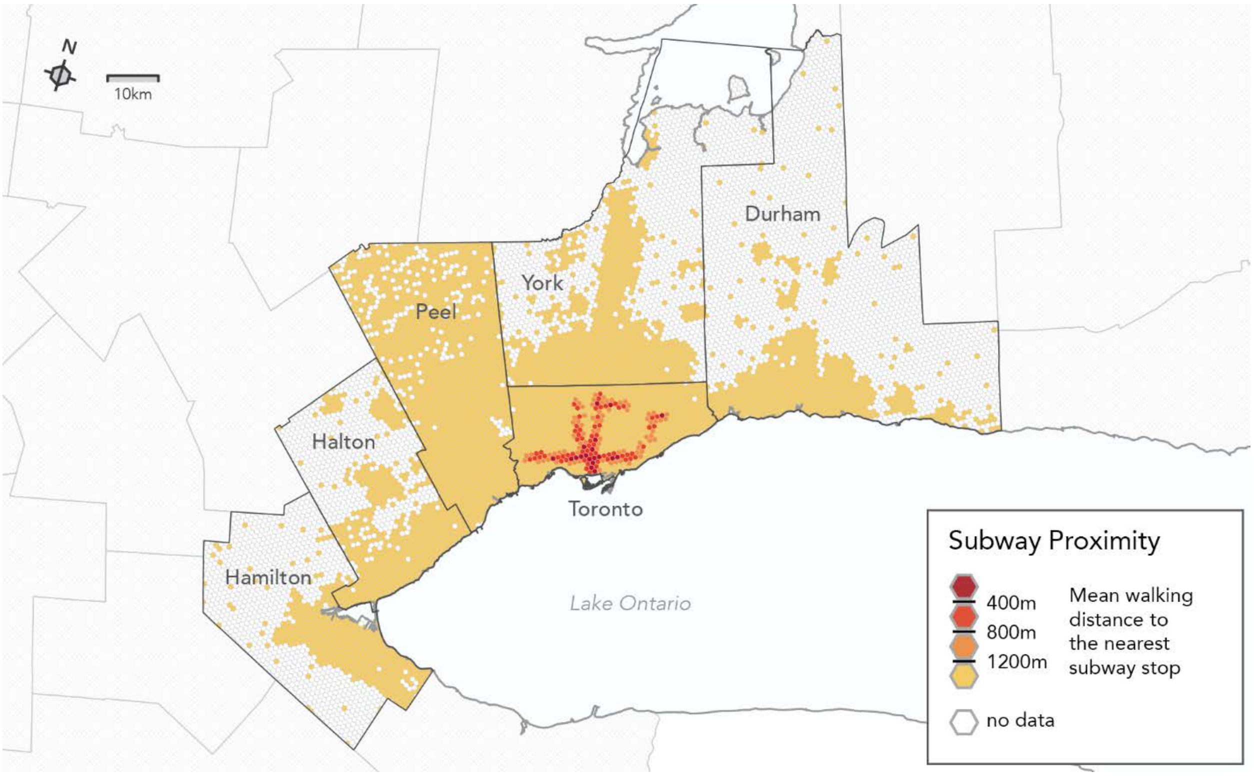

Figure 4: Walking Distance from FSALDU Centroid to Nearest Subway Stop

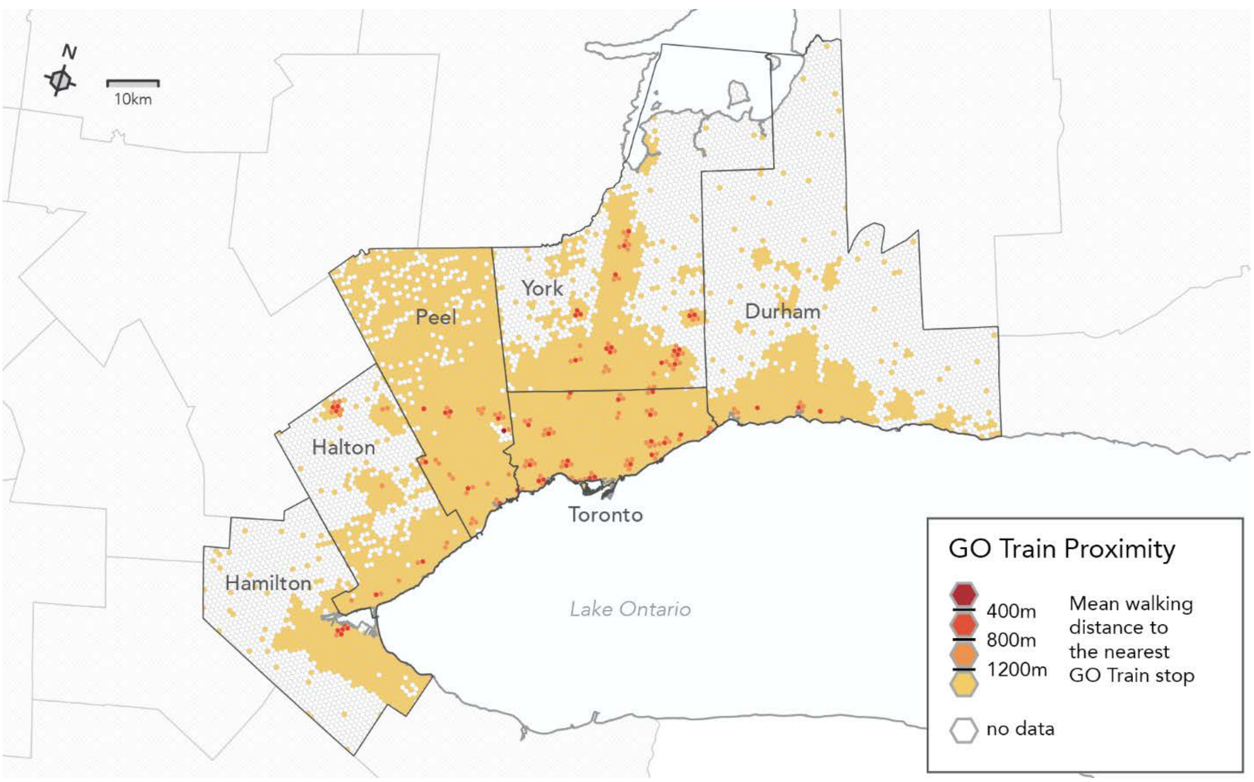

Figure 5: Walking Distance from FSALDU Centroid to Nearest GO Train Stop

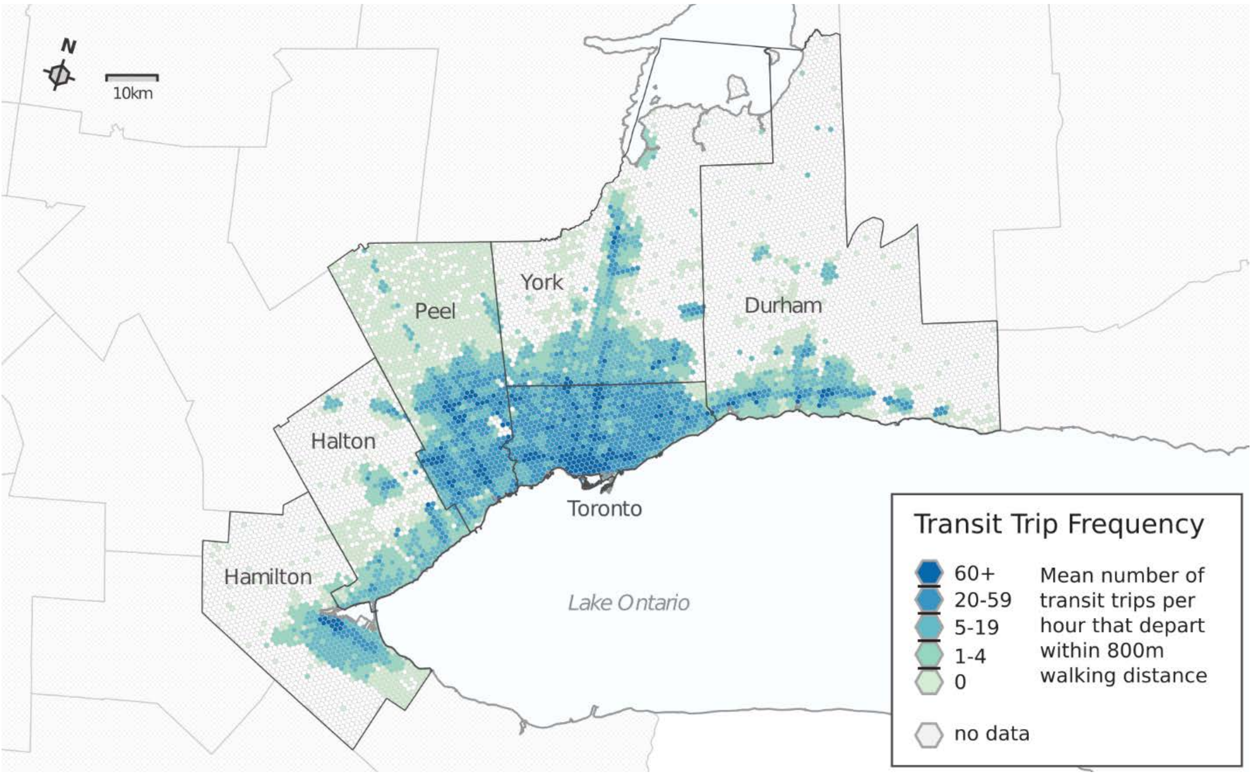

Figure 6: Level of Service: Number of Unique Transit Trips (per hour) within 800m Walking Distance from FSALDU Centroids

3.2.4 Urban Form Controls

Several urban form characteristics are known or suspected to influence the social and health outcomes of our study. For example, studies note that people walk more in neighbourhoods where intersection density is higher, but these are often the same neighbourhoods with higher levels of transit service. Accordingly, such urban form variables must be controlled for in our analysis in an attempt to isolate the independent effect of transit on health. Moreover, to more accurately depict the real lived conditions of GTHA residents, we calculated urban form variables for the 1km walkable area along the road network ("walkshed") around each survey respondent's postal code. DMTI 2014 Postal Code Suite and Route Logistics were used to geocode FSALDU's and create street network buffers. A full description of the urban form variables used in our study appears in **Table 5**. As with the transit access and LOS measures, the urban form measures show a very high degree of correspondence between the two distinct survey samples.

Table 5: Urban Form and Land Use Characteristics for the GSS and CCHS Respondents

Variable	GSS				CCHS			
	Mean	Standard Deviation	5th Percentile	95th Percentile	Mean	Standard Deviation	5th Percentile	95th Percentile
Land use diversity index	0.4077	0.1914	0.0741	0.7253	0.4323	0.1920	0.0760	0.7472
Population density of walkshed	4604.9	3169.1	610.0	10,324.2	4702.8	3281.0	853.5	10,204.3
Employment density of walkshed	1872.4	6345.4	107.9	5307.1	1572.8	3993.7	120.2	4550.8
Intersection density of walkshed	59.7	25.6	28.5	110.3	60.3	26.8	29.1	114.7
4-way intersections, as proportion of all intersections	22.9	11.4	7.6	42.5	23.2	11.9	8.5	42.1
Residential land use (% of 1km walkshed)	69.7	22.9	10.8	95.0	67.5	23.1	3.0	93.3
Commercial land use (% of 1km walkshed)	2.3	4.5	0.0	11.0	2.7	4.9	0.0	12.7
Parks and recreation land use (% of 1km walkshed)	6.9	9.6	0.0	21.1	8.0	11.1	0.0	25.1
Industrial and resource land use (% of 1km walkshed)	5.7	10.4	0.0	27.8	6.5	11.6	0.0	27.8
Gov't and institutional land use (% of 1km walkshed)	4.4	5.7	0.0	14.8	4.9	5.7	0.0	14.9

4 METHODS

Key points

- Nine health measures were assessed to provide a broad set of benchmarks.
- Obesity, diabetes and walking habits were among the factors studied, along with several social outcomes (neighbourhood ties, life satisfaction) that underpin a wide range of health outcomes.
- First, bivariate analyses tested the transit-health connection without adjusting for other factors. This also showed the distribution of health states across levels of transit access and service (i.e. which groups are being served well).
- Next, multivariate models adjusted for known and suspected confounders, "zeroing in" on the effect of transit alone.

Our research focusses on five outcomes from the GSS: 1) general health, 2) mental health, 3) knowing of neighbours, 4) favours done for neighbours, 5) life satisfaction, and four health outcomes from the CCHS: 1) obesity, 2) self-reported walking to school or work in past 3 months, 3) diabetes, and 4) asthma. Transit and urban form variables were linked to the survey microdata via each respondent's postal code. The relationships between outcome and transit variables were explored, first descriptively, using bivariate analyses, and then using logistic regression models. These approaches are detailed in this section of the report, and their results are provided in section 5.

4.1 Recoding of Outcome Variables

As a preparatory step, all outcome variables that were not already binary were dichotomized, following precedent from the current literature. This allowed comparability between outcomes.

For example, the GSS survey question "In general, would you say your mental health is excellent, very good, good, fair, or poor?" was recoded such that "excellent" and "very good" responses were recoded as the first level of the variable (the desirable health outcome) and "good", "fair" and "poor" were recoded as the second level of the variable (the undesirable health outcome). The complete recoding schema is as follows:

Survey	Survey question	Recoded as 0 (desirable health outcome)	Recoded as 1 (undesirable health outcome)
GSS q1	In general, would you say your physical health is excellent, very good, good, fair, or poor?	excellent or very good	good, fair or poor
GSS q2	In general, would you say your mental health is excellent, very good, good, fair, or poor?	excellent or very good	good, fair or poor
GSS q3	Would you say that you know most, many, a few, or none of the people in your neighbourhood?	most or many	a few or none
GSS q4	In the past month, have you done a favour for a neighbour?	yes	no
GSS q5	Using a scale of 0 to 10, where 0 means "Very dissatisfied" and 10 means "Very satisfied", how do you feel about your life as a whole right now?	7-10	1-6
CCHS q1	Obesity (a variable derived from BMI by Statistics Canada, where BMI was calculated from height, weight and age)	normal or underweight	overweight or obese
CCHS q2	Was there a time in the past 3 months when you walked to and from work or school?	yes	no
CCHS q3	Do you have diabetes? (Remember, we're interested in conditions diagnosed by a health professional and that are expected to last or have already lasted 6 months or more.)	no	yes
CCHS q4	Do you have asthma? (Remember, we're interested in conditions diagnosed by a health professional and that are expected to last or have already lasted 6 months or more.)	no	yes

These classifications are also noted in abbreviated form in each of the Appendices.

4.2 Bivariate Analysis

Bivariate analyses describe the relationship between two variables, such as the distance to respondents' first streetcar stop and their mental health. As a type of descriptive statistic, they give an indication of the "lay of the land" of this relationship, in the way tallies or headcounts would. By contrast, multivariate analyses (see below) are more complex and take into account the effect of other variables on this relationship. They allow us to answer whether distance to a respondent's first streetcar stop is *independently* associated with their mental health, even after controlling for individual-level variables such as age and income, and neighbourhood variables, such as urban form.

Since bivariate analyses do not account for controlling or confounding effects of covariates, their results need to be interpreted with some caution; some relationships may be strengthened, weakened, or reversed once additional variables are taken into account. Finally, causality cannot be implied (i.e. we cannot say that reduced distance to first streetcar stop causes improved mental health). Rather, from the bivariate results, we can say "respondents with lower mental health live farther away from their first streetcar stop". The multivariate analyses will allow us to make statements about whether these relationships persist even after taking into account a set of other controlling and confounding variables.

The bivariate analyses are presented in Appendices A2 and A3.

The tabular results provide weighted counts of survey respondents who live within four walking distance bands (<400m, 400-800m, 800-1200m, >1200m) to the nearest transit stop offering each type of service (bus, streetcar, subway, commuter rail). The Appendices A2 and A3 express the GSS and CCHS bivariate statistics results in four ways:

1. raw counts per outcome and distance band
2. percentages by distance band
3. indexed results (the most straightforward way to compare between distance bands and outcomes.)
4. percentages by outcome

TIP: Interpreting Bivariate Results (Appendices A2 and A3)

This section offers sample interpretations of the four formats above, using Appendix A2 as an example. Appendix A3 is interpreted the same way.

Note that the full set of bivariate results for both the GSS and CCHS surveys can be found in Section 5 "Results" section of this report.

Worksheet 1: Counts

The Counts sheet of Appendix 2 contains the raw weighted counts of respondents rounded to the nearest 50 people, as per Statistics Canada privacy requirements. As an example of how to interpret this table, the *Total* row of the "Self-rated health – binary" columns tells is that 3.386 million residents of the GTHA report having "Excellent or Very Good" overall health (considered good health), while 2.2 million report having "Good, Fair or Poor" overall health (considered poor health). Moving down those same columns, we see from the "Bus <400m" row that 1.6 million residents with poor health live within 400m of a bus stop.

Worksheet 2: Percentages by Distance Band

The Percentages by Distance Band sheet recasts the weighted and rounded counts in terms of percentages by mode and distance band. In the "Excellent, Very Good" column of "Self-rated health – binary", the rows *Bus <400m, Bus 400-800m, Bus 800-1200m* and *Bus >1200m* represent the breakdown of how the good general health population is distributed with respect to distance to bus stops. We see that 69.5% live within 400m, 22% between 400-800m, 3% between 800m-1200m and 6% at walking distances greater than 1200m from their nearest bus stop. This can be compared to the percentages in the next column (Good, Fair or Poor), indicating that the unhealthy population is, on average, living closer to bus stops (74% within 400m) in comparison to those rating themselves as healthy (69.5%).

Worksheet 3: Indexed Results

To make such comparisons easier, the Indexed Results sheet recasts the Percentages by Distance Band by standardizing against the overall population distribution within each distance band. So, using the same example as above, we calculated that 71% of the overall population lives within a 400m walk to a bus stop. At the same time, from the Percentages by Distance Band worksheet we know that 69.5% of the healthy population and 74% of the unhealthy population lives within this band. By dividing each of these percentages by the overall rate of 71%, we obtain indices of 0.97 and 1.04 for healthy and unhealthy respondents within 400m respectively (i.e. the "Excellent, Very Good" and "Good, Fair or Poor" columns of "Self-rated health – binary", respectively, for the *Bus <400m* row. This index therefore gives us a measure of expected results: an index less than 1 indicates that fewer than expected people live in that distance band, and indices greater than 1 indicate more than expected people live in that distance band. As another example, in the "Good, Fair or Poor" column of "Self-rated mental health – binary" for the row *Streetcar <400m*, the index of 1.09 indicates that, compared to the overall population, people with poor mental health are more likely to live within 400m of a streetcar.

Importantly, since the indices are ratios of percentages, this means that this index of 1.09 suggests that those with poor mental health are 9% more likely than the overall population to be serviced by close proximity to streetcars.

Worksheet 4: Percentages by Outcome

The Percentages by Outcome sheet assesses each distance band and displays how the population within that bandwidth is distributed amongst each health outcome. For example, , the *Bus <400m* row of the "Self-rated health – binary" columns tells us that 59% of the population living within 400m of a bus stop identifies as healthy, while 41% identifies as unhealthy. If we compare these to the *Total* row (i.e. the overall split in the overall population) in healthy/unhealthy, we see a 60/40 split. Comparing this to the Bus <400 row, we see that those within 400m of a bus stop are slightly more likely than expected to be unhealthy. Again, we can standardize these percentages against their expected values to obtain indices. However, due to the quantities being standardized, the indices obtained by standardizing these percentages would be identical to those produced above.

Difference of Means Tests

Finally, we draw your attention to the use of *italics* in the bivariate Appendices (A2 and A3) to indicate statistically significant differences according to a t-test of equal percentages at the 95% confidence level. For example, returning again to Appendix A2, consider the Percentages by Distance Band worksheet. For in the "Good, Fair or Poor" column of "Self-rated health – binary" for the row *Bus <400m*, we can observe that the percentage of poor health respondents within 400 meters of a bus stop is 74.0%, and the italics indicate that this percentage is *significantly* greater (at the 95% confidence level) than the percentage of good health respondents within 400 meters (69.5%). Here, the significance of the result indicates that the difference in percentages is large enough to be more than the margin of error incurred by the sampling procedure. Differences that are insignificant should be interpreted with extreme caution, since they are likely to be due to the use of survey sampling.

4.3 Multivariate Analysis

Multivariate models are used to estimate the relationship between a single outcome variable (e.g. mental health) and a set of multiple independent variables. In this research, we further divide the independent variables into variables of interest, such as *proximity to transit* and *transit level-of-service*, and control variables, such as age, income, and neighbourhood urban form, whose effects we are trying to separate from the effect of the variables of interest. In doing so, our goal is to measure the relationship between transit and health alone, while removing the possible effects of as many other factors related to health as is possible given our datasets.

In these multivariable models, we employ binomial logistic regressions to estimate the impact of each independent variable on the probability of a respondent stating a poor health outcome. This process is repeated for each of the 9 outcome variables using a consistent set of independent variables for the entire sample of respondents that reside in the GTHA. This provides us with an estimate of whether or not transit access and LOS is associated with higher or lower risks of poor health, even after controlling for the individual and neighbourhood determinants of health

While these estimates are a useful benchmark for the GTHA as a whole, we also look deeper into the sample at several populations of special interest. We repeat the modelling procedure for subgroups of the sample, called *strata,* who are hypothesized to have unique health risk factors, and potentially differing relationships between health and transit. Using precedent from current research literature, our selection of strata are:

1) Age (15-65, 65-74, 75+ years old)
2) Income (<40k, >150k)
3) Gender (male, female)
4) Immigration status (born in Canada, foreign born)
5) Respondent has children <4 years old at home (yes, no) [<5 in CCHS]
6) Respondent has children 5-14 years old at home (yes, no) [6-15 in CCHS]
7) Respondent has children 15-18 years old at home (yes, no) [15-17 in CCHS]
8) Municipality (Toronto, other)

TIP: Interpreting Logistic Regression Models

There are several equivalent ways to define the functional form of a binomial logistic regression model. Perhaps the simplest form is:

$$P(A|X) = \frac{1}{1 + e^{-X\beta}}$$

where $P(A|X)$ is the probability of an event, A (i.e. poor health), given a vector of independent variables, X, e is the base of the natural logarithm, and β is a vector of regression coefficients to be estimated. In the above notation, $X\beta$ is equivalent to the commonly found right-hand side of a linear regression, e.g. $\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots \beta_k x_k$.

In this notation e^{β_1} is interpreted as the odds ratio (OR) for the variable x_1. For a 1-unit increase in x_1, the odds of event A occurring is increased by a factor of e^{β_1}. Due to this very convenient interpretation of the regression coefficients, our results are reported using odds ratios. For each variable, we are also able to estimate whether β_k is significantly different to 0, or in other words, whether the OR is statistically different to 1. We present the significance level of each OR using its associated p-value. Put very simply, this p-value represents how likely a result would occur by chance. For example, "$p \leq 0.01$" indicates that the observed outcome would be expected to occur by chance less than 1 in 100 times if the test was repeated on different samples of the population. Similarly, "$p \leq 0.05$" indicates this would be expected in less than 1 in 20 times.

