Introduction

High-density housing is heralded as a foremost smart-growth instrument apt to reduce land consumption and automobile dependence (American Planning Association, 1998; Holtzclaw, 1994; Local Government Commission, 2003). But on its own it has little effect on journey patterns. To modify travel behaviour, density must be associated with a walking-conducive layout, proximity to quality public-transit services, nearby concentrations of diversified activities, and attitudes and socioeconomic attributes which are conducive to public-transit use and walking.

In this paper we have two objectives. First, we evaluate the impact of high-residential-density distribution on modal shares, bearing in mind that many of the policies guiding this distribution in the metropolitan region under investigation were intended to raise public-transit use and walking levels. Our second objective is to draw lessons from past density-distribution policies, which can be conducive to an elevated reliance on public transit and walking. In this paper we adhere to the smart-growth perspective. The work is part of efforts to find ways of reducing dependence on the car and thus lessen traffic congestion, improving air quality, lowering households’ transportation expenditures, and providing nonautomobile-oriented lifestyle options. In this paper we explore the feasibility of a car-use reduction strategy that entails minimal infringement of individuals’ freedom of choice—the juxtaposition of high residential density and high-quality public-transit services.

The empirical focus is on policies related to residential density adopted over the last five decades in the Toronto metropolitan region, an urban area long known for its public-transit orientation and metropolitan-wide planning capacity. Toronto is well suited for an examination of obstacles hampering a coordination of high residential density and high-quality public-transit services. Over the last fifty years, density-related policies have not elevated modal shares of walking and public-transit use as much as...
they could have, largely because objectives supportive of walking and public-transit use were watered down by compromises with opponents to high-density development. High-residential-density areas that cumulate variables conducive to walking and public-transit use post much higher nonautomobile modal shares than those where such variables are absent.

After a brief review of the recent literature, we chronicle the evolution of policies affecting the distribution of high residential density since the late 1950s. We then analyze present land-use and transportation patterns and interpret them in light of the historical narrative. We conclude with recommendations for improved density-transportation coordination.

Density distribution and journey patterns
Density is perceived as a key means of reducing sprawl and automobile dependence (Parsons Brinckerhoff Quade and Douglas Inc., 1997; Steiner, 1994). In a number of studies a negative relationship between metropolitan region density and automobile use has indeed been identified (Banister et al, 1997; Levinson and Kumar, 1997; Newman and Kenworthy, 1989). Other researchers have portrayed more complex relationships. In their view, to have an effect on journey patterns, density must be accompanied by other factors. These studies have followed in the steps of Pushkarev and Zupan (1977) who stressed the need to have connected, as opposed to isolated, density for it to induce heightened public-transit use.

Over the last fifteen years, a mushrooming literature has highlighted, along with the role of density, that of mixed land use (the proximity of retail, for example), design (pedestrian hospitality), and, of course, quality public-transit services (see Cervero and Kockelman, 1997). As regards urban form effects, studies point to more walking and public-transit use in neighbourhoods that combine density with other variables supportive of walking and public-transit use (see for reviews, Badoe and Miller, 2000; Boarnet and Crane, 2001; Crane, 2000; Ewing and Cervero, 2001). Yet, in their attempt to build models measuring the weight and sequencing of different variables with an effect on journey decisions, researchers further acknowledge the existence of an intricate relationship between urban form and socioeconomic and attitudinal factors affecting travel behaviour (for example, Cervero, 1994; 1996; 2002; Kitamura et al, 1997; Krizek, 2000; Krizek and Waddell, 2002). In fact, it is not unusual for studies to conclude that the effect of density, and indeed the effect of other land-use features, derivates largely from socioeconomic and mostly attitudinal and lifestyle variables. In their view, a great deal of self-selection operates in high-density transit-oriented environments, whereby individuals choose to reside in such areas precisely because their values predispose them to a public-transit and/or walking lifestyle (Bagley and Mokhtarian, 2002; Cervero and Duncan, 2002; Kitamura et al, 1997; Krizek, 2003).