For example, consider *Table 6: Full Sample Logistic Regression Results for the Five GSS Outcomes* (page 36). For the column General Health and the row Age Group of Respondent: 35 to 44 , the OR of 1.765 means that this group is 76% more likely to report “good, fair or poor” general health than the reference group (responders age 15-24). By contrast, if instead the OR was 0.80, this would mean that this group is 20% less likely (since 1.00 - 0.80=0.20) to report “good, fair or poor” general health.

> **TIP:** for more examples of how to interpret these tables of odds ratios, see *TIP: Interpreting results in these tables* (page 35)

When interpreting the ORs, one must also consider whether the coefficient is for a categorical or continuous variable. In the case of categorical variables, such as the “distance to nearest transit stop” variables of interest, the OR is used to compare a specific access level to the reference level of a stop being more than 1200 meters away. For a continuously measured variable, such as transit LOS (measured in 1,000’s of trips per day), the OR captures the hypothetical addition of 1,000 more daily trips within reach of a respondent.

In addition to the ORs and significance tests for each variable, the sample size and Nagelkerke’s r^2 are used to assess each model’s goodness-of-fit. We use Nagelkerke’s r^2 to assess whether our models are behaving within acceptable thresholds found in the literature. Generally, higher Nagelkerke’s r^2 indicate better model performance, with normal ranges for complex social and health outcome models between 0.1 and 0.4.

5 RESULTS

Key points

- Bivariate results do not take into account confounding factors, but they do point to **distribution trends** in the transit-health relationship. Of note: those with poor health and social outcomes tend to have better access to bus and rail than other groups, a positive sign of good access for these vulnerable groups. This trend was less clear for streetcar and subway access. >> page 33

- Multivariate results do adjust for confounding factors, so they zero in on transit effects as best as possible. Some notable results are:
  - Streetcar access is associated with better general health, and increased likelihood of knowing neighbours and doing favours for neighbours, even after adjusting for other confounders like income. >> page 43
  - Overall, more people know their neighbours (and do favours for neighbours) when transit access and service is better. >> page 44
  - Close proximity to a bus stop was associated with positive mental health among 65-74 year olds. >> page 44
  - Diabetes risk is high with all levels of bus access except the most distant (>1200m). This could be due to a negative aspect of such neighbourhoods not measured by these models, such as certain automobile-oriented characteristics. >> page 52
  - Obesity risk is markedly low in both of the middle access bands (400-800, 800-1200m) of subway. This is true across most subpopulations within the main sample, as well. Perhaps these distances to an attractive mode spurs active transport to the station? >> page 52
  - Walking was less likely with high service close to home (<400m), but more likely with high service in the next band (400-800m), a possible "big carrot" effect. >> page 52 and Table 9
  - Walking likelihoods are highest in close proximity to streetcar (<400m) and fairly close proximity to commuter rail (400-800m) >> page 52 and Table 9
  - Appendix 4 provide a rich collection of detailed results that are very suitable for communications purposes

5.1 Bivariate GSS

In this section, we share findings from our bivariate analysis of transit service and GSS outcomes. As a reminder, each of the five health and social outcomes has been dichotomized into two categories, simply referred to “good” and “poor” in the analysis below, and the bivariate results tell us how likely it is for residents of the GTHA with each health outcome to live within each distance band to transit service. We are particularly interested in transit-health relationships that are consistent across multiple health outcomes and modes of transit. These bivariate results offer a snapshot of how close different health-related groups (i.e. good versus poor mental health) live to the various modes of public transit in the region. These results do not take into account the effects of any other correlated effects, such as income, which may also be involved in the transit-health relationship. The latter are considered in the multivariate analysis, which are therefore more comprehensive. Nevertheless, we see the following trends emerging from the bivariate GSS analysis (Appendices 2 and 3):

1) Bus Access. Respondents with "poor" health and social outcomes are more likely to be living within close proximity to bus stops as compared to respondents with "good" outcomes. This indicates that the population with poor health has more access to the bus system in the GTHA.

2) Rail Access. The patterns for rail accessibility are similar to bus. Compared to those with "good" health and social outcomes, respondents with "poor" health and social outcomes have better access to rail. Specifically, those with "poor" health are more likely to be living within walking distance of commuter rail stops on the GO network.

3) Streetcar Access. Streetcar is disproportionately provided to respondents with "good" general health. At the same time, it is disproportionately provided to respondents with "poor" mental health, knowing of neighbours and life satisfaction. It can be noted that few of the t-tests for streetcar access were statistically significant at the 95% confidence level.

4) Subway Access. The results for subway indicate a very mixed and insignificant connection with general and mental health. Interestingly, people living within closer proximity of subways are far less likely to report knowing their neighbours, but those 800-1200 meters from a subway report much higher than average levels of knowing neighbours (a statistically significant index of 1.29). This might indicate that the more cohesive neighbourhoods are located farther away from actual subway stations, but that the presence of people walking to subways has a positive effect of knowing neighbours.

5.2 Bivariate CCHS

The results for bivariate analysis of the CCHS outcome variables are structured similarly to those for GSS and are found in Appendix A3. Given the pattern of results, it is more straightforward to summarize the results according to health outcome, rather than transit mode, as was done for the GSS. The major findings are as follows:

1) High BMI (Obesity) is most clearly related to subway proximity. Those living within 400-1200 meters of a subway station are 30% more likely to have a healthier BMI.
2) The results for walking to work or school are similar to but stronger than those for BMI. We see that proximity of subway, streetcar and rail are all very strongly associated with increased walking. At the same time, those living 800 meters or more away from a bus stop are far less likely to walk to work or school.
3) The diabetes outcome shows a less consistent pattern of relations to transit proximity. Close proximity of busses is associated with increased diabetes rates, while people living more than 1200m from bus stops are about 40% less likely to report having diabetes. At the same time, people living far away from streetcars or from subways are both more likely to report diabetes.
4) Finally, none of the t-tests for asthma rates were significant, indicating that proximity to transit does not have a strong bivariate relationship with this outcome.

5.3 Multivariate GSS

Full-Sample Results

In total, the GSS results include regression models for 5 outcomes and 18 strata. Below, we present the results for only the full-sample models (i.e. not individual strata) in Table 6. The table displays ORs for each independent variable, but we limit our attention to the transit variables in focus in this study, which appear at the top of the table. For categorical variables, the reference group is the first level of each variable (e.g. for the variable Census division code, it is Toronto) except for the transit access variables where the reference group is the >1200m distance band, as noted. Significance levels are denoted with red (p<0.01) or orange (p<0.05) backgrounds.

TIP: Interpreting results in these tables

Example 1: Under *Streetcar* for the outcome *General Health*, we see this result:

	General Health
⋮	⋮
800 to 1200m	0.546

0.546 is an odds ratio (or "OR") that compares the odds of people living in the 800-1200m band reporting the undesirable health outcome (*good, fair or poor* general health) compared to the odds of people in the reference group (who live in the > 1200m band) doing so. If the OR was 1.00, the odds would be the same. Instead, we see that the odds are less than 1. In fact, they are 0.454 less than 1 (since 1-0.546=0.454).

So we can express that 0.454 as a percentage, and say "Residents who live 800-1200m from a streetcar stop are 45.4% **less likely** to report good, fair or poor general health than those living more than 1200m from a stop".

Alternatively, we can phrase this in terms of the positive health outcome by reversing the sentence, which is often more intuitive to readers. Since appendix A2 shows us that the positive health outcome was *excellent or very good health,* we can say "Residents who live 800-1200m from a streetcar stop are 45.4% **more likely** to report **excellent or very good health** than those living more than 1200m from a stop". In either case, the orange shade of the OR cell indicates that this odds ratio is statistically significant at p ≤0.05.

Example 2: Hypothetically, suppose the OR in Example 1 was 1.70 instead of 0.546:

	General Health
⋮	⋮
800 to 1200m	1.70

The odds are now greater than 1, specifically 1-1.70 = -0.70, or -70%. This negative percentage means the trend is the opposite direction of Example 1, so we can say "Residents who live 800-1200m from a streetcar stop are 70% **less likely** to report **excellent or very good health** than those living more than 1200m from a stop".

For further reading: see "TIP: Interpreting Logistic Regression Models" in the Methods section (page 31) which also reviews Nagelkerke's r^2 and significance levels.

Table 6: Full Sample Logistic Regression Results for the Five GSS Outcomes

		General Health	Mental Health	Knowing of Neighbours	Favours Done for Neighbours	Life Satisfaction
	Unweighted count	6732	6727	6751	6658	6479
	Nagelkerke's r^2	0.147	0.087	0.148	0.112	0.101
		Odds ratio	Odds ratio	Odds ratio	Odds ratio	Odds ratio
Transit variables						
Bus: distance from home to first stop	0 to 400m	1.266	1.260	0.925	0.749	1.022
	400 to 800m	1.185	1.216	0.938	0.745	1.017
	800 to 1200m	0.882	1.236	0.806	0.566	1.026
	> 1200m *(reference category)*					
Streetcar: distance from home to first stop	0 to 400m	0.713	1.292	.562	0.679	0.971
	400 to 800m	0.676	1.285	.448	0.748	1.634
	800 to 1200m	0.546	1.537	0.635	0.709	1.940
	> 1200m *(reference category)*					
Subway: distance from home to first stop	0 to 400m	0.834	1.022	0.931	0.938	0.655
	400 to 800m	1.020	.842	0.958	0.889	0.877
	800 to 1200m	1.026	1.187	0.603	0.864	1.312
	> 1200m *(reference category)*					
Rail: distance from home to first stop	0 to 400m	1.598	0.865	1.084	0.765	0.706
	400 to 800m	1.081	1.475	.842	0.878	0.960
	800 to 1200m	1.360	0.819	.769	1.114	1.168
	> 1200m *(reference category)*					
# transit trips reachable over a typical 24 hour period / 1,000	0-400m walk from home	1.008	1.000	1.206	1.075	1.043
	400-800m walk from home	0.928	1.000	1.016	1.020	0.992
	800-1200m walk from home	1.082	1.000	0.983	1.070	0.997
Urban Form variables						
Census division code of the respondent's residence	Toronto					
	Durham	1.422	1.030	1.053	.970	1.449
	York	1.054	1.097	1.316	1.419	1.264
	Peel	1.052	.963	1.176	1.201	1.172
	Halton	1.150	1.062	1.025	1.089	1.156
	Hamilton	1.102	1.268	.735	1.058	1.149
Land use diversity index		0.877	1.143	.682	1.158	1.151
Population density of walkshed / 1000		1.031	1.023	1.003	1.013	1.024
Employment density of walkshed / 1000		1.007	0.993	1.017	1.024	1.005
Intersection density of walkshed		1.000	0.999	1.005	1.000	0.999
4-way intersection: proportion of all intersections		1.441	1.149	0.960	1.294	1.728
Residential land use (% of 1km walkshed)		1.138	.802	0.933	1.242	1.071

		General Health	Mental Health	Knowing of Neighbours	Favours Done for Neighbours	Life Satisfaction
Commercial land use (% of 1km walkshed)		0.228	.335	1.011	1.332	0.925
Parks and recr land use (% of 1km walkshed)		0.724	.606	0.792	1.534	0.863
Industrial and resource land use (% of 1km walkshed)		1.902	1.317	1.211	0.754	1.550
Gov't and institutional land use (% of 1km walkshed)		0.893	0.944	0.316	0.258	1.314
Individual/Household variables						
Sex of respondent	Female					
	Male	1.020	0.877	0.954	0.821	1.105
Age group of the respondent (groups of 10).	15 to 24					
	25 to 34	1.293	1.267	2.401	1.479	1.195
	35 to 44	1.765	1.558	2.840	1.410	1.776
	45 to 54	2.316	1.650	2.687	1.252	1.442
	55 to 64	2.352	1.601	2.392	1.156	1.278
	65 to 74	2.287	1.341	2.280	1.159	0.902
	75 years and over	3.018	1.765	2.528	2.039	0.991
Total household income	None to $19,999					
	$20,000 to $39,999	1.092	1.111	0.968	1.149	0.868
	$40,000 to $59,999	1.027	0.830	0.867	0.901	0.826
	$60,000 to $79,999	0.933	0.724	0.996	0.883	0.809
	$80,000 to $99,999	0.831	0.805	1.010	0.961	0.774
	over $100,000	0.692	0.732	0.849	0.652	0.548
	Don't know/Refusal	0.847	0.879	1.015	0.892	0.636
Education - highest degree	Less than high school diploma or its equivalent					
	High school diploma or equivalency certificate	0.792	0.746	1.106	0.812	1.161
	Certificate or diploma from trade, community college or CEGEP, or university certificate below the bachelors level	0.705	0.633	1.041	0.884	0.976
	Bachelor's degree	0.477	0.491	1.139	0.935	1.024
	University certificate, diploma, degree above the BA level	0.447	0.470	1.021	0.673	1.078
	Don't know/Refusal	0.633	1.193	0.887	0.702	1.787
Employed last week	Yes					
	No	0.939	1.004	1.152	0.962	1.328
	Don't know/Refusal	0.583	0.745	0.818	0.376	0.469
Language first spoken in childhood - English	Yes					
	No	1.384	1.100	1.020	1.163	1.185
	Don't know/Refusal	1.267	2.083	1.748	0.766	1.389
Home is owned by a household member	Yes					
	No	1.228	1.354	1.209	1.082	1.408
	Don't know/Refusal	1.859	1.229	1.378	0.721	1.428
Single child(ren) 0-4 living in the household	Yes	1.068	0.825	0.756	0.726	0.713

		General Health	Mental Health	Knowing of Neighbours	Favours Done for Neighbours	Life Satisfaction
Single child(ren) 5-14 in household	Yes	0.942	1.081	0.668	0.559	1.003
Single child(ren) 15-18 in household	Yes	1.091	1.031	0.781	0.897	0.942
Household size of respondent	1					
	2	1.226	1.051	1.247	1.016	1.105
	3	1.299	1.235	1.111	1.323	1.357
	4	1.175	1.116	0.975	1.391	1.043
	5 or more	1.253	0.996	0.848	1.538	1.180
Marital status	Married or common-law					
	Divorced/separated/widowed	1.053	1.187	1.363	1.332	1.613
	Single	1.282	1.416	1.607	1.595	1.828
	Don't know/Refusal or other	1.064	3.072	1.568	1.769	4.150
Main activity in past 3 months	Working at a paid job or business					
	Looking for paid work	2.011	1.871	0.868	0.860	1.837
	Going to school	0.725	0.871	1.140	1.149	0.689
	Caring for children, household work, or parental leave	1.208	0.920	0.648	1.009	0.823
	Retired	1.450	1.191	0.805	0.923	0.676
	Long term illness	8.861	4.521	1.070	1.351	2.898
	Don't know/Refusal or other	2.069	2.221	1.397	1.007	1.737
Born outside of Canada	Born in Canada					
	Born outside of Canada	0.978	0.931	1.096	1.199	.844
	Don't know/Refusal or other	1.390	1.254	1.080	1.145	1.372
Ethnic background of the respondent	European					
	Chinese only	1.545	1.510	1.812	1.169	1.437
	South Asian only (East Indian, Sri Lankan, Pakistani, Punjab)	1.459	1.331	0.929	0.825	1.089
	Other	1.168	1.242	1.185	1.004	1.070
	Don't know/Refusal or other	1.128	1.091	0.726	1.324	0.993
Time lived in current dwelling *	Less than 1 year					
	1year to less than 5 years	0.899	0.919	0.466	0.682	0.895
	5year to less than 10years	0.985	0.868	0.344	0.672	1.002
	10years and over	0.877	0.895	0.185	0.597	1.042
	Don't know/Refusal	1.812	0.983	0.620	0.823	1.052
Dwelling type *	Single detached house					
	Semi-detached, double, garden, town-house, row house, duplex	1.183	0.997	1.062	0.897	1.098
	Low-rise apartment (less than 5 stories)	1.144	0.879	1.228	1.191	0.972
	High-rise apartment (5 or more stories)	0.973	0.766	1.121	1.219	0.965
	Mobile home, trailer or other	1.187	0.641	0.869	0.802	1.214
	Don't know/Refusal	0.550	0.480	0.522	0.966	1.766
GSS cycle	26 (2012)					
	27 (2013)	0.765	0.792	1.117	0.656	0.990
Constant		0.251	0.399	1.978	0.687	0.224

		General Health	Mental Health	Knowing of Neighbours	Favours Done for Neighbours	Life Satisfaction
	Number of significant variables (total)	40	30	36	36	33
	Number of significant variables (transit)	1	0	4	2	2

Notes:

Significant at p ≤ 0.01
Significant at p ≤ 0.05
* Variable available in this survey, but not available in CCHS

The major result of the above full-sample regressions is that transit access only has a minor impact on the five GSS outcomes. The strongest findings are that streetcar access is associated with greater levels of general health, increased likelihood of knowing neighbours and doing favours for neighbours, and yet a decreased likelihood of having high life satisfaction for all but the closest band. There does not appear to be a relationship between streetcar access and mental health. In fact, according to these full-sample models, none of the transit variables are significantly related to mental health.

Living close to a bus stop (400-800 meters) is associated with doing favours for neighbours, but none of the other outcomes. Living somewhat close to a commuter rail station (800-1200 meters) is associated with a decline in general health, while living somewhat close to a subway stop (800-1200 meters) is positively related with doing favours for neighbours. Finally, for the LOS variables, the only significant relationship found is that higher LOS within 0-400 meters is actually associated with knowing fewer neighbours.

The lack of overall significance in the full-sample models is not all that surprising for three reasons. First, the models control for a very comprehensive set of urban form characteristics that are known to influence health and social well-being. Many of these are *also* associated with the presence and use of transit, so when controlling for urban form, we may also be controlling for these transit effects, possibly even removing their effect. Accordingly, we may not see a strong independent effect of transit availability. Second, the health and social benefits of transit accrue to the actual users of transit, not via a neighbourhood or ecological effect. It was our hope that high levels of transit access and service would serve as a proxy for transit use — not measured by these Statistics Canada surveys — but this does not appear to be confirmed by our analysis. Third, while the full-sample models control for socioeconomic factors, they do not allow for the detection of interactions, or differing effects of transit on health for different socioeconomic groups. We need to investigate the stratified modelling results for this.

Stratified Results

We present the stratified regression results for all transit access and LOS variables in Appendix A4 (adjusted by all other predictors which are not shown). To simplify and summarize these results, we also present a graphical interpretation in Table 7, below. Each block in Table 7 pertains to a different outcome, each row a measure of transit access or LOS, and each column a stratum. The entries in the table indicate the strength and direction of relationship between a transit variable and an outcome amongst a particular population subgroup. A green plus sign ("+") indicates a statistically significant positive effect on health, a red minus sign (“-“) indicates a significant negative effect, and a gold cell indicates no significant effect. Blank cells indicate where there were insufficient numbers of respondents in that set of conditions to generate a reliable result. We summarize the results tables by outcome and mode of transit. In doing so, we focus our attention to series of relationships that are pervasive across multiple social groups, as these provide more robust evidence of causal relationships as compared to sporadic significant coefficients. This summary appears below.

(Continued on next page)

Table 7: Graphical Depiction of the Stratified Transit Access and Level of Service Impacts on Five GSS Outcomes

	Full sample	15-65	65-74	75+	<40k	>150k	Female	Male	Canada Born	Foreign Born	C0-4 No	C0-4 Yes	C5-14 No	C5-14 Yes	C15-18 No	C15-18 Yes	Toronto	Suburbs
General Health																		
Bus - 0-400											-							
Bus - 400-800						-												
Bus - 800-1200																		
Streetcar - 0-400	+	+							+		+		+					
Streetcar - 400-800	+	+				+		+	+				+					
Streetcar - 800-1200	+	+						+		+	+		+		+			
Subway - 0-400		+												+				
Subway - 400-800																		
Subway - 800-1200																		
Rail - 0-400																		
Rail - 400-800										-						-		-
Rail - 800-1200	-									-	-		-					
Trips 0-400														-				
Trips 400-800									+									
Trips 800-1200		-					-											

	Full sample	15-65	65-74	75+	<40k	>150k	Female	Male	Canada Born	Foreign Born	C0-4 No	C0-4 Yes	C5-14 No	C5-14 Yes	C15-18 No	C15-18 Yes	Toronto	Suburbs
Mental Health																		
Bus - 0-400		-	+					-	-		-					-		
Bus - 400-800								-								-		
Bus - 800-1200			+											-		-		
Streetcar - 0-400										-								
Streetcar - 400-800										-				-				
Streetcar - 800-1200		-				-	-			-	-						-	
Subway - 0-400						+												
Subway - 400-800					-													
Subway - 800-1200																		
Rail - 0-400																		
Rail - 400-800		-									-							-
Rail - 800-1200			-				+											
Trips 0-400																		
Trips 400-800				-														
Trips 800-1200																		

	Full sample	15-65	65-74	75+	<40k	>150k	Female	Male	Canada Born	Foreign Born	C0-4 No	C0-4 Yes	C5-14 No	C5-14 Yes	C15-18 No	C15-18 Yes	Toronto	Suburbs
Know People																		
Bus - 0-400			-															
Bus - 400-800						+												+
Bus - 800-1200												+						
Streetcar - 0-400	+	+					+	+	+		+		+	+	+			
Streetcar - 400-800	+	+				+	+	+	+		+		+		+		+	
Streetcar - 800-1200	+								+				+					
Subway - 0-400						+												
Subway - 400-800														+				
Subway - 800-1200	+							+	+		+		+	+	+		+	
Rail - 0-400																		
Rail - 400-800																		+
Rail - 800-1200		+						+	+						+	-	+	
Trips 0-400	-	-						-		-		-		-	-	-	-	-
Trips 400-800																-		
Trips 800-1200																		

	Full sample	15-65	65-74	75+	<40k	>150k	Female	Male	Canada Born	Foreign Born	C0-4 No	C0-4 Yes	C5-14 No	C5-14 Yes	C15-18 No	C15-18 Yes	Toronto	Suburbs
Favours Done																		
Bus - 0-400				+			+				+				+			+
Bus - 400-800	+	+		+			+				+			+	+			+
Bus - 800-1200							+		+		+			+	+			+
Streetcar - 0-400	+	+						+	+		+				+			
Streetcar - 400-800									+						+	-		
Streetcar - 800-1200																		
Subway - 0-400																		
Subway - 400-800																		
Subway - 800-1200																		
Rail - 0-400							+											
Rail - 400-800																		
Rail - 800-1200												+				-		
Trips 0-400																	-	
Trips 400-800																	-	
Trips 800-1200																	-	

	Full sample	15-65	65-74	75+	<40k	>150k	Female	Male	Canada Born	Foreign Born	C0-4 No	C0-4 Yes	C5-14 No	C5-14 Yes	C15-18 No	C15-18 Yes	Toronto	Suburbs
Life Satisfaction																		
Bus - 0-400																		
Bus - 400-800																-		
Bus - 800-1200										-								
Streetcar - 0-400																		
Streetcar - 400-800	-	-			-	-		-	-		-		-		-		-	
Streetcar - 800-1200	-	-						-	-	-	-		-		-		-	
Subway - 0-400		+						+					+					
Subway - 400-800			-		-													
Subway - 800-1200			-								-				-			
Rail - 0-400																		
Rail - 400-800																		
Rail - 800-1200																		
Trips 0-400								-										
Trips 400-800												+						
Trips 800-1200																		

Table Legend

	Not statistically significant
+	Positive association with health (statistically significant)
-	Negative association with health (statistically significant)
	Not applicable

Next, we discuss these tables in more detail.

General Health

Overall, for most strata, transit has a positive effect on general health. This is supported by 21 significant positive coefficients, and 12 negative ones. Streetcar proximity was positively associated with increased general health amongst the full sample, but seems not to have any specific effect among many of the vulnerable groups: the elderly, those with low household income, women, those with children at home. In fact, streetcar access mostly associated with increased health among men, non-elderly, Canadian born residents, and those who do not have children at home.

Bus and subway proximity were overall very benign, with only two sporadic significant and negative coefficients for bus access, and two positive coefficients for subway. This may indicate slightly more positive associations between subway and health compared to bus, but the evidence is not overwhelmingly supportive of this hypothesis.

Rail proximity has slightly negative associations with general health. Access in the 800-1200 meter range has a negative baseline impact, but this only remains significant amongst three strata: foreign born, not having children 0-4 years old, and not having children 5-14 years old. Rail within the 400-800 meter range also had some negative associations with health, specifically among the foreign born, those with teenagers at home, and those living outside of the City of Toronto.

The LOS variables were mostly insignificant across all strata.

Mental Health

Overall, there were 24 significant and negative transit coefficients and 4 positive ones, indicating that transit access in the GTHA is associated with worse mental health outcomes. None of the transit variables were significant correlates of mental health in the full-sample model, but there are a few patterns for streetcar and bus access within individual strata that are worth highlighting. Streetcar proximity, was curiously associated with negative mental health outcomes amongst foreign-born respondents at all distance levels. In the 800-1200 meter range, streetcar proximity had a negative effect for: 15-65 year olds, high income households, females, foreign born, Torontonians and those without young children at home. Close proximity to a bus stop was associated with positive mental health among 65-74 year olds, but with negative outcomes for many of the less vulnerable strata: 15-65 year olds, men, Canadian-born, etc. Except for a few cases, rail, subway and LOS variables are mostly found to be insignificant predictors of mental health. The interesting exceptions are that close proximity to subway (0-400m) has a positive impact on mental health among wealthier households, but has no impact on any other strata.

Knowing Neighbours

The overall impact of transit on knowing neighbours appears to be a positive one. There are 41 positive coefficients and only 13 negative ones. Most strikingly, we see that streetcar proximity is strongly associated with knowing neighbours, although, as with general health, the positive impact is not necessarily felt by many of the traditionally more vulnerable strata, except women. At the same time, LOS within 0-400m is strongly associated with knowing fewer neighbours for most strata. This may be due to high LOS serving as a proxy for busy, and perhaps less cohesive, neighbourhoods, diminishing the opportunities for residents to know their neighbours. Interestingly the impacts of bus and rail access are relatively negligible, although subway proximity within the 800-1200m range seems to have a positive impact on knowing neighbours for many of the strata. The combination of results indicates that higher order transit (streetcars and subways) enables the knowing of neighbours, but the impact is counteracted if those same neighbourhoods serve as very busy transit hubs. Therefore, the strongest positive impacts of higher order transit accrue to those living slightly farther away at 800-1200 meters from the access station.

Doing Favours for Neighbours

As with the previous social outcome, transit's role in doing favours for neighbours seems to be a positive one with 28 positive coefficients and 5 negative ones. Interestingly, LOS within Toronto is associated with negative outcomes, echoing the thought that the busiest neighbourhoods are too busy to support neighbourly relations. That being said, streetcar and bus proximity quite clearly has many positive effects on doing favours. Access to these two modes at the 0-400m level are positive in the full-sample model. Mirroring the "Know People" pattern of results, nearby streetcar access is significant and positive for 15-65 year olds, males and Canadian born, echoing previous findings that the benefits of streetcar proximity mostly accrue to less vulnerable groups. However, for bus proximity, bus access attains significance within several of the more marginalized strata: seniors 75 years or older and women, as well as among those living outside of City of Toronto.

Life Satisfaction

Transit proximity is curiously associated with poorer levels of life satisfaction with 27 negative and only 4 positive coefficients. The negative effects are concentrated among the 400-800m and 800-1200m streetcar proximity measures, and mostly impact the non-marginalized groups (except for low-income households and foreign born). Interestingly, 3 of the 4 positive coefficients are for 0-400m subway proximity, but the effects are concentrated among the non-elderly, males, and those without children 5-14 years old at home.

5.4 Multivariate CCHS

In the same manner as above, we now move to results from the CCHS. First we present findings from the full-sample model for each outcome variable. After this, we present the results for the stratified sub-sample models.

Full-Sample Results

Recall that the full-sample results refer to non-stratified models, meaning those containing estimates using the complete sample of CCHS respondents in the GTHA. The results for these models appear in Table 8 below.

This table can be interpreted in the same way as the analogous GSS table (Table 6). For guidance and examples, see the "Tips" section on page 35 that precedes Table 6.

Table 8: Full Sample Logistic Regression Results for the Four CCHS Outcomes

		Obesity	Walking to school or work in past 3 months	Diabetes	Asthma
	Unweighted count	5188	3726	5855	5857
	Nagelkerke's r^2	0.208	0.276	0.272	0.122
		Odds ratio	**Odds ratio**	**Odds ratio**	**Odds ratio**
Transit variables					
Bus: distance from home to first stop	0 to 400m	1.180	.586	3.170	.892
	400 to 800m	1.280	.661	2.600	1.358
	800 to 1200m	2.045	1.143	3.450	1.488
	> 1200m *(reference category)*				
Streetcar: distance from home to first stop	0 to 400m	.705	.633	.666	.877
	400 to 800m	1.442	1.246	.791	.910

		Obesity	Walking to school or work in past 3 months	Diabetes	Asthma
	800 to 1200m	.764	1.523	.570	1.645
	> 1200m *(reference category)*				
Subway: distance from home to first stop	0 to 400m	.808	.737	.364	.231
	400 to 800m	.629	.755	1.331	.721
	800 to 1200m	.573	.703	.436	1.077
	> 1200m *(reference category)*				
Rail: distance from home to first stop	0 to 400m	.618	.880	4.826	.883
	400 to 800m	.932	.556	[a]	.728
	800 to 1200m	1.282	1.289	.986	.423
	> 1200m *(reference category)*				
ln(# transit trips reachable over a typical 24 hour period / 10,000)	0-400m walk from home	1.447	2.675	1.175	1.991
	400-800m walk from home	.846	.676	1.033	1.048
	800-1200m walk from home	1.011	.762	1.365	1.283
Urban Form variables					
Census division code of the respondent's residence	Toronto				
	Durham	.972	1.083	.804	1.665
	York	.586	1.182	1.099	1.000
	Peel	.935	1.425	.923	.810
	Halton	.799	1.230	1.007	1.108
	Hamilton	1.273	.858	.973	1.530
Land use diversity index		.477	.847	3.830	8.517
Population density of walkshed / 1000		.963	.990	1.006	1.017
Employment density of walkshed / 1000		.980	.962	.982	1.037
Intersection density of walkshed		1.003	.992	1.004	1.000
4-way intersection: proportion of all intersections		.545	1.325	.430	.919
Residential land use (% of 1km walkshed)		.916	.812	.745	1.090
Commercial land use (% of 1km walkshed)		1.480	1.015	.589	1.147
Parks and recr land use (% of 1km walkshed)		1.214	1.024	.695	.994
Industrial and resource land use (% of 1km walkshed)		1.191	.974	.632	.462
Gov't and institutional land use (% of 1km walkshed)		1.065	1.092	.802	.397
Individual/Household variables					
Sex of respondent	Female				
	Male	2.068	1.306	1.367	.595
Age group of the respondent	15 to 24				
	25 to 34	2.573	3.856	2.448	.463

		Obesity	Walking to school or work in past 3 months	Diabetes	Asthma
	35 to 44	2.451	3.429	13.983	.654
	45 to 54	4.115	4.520	19.833	.926
	55 to 64	4.068	7.976	41.737	.675
	65 to 74	4.895	10.200	60.670	.899
	75 years and over	4.967	4.541	105.112	.863
Total household income	None to $19,999				
	$20,000 to $39,999	1.002	1.548	.500	.745
	$40,000 to $59,999	.751	1.507	.550	1.266
	$60,000 to $79,999	.807	1.613	.840	.901
	$80,000 to $99,999	.955	2.993	.853	1.115
	over $100,000	.967	1.797	.736	1.003
Education - highest degree	Less than high school diploma or its equivalent				
	High school diploma or equivalency certificate	1.014	1.669	1.000	.972
	Certificate or diploma from trade, community college or CEGEP, or university certificate below the bachelors level	1.006	1.212	.938	.973
	Bachelor's degree	.693	1.502	.781	.981
	University certificate, diploma, degree above the BA level	.529	.774	.555	.627
	Don't know/Refusal	1.283	.552	1.165	.960
Employed last week	Yes				
	No	.771	1.083	.664	.541
	Don't know/Refusal	.694	1.902	1.147	.938
Language first spoken in childhood - English	Yes				
	No	1.123	1.051	1.368	.731
	Don't know/Refusal	1.752	.860	.348	.726
Home is owned by a household member	Yes				
	No	1.435	.827	1.243	1.557
	Don't know/Refusal	.984	1.534	3.514	1.293
Single child(ren) 0-4 living in the household	Yes	.756	1.263	.873	1.219
Single child(ren) 5-14 in household	Yes	1.424	.868	.555	.709
Single child(ren) 15-18 in household	Yes	1.108	.985	.775	1.267
Household size of respondent	1				
	2	.871	.502	1.439	1.110
	3	.996	.536	.951	1.235
	4	.960	.590	2.096	1.311
	5 or more	.671	.536	2.859	.852
Marital status	Married or common-law				
	Divorced/separated/widowed	.745	.974	1.401	1.220
	Single	.750	.627	.689	1.506
	Don't know/Refusal or other	2.459	1.410	.260	.001
Main activity in past 3 months	Working at a paid job or business				
	Going to school	.885	.993	.399	1.216

		Obesity	Walking to school or work in past 3 months	Diabetes	Asthma
	Caring for children, household work, or parental leave	1.241	1.768	1.273	1.537
	Retired	.944	.331	2.565	1.723
	Long term illness	1.121	2.074	3.301	5.560
	Don't know/Refusal	.570	1.320	1.341	2.422
Born outside of Canada	Born in Canada				
	Born outside of Canada	.752	.737	.880	.716
	Don't know/Refusal or other	.728	.845	.405	.553
Ethnic background of the respondent	European				
	Chinese only	.378	.717	1.074	1.068
	South Asian only (East Indian, Sri Lankan, Pakistani, Punjab)	.880	.797	2.858	.978
	Other	.983	.990	1.185	.818
	Don't know/Refusal or other	.991	.528	1.959	.820
Leisure physical activity index *	Active				
	Moderate active	1.178	.986	1.617	1.013
	Inactive	1.355	1.230	1.845	.968
	Don't know/Refusal	11.290		1.504	.808
Constant		5.021	7.364	1.009E-06	.016
	Number of significant variables (total)	41	35	32	23
	Number of significant variables (transit)	4	4	5	3

Notes:

Significant at $p \leq 0.01$ (red)
Significant at $p \leq 0.05$ (orange)
* Not available in GSS.
a Small sample; could not estimate.

The models obtain fairly high levels of fit, with Nagelkerke's r^2 ranging from 0.12 for the *asthma* outcome, to 0.27 for the *walking to work and school* outcome. Despite these fits, not much of the explanatory power appears to be related to transit proximity or LOS, since we see that relatively few transit variables were statistically significant compared to the number of overall significant variables (see the final rows "Number of significant variables (total)" versus "Number of significant variables (transit)"). As expected, this suggests that the individual- and household-level factors (and to a lesser degree, urban form factors) are more influential predictors of these outcomes. Nonetheless, these results show that transit still has an important association with the outcomes.

We summarize the full-sample results by outcome, focussing on the transit variables, as follows:

1) For the *BMI/obesity* outcome, holding all else constant, living within 400-1200 meters of the subway or within 400 meters of a streetcar stop is associated with having healthier weights. Living within 800-1200 meters of a bus stop and having higher levels of service within the 400

meter walking range is associated with higher obesity. At the same time, land-use measures, such as density, diversity, and 4-way intersections, are all associated with lower BMI.

2) For *walking to school or work within the last 3 months*, close proximity to streetcar (<400m) and fairly close proximity to commuter rail (400-800m) are both associated with increased propensity to walk. Interestingly, very high levels of transit service at the 400m threshold is actually associated with less walking, presumably due to more transit use, while LOS at 400-800m distance seems to encourage walking. Employment density and 4-way intersection density are both seen to be associated with higher rates of walking.
3) The results for *diabetes* perhaps have the clearest association with transit, especially in relation to bus stop access, which is clearly associated with higher levels of diabetes. At the same time, having a commuter rail stop 800-1200 meters away is associated with lower levels of diabetes, perhaps because this amount of walking associated with a potential commuter-rail -based daily commute has a positive impact on cardiovascular activity.
4) *Asthma* was the least predictable outcome overall, with a Nagelkerke r^2 of only 0.12. Of all the transit variables, close proximity to subway is associated with lower asthma incidence, while, at the same time, higher levels of transit service at the 400m buffer is associated with higher asthma incidence. Since these two variables are so clearly negatively related to one another, it is our inclination to assume that these two effects wash themselves out.

Stratified Results

In addition to the full-sample results, we estimated the same models for a large number of strata. The summary table of stratified regression results can be found in Table 9, and the actual coefficient tables are in the Appendix A4. As with the GSS results presented in Table 7, we simplify the results by visualizing positive, negative, and insignificant regression coefficients in a graphical format below. Once again, a green plus sign ("+") indicates a statistically significant positive effect on health, a red minus sign ("-") indicates a significant negative effect, and a gold cell indicates no significant effect. Blank cells indicate where there were insufficient numbers of respondents in that set of conditions to generate a reliable result.

(continued on next page)

Table 9: Graphical Depiction of the Stratified Transit Access and Level of Service Impacts on Four CCHS Outcomes

Obesity	Full-Sample	15-65	65-74	75+	<40k	>150k	Female	Male	Canada Born	Foreign Born	C0-5 No	C0-5 Yes	C6-15 No	C6-15 Yes	C16-17 No	C16-17 Yes	Toronto	Suburbs
Bus - 0-400						-												
Bus - 400-800						-												
Bus - 800-1200	-	-				-	-				-		-		-			-
Streetcar - 0-400	+	+											+					
Streetcar - 400-800								-		-								
Streetcar - 800-1200									+									
Subway - 0-400					+					+								
Subway - 400-800	+	+				+	+			+	+		+		+		+	
Subway - 800-1200	+		+		+			+	+		+		+		+		+	
Rail - 0-400					+				+									
Rail - 400-800								+										
Rail - 800-1200		-				-	-				-				-			
Trips 0-400	-	-						-		-	-		-					-
Trips 400-800					+					+								
Trips 800-1200																		

Walk to School or Work	Full-Sample	15-65	65-74	75+	<40k	>150k	Female	Male	Canada Born	Foreign Born	C0-5 No	C0-5 Yes	C6-15 No	C6-15 Yes	C16-17 No	C16-17 Yes	Toronto	Suburbs
Bus - 0-400								+										
Bus - 400-800								+							+			
Bus - 800-1200																		
Streetcar - 0-400	+	+						+		+	+						+	
Streetcar - 400-800							-	+					-					
Streetcar - 800-1200							-			-			-					
Subway - 0-400																	+	
Subway - 400-800								+					+				+	
Subway - 800-1200						+		+			+		+					
Rail - 0-400																		+
Rail - 400-800	+	+									+							
Rail - 800-1200								-										
Trips 0-400	-	-					-	-	-	-	-				-		-	
Trips 400-800	+	+						+	+				+		+			+
Trips 800-1200		+							+				+		+			

Diabetes	Full-Sample	15-65	65-74	75+	<40k	>150k	Female	Male	Canada Born	Foreign Born	C0-5 No	C0-5 Yes	C6-15 No	C6-15 Yes	C16-17 No	C16-17 Yes	Toronto	Suburbs
Bus - 0-400	-					-			-				-		-			-
Bus - 400-800	-					-							-		-			-
Bus - 800-1200	-						-						-					-
Streetcar - 0-400																		
Streetcar - 400-800																		
Streetcar - 800-1200																		
Subway - 0-400													+					
Subway - 400-800					-													
Subway - 800-1200							+						+		+			
Rail - 0-400	-														-			
Rail - 400-800	+				+								+		+			
Rail - 800-1200																		+
Trips 0-400					-				-									
Trips 400-800																		
Trips 800-1200						-												-

Asthma	Full-Sample	15-65	65-74	75+	<40k	>150k	Female	Male	Canada Born	Foreign Born	C0-5 No	C0-5 Yes	C6-15 No	C6-15 Yes	C16-17 No	C16-17 Yes	Toronto	Suburbs
Bus - 0-400																	+	
Bus - 400-800						-											+	-
Bus - 800-1200																	+	
Streetcar - 0-400																		
Streetcar - 400-800						-												
Streetcar - 800-1200																	-	
Subway - 0-400	+	+							+		+		+		+		+	
Subway - 400-800							+											
Subway - 800-1200										-								
Rail - 0-400																		
Rail - 400-800																		
Rail - 800-1200	+	+			+				+				+				+	
Trips 0-400	-	-			-			-	-		-		-		-		-	
Trips 400-800						+												
Trips 800-1200								-	-	+								

Table Legend

	Not statistically significant
+	Positive association with health (statistically significant)
-	Negative association with health (statistically significant)
	No results available due to insufficient respondents in strata

Next, we discuss these CCHS summary tables in more detail. It is important to notice that there were insufficient sample sizes to estimate reliable models for some outcomes and strata. This was especially an issue for the rarer Asthma and Diabetes outcomes, and for the rarer “children at home” strata. We have supressed the results from a selection of aberrant strata-outcome combinations in this report, but believe it possible to improve the modelling of these strata in the future with more time.

Obesity

There is a strong and persistent positive effect of subway proximity on weight, primarily at the 400-800m and 800-1200m levels of access. Interestingly, there is no effect of subway on BMI for those older than 75, and this is the only strata for which there is no effect. The second most consistent effect across strata is that for 400m LOS, which appears to have a negative impact overall and in about half the strata.

Walking to School or Work

Level of service show a consistent negative effect at the 0-400m band, and a positive effect on walking at the 400-800m and 800-1200m bands. Again, our hypothesis is that conveniently close and frequent service probably encourages commuting by transit at the expense of active modes. Conversely, when the next closest band (400-800m) has high service, this might strike the right balance of an achievable walkable distance to a "big carrot" of enticingly frequent service. (We will see this "big carrot" effect again with respect to diabetes, below). Quite interestingly, there is a large difference between effects for males and females, with women being negatively associated with streetcar access, while men being positively impacted by streetcar, bus and subway proximity.

Diabetes

The negative association of diabetes with bus proximity is observed across many strata. Interestingly this effect is not pronounced among Canadian-born respondents, but more pronounced among suburban residents, compared to those living in the City of Toronto. Given that bus networks are very developed in Toronto, but less so in the other regions, the negative effect of bus proximity may be an indication of living very close to a major suburban arterial, which, in more automobile-oriented settings, is also associated with lower environmental quality or socioeconomic characteristics. Subway access in the 800-1200m band was associated with lower diabetes risk for females, hinting at a possible "big carrot" effect (see above) of enticement to physical activity. This was not observed for males, though, so this observation warrants further inquiry. For rail, higher diabetes risk is associated with access in the 0-400m range, but this could be an artefact of the low population counts in that band, which are the lowest of all of the four transit modes (see counts in the diabetes tables of Appendix 3). Indeed, these counts were so low that Statistics Canada's confidentiality rules required that band to be merged with the adjoining 400-800m band before the count could be disclosed in that table). . It may be that the positive effect at the mid-range distance is an indication of walking to a desirable transit mode. In fact, this argument holds in the suburban strata as well, at the larger walking distance of 800-1200 meters.

Asthma

The relationships observed in the full-sample model mostly persist among the larger and less vulnerable strata (e.g. Canadian born, 15-65 years old, not having children at home), but are seldom significant among other groups (e.g. females and immigrants). Overall, this indicates that these minority strata are no more sensitive to transit provision than the full population, on average. Interestingly, the results for Toronto compared to the other municipalities are quite divergent. Within Toronto, there is a strong positive relationship between reduced asthma and bus proximity, which is not seen in the full-sample model nor the model consisting of those living in the suburbs only.

DISCUSSION

6 DISCUSSION

Key points

- For the first time, this study established GTHA benchmarks of the health-transit relationship on a comprehensive list of health and social outcomes
- These benchmarks will allow monitoring of changes as transit – and transportation – continues to evolve in the region.
- Results are also useful as key statistics in health messaging for public communications. This can engage and energize GTHA residents and stakeholders on the diverse benefits of high quality accessible transit.
- Future work should increase sample sizes, and assess automobile and transit use. We suggest some routes for these goals.

We approached this project with Metrolinx with the shared understanding that transit is a vital public good that offers far-reaching social, economic and health benefits. For this reason, equitable access to transit is foundational to an equitable, productive and globally competitive region. But we also recognized that indicators of transit-health relationships – particularly benchmarks covering a diverse spread of health outcomes – were lacking in the GTHA, as they generally are in all but a few heavily-studied global regions. Finally, our survey of the literature identified well-studied health outcomes (particularly physical activity) that have overshadowed other important outcomes, such as mental health. Our literature review also highlighted a lack of individual-level data, and a preponderance of small-sample work in specific cities with limited relevance to the GTHA. Taken together with other methodological shortcomings noted in the literature, we are left with knowledge gaps that hinder evidence-based policymaking as well as surveillance of health conditions over time, especially through far-reaching plans for transit improvements like *The Big Move*.

To address these knowledge gaps, we examined individual-level data specifically from the GTHA across a range of health outcomes, including rarely-examined social underpinnings of health like social networks (e.g. knowing of neighbours and doing favours for your neighbours).

Our work set out four research goals: to benchmark the current state of the health/transit relationships in the GTHA, to quantify these relationships across a large set of health outcomes, to probe these for vulnerable subpopulations within the GTHA, and to take account of possibly confounding influences (built environment but also individual-level factors) that might otherwise mask the unique relationships between transit and health.

Our analyses have achieved these goals by leveraging new datasets and demonstrating that they could be linked usefully with transit data. But along with showing the opportunities of these datasets, we also flagged limitations, especially when insufficient numbers of respondents in certain strata for certain rarer conditions meant that the sample became to finely subdivided to yield enough cases to permit a robust statistical analysis. Our analysis of these lessons will allow future work to build on this study and achieve additionally productive and further-reaching insights. In particular, we feel that merging additional cycles of either survey will yield a sample large enough to allow greater examination of some of these problematic outcomes and strata. With similar logic, collapsing low-population transit distance bands (such as the 0-400m and 400-800m rings around rail stops) will offer further analytic reach as well. And while these surveys do not normally capture individuals' automobile and transit use, certain specific cycles (like the time-use GSS, collected every five years) offer this data. With such data in hand, we could move from examining the ecological influence of transit – meaning the influence of areal transit availability on health – to examine more causal linkages, such as whether these links are different for individuals who *use* this transit and with what frequency.