On the one hand, our present paper is inspired by the research investigating determinants of individuals’ travel behaviour. We share with this literature the perspective that, to reduce automobile dependency, ‘raw’ density must be enabled by other factors, such as proximity to quality public-transit services(1), mixed use, and pedestrian hospitality, as well as socioeconomic and attitudinal attributes conducive to walking and public-transit use (see, Bernick, 1993; Boarnet and Compion, 1996; Calthorpe, 1993; Luscher, 1995; Newman and Kenworthy, 1996). On the other hand,

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(1) In this paper ‘quality’ public transit refers to services that are competitive with the automobile in terms of speed and comfort. They are generally services with frequent headways, using their own right of way. In Toronto the subway and the Scarborough rail transit correspond most closely to this definition.
our paper does not as such belong to this body of literature. Our purpose is not to
explore further the range, weight, and causality patterns of variables affecting the
journey choices of individuals. It is rather to trace the impact of policies dictating
the form and distribution of high residential density on public-transit use and walking,
to identify the circumstances in which they achieve a higher reliance on these modes
and those in which they fail to do so (that is, in which density is wasted from the
perspective of public-transit use and walking), and to draw lessons for future policies.

These differences of objectives account for the spatial orientation of our method-
ology, which contrasts with the individual or household focus predominant in the
research on determinants of travel behaviour. As policies that promote high residential
density are defined in spatial terms, it is logical to adopt a spatial unit of observation.
We rely on the census tract, which makes it possible to single out high-residential-
density sectors. Differences of purpose also translated into an aggregate treatment of
the respective impact of different variables on the travel decisions of individuals and
of causal relations between these variables. From a land-use planning perspective, this
approach suffices to identify the factors that are capable of producing desired journey
patterns and how these can be brought together in a given location.

The Toronto case study
During the 1960s, 1970s, and 1980s, Toronto was acclaimed as a model of successful
This situation was attributed in large part to transportation policies that balanced road
and public-transit investments. In the 1950s, Toronto launched the first postwar North
American subway-construction project, laying the groundwork for a system that was
extended substantially over subsequent decades. Along with the subway, the provision
of bus services to all newly urbanized areas yielded one of the highest levels of public-
transit use in North America. Today, the Toronto census metropolitan area is second in
North America for the proportion of commuters who use public transit (22.4%), just
below the New York City consolidated metropolitan statistical area (24.9%) (Statistics
Canada, 2003; US Census Bureau, 2004). Residential density in the metropolitan
region is also above the North American norm due to the presence of high-density
development in all urban zones and a vibrant inner city. Within a sample of fifteen
North American metropolitan regions with populations ranging from 1.60 million to
5.01 million, Toronto ranks first for the overall residential density of its continuously
built up area (2826 persons per km\(^2\) versus an average of 1783 persons per km\(^2\) for the
fifteen regions) (Filion et al, 2004). Finally, Toronto remains a centralized metropolitan
region by North American standards. Although the relative weight of downtown Toronto
within the metropolitan region has declined, the district still contains by far the largest
concentration of retail and employment. In 2001, there were approximately 400,000
jobs in downtown Toronto, 17% of the metropolitan region total (City of Toronto, 2002,
pages 14–15). By comparison, in Boston, Chicago, and Montréal, other centralized
metropolitan regions, the downtown percentage of all metropolitan-region employment
was 14%, 14%, and 16%, respectively (Demographia, 2001).

The distinctiveness of Toronto is in part due to its administrative structure. In 1953,
a second-tier government, the Regional Municipality of Metropolitan Toronto (referred
to as Metro Toronto), was set up by the Provincial Government to administer the
entire urbanized territory as well as a significant amount of rural land. Metro Toronto
assumed responsibility for major roads, sanitation systems, large parks, public trans-
portation, and land-use designations of metropolitan significance (although not the
zoning process, which remained a local concern) (Frisken, 1991; Rose, 1972). In 1998,
Metro Toronto municipalities (the former City of Toronto and the boroughs of York,
East York, Etobicoke, North York, and Scarborough) were amalgamated into a single-tier administration, the new City of Toronto.

It is important to note that, until 1973, Metro Toronto's planning responsibilities extended beyond its jurisdictional territory to encompass the entire metropolitan region. This arrangement ceased, however, with the creation, between 1971 and 1974, of four regional governments covering the remainder of the metropolitan region (see figure 1).