Several notable results from earlier need re-emphasis here. The bivariate cross-tabulations of health outcomes by distance to transit uncover new knowledge of the spatial distributions of populations in the GTHA. Those with lower general health, lower mental health, lower life satisfaction and higher rates of diabetes, were significantly more likely to be living within 400m walking distance to the nearest bus stop. At the same time, living very close to a subway was associated with lower levels of social capital, while those living 800-1200m away had significantly higher levels of social support (as indicated by the knowing neighbours and doing favours variables), and higher levels of overall life satisfaction. Those living within 1200m of the nearest subway or streetcar stop were also significantly more likely to walk to work or school, have normal weights, and lower incidences of diabetes. The findings suggest the existence of an ecologically optimal trade-off between the benefits of walkable access to subway and the drawbacks of living too close to a crowded subway station.

The bivariate results act as snapshot of how health patterns play out across different transit availabilities. As mentioned earlier, this allows them to serve both as a check for equitable access (are less healthy populations getting equal access to transit?) and a flag of causal relationships. These could be potentially detrimental to health (are asthma cases gathered around specific transit conditions?) or positive (does the availability of transit influence people to be more physically active?).

The direction of the associations – and sometimes causality – needs to be considered in interpreting the cross-tabulation results. Put simply, when ill health is clustered significantly around transit, what does this tell us? Two interpretations exist: we can ask if there is something of concern, in that transit is failing to drive a healthful change in an outcome that we think should respond positively to good transit? Or, is this a reassuring trend from an equity standpoint, illustrating that people with health needs are within reach of transit? It is not always easy to know which of these interpretations is more likely or important, and more complex studies like case-control studies may be needed. But ambiguities aside, one thing that is undeniably useful is that these results are now known -- we have established a benchmark that can be followed through time, alerting us to changes. For instance, a change to better population health in an area of optimal transit access might be signaling transit's contribution to improving health there, or seen conversely, it may be flagging a loss of equitable transit access to less healthy populations that are no longer living there.

The regression results also provide valuable insights into the relationships between transit access, levels of service, and health outcomes. In particular, they allow us to detect the residual effects of transit on health, even after controlling for health's more significant individual, household, and urban form determinants. By and large, the modelling taught us that the ecological effect of transit on health is quite muted, and actually difficult to detect. In particular, the effects found in the uncontrolled cross-tabulations did not always hold after adjusting for other factors. For example, despite so many lower-health populations living within close proximity to busses in the GTHA, bus access is only found to be clearly negatively associated with diabetes and obesity after controlling for all else. Another clear result from the regressions is that neighbourhoods with closer proximity to streetcar and 800-1200m proximity to subway were quite consistently more cohesive, with people knowing more of their neighbours. No significant effect was found for the other social support variable, doing favours for neighbours. This indicates the elusiveness of the transit-wellbeing connections, where choice of measurement may make or break a hypothesis. It therefore speaks to the importance of casting a wider net, in terms of potential outcome variables, when dealing with subjectively defined social constructs.

Limitations to our current study stem largely from its breadth and the limitations of the available data. In seeking to paint as large a picture of diverse health outcomes as possible – necessary given the largely unstudied nature of these relationships in the GTHA – we necessarily sacrificed depth. The outcomes are quite different in physiological and psychosocial underpinnings and deserve specialized study on their own. Unusual and occasionally conflicting results, common in the literature we surveyed, also deserve future investigation. The relative rarity of some conditions such as asthma, especially amongst certain strata, meant that sample size was too small to permit the probing of these interesting groups and suppression of results was required. Second, despite our efforts to statistically remove the effects of individual- and environment-level factors that might confound the actual transit-health relationship, more work can be done. Put another way, there are likely to be other co-located conditions that are influencing the transit-health relationship, possibly including crime and cultural beliefs that moderate use of public space and goods. Along the same lines, residential sorting needs exploration: who is selectively drawn to transit-friendly neighbourhoods, and how does housing affordability play out here? Third, interaction between our studied health outcomes is likely to be occurring and would be revealing to examine (e.g. does greater neighbourhood cohesion prompt more outdoor time, and thus physical activity). And finally, as noted earlier, knowing transit use and frequency at the individual level would add additional depth to our work.

In summary, this work offers important benchmarks of a wide range of the present transit/health relationships in the GTHA, and thereby allows monitoring of changes as transit – and transportation – continues to evolve in the region. These benchmarks could also support economic analyses (monetization) of the health benefits of high-quality and equitable transit. We also provide health statistics that can be of use in valuable health messaging for public communications to engage and energize GTHA residents and stakeholders on the diverse benefits of high quality accessible transit. Finally, we are excited to have identified further opportunities for extending this research with the goal of supporting informed and foresightful transit leadership for the region.

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APPENDIX 1: LITERATURE REVIEW

Appendix A1 - A Survey of Recent Literature

Search methodology:
Our focus of this review is specifically on public transit and health, and not the wider and more researched general area of transportation and health. Consequently, we used a semi-structured protocol to search established scholarly databases: PubMed and Google Scholar. We used the search terms *transit and health* and *transit and public health* with some search-term supplementation to explore under-represented research areas. Special emphasis was given to Canadian studies, recent papers, and those deemed as very influential by their citation count. Our focus was on peer-reviewed journal articles except in cases that were particularly salient to the GTHA study area (e.g. Next Stop Health: Transit Access and Health Inequities in Toronto, Toronto Public Health, 2013).

Limitations:
Physical activity is over-represented in the transit-health literature, and this methodology does not attempt to adjust for this except for via minor emphases noted above. As a result, several very relevant health and health-related outcomes were under-represented in the summary below but need further investigation. These include health services (transportation barriers, access and usage) and food (access, quality and cost).

Key abbreviations:
CT: census tract
GTFS: General Transit Feed Specification
PA: physical activity
SES: socioeconomic status

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
2005	Besser, L. M., & Dannenberg, A. L. (2005). Walking to public transit: steps to help meet physical activity recommendations. *American Journal of Preventive Medicine*, *29*(4), 273–80.	physical activity	Walking to and from public transportation. Used transit-associated walking times for 3312 transit users were examined among the 105,942 adult respondents to the 2001 National Household Travel Survey	Mobility: mode (bus vs rail). Income, age, education, race, gender, population density, household car ownership population density	Daily walking time	Drivers of walking to and from transit (WTFT): high population density, no car household, low SES, nonwhite (even controlling for income). Over 72% of WTFT trips were <10min, below the Surgeon General's recommendation for episodes. High WTFT walkers tended to be rail users over bus. About 29% of those walking to and from transit get >30 minutes of daily physical activity from this alone; helps income, minority and physically inactive populations in particular. The authors cite Toronto as outlier for its high transit use.
2014	Blais, D., & El-Geneidy, A. (2014). Better Living Through Mobility: The relationship between access to transportation, well-being and disability. In *93rd Annual Meeting of the Transportation Research Board*, Washington, DC, USA.	disability	Employed factor and cluster statistical analysis to examine relationships between access to transportation, well-being and type of disability. Data came from Statistics Canada's 2006 Participation and Activity Limitation Survey (PALS), representing approximately 4.2 million Canadians over 15 years old with a disability.	Not directly applicable. The authors chose analytic tools aimed at data reduction and structure detection, not correlation. Specifically, factor analysis was used to reduce 34 variables (from the local transportation, satisfaction with life, social contacts and stress modules, as well as some socio-demographic modules including age, level of education, total income and employment) into 14 "factors" that could be more	Not applicable (see left).	People who do not have access to public transit have a lower sense of well-being, and more so if they cannot afford personal transportation modes such as the car. This relationship between access to public transportation and well-being is more pronounced for people with mental/cognitive disabilities. The authors conclude that people with disabilities will have a greater quality of life if they live in areas that provide multiple transportation options, even more so if these areas facilitate walking and have enough density to support reliable and frequent transit options.

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
				succinctly and coherently studied. These factors included transit use, paratransit use, travel barriers, social interaction, well-being, and others.		This is particularly true for people with mental/cognitive disabilities, who face an added barrier of having lower incomes and not being eligible for paratransit.
2015	Brown, B. B., Werner, C. M., Tribby, C. P., Miller, H. J., & Smith, K. R. (2015). Transit use, physical activity, and body mass index changes: objective measures associated with complete street light-rail construction. *American Journal of Public Health*, 105(7), 1468-1474.	physical activity, BMI	Used accelerometers and GPS loggers for 1 week before (2012) and after (2013) a complete street intervention that extended a LRT line in Salt Lake City, Utah. Authors compared change scores of participants living within 2km of the new line who never rode transit with continuing, former, and new riders. *NB. See two other related study in this review that use the same dataset:* *Miller et al. (2015) Public transit generates new physical activity.* *Brown et al. (2016). Environmental, behavioral, and psychological predictors of transit ridership.*	Age, gender, Hispanic ethnicity, college degree, married status, changes in employment and in health status. Time between the "before" and "after" participation weeks, and temperature differences across the 2 beginning time points.	Moderate-to-vigorous physical activity (MVPA) and BMI	New riders had significantly more PA than never-riders, and former riders had significantly less. New riders lost weight while former riders gained weight. On average, new riders gained 4.2 minutes of MVPA time and lost 12.8 sedentary minutes per 10 hours accelerometer wear. Taken together, results suggest that transit use associated with a complete street intervention yields beneficial PA and BMI outcomes for those who begin to use transit. Similarly, individuals who stopped using transit gained sedentary activity and BMI, and lost MVPA minutes.

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
2016	Brown, B. B., Werner, C. M., Smith, K. R., Tribby, C. P., Miller, H. J., Jensen, W. A., & Tharp, D. (2016). Environmental, behavioral, and psychological predictors of transit ridership: Evidence from a community intervention. *Journal of Environmental Psychology*, 46, 188-196.	indirect: behavioural factors influencing use and physical activity.	Probes the environmental, behavioral, and psychological predictors and promoters of transit use. *NB. See two other related study in this review that use the same dataset:* *Miller et al. (2015) Public transit generates new physical activity.* *Brown et al. (2015). Transit use, physical activity, and body mass index changes.*	Same GPS and accelerometer measures of previous papers on same study (see elsewhere in table) Place attachment (index assessing pride in dwelling and neighbourhood, etc) Pro-city attitudes (index assessing interest in travelling downtown, exploring amenities accessible by new LRT) Perceived physical incivilities on the path to transit Access to car, being a renter, baseline obesity and PA Dwelling density, land use diversity	LRT use (membership in four transit ridership groups: never-riders, continuing riders, former riders, and new riders.) Physical activity	Participants who use transit at either 'before" or "after" timepoints are more physically active. Place attachment, but not perceived physical incivilities on the path to transit, was associated with those who continued to ride or became new riders of transit. This effect was mediated through pro-city attitudes. Thus, place attachment, along with physical and health conditions, may be important predictors and promoters of transit use.
1997	Cervero, R., & Kockelman, K. (1997). Travel demand and the 3Ds: Density, diversity, and design. *Transportation Research Part D: Transport and Environment*, *2*(3), 199–219.	physical activity	Using 1990 travel diary data and land-use records obtained from the U.S. census, regional inventories, and field surveys, models are estimated that relate features of the built environment to variations in vehicle miles traveled per household and mode choice, mainly for non-work trips. Factor analysis can usefully combine collinear built environment variables. Very methodologically	Mobility: Mode and trip length, transit service intensity. Age, gender, possession of driver's license, income, tenure, persons per household, distance to onramp/BART/rail, distance to central business districts. Population density, employment density, land use, block length, street trees, intersection dens	Vehicle miles travelled, mode choice	Built environment variables had larger explanatory power for walking non-work trips. Pedestrian-friendly environment and retail density induced transit/walking, not residential density. Hence some support for New Urbanist compact, mixed use, pedestrian-friendly design

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
			comprehensive study. Disadvantages: combined walk, bicycle and transit as one variable.			
2015	El-Geneidy, A., Buliung, R., Diab, E., van Lierop, Langlois, M., & Legrain, A. (2015). Non-stop equity: Assessing daily intersections between transit accessibility and social disparity across the Greater Toronto and Hamilton Area (GTHA) *Environment and Planning B: Planning and Design.*	indirect (equity, disparity)	Uses 2011 National Household Survey (NHS) to examine whether transit access is equitable across the GTHA. Novel: uses competitive accessibility measure, not just gravity-based. Comparisons are presented in terms of regional accessibility, trends by social decile, spatial distribution of accessibility during the day, and travel time impacts.	NHS: CT origins and destinations, time period, mode. GTFS for travel times. Census tract income, unemployment rate, % immigrant, >30% income on rent. Decile index created using z-scores	Competitive measure of accessibility	Residents in socially disadvantaged areas have equitable if not better transit accessibility to jobs than others, but degree and impact varies by time of day. Note that low SES CTs had better transit times ($P<0.05$) to low-wage jobs for only for one time slot, while other jobs for all slots.
2014	Farber, S., Morang, M. Z., & Widener, M. J. (2014). Temporal variability in transit-based accessibility to supermarkets. *Applied Geography*, 53, 149–159.	food access	Examines public transit access to supermarkets in Cincinnati, Ohio, working from each census block to its nearest supermarkets to identify underserved areas (food deserts), exploring time-of-day effects (temporal variability) and implications for vulnerable subgroups	walking/transit travel time between census block and supermarket Census tract level measures of • race • age • % below poverty line • % no-vehicle households from American Community Survey (2008-2012)	Time-varying accessibility to food (transit time from census block nearest supermarkets at different times of day, and dispersion measure)	The study llustrates how well schedule-based, fixed-route transit systems provide time-varying levels of accessibility to supermarkets. Transit access to destinations was found to be characterized by a high degree of variability depending on distance from origin to destination, the existence of transit options, and headways along transit routes. Thus, analyses using single time of day measures are incomplete. Transit users may have less flexibility than hoped, since once time of day is considered, very few people attain

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
						consistent access to supermarkets throughout the full day. Black/ African-American and older adults tend to have lower levels of consistent access, but few inequities by income were noted.
2013	Feng, Z., & Boyle, P. (2013). Do Long Journeys to Work Have Adverse Effects on Mental Health? *Environment and Behavior*, *46*, 609–625.	mental health	Longitudinal: 16yrs / 5,216 participants in the British Household Panel Survey. Stress is related to mental health	Commute duration, mode. Age, marital status, social class, education, net household income, housing tenure, and living arrangements.	Psychological distress (via GHQ)	Long journeys to work were associated with a higher risk of poor mental health for women but not for men. Of these women, those with children are most likely to suffer from long commuting. These effects were noted even after controlling for a number of demographic and socioeconomic factors.
2015	Ferenchak, N. N., & Katirai, M. (2015). Commute mode and mental health in major metropolitan areas. *Transportation Letters*, 7(2), 92-103.	mental health	Instead of individual-level data, authors chose much larger sample at expense of aggregation to sub-state level (68 of these, covering all of US).	Demographics and commute mode: American Community Survey. Driving alone, carpooling, public transportation, walking, bicycling. The above variables were used for descriptive tables; regression models analyzed association between commute mode and each of the 4 mental health outcomes in turn without adjusting for any control variables.	Four mental health outcomes: depression, mental illness, severe mental illness, and thoughts of suicide for respondents over 16 years old in National Survey on Drug Use and Health	Carpooling and public transportation were both found to have a strong and statistically significant Association better mental health outcomes, while the reverse was seen for driving alone to work. No significant associations were noted for bicycling and walking. Limitations included regression models without control variables (so contextual influences cannot be noted) and the strategic choice to forego individual-level analyses for the greater "reach" of this broad nation-wide examination.

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
2012	Jiao, J., Moudon, A. V., Ulmer, J., Hurvitz, P. M., & Drewnowski, A. (2012). How to identify food deserts: Measuring physical and economic access to supermarkets in King County, Washington. *American Journal of Public Health*, *102*(10), 32–40.	food access	Seeking innovative ways to identify food deserts, the authors estimated physical and economic access to supermarkets for 5 low-income groups in Seattle–King County, Washington. Used 5 different low-income group definitions for maximum breadth.	Descriptive analyses only. Focal variables: • Physical access: service areas around each supermarket were delineated by ability to walk, bicycle, ride transit, or drive within 10 minutes. • Economic access: supermarkets classifications (low, medium, and high cos), car ownership.	Access to supermarkets via 5 travel modes/ duration combinations	Almost all of the vulnerable populations lived with a 10-minute drive or bus ride of a low of medium-cost supermarket. Yet at most 34% of the vulnerable populations could walk to any supermarket, and as few as 3% could walk to a low-cost supermarket. Combining income and access criteria generated multiple ways to estimate food deserts. By using a range of access and deprivation measures, illustrated that the criteria used to define low-income status and access to supermarkets greatly affect estimates of populations living in food deserts.
2012	Jones, P., & Lucas, K. (2012). The social consequences of transport decision-making: clarifying concepts, synthesising knowledge and assessing implications. *Journal of Transport Geography*, 21, 4–16.	review / commentary	Reviews literature, focussing on five short-term or 'immediate' categories of social impact of transit: accessibility, movement and activities, health-related, financial related and community-related impacts. Some longer-term consequences of these social impacts are reviewed (health, individual and community wellbeing and social equity, and justice.	n/a	n/a	The authors feel that research has focussed too intensely on economic, environmental and 'distributional issues' of transit, and not enough on social consequences, including health effects. While accessibility, movement, health-related, financial related and community-related impacts dominate the review, some developments in social exclusion, social networks, social capital, residential relocation due transit investment and crime/safety are highlighted.

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
2009	Lachapelle, U., & Frank, L. D. (2009). Transit and health: mode of transport, employer-sponsored public transit pass programs, and physical activity. *Journal of Public Health Policy*, *30 Suppl 1*(1), S73–S94.	physical activity	This study assessed whether transit and car trips were associated with meeting the recommended levels of physical activity by using walking as a means of transportation, and secondly, it probed possible associations between walking and using an employer-sponsored public transit pass.	Age, non-white status, income, gender, employer-sponsored transit pass, distance from home to any transit, car availability Residential density, presence of retail stores within 10min walk of workplace	Daily distance walked for transit purposes (avg over 2d): 3 levels. Highest: "≥2.4km", i.e. Surgeon-General recommendation	Transit trips, white, having and using a employer-sponsored transit pass, living in a low-density neighbourhood, and being in non-middle income group were associated meeting PA recommendation. While car availability had a negative association. Transit use was associated with meeting recommendation. Within users though, living within 450m of bus or rail stops was not associated with walking. Atlanta has low mode share for transit (5.4%) so some aspects of this study must be interpreted cautiously. Also, the sample was older, wealthier, and lived in denser areas with better transit access than the general population of Atlanta.
2011	Lachapelle, U., Frank, L., Saelens, B. E., Sallis, J. F., & Conway, T. L. (2011). Commuting by public transit and physical activity: where you live, where you work, and how you get there. *Journal of Physical Activity & Health*, *8 Suppl 1*(Suppl 1), S72–S82.	physical activity	Seattle and Baltimore: adults aged 20 to 65 working outside the home (n = 1237) Adjusted for clustering via hierarchical linear modelling, which takes into account the fact the "nestedness" arising from individuals being clustered into neighbourhoods.	Frequency of commuting by transit Household income, age, gender, marital status, ethnicity, and cars-per adults in the household Enjoyment of PA, self-reported work-related and leisure PA Neighborhood walkability: net residential density, intersection density, retail floor area ratio and an entropy-based measure of land use mix	Mean daily minutes of accelerometer-measured moderate-intensity physical activity (MPA) Self-reported days walked to destinations near home and work	Transit commuters accumulated more MPA and walked more to services and destinations near home and near the workplace than transit nonusers. Enjoyment of physical activity was not associated with more transit commute.

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
2015	Legrain, A., Eluru, N., & El-Geneidy, A. M. (2015). Am stressed, must travel: The relationship between mode choice and commuting stress. *Transportation Research Part F: Traffic Psychology and Behaviour*, 34, 141–151.	mental health (stress)	A travel survey of McGill University students, faculty and staff (n=3794). Authors compared commuter stress across three modes of transportation (walking, driving, and using public transit). The study acknowledged climate: assessed on a typical cold snowy day and a typical warm dry day.	Mobility: time of commute, transfer needed, vehicles per household, satisfaction with their commute time, cost of their commute. 3 residential-location choice variables: importance of living close to transit / living in a location where driving is not necessary / living close to campus Days per month spent on campus Age, gender, and income, overall life satisfaction Objective stressors: number of modes tried in past year, commute time, additional time budgeted Subjective stressors: the only good thing about traveling is arriving at my destination, would like to walk more, would like to use transit more, would like to drive more Self-rated feelings of comfort, 'safety from crime,' and 'safety from traffic'	Self-reported stress: agree or disagree to "felt stressed during their commute to McGill."	Driving is the most stressful mode of transportation, with drivers budgeting more time than others to deal with unexpected delays. Stressors for some modes are not stressors for others. Pedestrians were least stressed of all groups. Commuting stress was felt to be caused by an interaction between objective stressors and mediators (time, control, and comfort) and subjective stressors which act as mediators (feelings, desires, and satisfaction). Could have employed a more standard measure of stress as well as outcomes of stress (missed days at work or school, mental or physical side effects).

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
2013	Litman, T. (2013). Transportation and public health. *Annual Review of Public Health*, *34*, 217–33.	review / commentary	A forward-thinking planning-focussed review of ways that transportation policy and planning decisions affect public health.	n/a	n/a	The author reviews five health impacts of transportation policies (crash risk, exposure to vehicle pollution, physical activity, access to health-related goods and services, and mental health) arguing that planning practice underemphasizes the latter three. Although public transit is not the central focus, the effectiveness of current health improvement strategies are reviewed well, focussing on "win-win strategies" that may improve public health while also achieving planning objectives.
2015	Mackett, R. L., & Thoreau, R. (2015). Transport, social exclusion and health. *Journal of Transport & Health*, 2(4), 610-617.	review / commentary	Explores the nature of social exclusion and how transport contributes to it by providing barriers to access. Transport influences health in several ways: by providing physical activity through walking and cycling, and by providing access to healthy food, recreation facilities and healthcare. Externalities are also produced (casualties, noise and atmospheric pollution which are a function of traffic levels) These effects impinge on society unequally, with socially excluded people able to access fewer facilities than others but	n/a	n/a	Transport is a significant factor in social exclusion, and can affect health directly through walking and cycling. Transport provides access to healthy food, healthcare and recreation facilities, so differential access and exclusion for transport options will influence exposure to these benefits. Barriers to travel include cost, lack of information and psychological barriers. A variety of transport interventions (reviewed in moderate detail in the article) have been used to address social exclusion.

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
			suffering more from the externalities.			
2015	Miller, H. J., Tribby, C. P., Brown, B. B., Smith, K. R., Werner, C. M., Wolf, J., … Oliveira, M. G. S. (2015). Public transit generates new physical activity: Evidence from individual GPS and accelerometer data before and after light rail construction in a neighborhood of Salt Lake City, Utah, USA. *Health & Place*, 36, 8–17. doi:10.1016/j.healthplace.2015.08.005	physical activity	536 participants in Salt Lake City, Utah wore GPS units and accelerometers before (2012) and after (2013) LRT construction. Tested within-person differences in individuals' PA time based on changes in transit usage pre- versus post-intervention. Also mapped transit-related PA to detect spatial clustering of PA around the new transit stops, and to distinguish effect of bus versus LRT on PA. *NB. See two other related study in this review that use the same dataset:* *Brown et al. (2015). Transit use, physical activity, and body mass index changes.* *Brown et al. (2016). Environmental, behavioral, and psychological predictors of transit ridership.*	Transit use status pre/post intervention: *never, continued, former, new.* Covariates: gender, Hispanic ethnicity, employment status, weight status, college graduate, and household income.	3 classes of physical activity time: total, transit-related, other PA measure was "light-to-moderate PA" (LMPA). NB. this is a lower threshold than the "moderate to vigorous PA" (MVPA) levels typically associated with health benefits	Transit users are more physically active than non-transit users and this can be directly associated with transit use. In other words, this new PA is not simply being shifted from activities such as recreational walking via a "substitution effect". LRT has stronger influence on PA than bus public transit, based on the spatial distribution of PA Demographic factors, employment, weight education and income had no effect on these relationships. Transit-related walking opportunities require attractive destinations in addition to built environment enhancements.
2015	Plano, C. E., Darby, K. J., Shaffer, C. L., & Jadud, M. C. (2015). Considering Public Transit: New Insights into Job and Healthy Food Access for Low-Income Residents	food access	Unlike other studies that assess food access for drivers or pedestrians, this study focusses on public transit. Examines low-income urban residents in	Descriptive analyses only. Geography: metropolitan planning organization-defined transportation analysis zones	Variables of interest: public transit access to healthy food (i.e., grocery stores)	Food access: mixed results of poverty's association with transit inaccessibility were seen. Forty percent of the study area population, or 564,060 people, have no access to grocery stores within a 30-

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
	in Baltimore, Maryland. *Environmental Justice*, *8*(3), 65–71.		Baltimore who must rely on public transit systems to access supermarkets and employment. Poverty is severe in Baltimore, and 11% of households do not own a personal vehicle	(TAZ). For each TAZ: median household income, total population, and supermarket and employment density Farmers' markets were excluded due to seasonality and limited hours. NB. Walking times from residence to transit stop or from transit stop to destination were not considered.	and employment opportunities	minute public transit trip, but this includes many wealthier TAZ's, suggesting food deserts cut across income lines in Baltimore. But the poor are significantly affected with 5% of the study area population, or 73,012 people, having no grocery stores within a 30-minute public transit trip and large numbers of other residents having few stores. Strategies for addressing these addressing inequities must be considered when prioritizing transit redevelopment; some options are briefly reviewed.
2011	Roberts, J., Hodgson, R., & Dolan, P. (2011). “It's driving her mad”: Gender differences in the effects of commuting on psychological health. *Journal Of Health Economics*, 30(5), 1064-1076.	mental health	Excellent "long snapshot of time": used data from 14 waves (1991–2004) of the British Household Panel Survey, a longitudinal survey (i.e. follows same subjects in each survey).	Age, marital status, number of children,, working hours, housing quality, job satisfaction and net household income, job satisfaction Mobility: one-way commute time, mode	Psychological health (score on the General Health Questionnaire or GHQ, a standard and validated survey)	In the overall sample, non-single status, higher household income, job satisfaction and housing quality had a significant positive effect on psychological health. Education, number of children and working hours were not significant. A broad selection of explanatory variables included factors which may provide *compensation* for commuting stress, such as income, job satisfaction and housing quality made possible by more stressful commutes. This strengthened the likelihood that associations between commute and stress were truly linked to commuting and not other factors. After these adjustments, commuting had an important detrimental effect on the psychological health of women, but not

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
						men. There was no evidence that this was due to women's shorter working hours or weaker occupational position in the data. The authors speculate that women's greater sensitivity to commuting time seems to be a result of their larger responsibility for day-to-day household tasks, including childcare and housework.
2014	Saelens, B. E., Moudon, A. V., Kang, B., Hurvitz, P. M., & Zhou, C. (2014). Relation between higher physical activity and public transit use. *American Journal of Public Health*, *104*(5), 854–859.	physical activity, BMI	693 adults living near a future site of Travel Assessment and Community study participants from future light-rail stops in King County, Washington. All were equipped with an accelerometer and portable GPS and completed a 7-day travel log.	Transit use status: users vs nonuser, then compared by less and more frequent transit users, and between transit and non-transit days for transit users Covariates: gender, household income, education, and ethnicity (Hispanic/non-White/non-Hispanic White) Residential density, housing type, home values, bus transit access, proximity to a neighbor-hood retail center, household income and race/ ethnicity	Average daily overall physical activity, average daily non-walking physical activity, and average daily transit and non-transit-related walking	Transit users had a lower BMI than did non-transit users. They also had more daily overall physical activity and more total walking than non-transit users but did not differ on either non–transit-related walking or non-walking physical activity. No evidence of a substitution effect was seen (substitution between transit-related walking and other types of PA either on transit days or in the form of transit users adding more PA on non-transit days.) Most frequent transit users had more walking time than least frequent transit users. Higher physical activity levels for transit users were observed only on transit days.

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
2015	Schwanen, T., Lucas, K., Akyelken, N., Cisternas, D., Carrasco, J., & Neutens, T. (2015). Rethinking the links between social exclusion and transport disadvantage through the lens of social capital. *Transportation Research Part a*, *74*, 123–135.	review / commentary	Social exclusion has been shown to be an "upstream" predictor of many health outcomes, from heart disease to poor nutrition. This paper provides a critical review of the progress in understanding the linkages between transport disadvantage and social exclusion. It examines the idea of social capital – beneficial shared norms, trust and networks -- as a concept that mediates those linkages.	n/a	n/a	Social capital (defined at left) plays a key role in mediating the links between transport disadvantage and social exclusion, the authors argue, but its effects are not always clear and uniformly benign since it can act to advance progressive social change or perpetuate (or create) social inequalities. Importantly, the authors conceptualize transport disadvantage as a relational and dynamic process that can be absolute and relative, occurring at both individual and collective levels. The paper reviews how recent transport-related literature supports or rejects their hypothesised pathways, and key avenues for future research are identified.
2016	Sener, I. N., Lee, R. J., & Elgart, Z. (2016). Potential health implications and health cost reductions of transit-induced physical activity. *Journal of Transport & Health*, 3(2), 133-140.	review / commentary	A broad review of almost 25 years of empirical work on links between transit and physical activity.	n/a	n/a	Overall, the literature strongly suggests that transit use is associated with increased levels of physical activity and improved health outcomes, but the magnitude of these effects is uncertain. Few studies estimated the health care cost savings of transit systems, and those that did tended to be imprecise and simplistic. Studies should draw more on objective physical activity measures and frequency-based transit measures to allow for greater consistency across studies and help more directly attribute physical activity gains to transit ridership. Disaggregate estimation techniques and more robust health

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
						datasets that can be better linked with existing transit data are also needed. Risks can accompany this transit-associated physical activity, and these need to be considered. For instance, in terms of safety from vehicle traffic or emissions, walking and bicycling to transit can be riskier travel options than other modes.
2012	Sheppard, A. J., Salmon, C., Balasubramaniam, P., Parsons, J., Singh, G., et al. (2012). Are residents of downtown Toronto influenced by their urban neighbourhoods? Using concept mapping to examine neighbourhood characteristics and their perceived impact on self-rated mental well-being. *International Journal of Health Geographics*, *11*(1), 31.	mental health	Concept mapping was conducted with residents from five Toronto neighbourhoods representing low income and non-low income socio-economic groups. Respondents first generated a list of neighbourhood characteristics that influenced their mental well-being, then rated their relative importance in affecting residents' 'good' and 'poor' mental well-being. Conceptual maps of neighbourhood characteristics influencing mental well-being were then derived.	n/a (qualitative methods)	n/a	Transit access was only one of many study elements, but specific transit-relevant results were that low-income residents emphasized public transportation as important to good mental well-being, while non-low-income residents rated crime, negative neighbourhood environment and social concerns as more important contributors to good mental well-being. The study is particularly relevant since it used a Toronto sample.
2012	Topalovic, P., Carter, J., Topalovic, M., & Krantzberg, G. (2012). Light rail transit in Hamilton: Health, environmental and economic	review / commentary	The paper explores the potential health, environmental, social and economic impacts of light rail in Hamilton, Ontario and performs a comparative	n/a	Health receives lesser review than other factors, but good review of obesity and air pollution	As a once industrial and transportation-oriented city, Hamilton is well suited for rapid transit, especially when coupled with its growing population, developing and diversifying economy, redeveloping

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
	impact analysis. *Social Indicators Research*, 108(2), 329-350.		analysis with other major North American cities that have successfully implemented LRTs Of particular value since it focusses on GTHA, and contextualizes Hamilton and its sociodemographic and environmental conditions within the Big Move.		conditions in study area.	downtown core, and proximity to larger economies like the GTA. LRT development in Hamilton is a viable and desirable transit option. It could be a catalyst for transit oriented, high density, mixed use development; an economically sound investment opportunity, providing a return on investment to property owners, businesses and the municipality; and a catalyst for social change, improving the health, environment and connectivity of the community.
2013	Toronto Public Health. (2013). *Next Stop Health : Transit Access and Health Inequities in Toronto*, (March 2013).	review / commentary	Offers synopsis of current transit conditions and policy in Toronto (transit use, affordability, availability, expansions) then examines four health impacts of limited access to transit, citing cross-agency policy documents and studies as well as peer-reviewed research papers.	n/a	n/a	This report offers evidence – including some from Toronto – indicating that access to public transit contributes to the health of individuals, neighbourhoods, and to the city overall. Compared to other Canadian cities, Torontonians are above-average users of public transit for their commute to work, and this is especially true for lower income communities where transit affordability is an obstacle. In particular, the number of such commuters is rising in the inner suburbs where transit is not always readily available. Such obstacles to access can hamper lower income residents' ability to access four important categories of goods and services: food, health care, education and employment, and recreation, all of which impact their health. Addressing these obstacles can include improving the affordability and availability of transit, and improving data

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
						collection to support forward-thinking and equitable transit planning.
2016	van den Berg, P., Kemperman, A., de Kleijn, B., & Borgers, A. (2016). Ageing and loneliness: the role of mobility and the built environment. *Travel Behaviour and Society*, 5, 48-55.	mental health (social isolation/ loneliness)	Surveyed 344 respondents in Netherlands of broad but not completely representative age range. Diaries and surveys were used to capture a one week period.	Individual: age, gender, household composition, education level, work, income, health status (satisfaction with health status) and social contacts (number of face-to-face social interactions in 2 days) Built environment: type of dwelling, urban density, distance to and satisfaction with public, commercial, and cultural services in the residential area Mobility characteristic: use of a car, a bicycle or public transport.	Degree to which "respondent experiences social isolation/ loneliness".	Using a car, public transport or bicycle (the latter for youngest groups only) was associated with lower loneliness/isolation, in line with authors' hypothesis that certain transport modes increase the opportunities to interact with more distant others. But the effect was rather small compared to the other explanatory variables in the model. Of these, living in higher density, being of good health, and living in an apartment (for the oldest age groups) had particularly positive associations. Density or distance to green space or shops had no association with loneliness/isolation. Limitations included single-season (winter) data collection, use of the word negatively-charged word "loneliness" in the key survey question, and the assessment of mobility via a binary (yes/no) survey item rather than one that would capture greater ranges of mobility.
2015	Voss, C., Winters, M., Frazer, A., & McKay, H. (2015). School-travel by public transit: rethinking active transportation. Preventive Medicine Reports, 2, 65-70.	physical activity	Probed whether public transit use for travel to school was a significant promoter of physical activity.	Age, gender, BMI. Trip variables: trip mode, duration, speed, distance.	Moderate-to-vigorous physical activity (MVPA)	Students who used transit covered a similar distance on foot as students who walked, which resulted in similar and meaningful trip-based PA in both groups. Students accrued on average nine

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
			Examined 100 school-trips made by 42 students in grades 8–10 in downtown Vancouver. Used GPS and accelerometers.			minutes of MVPA during a school-trip. Walk distance was associated with MVPA in a dose–response manner (i.e. a change in one was matched with a proportionate change in the other) Public transit use appears to contribute meaningfully toward daily PA.
2013	Wasfi, R. A., Ross, N. A., & El-Geneidy, A. M. (2013). Achieving recommended daily physical activity levels through commuting by public transportation: unpacking individual and contextual influences. *Health & Place*, *23*, 18–25.	physical activity	A travel diary survey in Montreal (n=6913) assessing mode choice, route, etc. Proxy reporting for other household members (possible weakness). Walking distance to and from transit stops. Multilevel regression modelling.	Age, gender, income and individual travel behavior, including type of transit used, and trip distance. Census tract level: education level, population and land use density, land use diversity, street connectivity, type of transit service, frequency and schedule of transit service	Daily walking minutes to transit stops	Daily walking distance to public transit varied by individual characteristics (esp. gender and socio-economics) and mode of transportation. Suburban train users walked the highest number of minutes to and from stations. For all users, neighbourhood physical characteristics did not affect walking to public transit. The WHO recommendation of 30 minutes of daily PA can be met by walking to and from transit, particularly for train users living in affluent suburbs.
2003	Wener, R. E., Evans, G. W., Phillips, D., & Nadler, N. (2003). Running for the 7:45: The effects of public transit improvements on commuter stress. *Transportation*, 30(2), 203-220.	mental health (stress)	Though not directly focussing on transit access or equity, strong methods and salient outcome (stress) make it relevant to this review. Authors took advantage of a "natural experiment" opportunity to measure changes around the elimination of a transfer on a New Jersey – New York route. Several stress	Age, gender, race, income, job, type, place of residence, place of employment, family composition Commuting measures: start and end points, mode, time of day.	Stress (mixed methods/ indicators; see left) including "spillover" via ratings of subject's stress by spouse	Reduced commute time was the most significant predictor of reduced stress, although predictability of the commute was also significant in some sub-experiments. Repeating the experiment with previously non-commuting students largely replicated the results, suggesting robustness.

Year	Reference	Health outcome?	Summary notes	Independent variables	Outcome variables	Key results
			indicators were measured before and after the route change, including physiological measurements (cortisol) and tests of motivational performance (proofreading while on route).			
2015	Widener, M. J., Farber, S., Neutens, T., & Horner, M. (2015). Spatiotemporal accessibility to supermarkets using public transit: An interaction potential approach in Cincinnati, Ohio. *Journal of Transport Geography*, 42, 72–83.	food access	Expands on previous food desert studies by considering "interaction potential": the amount of time a resident has to 'interact'' with healthy food stores (i.e. grocery shop) given a time budget, the transit network, and the transit schedule.	At level of transportation analysis zones (TAZs): • commuting flows of transit riders between home and work • median income • number of commuters • % population in labour force • % households with vehicles	"Interaction potentials" expressing the average time residents of a TAZ have to shop at the five most accessible supermarkets while travelling by public transit. Calculated for home and work TAZ	The average access scores for transit users are much lower than for automobile, whether using whether using the interaction potential measure for home or work. Moreover, the variability is much higher for transit users, indicating that the benefit of accessibility is far more unevenly distributed among the population. No wide-ranging income inequities were noted since despite some exceptions, as both income and vehicle ownership decrease, there is increased access to supermarkets via transit. By comparing trips departing from home versus work, the authors are able to compare access based on origins. They note that a significant number of residents that have improved access to supermarkets when a grocery shopping trip is made on the way home from work versus if they were to depart from their home location.

<u>Further reading:</u>

Several other works fell outside of the stated criteria of our review, but deserve mention for the reasons listed below.

Graham, S., Lewis, B., Flanagan, B., Watson, M., & Peipins, L. (2015). Travel by public transit to mammography facilities in 6 US urban areas. *Journal of Transport & Health*, 2(4), 602-609.

A good examination of transit marginalization regarding access to health services, but was excluded from main review table since it does not use this access as a direct study outcome.

Miles, R., Coutts, C., & Mohamadi, A. (2012). Neighborhood urban form, social environment, and depression. *Journal of Urban Health*, 89(1), 1-18.

Although transit is not a key focus and is only assessed at aggregate level (as auto commuter density), the study still provides very good survey of urban built environment characteristics used as control variables on our analyses. Interestingly, results suggested that high auto commuter density was associated with greater depressive symptoms – possibly via noise and air pollution effects. The authors note too that auto commuter density acted as a suppressor variable since its inclusion in models led to an increase in the contribution of housing density, economic deprivation, and age concentration to predicting extent of depressive symptoms in the full model

Páez, A., Farber, S., Mercado, R., Roorda, M., & Morency, C. (2013). Jobs and the Single Parent: An Analysis of Accessibility to Employment in Toronto. *Urban Geography*, 34(6), 815-842.

No direct health outcomes but good coverage of equity, and relevant for its direct focus on Toronto.

Wener, R. E., & Evans, G. W. (2011). Comparing stress of car and train commuters. *Transportation Research Part F: Traffic Psychology and Behaviour*, 14(2), 111-116.

A strong cross-sectional comparison of car and train commuters in New York City using multiple indicators of stress. Car commuters showed significantly higher levels of reported stress and more negative mood, possibly mediated through effort and predictability processes.

APPENDIX 2:
BIVARIATE CROSSTABULATIONS FOR GSS OUTCOMES

	Self-rated health - binary weighted & rounded (50)		Self-rated mental health - binary weighted & rounded (50)		Know ppl in your neighbourhood - binary weighted & rounded (50)		Favours done for neighbour this month weighted & rounded (50)		Life Satisfaction - binary weighted & rounded (50)	
	Excellent, Very Good	Good,Fair or Poor	Excellent, Very Good	Good, Fair or Poor	most or many	a few or none	Yes	No	Very satisfied	Dissatisfied
	Count	Count	Count	Count	Count	Count	Count	Count	Count	Count
Total	***3,386,000***	***2,215,200***	***3,903,850***	***1,693,300***	***2,090,850***	***3,523,850***	***3,491,200***	***2,044,700***	***3,453,550***	***1,944,050***
Bus <400m	*2,353,200*	*1,639,700*	*2,749,200*	*1,243,950*	*1,439,700*	*2,568,800*	*2,450,400*	*1,497,400*	*2,411,100*	*1,434,550*
Bus 400-800m	747,150	451,650	854,150	340,150	*481,250*	*715,300*	*772,250*	*408,150*	*768,000*	*386,150*
Bus 800-1200m	*96,200*	*37,350*	98,100	35,450	58,950	74,600	93,600	43,550	85,250	40,150
Bus >1200m	*189,500*	*86,450*	202,350	73,750	110,950	165,150	174,950	95,550	*189,150*	*83,200*
Streetcar <400m	167,500	92,800	173,650	84,900	84,750	175,850	162,750	93,600	152,550	103,450
Streetcar 400-800m	85,650	42,700	83,800	44,500	*58,950*	*69,600*	85,650	41,550	*65,750*	*61,900*
Streetcar 800-1200m	*63,700*	*24,350*	57,350	32,450	34,700	55,400	60,050	28,550	*43,550*	*42,150*
Streetcar >1200m	*3,069,200*	*2,055,350*	*3,589,050*	*1,531,450*	1,912,400	3,223,000	3,182,750	1,881,000	*3,191,700*	*1,736,600*
Subway <400m	82,800	44,000	86,500	40,250	*31,100*	*95,650*	68,600	55,150	80,900	45,600
Subway 400-800m	165,550	95,200	184,600	74,050	*75,000*	*185,300*	152,800	102,650	150,750	105,850
Subway 800-1200m	132,000	90,900	150,650	75,850	*108,750*	*117,800*	150,050	75,200	*126,650*	*94,950*
Subway >1200m	3,005,650	1,985,150	3,482,100	1,503,100	1,876,000	3,125,100	3,119,750	1,811,700	*3,095,250*	*1,697,650*
Rail <400m	10,050	14,050	14,850	7,850	5,650	16,200	14,650	9,400	15,150	8,950
Rail 400-800m	58,650	40,900	*58,100*	*41,450*	36,300	63,050	62,900	36,850	55,650	42,450
Rail 800-1200m	*91,000*	*82,100*	127,000	47,800	66,500	108,250	97,050	74,100	98,000	70,350
Rail >1200m	*3,226,350*	*2,078,200*	3,703,900	1,596,200	1,982,350	3,336,350	3,316,550	1,924,300	*3,284,750*	*1,822,300*

	Self-rated health - binary		Self-rated mental health - binary		Know ppl in your neighbourhood - binary		Favours done for neighbour this month		Life Satisfaction - binary	
	weighted & rounded (50)		weighted & rounded (50)		weighted & rounded (50)		weighted & rounded		weighted & rounded (50)	
	Excellent, Very Good	Good,Fair or Poor	Excellent, Very Good	Good, Fair or Poor	most or many	a few or none	Yes	No	Very satisfied	Dissatisfied
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Total	3386000	2215200	3903850	1693300	2090850	3523850	3491200	2044700	3453550	1944050
Bus <400m	69.50%	74.02%	70.42%	73.46%	68.86%	72.90%	70.19%	73.23%	69.82%	73.79%
Bus 400-800m	22.07%	20.39%	21.88%	20.09%	23.02%	20.30%	22.12%	19.96%	22.24%	19.86%
Bus 800-1200m	2.84%	1.69%	2.51%	2.09%	2.82%	2.12%	2.68%	2.13%	2.47%	2.07%
Bus >1200m	5.60%	3.90%	5.18%	4.36%	5.31%	4.69%	5.01%	4.67%	5.48%	4.28%
Streetcar <400m	4.95%	4.19%	4.45%	5.01%	4.05%	4.99%	4.66%	4.58%	4.42%	5.32%
Streetcar 400-800m	2.53%	1.93%	2.15%	2.63%	2.82%	1.98%	2.45%	2.03%	1.90%	3.18%
Streetcar 800-1200m	1.88%	1.10%	1.47%	1.92%	1.66%	1.57%	1.72%	1.40%	1.26%	2.17%
Streetcar >1200m	90.64%	92.78%	91.94%	90.44%	91.47%	91.46%	91.16%	91.99%	92.42%	89.33%
Subway <400m	2.45%	1.99%	2.22%	2.38%	1.49%	2.71%	1.96%	2.70%	2.34%	2.35%
Subway 400-800m	4.89%	4.30%	4.73%	4.37%	3.59%	5.26%	4.38%	5.02%	4.37%	5.44%
Subway 800-1200m	3.90%	4.10%	3.86%	4.48%	5.20%	3.34%	4.30%	3.68%	3.67%	4.88%
Subway >1200m	88.77%	89.61%	89.20%	88.77%	89.72%	88.68%	89.36%	88.60%	89.63%	87.33%
Rail <400m	0.30%	0.63%	0.38%	0.46%	0.27%	0.46%	0.42%	0.46%	0.44%	0.46%
Rail 400-800m	1.73%	1.85%	1.49%	2.45%	1.74%	1.79%	1.80%	1.80%	1.61%	2.18%
Rail 800-1200m	2.69%	3.71%	3.25%	2.82%	3.18%	3.07%	2.78%	3.62%	2.84%	3.62%
Rail >1200m	95.28%	93.82%	94.88%	94.27%	94.81%	94.68%	95.00%	94.11%	95.11%	93.74%

	Self-rated health - binary		Self-rated mental health - binary		Know ppl in your neighbourhood - binary		Favours done for neighbour this month		Life Satisfaction - binary	
	weighted & rounded (50)		weighted & rounded (50)		weighted & rounded (50)		weighted & rounded (50)		weighted & rounded (50)	
	Excellent, Very Good	Good,Fair or Poor	Excellent, Very Good	Good, Fair or Poor	most or many	a few or none	Yes	No	Very satisfied	Dissatisfied
	Index	Index	Index	Index	Index	Index	Index	Index	Index	Index
Total	**60.5%**	**39.5%**	**69.7%**	**30.3%**	**37.2%**	**62.8%**	**63.1%**	**36.9%**	**64.0%**	**36.0%**
Bus <400m	*0.97*	*1.04*	*0.99*	*1.03*	*0.96*	*1.02*	*0.98*	*1.03*	*0.98*	*1.04*
Bus 400-800m	1.03	0.95	1.03	0.94	*1.08*	*0.95*	*1.04*	*0.94*	*1.04*	*0.93*
Bus 800-1200m	*1.19*	*0.71*	1.05	0.88	1.19	0.89	1.08	0.86	1.06	0.89
Bus >1200m	*1.14*	*0.79*	1.05	0.88	1.08	0.95	1.03	0.96	*1.09*	*0.85*
Streetcar <400m	1.06	0.90	0.96	1.09	0.87	1.08	1.01	0.99	0.93	1.12
Streetcar 400-800m	1.10	0.84	0.94	1.15	1.23	0.86	1.07	0.88	*0.81*	*1.35*
Streetcar 800-1200m	*1.20*	*0.70*	0.92	1.19	*1.03*	*0.98*	1.07	0.87	*0.79*	*1.37*
Streetcar >1200m	*0.99*	*1.01*	*1.00*	*0.99*	1.00	1.00	1.00	1.01	*1.01*	*0.98*
Subway <400m	1.08	0.88	0.98	1.05	*0.66*	*1.20*	*0.88*	*1.21*	1.00	1.00
Subway 400-800m	1.05	0.92	1.02	0.95	*0.77*	*1.13*	0.95	1.09	0.92	1.15
Subway 800-1200m	0.98	1.03	0.95	1.11	*1.29*	*0.83*	1.06	0.90	*0.89*	*1.19*
Subway >1200m	1.00	1.01	1.00	1.00	1.01	1.00	1.00	0.99	*1.01*	*0.98*
Rail <400m	0.69	1.47	0.94	1.14	0.69	1.18	0.97	1.06	0.98	1.03
Rail 400-800m	0.97	1.04	*0.84*	*1.38*	0.98	1.01	1.00	1.00	0.89	1.20
Rail 800-1200m	*0.87*	*1.20*	1.04	0.90	1.02	0.99	0.90	1.17	0.91	1.16
Rail >1200m	*1.01*	*0.99*	1.00	1.00	1.00	1.00	1.00	0.99	*1.01*	*0.99*

	Self-rated health - binary			Self-rated mental health - binary			Know ppl in your neighbourhood - binary			Favours done for neighbour this month			Life Satisfaction - binary	
	weighted & rounded (50)			weighted & rounded (50)			weighted & rounded (50)			weighted & rounded (50)			weighted & rounded (50)	
	Excellent, Very Good	Good,Fair or Poor		Excellent, Very Good	Good, Fair or Poor		most or many	a few or none		Yes	No		Very satisfied	Dissatisfied
	Percent	Percent		Percent	Percent		Percent	Percent		Percent	Percent		Percent	Percent
Total	***60.45%***	***39.55%***		***69.75%***	***30.25%***		***37.24%***	***62.76%***		***63.06%***	***36.94%***		***63.98%***	***36.02%***
Bus <400m	*58.93%*	*41.07%*		*68.85%*	*31.15%*		*35.92%*	*64.08%*		*62.07%*	*37.93%*		*62.70%*	*37.30%*
Bus 400-800m	62.32%	37.68%		71.52%	28.48%		*40.22%*	*59.78%*		*65.42%*	*34.58%*		*66.54%*	*33.46%*
Bus 800-1200m	*72.03%*	*27.97%*		73.46%	26.54%		44.14%	55.86%		68.25%	31.75%		67.98%	32.02%
Bus >1200m	*68.67%*	*31.33%*		73.29%	26.71%		40.18%	59.82%		64.68%	35.32%		*69.45%*	*30.55%*
Streetcar <400m	64.35%	35.65%		67.16%	32.84%		32.52%	67.48%		63.49%	36.51%		59.59%	40.41%
Streetcar 400-800m	66.73%	33.27%		65.32%	34.68%		*45.86%*	*54.14%*		67.33%	32.67%		*51.51%*	*48.49%*
Streetcar 800-1200m	*72.35%*	*27.65%*		63.86%	36.14%		38.51%	61.49%		67.78%	32.22%		*50.82%*	*49.18%*
Streetcar >1200m	*59.89%*	*40.11%*		*70.09%*	*29.91%*		37.24%	62.76%		62.85%	37.15%		*64.76%*	*35.24%*
Subway <400m	65.30%	34.70%		68.24%	31.76%		*24.54%*	*75.46%*		*55.43%*	*44.57%*		63.95%	36.05%
Subway 400-800m	63.49%	36.51%		71.37%	28.63%		*28.81%*	*71.19%*		59.82%	40.18%		58.75%	41.25%
Subway 800-1200m	59.22%	40.78%		66.51%	33.49%		*48.00%*	*52.00%*		66.61%	33.39%		*57.15%*	*42.85%*
Subway >1200m	60.22%	39.78%		69.85%	30.15%		37.51%	62.49%		63.26%	36.74%		*64.58%*	*35.42%*
Rail <400m	41.70%	58.30%		65.42%	34.58%		25.86%	74.14%		60.91%	39.09%		62.86%	37.14%
Rail 400-800m	58.92%	41.08%		*58.36%*	*41.64%*		36.54%	63.46%		63.06%	36.94%		56.73%	43.27%
Rail 800-1200m	*52.57%*	*47.43%*		72.65%	27.35%		38.05%	61.95%		56.70%	43.30%		58.21%	41.79%
Rail >1200m	*60.82%*	*39.18%*		69.88%	30.12%		37.27%	62.73%		63.28%	36.72%		*64.32%*	*35.68%*

APPENDIX 3:
BIVARIATE CROSSTABULATIONS FOR CCHS OUTCOMES

	BMI of Adult		Walked to and from School or Work in past 3 Months		Diabetes		Asthma	
	weighted & rounded (50)		weighted & rounded (50)		weighted & rounded (50)		weighted & rounded (50)	
	Normal or Underweight	Overweight or Obese	Yes	No	No	Yes	No	Yes
	Count	Count	Count	Count	Count	Count	Count	Count
Total	***2,553,163***	***2,689,115***	***1,058,714***	***3,256,314***	***5,450,162***	***416,865***	***5,444,071***	***422,031***
Bus <400m	1,864,380	1,935,883	*815,268*	*2,299,243*	*3,937,249*	*317,180*	3,956,947	296,558
Bus 400-800m	548,665	558,957	218,249	712,836	1,164,013	77,696	1,149,958	91,750
Bus 800-1200m	33,288	64,376	*8,105*	*63,194*	98,885	11,321	99,494	10,712
Bus >1200m	106,830	129,899	*17,092*	*181,041*	*250,015*	*10,668*	237,672	23,011
Streetcar <400m	162,181	130,210	*91,256*	*130,668*	292,991	15,315	279,445	28,861
Streetcar 400-800m	62,805	64,647	39,830	65,492	142,448	9,647	143,778	8,318
Streetcar 800-1200m	*56,199*	*39,177*	26,840	53,954	102,414	4,258	94,876	11,414
Streetcar >1200m	2,271,979	2,455,081	*900,788*	*3,006,200*	*4,912,308*	*387,643*	4,925,972	373,440
Subway <400m	*47,616*	*41,133*	*21,073*	*44,677*	410,167	21,996	95,829	4,903
Subway 400-800m	197,113	104,583	*121,690*	*149,472*			304,229	26,819
Subway 800-1200m	*124,558*	*72,381*	*62,415*	*87,211*	*212,032*	*7,511*	198,602	21,332
Subway >1200m	*2,183,876*	*2,471,019*	853,538	2,974,955	*4,827,963*	*387,357*	4,845,413	368,977
Rail <400m	*7,944*	*10,084*	*34,621*	*51,435*	107,649	5,396	281,991	15,724
Rail 400-800m	45,944	44,249						
Rail 800-1200m	70,577	97,503	25,974	102,473	168,162	16,509		
Rail >1200m	2,428,698	2,537,280	*998,119*	*3,102,407*	5,174,351	394,960	5,162,081	406,307

Note: t-test significance at p<0.05 is denoted with italics font

	BMI of Adult		Walked to and from School or Work in past 3 Months		Diabetes		Asthma	
	weighted & rounded (50)		weighted & rounded (50)		weighted & rounded		weighted & rounded	
	Normal or Underweight	Overweight or Obese	Yes	No	No	Yes	No	Yes
	Count	Count	Count	Count	Count	Count	Count	Count
Total	***2553163***	***2689115***	***1058714***	***3256314***	***5450162***	***416865***	***5444071***	***422031***
Bus <400m	73.02%	71.99%	*77.01%*	*70.61%*	*72.24%*	*76.09%*	72.68%	70.27%
Bus 400-800m	21.49%	20.79%	20.61%	21.89%	21.36%	18.64%	21.12%	21.74%
Bus 800-1200m	1.30%	2.39%	*0.77%*	*1.94%*	1.81%	2.72%	1.83%	2.54%
Bus >1200m	4.18%	4.83%	*1.61%*	*5.56%*	*4.59%*	*2.56%*	4.37%	5.45%
Streetcar <400m	6.35%	4.84%	*8.62%*	*4.01%*	5.38%	3.67%	5.13%	6.84%
Streetcar 400-800m	*2.46%*	*2.40%*	3.76%	2.01%	2.61%	2.31%	2.64%	1.97%
Streetcar 800-1200m	2.20%	1.46%	2.54%	1.66%	1.88%	1.02%	1.74%	2.70%
Streetcar >1200m	*88.99%*	*91.30%*	*85.08%*	*92.32%*	*90.13%*	*92.99%*	90.48%	88.49%
Subway <400m	1.86%	1.53%	*1.99%*	*1.37%*	7.53%	5.28%	1.76%	1.16%
Subway 400-800m	*7.72%*	*3.89%*	*11.49%*	*4.59%*			5.59%	6.35%
Subway 800-1200m	*4.88%*	*2.69%*	*5.90%*	*2.68%*	*3.89%*	*1.80%*	3.65%	5.05%
Subway >1200m	*85.54%*	*91.89%*	*80.62%*	*91.36%*	*88.58%*	*92.92%*	89.00%	87.43%
Rail <400m	0.31%	0.37%	*3.27%*	*1.58%*	1.98%	1.29%	5.18%	3.73%
Rail 400-800m	1.80%	1.65%						
Rail 800-1200m	2.76%	3.63%	2.45%	3.15%	3.09%	3.96%		
Rail >1200m	95.13%	94.35%	*94.28%*	*95.27%*	94.94%	94.75%	94.82%	96.27%

Note: t-test significance at p<0.05 is denoted with italics font

	BMI of Adult		Walked to and from School or Work in past 3 Months		Diabetes		Asthma	
	weighted & rounded (50)		weighted & rounded (50)		weighted & rounded		weighted & rounded	
	Normal or Underweight	Overweight or Obese	Yes	No	No	Yes	No	Yes
	Count	Count	Count	Count	Count	Count	Count	Count
Total	***48.70%***	***51.30%***	***24.54%***	***75.46%***	***92.89%***	***7.11%***	***92.81%***	***7.19%***
Bus <400m	1.01	0.99	*1.07*	*0.98*	*1.00*	*1.05*	1.00	0.97
Bus 400-800m	1.02	0.98	0.96	1.01	1.01	0.88	1.00	1.03
Bus 800-1200m	0.70	1.28	*0.46*	*1.17*	0.97	1.45	0.97	1.35
Bus >1200m	0.93	1.07	*0.35*	*1.21*	*1.03*	*0.58*	0.98	1.23
Streetcar <400m	1.14	0.87	*1.68*	*0.78*	1.02	0.70	0.98	1.30
Streetcar 400-800m	*1.01*	*0.99*	1.54	0.82	1.01	0.89	1.02	0.76
Streetcar 800-1200m	1.21	0.80	1.35	0.88	1.03	0.56	0.96	1.49
Streetcar >1200m	*0.99*	*1.01*	*0.94*	*1.02*	*1.00*	*1.03*	1.00	0.98
Subway <400m	1.10	0.90	*1.31*	*0.90*	1.02	0.72	1.03	0.68
Subway 400-800m	*1.34*	*0.68*	*1.83*	*0.73*			0.99	1.13
Subway 800-1200m	*1.30*	*0.72*	*1.70*	*0.77*	*1.04*	*0.48*	0.97	1.35
Subway >1200m	*0.96*	*1.03*	*0.91*	*1.03*	*1.00*	*1.05*	1.00	0.98
Rail <400m	0.90	1.09	*1.64*	*0.79*	1.03	0.67	1.02	0.73
Rail 400-800m	1.05	0.96						
Rail 800-1200m	0.86	1.13	0.82	1.06	0.98	1.26		
Rail >1200m	1.00	1.00	*0.99*	*1.00*	1.00	1.00	1.00	1.01

Note: t-test significance at p<0.05 is denoted with italics font

	BMI of Adult		Walked to and from School or Work in past 3 Months		Diabetes		Asthma	
	weighted & rounded (50)		weighted & rounded (50)		weighted & rounded (50)		weighted & rounded	
	Normal or Underweight	Overweight or Obese	Yes	No	No	Yes	No	Yes
	Count	Count	Count	Count	Count	Count	Count	Count
Total	***48.70%***	***51.30%***	***24.54%***	***75.46%***	***92.89%***	***7.11%***	***92.81%***	***7.19%***
Bus <400m	49.06%	50.94%	*26.18%*	*73.82%*	*92.54%*	*7.46%*	93.03%	6.97%
Bus 400-800m	49.54%	50.46%	23.44%	76.56%	93.74%	6.26%	92.61%	7.39%
Bus 800-1200m	34.08%	65.92%	*11.37%*	*88.63%*	89.73%	10.27%	90.28%	9.72%
Bus >1200m	45.13%	54.87%	*8.63%*	*91.37%*	*95.91%*	*4.09%*	91.17%	8.83%
Streetcar <400m	55.47%	44.53%	*41.12%*	*58.88%*	95.03%	4.97%	90.64%	9.36%
Streetcar 400-800m	*49.28%*	*50.72%*	37.82%	62.18%	93.66%	6.34%	94.53%	5.47%
Streetcar 800-1200m	58.92%	41.08%	33.22%	66.78%	96.01%	3.99%	89.26%	10.74%
Streetcar >1200m	*48.06%*	*51.94%*	*23.06%*	*76.94%*	*92.69%*	*7.31%*	92.95%	7.05%
Subway <400m	53.65%	46.35%	*32.05%*	*67.95%*	94.91%	5.09%	95.13%	4.87%
Subway 400-800m	*65.33%*	*34.67%*	*44.88%*	*55.12%*			91.90%	8.10%
Subway 800-1200m	*63.25%*	*36.75%*	*41.71%*	*58.29%*	*96.58%*	*3.42%*	90.30%	9.70%
Subway >1200m	*46.92%*	*53.08%*	*22.29%*	*77.71%*	*92.57%*	*7.43%*	92.92%	7.08%
Rail <400m	44.06%	55.94%	*40.23%*	*59.77%*	95.23%	4.77%	94.72%	5.28%
Rail 400-800m	50.94%	49.06%						
Rail 800-1200m	41.99%	58.01%	20.22%	79.78%	91.06%	8.94%		
Rail >1200m	48.91%	51.09%	*24.34%*	*75.66%*	92.91%	7.09%	92.70%	7.30%

Note: t-test significance at p<0.05 is denoted with italics font

APPENDIX 4:
STRATIFIED REGRESSION RESULTS FOR TRANSIT VARIABLES (GSS AND CCHS)

Stratified Regression Results for Transit Variables -- GSS Outcomes

These tables provide OR estimates and significance levels for the transit access and level-of-service variables.
All of these ORs have been adjusted by the full set of Urban Form and Individual/Household level variables described in the report.

Legend
- Significant at p ≤ 0.01
- Significant at p ≤0.05
- Extreme-value OR. Interpret with caution.

General Health

(0=excellent, very good; 1= good, fair or poor)

	Full Sample		Age: 15-64		Age: 65-74		Age: 75+		<$40k hhold income		>$150k hhold income		Female		Male	
Unweighted Sample Size	6732		5102		906		724		1190		853		3734		2998	
Nagelkerke r2	0.147		0.141		0.239		0.319		0.288		0.210		0.198		0.146	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	1.266	0.142	1.358	0.083	0.419	0.146	0.584	0.494	1.120	0.852	1.269	0.600	1.372	0.179	1.131	0.590
Bus 400-800m	1.185	0.303	1.285	0.166	0.470	0.211	0.365	0.205	1.292	0.684	2.468	0.043	1.332	0.234	1.053	0.824
Bus 800-1200m	0.882	0.593	0.907	0.705	0.470	0.417	0.893	0.913	0.771	0.778	0.826	0.801	1.081	0.818	0.709	0.315
Streetcar <400m	0.713	0.055	0.568	0.005	1.884	0.313	2.602	0.180	0.442	0.084	1.334	0.588	0.653	0.127	0.667	0.088
Streetcar 400-800m	0.676	0.058	0.587	0.019	1.530	0.559	1.335	0.845	0.648	0.421	0.170	0.026	1.213	0.506	0.365	0.001
Streetcar 800-1200m	0.546	0.016	0.532	0.021	0.345	0.306	1.474	0.767	0.604	0.556	0.455	0.280	0.921	0.812	0.284	0.002
Subway <400m	0.834	0.428	0.587	0.045	3.346	0.157	2.879	0.244	0.973	0.961	1.297	0.743	0.668	0.216	0.979	0.952
Subway 400-800m	1.020	0.904	1.004	0.983	1.545	0.504	1.761	0.387	2.205	0.078	1.792	0.251	0.855	0.500	1.151	0.552
Subway 800-1200m	1.026	0.872	0.985	0.930	1.705	0.379	1.724	0.487	1.556	0.350	1.432	0.421	0.990	0.966	1.071	0.757
Rail <400m	1.598	0.252	1.456	0.383	5.578	0.425	3.21E+04	0.963	2.041	0.526	8.41E-07	0.991	1.968	0.316	1.845	0.257
Rail 400-800m	1.081	0.723	1.156	0.543	2.096	0.413	0.711	0.743	1.016	0.979	0.000	0.971	1.263	0.438	0.930	0.830
Rail 800-1200m	1.360	0.055	1.274	0.168	1.770	0.346	2.577	0.244	2.184	0.102	0.761	0.723	1.214	0.374	1.575	0.068
LOS <400m (/1k)	1.008	0.906	1.084	0.305	0.632	0.104	0.832	0.513	0.891	0.551	0.796	0.558	1.000	0.920	1.000	0.801
LOS 400-800m (/1k)	0.928	0.173	0.903	0.108	0.885	0.508	0.983	0.937	0.747	0.043	1.277	0.198	1.000	0.489	1.000	0.303
LOS >1200m (/1k)	1.082	0.081	1.108	0.039	0.827	0.251	1.215	0.412	0.787	0.078	1.094	0.544	1.000	0.044	1.000	0.528

Stratified Regression Results

General Health (cont'd)

	Born in Canada		Foreign Born		Child 0-4: no		Child 0-4: yes		Child 5-14: no		Child 5-14: yes		Child 15-18: no		Child 15-18: yes		Toronto		Suburbs	
Unweighted Sample Size	3395		3271		6084		648		5568		1164		6273		459		2738		3994	
Nagelkerke r2	0.136		0.193		0.155		0.285		0.160		0.180		0.147		0.321		0.215		0.144	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	1.261	0.244	1.321	0.364	1.476	0.026	0.507	0.214	1.304	0.145	1.043	0.912	1.216	0.251	1.681	0.369	0.887	0.927	1.208	0.267
Bus 400-800m	1.130	0.552	1.367	0.313	1.356	0.086	0.531	0.263	1.196	0.338	1.177	0.674	1.101	0.583	2.062	0.208	0.835	0.891	1.150	0.420
Bus 800-1200m	0.662	0.193	1.209	0.637	1.066	0.799	0.199	0.077	0.893	0.668	0.727	0.579	0.763	0.291	3.400	0.099	0.517	0.635	0.907	0.698
Streetcar <400m	0.623	0.054	0.753	0.302	0.659	0.027	1.828	0.346	0.686	0.047	0.460	0.182	0.770	0.147	0.157	0.135	0.959	0.839	n/a	
Streetcar 400-800m	0.499	0.019	0.898	0.738	0.677	0.068	0.478	0.497	0.529	0.006	2.215	0.164	0.694	0.090	0.841	0.846	0.754	0.209	n/a	
Streetcar 800-1200m	0.587	0.109	0.415	0.037	0.593	0.051	0.332	0.251	0.514	0.016	0.473	0.276	0.549	0.020	2.869	0.629	0.660	0.128	n/a	
Subway <400m	0.736	0.381	1.014	0.965	0.849	0.497	1.412	0.714	1.102	0.699	0.097	0.002	0.892	0.628	1.8E-06	0.922	0.901	0.686	n/a	
Subway 400-800m	0.948	0.820	0.980	0.932	0.957	0.799	2.400	0.163	1.124	0.503	0.624	0.348	1.041	0.811	0.345	0.281	0.979	0.912	n/a	
Subway 800-1200m	1.036	0.873	0.996	0.987	1.002	0.989	0.978	0.967	1.023	0.898	0.881	0.734	1.037	0.822	0.403	0.246	1.088	0.638	n/a	
Rail <400m	1.562	0.502	1.299	0.661	2.017	0.123	0.173	0.243	2.057	0.123	0.251	0.229	1.748	0.199	0.956	0.981	2.161	0.227	1.006	0.992
Rail 400-800m	0.793	0.448	2.044	0.047	1.329	0.208	0.100	0.163	1.031	0.899	1.335	0.646	0.883	0.591	14.121	0.020	0.669	0.198	1.718	0.120
Rail 800-1200m	1.081	0.741	1.899	0.007	1.502	0.016	0.272	0.088	1.467	0.026	1.014	0.978	1.185	0.323	2.384	0.226	0.824	0.424	2.045	0.002
LOS <400m (/1k)	0.964	0.743	1.035	0.719	0.967	0.662	1.258	0.406	0.948	0.472	1.760	0.031	1.012	0.866	0.817	0.623	0.960	0.654	1.087	0.527
LOS 400-800m (/1k)	0.841	0.037	1.024	0.766	0.911	0.108	1.235	0.361	0.908	0.108	0.971	0.851	0.953	0.398	0.804	0.374	1.021	0.805	0.878	0.118
LOS >1200m (/1k)	1.115	0.109	1.041	0.532	1.080	0.114	1.299	0.092	1.069	0.178	1.168	0.208	1.069	0.151	1.299	0.212	1.119	0.080	1.093	0.209

Mental Health (0=excellent, very good; 1= good, fair or poor)

	Full Sample		Age: 15-64		Age: 65-74		Age: 75+		<$40k hhold income		>$150k hhold income		Female		Male	
Unweighted Sample Size	6727		5103		899		725		1187		853		3727		3000	
Nagelkerke r2	0.087		0.09		0.26		0.291		0.219		0.175		0.108		0.114	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	1.260	0.164	1.436	0.046	0.221	0.023	0.757	0.718	0.671	0.501	1.248	0.597	0.805	0.339	2.072	0.004
Bus 400-800m	1.216	0.251	1.384	0.081	0.297	0.069	0.626	0.547	0.887	0.844	1.693	0.206	0.821	0.398	1.968	0.010
Bus 800-1200m	1.236	0.376	1.414	0.180	0.049	0.049	3.372	0.243	0.761	0.761	0.248	0.203	1.085	0.803	1.437	0.328
Streetcar <400m	1.292	0.147	1.223	0.307	1.411	0.624	2.300	0.229	0.867	0.749	1.193	0.740	1.000	1.000	1.517	0.083
Streetcar 400-800m	1.285	0.214	1.414	0.108	1.035	0.969	0.375	0.484	1.148	0.789	2.331	0.140	1.405	0.238	1.133	0.673
Streetcar 800-1200m	1.537	0.066	1.600	0.059	1.078	0.939	0.931	0.955	0.655	0.583	4.954	0.008	2.343	0.007	0.937	0.860
Subway <400m	1.022	0.924	1.032	0.902	0.603	0.640	0.781	0.769	2.729	0.066	0.064	0.017	0.840	0.584	1.332	0.412
Subway 400-800m	0.842	0.309	0.852	0.389	1.316	0.692	0.541	0.384	2.239	0.059	1.320	0.577	0.661	0.088	1.080	0.754
Subway 800-1200m	1.187	0.282	1.258	0.184	1.108	0.879	0.995	0.995	1.385	0.482	1.148	0.756	1.294	0.262	1.074	0.759
Rail <400m	0.865	0.744	0.917	0.855	2.108	0.746	1.5E-05	0.975	0.555	0.559	4.282	0.275	1.318	0.699	0.718	0.585
Rail 400-800m	1.475	0.067	1.666	0.026	0.706	0.708	0.355	0.305	0.771	0.655	0.387	0.314	1.507	0.157	1.705	0.107
Rail 800-1200m	0.819	0.248	0.717	0.087	3.846	0.040	0.691	0.604	2.153	0.082	0.318	0.214	0.624	0.048	1.097	0.724
LOS <400m (/1k)	1.000	0.928	0.999	0.988	0.961	0.892	1.080	0.790	0.871	0.485	1.356	0.395	0.993	0.944	1.041	0.723
LOS 400-800m (/1k)	1.000	0.532	0.977	0.725	0.906	0.618	1.737	0.010	1.045	0.766	1.134	0.545	1.075	0.348	0.948	0.542
LOS >1200m (/1k)	1.000	0.910	0.991	0.862	0.912	0.626	1.132	0.562	0.724	0.021	1.049	0.760	1.034	0.599	0.948	0.473

Mental Health (cont'd)

	Born in Canada		Foreign Born		Child 0-4: no		Child 0-4: yes		Child 5-14: no		Child 5-14: yes		Child 15-18: no		Child 15-18: yes		Toronto		Suburbs	
Unweighted Sample Size	3396		3267		6079		648		5562		1165		6265		462		2736		3991	
Nagelkerke r2	0.106		0.133		0.088		0.25		0.094		0.174		0.092		0.36		0.124		0.103	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	1.481	0.055	1.305	0.426	1.427	0.046	0.609	0.423	1.205	0.316	2.043	0.099	1.182	0.338	4.443	0.034	1.214	0.883	1.314	0.127
Bus 400-800m	1.398	0.114	1.381	0.340	1.394	0.068	0.478	0.249	1.178	0.391	2.043	0.105	1.060	0.745	9.481	0.001	1.186	0.898	1.253	0.217
Bus 800-1200m	1.062	0.849	1.867	0.141	1.404	0.179	0.594	0.587	1.012	0.964	4.194	0.017	0.978	0.932	25.289	0.000	0.533	0.659	1.470	0.132
Streetcar <400m	1.021	0.933	1.751	0.041	1.300	0.160	0.903	0.888	1.316	0.148	0.804	0.711	1.230	0.257	2.408	0.391	1.293	0.208	n/a	
Streetcar 400-800m	0.869	0.623	2.115	0.017	1.311	0.193	0.533	0.593	1.142	0.553	2.937	0.054	1.205	0.377	4.828	0.062	1.297	0.233	n/a	
Streetcar 800-1200m	1.301	0.419	2.327	0.019	1.747	0.025	0.442	0.412	1.562	0.081	1.217	0.773	1.398	0.164	6.902	0.339	1.650	0.047	n/a	
Subway <400m	0.805	0.538	1.072	0.834	1.062	0.802	0.932	0.953	1.189	0.489	0.252	0.069	1.072	0.772	0.708	0.810	0.873	0.596	n/a	
Subway 400-800m	0.734	0.215	0.866	0.563	0.873	0.438	0.384	0.237	0.878	0.474	0.636	0.404	0.867	0.411	0.307	0.325	0.783	0.217	n/a	
Subway 800-1200m	1.261	0.306	1.196	0.453	1.230	0.229	0.552	0.285	1.229	0.247	0.992	0.984	1.175	0.335	0.721	0.654	1.244	0.222	n/a	
Rail <400m	1.552	0.518	0.536	0.378	1.071	0.884	3.5E-05	0.962	0.653	0.408	1.886	0.542	0.689	0.463	13.484	0.117	1.187	0.795	0.719	0.632
Rail 400-800m	1.207	0.519	1.834	0.071	1.673	0.019	0.776	0.872	1.367	0.177	2.790	0.104	1.519	0.061	1.916	0.515	1.433	0.219	1.934	0.057
Rail 800-1200m	1.088	0.729	0.715	0.199	0.880	0.477	0.292	0.202	0.893	0.539	0.339	0.110	0.881	0.485	0.361	0.216	0.862	0.553	1.021	0.935
LOS <400m (/1k)	1.054	0.651	0.959	0.681	1.017	0.830	0.823	0.479	0.972	0.716	1.449	0.174	0.974	0.731	1.675	0.195	1.070	0.462	0.891	0.412
LOS 400-800m (/1k)	1.050	0.562	1.053	0.525	1.029	0.622	1.004	0.989	1.039	0.527	0.894	0.507	1.055	0.357	0.627	0.139	1.091	0.322	1.003	0.971
LOS >1200m (/1k)	0.996	0.951	0.987	0.849	0.999	0.990	0.956	0.813	1.009	0.862	0.915	0.521	1.003	0.953	1.375	0.152	1.000	0.999	0.951	0.493

Know People (0= most or many; 1= a few or none)

	Full Sample		Age: 15-64		Age: 65-74		Age: 75+		<$40k hhold income		>$150k hhold income		Female		Male	
Unweighted Sample Size	6751		5117		906		728		1193		854		3745		3006	
Nagelkerke r2	0.148		0.166		0.172		0.282		0.245		0.282		0.171		0.175	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	0.925	0.622	0.787	0.166	3.256	0.047	1.227	0.793	0.642	0.503	0.574	0.134	0.850	0.467	1.072	0.764
Bus 400-800m	0.938	0.689	0.807	0.225	2.776	0.088	1.233	0.789	0.800	0.742	0.621	0.204	0.794	0.314	1.210	0.422
Bus 800-1200m	0.806	0.333	0.664	0.091	2.369	0.320	2.568	0.382	0.393	0.296	0.329	0.043	0.867	0.659	0.825	0.553
Streetcar <400m	0.562	0.001	0.507	0.001	1.395	0.599	0.452	0.259	1.334	0.573	0.476	0.110	0.539	0.022	0.525	0.009
Streetcar 400-800m	0.448	0.000	0.425	0.000	0.586	0.457	0.575	0.687	0.713	0.545	0.323	0.053	0.370	0.001	0.516	0.023
Streetcar 800-1200m	0.635	0.057	0.632	0.078	0.687	0.666	0.895	0.932	0.244	0.097	1.492	0.496	0.629	0.159	0.666	0.265
Subway <400m	0.931	0.768	1.050	0.863	0.551	0.479	0.459	0.352	1.223	0.740	0.273	0.054	1.232	0.536	0.674	0.292
Subway 400-800m	0.958	0.802	0.971	0.877	0.582	0.384	1.182	0.812	1.956	0.179	0.630	0.330	1.000	0.999	0.867	0.570
Subway 800-1200m	0.603	0.001	0.552	0.001	1.358	0.591	0.649	0.545	1.365	0.512	0.745	0.462	0.751	0.221	0.478	0.001
Rail <400m	1.084	0.870	0.836	0.727	2.616	0.655	2.5E+04	0.966	1.507	0.731	0.787	0.871	0.545	0.349	3.714	0.182
Rail 400-800m	0.842	0.440	0.850	0.507	1.161	0.863	0.492	0.499	2.288	0.228	0.206	0.064	0.827	0.523	0.907	0.781
Rail 800-1200m	0.769	0.111	0.699	0.047	0.980	0.972	1.613	0.557	0.452	0.087	0.702	0.591	0.851	0.470	0.582	0.035
LOS <400m (/1k)	1.206	0.025	1.235	0.030	0.976	0.927	1.202	0.564	1.083	0.708	1.083	0.812	1.157	0.201	1.322	0.034
LOS 400-800m (/1k)	1.016	0.785	1.000	0.998	0.923	0.670	1.457	0.135	0.935	0.656	1.212	0.316	1.035	0.669	1.001	0.989
LOS >1200m (/1k)	0.983	0.713	0.981	0.714	0.918	0.582	1.153	0.524	0.962	0.770	0.855	0.257	0.959	0.504	1.021	0.777

Know People (cont'd)

	Born in Canada		Foreign Born		Child 0-4: no		Child 0-4: yes		Child 5-14: no		Child 5-14: yes		Child 15-18: no		Child 15-18: yes		Toronto		Suburbs	
Unweighted Sample Size	3391		3281		6098		653		5581		1170		6289		462		2751		4000	
Nagelkerke r2	0.184		0.141		0.154		0.318		0.154		0.221		0.149		0.312		0.19		0.166	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	0.856	0.423	1.120	0.709	1.000	0.998	0.531	0.273	0.860	0.407	1.250	0.525	1.023	0.890	0.392	0.064	12.939	0.096	0.761	0.110
Bus 400-800m	0.839	0.379	1.250	0.470	1.030	0.862	0.579	0.357	0.889	0.527	1.167	0.666	1.018	0.919	0.405	0.074	17.614	0.062	0.692	0.034
Bus 800-1200m	0.593	0.064	1.373	0.437	0.983	0.944	0.096	0.005	0.930	0.775	0.369	0.071	0.930	0.761	0.288	0.076	16.196	0.080	0.684	0.116
Streetcar <400m	0.395	0.000	0.790	0.408	0.550	0.002	0.466	0.225	0.582	0.005	0.214	0.010	0.552	0.001	0.856	0.875	0.747	0.156	n/a	
Streetcar 400-800m	0.251	0.000	0.833	0.580	0.424	0.000	0.705	0.700	0.364	0.000	1.536	0.438	0.441	0.000	0.295	0.183	0.559	0.008	n/a	
Streetcar 800-1200m	0.506	0.036	0.709	0.359	0.629	0.078	0.636	0.501	0.524	0.015	1.311	0.662	0.638	0.068	0.201	0.381	0.896	0.670	n/a	
Subway <400m	1.128	0.742	0.853	0.649	1.059	0.825	0.421	0.339	1.153	0.605	0.444	0.199	1.049	0.853	1.9E-08	0.203	1.057	0.837	n/a	
Subway 400-800m	0.949	0.830	0.930	0.775	1.062	0.740	0.445	0.202	1.197	0.341	0.235	0.005	1.006	0.975	0.184	0.089	1.116	0.578	n/a	
Subway 800-1200m	0.495	0.002	0.679	0.100	0.614	0.005	0.435	0.084	0.627	0.009	0.404	0.020	0.618	0.003	0.496	0.315	0.621	0.007	n/a	
Rail <400m	0.796	0.749	1.427	0.624	1.135	0.812	0.283	0.397	1.160	0.792	0.759	0.797	1.123	0.832	0.237	0.321	0.890	0.852	1.681	0.543
Rail 400-800m	0.891	0.705	0.702	0.306	1.005	0.982	0.158	0.268	0.936	0.786	0.472	0.262	0.887	0.608	0.375	0.272	1.178	0.599	0.418	0.013
Rail 800-1200m	0.495	0.003	1.181	0.520	0.847	0.339	0.288	0.061	0.777	0.154	0.814	0.703	0.662	0.018	5.970	0.038	0.515	0.005	1.080	0.759
LOS <400m (/1k)	1.166	0.256	1.292	0.026	1.145	0.122	2.226	0.031	1.134	0.152	2.009	0.016	1.188	0.050	2.211	0.042	1.277	0.033	1.351	0.040
LOS 400-800m (/1k)	1.105	0.261	0.953	0.553	1.031	0.616	0.826	0.449	0.991	0.893	1.117	0.508	0.996	0.949	1.713	0.056	1.010	0.916	1.090	0.321
LOS >1200m (/1k)	0.968	0.641	1.008	0.902	0.982	0.727	0.967	0.830	0.970	0.556	1.027	0.830	0.973	0.581	1.156	0.480	1.035	0.617	0.941	0.404

Favours Done (0= yes; 1= no)

	Full Sample		Age: 15-64		Age: 65-74		Age: 75+		<$40k hhold income		>$150k hhold income		Female		Male	
Unweighted Sample Size	6658		5042		900		716		1170		840		3684		2974	
Nagelkerke r2	0.112		0.122		0.21		0.321		0.23		0.220		0.132		0.132	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	0.749	0.066	0.732	0.068	2.896	0.120	0.187	0.037	0.419	0.170	1.193	0.660	0.613	0.025	0.923	0.735
Bus 400-800m	0.745	0.069	0.730	0.073	3.462	0.072	0.156	0.022	0.316	0.076	1.025	0.951	0.599	0.023	0.969	0.896
Bus 800-1200m	0.566	0.013	0.541	0.013	1.966	0.504	0.355	0.330	1.280	0.779	1.140	0.815	0.532	0.051	0.640	0.190
Streetcar <400m	0.679	0.031	0.641	0.025	1.052	0.939	0.481	0.328	1.848	0.178	0.659	0.448	0.797	0.392	0.584	0.033
Streetcar 400-800m	0.748	0.161	0.759	0.211	0.468	0.405	1.098	0.943	1.171	0.762	1.476	0.521	0.747	0.317	0.700	0.244
Streetcar 800-1200m	0.709	0.159	0.762	0.299	0.641	0.625	0.156	0.164	0.903	0.894	0.939	0.922	0.855	0.632	0.577	0.156
Subway <400m	0.938	0.778	0.983	0.946	0.833	0.844	0.639	0.596	1.869	0.265	0.372	0.185	1.102	0.747	0.743	0.405
Subway 400-800m	0.889	0.469	0.837	0.317	1.180	0.800	1.775	0.384	1.305	0.546	0.956	0.930	1.119	0.620	0.723	0.179
Subway 800-1200m	0.864	0.368	0.921	0.640	1.165	0.802	0.223	0.068	1.356	0.505	0.545	0.202	1.200	0.430	0.665	0.092
Rail <400m	0.765	0.520	0.689	0.393	6.427	0.445	4.5E-05	0.963	0.205	0.105	3.3E-05	0.950	0.126	0.027	2.151	0.188
Rail 400-800m	0.878	0.548	0.915	0.704	1.767	0.506	0.184	0.186	0.727	0.577	0.012	0.234	0.783	0.406	0.987	0.969
Rail 800-1200m	1.114	0.500	1.172	0.363	0.718	0.631	0.671	0.575	0.649	0.343	0.752	0.691	1.101	0.656	0.969	0.900
LOS <400m (/1k)	1.075	0.313	1.084	0.311	1.010	0.970	1.233	0.457	0.933	0.728	1.499	0.214	1.086	0.408	1.134	0.248
LOS 400-800m (/1k)	1.020	0.706	1.005	0.937	0.948	0.792	1.221	0.335	1.008	0.955	0.749	0.147	0.953	0.513	1.095	0.262
LOS >1200m (/1k)	1.070	0.126	1.042	0.393	1.219	0.272	1.331	0.176	0.959	0.752	1.024	0.858	1.077	0.211	1.064	0.375

Favours Done (cont'd)

	Born in Canada		Foreign Born		Child 0-4: no		Child 0-4: yes		Child 5-14: no		Child 5-14: yes		Child 15-18: no		Child 15-18: yes		Toronto		Suburbs	
Unweighted Sample Size	3351		3232		6014		644		5503		1155		6203		455		2706		3952	
Nagelkerke r2	0.141		0.133		0.115		0.324		0.109		0.174		0.116		0.388		0.181		0.11	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	0.838	0.367	0.643	0.152	0.694	0.029	1.333	0.655	0.763	0.123	0.535	0.108	0.697	0.032	1.435	0.527	0.228	0.328	0.692	0.028
Bus 400-800m	0.834	0.370	0.697	0.247	0.669	0.019	2.324	0.199	0.783	0.175	0.448	0.044	0.708	0.046	1.194	0.756	0.239	0.345	0.653	0.014
Bus 800-1200m	0.554	0.051	0.726	0.424	0.527	0.008	0.940	0.948	0.674	0.111	0.108	0.007	0.569	0.020	0.621	0.584	0.129	0.195	0.554	0.016
Streetcar <400m	0.616	0.054	0.794	0.398	0.699	0.057	0.300	0.142	0.718	0.079	0.508	0.299	0.635	0.013	1.139	0.903	0.765	0.194	n/a	
Streetcar 400-800m	0.523	0.027	1.190	0.582	0.782	0.247	0.113	0.174	0.795	0.299	0.529	0.348	0.625	0.031	18.766	0.004	0.895	0.621	n/a	
Streetcar 800-1200m	0.760	0.420	0.760	0.454	0.766	0.298	0.748	0.792	0.690	0.158	0.819	0.786	0.718	0.183	3.0E-06	0.983	0.857	0.554	n/a	
Subway <400m	1.109	0.762	0.845	0.597	0.871	0.560	0.731	0.762	1.030	0.904	0.381	0.204	0.962	0.865	0.529	0.751	0.693	0.150	n/a	
Subway 400-800m	0.886	0.613	0.863	0.535	0.933	0.680	0.353	0.319	0.924	0.648	0.489	0.242	0.934	0.679	2.2E-07	0.958	0.750	0.132	n/a	
Subway 800-1200m	1.121	0.616	0.685	0.121	0.833	0.300	1.498	0.468	0.873	0.449	0.813	0.634	0.856	0.357	1.640	0.552	0.763	0.145	n/a	
Rail <400m	0.498	0.443	0.667	0.463	0.795	0.611	0.296	0.385	0.885	0.788	2.5E-05	0.931	1.057	0.900	3.3E-07	0.977	0.343	0.122	1.893	0.318
Rail 400-800m	0.926	0.789	0.732	0.381	0.863	0.515	5.211	0.150	0.860	0.513	0.888	0.873	0.935	0.763	3.8E-07	0.964	0.962	0.893	0.814	0.561
Rail 800-1200m	1.036	0.880	1.235	0.368	1.220	0.236	0.045	0.007	1.088	0.619	0.863	0.793	0.916	0.613	12.403	0.002	0.963	0.873	1.156	0.539
LOS <400m (/1k)	0.940	0.597	1.196	0.071	1.083	0.302	1.182	0.592	1.069	0.376	1.283	0.400	1.084	0.274	1.611	0.269	1.287	0.011	0.914	0.493
LOS 400-800m (/1k)	1.044	0.590	0.989	0.883	1.041	0.472	0.683	0.172	1.054	0.366	0.820	0.272	1.028	0.623	1.252	0.421	1.175	0.059	0.978	0.790
LOS >1200m (/1k)	1.059	0.381	1.055	0.401	1.070	0.158	1.015	0.934	1.077	0.125	1.107	0.437	1.067	0.157	0.969	0.892	1.199	0.006	1.009	0.893

Life Satisfaction (0 "satisfied" = satisfaction scale 7-10; 1 "dissatisfied"= satisfaction scale 1-6)

	Full Sample		Age: 15-64		Age: 65-74		Age: 75+		<$40k hhold income		>$150k hhold income		Female		Male	
Unweighted Sample Size	6479		5002		852		625		1140		841		3583		2896	
Nagelkerke r2	0.101		0.102		0.271		0.276		0.271		0.209		0.123		0.118	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	1.022	0.895	0.994	0.972	0.500	0.397	5.343	0.120	1.143	0.821	0.891	0.777	1.179	0.491	0.929	0.750
Bus 400-800m	1.017	0.921	0.987	0.939	0.501	0.401	5.701	0.105	1.218	0.747	0.751	0.486	1.383	0.183	0.785	0.306
Bus 800-1200m	1.026	0.912	1.054	0.831	0.217	0.252	4.072	0.328	1.040	0.965	0.365	0.165	1.198	0.602	1.026	0.939
Streetcar <400m	0.971	0.865	0.991	0.960	1.883	0.371	0.378	0.286	1.135	0.781	0.702	0.510	0.903	0.700	1.004	0.986
Streetcar 400-800m	1.634	0.012	1.825	0.004	0.938	0.940	0.609	0.682	3.401	0.024	3.297	0.025	1.405	0.227	2.014	0.013
Streetcar 800-1200m	1.940	0.005	2.055	0.004	2.284	0.398	0.443	0.543	2.833	0.193	2.443	0.129	1.766	0.081	2.509	0.009
Subway <400m	0.655	0.064	0.585	0.032	1.150	0.897	0.958	0.963	0.923	0.887	0.422	0.229	0.788	0.446	0.502	0.052
Subway 400-800m	0.877	0.416	0.807	0.220	4.485	0.035	0.813	0.770	2.262	0.067	0.547	0.235	1.050	0.829	0.686	0.116
Subway 800-1200m	1.312	0.082	1.251	0.180	3.493	0.052	3.863	0.133	2.459	0.045	1.359	0.472	1.440	0.113	1.186	0.439
Rail <400m	0.706	0.403	0.577	0.217	83.316	0.115	2.2E-05	0.975	0.754	0.775	10.244	0.099	1.253	0.731	0.423	0.137
Rail 400-800m	0.960	0.848	0.958	0.850	1.742	0.569	0.614	0.660	1.061	0.921	0.294	0.261	0.959	0.887	1.065	0.844
Rail 800-1200m	1.168	0.339	1.103	0.578	2.086	0.272	1.504	0.580	1.061	0.899	0.210	0.074	1.130	0.574	1.148	0.585
LOS <400m (/1k)	1.043	0.553	1.089	0.271	0.709	0.308	0.719	0.311	1.095	0.649	0.656	0.249	0.835	0.094	1.359	0.007
LOS 400-800m (/1k)	0.992	0.882	0.993	0.913	0.795	0.286	1.030	0.897	0.955	0.753	0.992	0.963	1.022	0.769	0.940	0.457
LOS >1200m (/1k)	0.997	0.954	1.013	0.787	0.907	0.604	0.744	0.286	0.834	0.192	0.821	0.156	1.011	0.862	0.977	0.739

Life Satisfaction (cont'd)

	Born in Canada		Foreign Born		Child 0-4: no		Child 0-4: yes		Child 5-14: no		Child 5-14: yes		Child 15-18: no		Child 15-18: yes		Toronto		Suburbs	
Unweighted Sample Size	3341		3087		5835		644		5333		1146		6029		450		2627		3852	
Nagelkerke r2	0.149		0.108		0.1		0.217		0.112		0.16		0.103		0.376		0.134		0.106	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	1.060	0.767	1.436	0.306	1.006	0.971	1.556	0.525	0.959	0.819	1.318	0.477	0.955	0.790	1.949	0.261	0.763	0.844	1.088	0.627
Bus 400-800m	0.857	0.451	1.771	0.109	0.998	0.992	1.334	0.685	0.944	0.760	1.340	0.460	0.884	0.487	3.475	0.034	0.818	0.883	1.042	0.819
Bus 800-1200m	0.645	0.163	2.834	0.017	0.940	0.804	2.958	0.221	0.954	0.858	1.663	0.395	0.977	0.927	1.953	0.446	0.643	0.758	1.097	0.716
Streetcar <400m	0.834	0.448	1.165	0.581	1.120	0.538	0.283	0.075	0.934	0.716	1.149	0.805	0.916	0.624	1.172	0.900	1.029	0.886	n/a	
Streetcar 400-800m	1.717	0.041	1.510	0.183	1.589	0.021	1.433	0.710	1.533	0.045	2.558	0.078	1.543	0.033	4.118	0.089	1.619	0.023	n/a	
Streetcar 800-1200m	1.880	0.045	2.401	0.020	2.102	0.003	1.080	0.923	1.943	0.010	2.275	0.192	1.679	0.031	19.432	0.110	1.959	0.007	n/a	
Subway <400m	0.647	0.196	0.792	0.478	0.646	0.067	1.561	0.605	0.603	0.045	1.155	0.813	0.688	0.111	0.215	0.381	0.703	0.160	n/a	
Subway 400-800m	0.693	0.121	1.164	0.520	0.880	0.445	0.806	0.753	0.911	0.589	0.699	0.473	0.921	0.617	0.696	0.705	0.974	0.889	n/a	
Subway 800-1200m	1.439	0.097	1.341	0.209	1.380	0.057	0.802	0.656	1.374	0.071	1.248	0.554	1.363	0.056	0.285	0.149	1.363	0.075	n/a	
Rail <400m	1.770	0.411	0.488	0.237	0.630	0.309	0.524	0.595	0.679	0.401	1.256	0.825	0.475	0.122	2.61E+05	0.950	0.474	0.232	0.788	0.692
Rail 400-800m	0.768	0.361	1.518	0.215	0.944	0.792	1.755	0.669	0.929	0.747	0.907	0.878	0.955	0.835	2.263	0.353	0.981	0.947	0.967	0.925
Rail 800-1200m	1.257	0.324	1.201	0.445	1.233	0.217	0.702	0.653	1.153	0.412	1.133	0.817	1.217	0.253	0.946	0.941	1.223	0.376	1.370	0.205
LOS <400m (/1k)	1.015	0.896	1.002	0.984	1.012	0.875	0.921	0.735	1.047	0.542	0.914	0.741	1.044	0.557	0.903	0.833	1.050	0.585	1.069	0.622
LOS 400-800m (/1k)	0.915	0.273	1.056	0.482	1.021	0.721	0.587	0.028	0.999	0.992	0.910	0.555	0.963	0.503	1.219	0.473	0.989	0.899	0.971	0.728
LOS >1200m (/1k)	1.004	0.954	0.980	0.753	1.010	0.833	0.844	0.305	1.003	0.945	1.037	0.767	0.999	0.991	1.290	0.283	1.057	0.390	0.902	0.147

Stratified Regression Results for Transit Variables -- CCHS Outcomes

These tables provide OR estimates and significance levels for the transit access and level-of-service variables.
All of these ORs have been adjusted by the full set of Urban Form and Individual/Household level variables described in the report.

Legend
- Significant at p ≤ 0.01 (red)
- Significant at p ≤0.05 (orange)
- Extreme-value OR. Interpret with caution. (grey)
- Model suppressed due to insufficient sample size (hatched)

Obesity

(0=normal or underweight; 1= overweight or obese)

	Full Sample		Age: 15-64		Age: 65-74		Age: 75+		<$40k hhold income		>$150k hhold income		Female		Male	
Unweighted Sample Size	5188		3669		856		663		1374		1712		2938		2250	
Nagelkerke r2	0.208		0.233		0.339		0.369		0.265		0.371		0.23		0.229	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	1.180	0.390	1.226	0.343	0.607	0.441	0.997	0.998	0.542	0.327	1.893	0.033	1.215	0.484	0.915	0.770
Bus 400-800m	1.280	0.209	1.373	0.146	0.585	0.428	1.252	0.826	0.773	0.694	1.852	0.039	1.037	0.900	1.243	0.477
Bus 800-1200m	2.045	0.015	2.602	0.005	0.788	0.782	0.829	0.881	3.473	0.229	3.102	0.013	2.438	0.030	1.620	0.279
Streetcar <400m	0.705	0.057	0.624	0.022	0.737	0.647	1.393	0.698	0.561	0.147	1.168	0.650	0.835	0.503	0.716	0.210
Streetcar 400-800m	1.442	0.122	1.419	0.192	0.736	0.687	1.258	0.835	1.081	0.892	1.498	0.324	0.713	0.345	3.586	0.000
Streetcar 800-1200m	0.764	0.290	0.772	0.363	2.025	0.534	0.456	0.602	0.629	0.418	1.398	0.455	0.993	0.986	0.525	0.090
Subway <400m	0.808	0.434	0.810	0.503	0.413	0.322	2.840	0.455	0.361	0.057	2.631	0.147	0.875	0.751	0.621	0.219
Subway 400-800m	0.629	0.009	0.656	0.030	0.364	0.171	1.315	0.802	0.677	0.302	0.516	0.053	0.365	0.000	0.888	0.664
Subway 800-1200m	0.573	0.004	0.752	0.187	0.073	0.001	0.465	0.338	0.339	0.009	1.800	0.090	0.810	0.429	0.337	0.000
Rail <400m	0.618	0.386	1.157	0.826	0.058	0.081	1.4E-05	0.982	0.006	0.041	2.232	0.612	0.084	0.148	1.086	0.910
Rail 400-800m	0.932	0.782	1.024	0.930	0.384	0.363	2.817	0.472	0.463	0.070	1.218	0.726	1.957	0.075	0.500	0.050
Rail 800-1200m	1.282	0.176	1.492	0.046	0.786	0.783	2.317	0.440	0.996	0.992	2.677	0.012	2.008	0.014	1.465	0.157
LOS <400m (LN(/10k))	1.447	0.028	1.578	0.014	1.460	0.579	0.674	0.622	1.288	0.472	0.649	0.299	0.951	0.837	2.378	0.001
LOS 400-800m (LN(/10k))	0.846	0.181	0.805	0.119	0.940	0.900	1.328	0.643	0.608	0.036	1.562	0.092	0.933	0.698	0.762	0.157
LOS >1200m (LN(/10k))	1.011	0.924	0.967	0.792	2.066	0.123	0.716	0.516	0.870	0.538	0.976	0.911	1.016	0.924	1.091	0.617

Stratified Regression Results

Obesity (cont'd)

	Born in Canada		Foreign Born		Child 0-5: no		Child 0-5: yes		Child 6-15: no		Child 5-15: yes		Child 16-17: no		Child 16-17: yes		Toronto		Suburbs	
Unweighted Sample Size	2908		2034		4590				4421				5026				1530		3658	
Nagelkerke r2	0.255		0.28		0.222				0.207				0.209				0.276		0.23	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	1.291	0.297	0.988	0.975	1.167	0.457			1.011	0.960			1.154	0.469			0.978	0.988	1.309	0.213
Bus 400-800m	1.277	0.323	1.016	0.970	1.170	0.462			1.089	0.711			1.228	0.307			1.158	0.918	1.381	0.135
Bus 800-1200m	1.340	0.418	2.678	0.114	1.837	0.050			1.889	0.051			1.869	0.036			7.408	0.289	1.908	0.037
Streetcar <400m	0.725	0.204	0.661	0.192	0.825	0.328			0.687	0.059			0.706	0.063			0.739	0.153	n/a	
Streetcar 400-800m	0.543	0.078	3.779	0.001	1.168	0.565			1.300	0.305			1.308	0.264			1.509	0.114	n/a	
Streetcar 800-1200m	0.372	0.011	0.857	0.688	0.604	0.070			0.735	0.273			0.720	0.201			0.772	0.355	n/a	
Subway <400m	2.158	0.100	0.429	0.041	1.009	0.976			0.699	0.221			0.804	0.432			0.768	0.384	n/a	
Subway 400-800m	0.719	0.223	0.559	0.031	0.662	0.034			0.583	0.006			0.688	0.041			0.574	0.011	n/a	
Subway 800-1200m	0.492	0.008	0.856	0.621	0.408	0.000			0.541	0.003			0.632	0.019			0.641	0.041	n/a	
Rail <400m	0.036	0.008	3.094	0.156	0.481	0.197			0.480	0.216			0.643	0.426			0.997	0.997	0.189	0.071
Rail 400-800m	0.849	0.696	0.917	0.811	1.018	0.947			1.178	0.550			1.022	0.933			0.631	0.200	1.713	0.183
Rail 800-1200m	1.263	0.442	1.481	0.136	1.508	0.047			1.141	0.535			1.435	0.056			1.094	0.742	1.265	0.415
LOS <400m (LN(/10k))	1.207	0.496	1.669	0.039	1.438	0.044			1.513	0.028			1.332	0.098			1.329	0.230	2.547	0.001
LOS 400-800m (LN(/10k))	1.036	0.862	0.638	0.013	0.829	0.176			0.825	0.175			0.838	0.176			0.973	0.891	0.816	0.273
LOS >1200m (LN(/10k))	1.153	0.410	0.989	0.947	1.034	0.787			0.957	0.733			0.951	0.668			0.888	0.532	1.328	0.075

Walk to School or Work (0=yes; 1= no)

	Full Sample		Age: 15-64		Age: 65-74		Age: 75+		<$40k hhold income		>$150k hhold income		Female		Male	
Unweighted Sample Size	3726		3453								1614		1935		1791	
Nagelkerke r2	0.276		0.271								0.304		0.309		0.344	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	0.586	0.100	0.594	0.109							0.655	0.323	1.022	0.961	0.208	0.003
Bus 400-800m	0.661	0.204	0.660	0.205							0.701	0.407	1.543	0.342	0.222	0.004
Bus 800-1200m	1.143	0.790	1.125	0.814							1.008	0.989	1.195	0.798	1.121	0.895
Streetcar <400m	0.633	0.047	0.606	0.034							0.638	0.245	0.772	0.427	0.483	0.048
Streetcar 400-800m	1.246	0.435	1.194	0.538							1.056	0.898	4.490	0.002	0.385	0.014
Streetcar 800-1200m	1.523	0.180	1.531	0.179							0.992	0.989	5.271	0.001	0.499	0.139
Subway <400m	0.737	0.421	0.684	0.326							0.446	0.250	0.592	0.362	0.663	0.464
Subway 400-800m	0.755	0.171	0.743	0.154							0.595	0.172	0.804	0.453	0.540	0.060
Subway 800-1200m	0.703	0.121	0.757	0.232							0.477	0.046	1.035	0.913	0.355	0.004
Rail <400m	0.880	0.862	0.883	0.868							1.515	0.701	42.962	0.176	0.286	0.115
Rail 400-800m	0.556	0.048	0.540	0.040							7.589	0.081	0.549	0.181	0.607	0.279
Rail 800-1200m	1.289	0.330	1.382	0.220							1.017	0.967	0.636	0.230	3.081	0.012
LOS <400m (LN(/10k))	2.675	0.000	2.759	0.000							2.218	0.108	2.023	0.033	3.933	0.000
LOS 400-800m (LN(/10k))	0.676	0.015	0.683	0.018							0.644	0.176	0.710	0.138	0.596	0.043
LOS >1200m (LN(/10k))	0.762	0.064	0.752	0.053							0.868	0.577	0.845	0.435	0.680	0.085

Walk to School or Work (cont'd)

	Born in Canada		Foreign Born		Child 0-5: no		Child 0-5: yes		Child 6-15: no		Child 5-15: yes		Child 16-17: no		Child 16-17: yes		Toronto		Suburbs	
Unweighted Sample Size	2293		1286		3208				2881				3344				1095		2631	
Nagelkerke r2	0.362		0.302		0.303				0.302				0.257				0.296		0.323	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	0.667	0.270	0.066	0.140	0.576	0.102			1.018	0.961			0.829	0.593			4.0E-05	0.950	0.596	0.154
Bus 400-800m	0.647	0.235	0.095	0.201	0.695	0.286			0.982	0.961			0.816	0.566			6.5E-05	0.952	0.564	0.112
Bus 800-1200m	1.464	0.515	0.156	0.357	1.885	0.277			1.387	0.562			1.604	0.405			9.4E-04	0.965	0.735	0.561
Streetcar <400m	0.709	0.294	0.451	0.049	0.504	0.005			0.957	0.866			0.705	0.144			0.522	0.014	n/a	
Streetcar 400-800m	2.075	0.078	0.744	0.527	1.030	0.924			2.085	0.024			1.306	0.373			1.349	0.335	n/a	
Streetcar 800-1200m	1.076	0.867	3.322	0.049	1.277	0.470			2.625	0.009			1.500	0.212			1.849	0.069	n/a	
Subway <400m	0.358	0.089	1.056	0.925	0.613	0.233			0.817	0.620			0.722	0.409			0.412	0.027	n/a	
Subway 400-800m	0.735	0.340	1.034	0.916	0.696	0.110			0.627	0.046			0.858	0.481			0.621	0.053	n/a	
Subway 800-1200m	0.667	0.190	1.276	0.563	0.617	0.054			0.613	0.060			0.690	0.115			0.688	0.141	n/a	
Rail <400m	1.818	0.782	1.198	0.838	1.107	0.899			1.032	0.971			0.906	0.894			4.998	0.181	0.044	0.003
Rail 400-800m	0.443	0.091	0.821	0.659	0.411	0.007			0.579	0.094			0.501	0.024			0.596	0.226	0.641	0.365
Rail 800-1200m	1.188	0.637	1.454	0.384	0.999	0.996			1.854	0.074			1.311	0.307			1.957	0.101	0.834	0.627
LOS <400m (LN(/10k))	2.400	0.020	2.585	0.009	3.279	0.000			1.474	0.153			2.418	0.000			5.543	0.000	0.948	0.896
LOS 400-800m (LN(/10k))	0.610	0.053	0.728	0.190	0.726	0.073			0.571	0.003			0.690	0.030			0.809	0.393	0.588	0.031
LOS >1200m (LN(/10k))	0.552	0.006	0.815	0.385	0.864	0.366			0.661	0.017			0.701	0.022			0.766	0.241	0.862	0.500

Diabetes (0=no; 1= yes)

	Full Sample		Age: 15-64		Age: 65-74		Age: 75+		<$40k hhold income		>$150k hhold income		Female		Male	
Unweighted Sample Size	5855								1541		1930		3332			
Nagelkerke r2	0.272								0.405		0.387		0.322			
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	3.170	0.009							3.229	0.336	6.883	0.026	2.067	0.241		
Bus 400-800m	2.600	0.035							2.522	0.461	6.559	0.027	2.258	0.199		
Bus 800-1200m	3.450	0.021							5.769	0.181	1.636	0.685	4.092	0.054		
Streetcar <400m	0.666	0.272							0.725	0.617	0.128	0.262	0.685	0.523		
Streetcar 400-800m	0.791	0.587							1.657	0.518	0.001	0.728	1.043	0.950		
Streetcar 800-1200m	0.570	0.317							0.491	0.546	0.266	0.508	1.501	0.613		
Subway <400m	0.364	0.086							0.073	0.064	0.003	0.847	2.4E-06	0.963		
Subway 400-800m	1.331	0.439							7.551	0.006	0.328	0.463	0.814	0.712		
Subway 800-1200m	0.436	0.057							0.559	0.406	0.221	0.327	0.242	0.050		
Rail <400m	4.826	0.024							1.222	0.871	0.003	0.896	0.097	0.451		
Rail 400-800m	0.064	0.009							0.034	0.009	0.457	0.736	0.292	0.269		
Rail 800-1200m	0.986	0.966							1.183	0.799	0.313	0.349	1.844	0.191		
LOS <400m (LN(/10k))	1.175	0.598							3.658	0.024	0.213	0.200	1.770	0.198		
LOS 400-800m (LN(/10k))	1.033	0.898							0.619	0.305	2.309	0.122	0.939	0.853		
LOS >1200m (LN(/10k))	1.365	0.142							1.110	0.796	3.219	0.010	0.913	0.772		

Diabetes (cont'd)

	Born in Canada		Foreign Born		Child 0-5: no		Child 0-5: yes		Child 6-15: no		Child 5-15: yes		Child 16-17: no		Child 16-17: yes		Toronto		Suburbs	
Unweighted Sample Size	3328								4852				5442						4124	
Nagelkerke r2	0.328								0.287				0.253						0.280	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	4.195	0.021							4.778	0.008			3.282	0.010					3.889	0.005
Bus 400-800m	2.889	0.096							3.829	0.025			3.109	0.015					2.553	0.060
Bus 800-1200m	1.434	0.692							4.036	0.042			2.183	0.201					4.007	0.014
Streetcar <400m	0.723	0.599							0.589	0.198			0.598	0.167					n/a	
Streetcar 400-800m	1.087	0.920							0.646	0.375			0.807	0.620					n/a	
Streetcar 800-1200m	0.286	0.360							0.623	0.417			0.518	0.243					n/a	
Subway <400m	0.205	0.162							0.179	0.030			0.366	0.089					n/a	
Subway 400-800m	0.768	0.736							0.766	0.526			1.537	0.252					n/a	
Subway 800-1200m	0.292	0.118							0.290	0.017			0.434	0.055					n/a	
Rail <400m	2.079	0.523							1.819	0.487			4.458	0.036					5.080	0.084
Rail 400-800m	3.3E-06	0.962							0.044	0.003			0.075	0.013					0.209	0.217
Rail 800-1200m	0.300	0.267							1.170	0.653			0.957	0.893					0.243	0.047
LOS <400m (LN(/10k))	2.873	0.056							1.111	0.758			1.235	0.498					1.040	0.938
LOS 400-800m (LN(/10k))	0.846	0.719							1.351	0.279			0.880	0.624					1.026	0.945
LOS >1200m (LN(/10k))	1.209	0.637							1.302	0.257			1.382	0.134					2.424	0.001

Asthma (0=no; 1= yes)

	Full Sample		Age: 15-64		Age: 65-74		Age: 75+		<$40k hhold income		>$150k hhold income		Female		Male	
Unweighted Sample Size	5857		4207						1544		1927		3334		2523	
Nagelkerke r2	0.122		0.154						0.248		0.184		0.169		0.189	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	0.892	0.734	0.833	0.622					2.142	0.429	1.872	0.264	1.178	0.715	0.680	0.483
Bus 400-800m	1.358	0.369	1.181	0.656					2.994	0.274	2.912	0.052	1.369	0.494	1.783	0.287
Bus 800-1200m	1.488	0.376	1.302	0.608					4.074	0.207	1.174	0.853	1.727	0.391	1.624	0.485
Streetcar <400m	0.877	0.677	0.665	0.258					1.261	0.698	2.408	0.188	1.021	0.961	0.899	0.838
Streetcar 400-800m	0.910	0.829	0.867	0.773					1.294	0.804	3.703	0.058	0.881	0.850	0.974	0.969
Streetcar 800-1200m	1.645	0.203	1.326	0.515					1.722	0.541	2.701	0.183	1.641	0.392	1.142	0.841
Subway <400m	0.231	0.009	0.228	0.015					0.378	0.342	4.480	0.162	0.383	0.181	0.140	0.062
Subway 400-800m	0.721	0.297	0.694	0.297					1.042	0.950	0.888	0.865	0.171	0.002	2.411	0.062
Subway 800-1200m	1.077	0.806	1.054	0.877					1.718	0.365	0.653	0.519	1.080	0.851	1.388	0.511
Rail <400m	0.883	0.900	1.425	0.745					3.445	0.303	3.3E-05	0.965	1.974	0.584	0.000	1.000
Rail 400-800m	0.728	0.475	0.932	0.880					0.553	0.420	2.4E-05	0.939	0.095	0.076	1.738	0.395
Rail 800-1200m	0.423	0.038	0.380	0.048					0.106	0.048	2.296	0.171	0.524	0.230	0.266	0.097
LOS <400m (LN(/10k))	1.991	0.009	2.162	0.009					2.858	0.055	0.227	0.108	1.466	0.296	3.649	0.005
LOS 400-800m (LN(/10k))	1.048	0.823	0.943	0.802					1.526	0.315	0.360	0.058	1.250	0.408	1.186	0.652
LOS >1200m (LN(/10k))	1.283	0.185	1.336	0.164					1.935	0.071	1.070	0.861	0.971	0.908	2.044	0.027

Asthma (cont'd)

	Born in Canada		Foreign Born		Child 0-5: no		Child 0-5: yes		Child 6-15: no		Child 5-15: yes		Child 16-17: no		Child 16-17: yes		Toronto		Suburbs	
Unweighted Sample Size	3328		2250		5198				4854				5444				1731		4129	
Nagelkerke r2	0.165		0.222		0.177				0.134				0.143				0.290		0.152	
	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.	OR	Sig.
Bus <400m	0.908	0.815	0.493	0.315	0.804	0.547			0.923	0.834			0.711	0.343			0.001	0.001	1.988	0.084
Bus 400-800m	1.508	0.321	0.859	0.833	1.179	0.656			1.171	0.684			1.121	0.754			0.002	0.003	2.241	0.040
Bus 800-1200m	2.443	0.082	0.289	0.317	1.521	0.375			1.853	0.204			1.593	0.320			0.003	0.017	2.278	0.097
Streetcar <400m	0.851	0.683	0.698	0.611	0.785	0.461			1.119	0.732			0.991	0.977			0.702	0.367	n/a	
Streetcar 400-800m	1.182	0.763	0.673	0.661	0.634	0.366			0.891	0.811			1.178	0.714			0.878	0.803	n/a	
Streetcar 800-1200m	1.888	0.199	0.495	0.500	1.397	0.413			1.373	0.472			1.942	0.098			3.360	0.011	n/a	
Subway <400m	0.166	0.008	0.428	0.526	0.219	0.007			0.164	0.005			0.229	0.010			0.136	0.003	n/a	
Subway 400-800m	0.604	0.213	2.091	0.234	0.801	0.499			0.827	0.585			1.016	0.962			0.497	0.122	n/a	
Subway 800-1200m	0.634	0.253	4.860	0.009	1.125	0.708			1.375	0.324			1.387	0.296			1.586	0.215	n/a	
Rail <400m	1.265	0.845	3.0E-05	0.952	0.954	0.963			0.940	0.952			0.676	0.696			2.458	0.424	0.001	0.914
Rail 400-800m	1.021	0.969	8.7E-05	0.918	0.898	0.813			0.951	0.913			0.826	0.674			1.372	0.643	0.664	0.558
Rail 800-1200m	0.158	0.012	2.162	0.157	0.493	0.092			0.369	0.040			0.477	0.087			0.169	0.032	1.584	0.375
LOS <400m (LN(/10k))	2.735	0.006	1.634	0.309	2.068	0.007			1.856	0.035			2.308	0.002			2.049	0.054	1.180	0.723
LOS 400-800m (LN(/10k))	1.266	0.397	0.513	0.104	0.986	0.949			0.825	0.430			0.763	0.244			1.109	0.778	1.116	0.713
LOS >1200m (LN(/10k))	1.981	0.004	0.418	0.034	1.326	0.160			1.132	0.566			1.124	0.570			0.678	0.247	1.547	0.080