There is widespread feeling that Toronto is losing its way; that although density in its newly urbanized zones remains high by North American standards, modal splits and urban form in its outer suburbs (those beyond Metro Toronto or new City of Toronto boundaries) increasingly conform to the continental norm. Identified culprits are an absence of planning capacity at the scale of the entire region, the overall automobile orientation of recent developments, and insufficient public-transit investment to keep up with outward growth (Isin, 1998; Keil, 1998; Perl and Pucher, 1995; Williams, 1999).

The evolution of high-residential-density distribution in the Toronto metropolitan region

From the appearance of high-rise apartment buildings in the late 1950s, battle lines, which have persisted to this day, were drawn between two opposing camps: one grouping residents living in, or close to, areas that were the object of high-density development proposals, and the other dominated by developers. Residents objected to such developments on the grounds of an overburdening of local services and roads, anticipated losses in property values, and the socioeconomic status of newcomers (Globe and Mail 1961).
Municipal administrations have been ambivalent towards high-density residential development. Although they were enticed by the high property-tax yields accruing from such developments and occasional favours from developers, and showed sensitivity towards the need for affordable housing, municipal representatives also heeded the electoral muscles of ratepayers and neighbourhood associations protesting high-density residential developments (Shimko, 1989, page A1).

In the early 1970s, Toronto city council abandoned a spot-zoning approach to high-rise residential development, as it shifted from a prodevelopment to a neighourhood-preservation stand (Bourne, 1967; Toronto Star 1964). Henceforth, such development was mostly excluded from low-rise traditional neighbourhoods, and concentrated in specific locations such as arterial roads, in and close to the downtown, and in redevelopment projects such as the waterfront.

The situation was different in the suburbs. With development taking place on greenfield sites, suburban planners and developers were able, early on, to devise a land-use formula that reduced tensions between high-density and low-density residential areas. The formula, which congealed soon after the first appearance of suburban high-rise residential buildings, consisted in placing high-density structures on arterial roads, preferably at their intersections. Interference with low-density neighbourhoods, which occupied the space within super blocs formed by arterial roads, was thus minimized (Metro Toronto, 1979, pages 6 – 8).

Metro Toronto first became actively involved in high-density residential planning in the late 1960s. Its 1968 Apartment Control Policy was intended to prevent important high-rise-apartment-building clusters deemed too large for available infrastructures and services, and which would be susceptible of becoming low-income ghettos (Metro Toronto, 1967, page 4). Another goal was to distribute high residential density across the Metro Toronto territory and thus prevent an inner-city concentration of such developments. This objective dovetailed with the erection by Metro Toronto and the Provincial Government of most public-housing units in suburban municipalities, in large part to take advantage of low land costs (Murdie, 1994). Finally, the Metro Toronto Apartment Control Policy promoted the tower-in-the-park model, which had already become the norm in the inner city and suburbs (Metro Toronto, 1968). Overall, this policy resulted in a scattering of pockets of high residential density across Metro Toronto.

All these decisions were taken against a background of steep variations over time in the number of apartment units erected. Apartment construction slowed down in the mid-1970s and never reached levels registered in the 1960s and 1970s, despite peaks in the late 1980s and early 1990s (figure 2, over).

The coincidence of the period of development of the outer suburbs with reduced metropolitan-wide apartment construction, accounts in part for a lesser presence of high-density residential developments in these jurisdictions. This situation is equally tied to the deflection of such developments by many outer-suburban municipalities intent on preserving their low-density upper-middle-class character (for example, City of Vaughan, 1982). In this regard, Mississauga and Brampton, in the western part of the region, stand out as exceptions because they were far more accommodating of high-density residential developments (City of Mississauga, 1978, pages 35 and 71). In the outer suburbs, as in Metro Toronto, high-density residential development takes the form of pockets, but in the outer suburbs these are fewer and more scattered.

At numerous times over the period under study, efforts were made to plan high residential density in a way that would be conducive to walking and transit use. From the early appearance of high-rise apartment buildings onwards, City of Toronto and Metro Toronto planners attempted to steer some of these close to subway stations,
so as to provide a nearby market for rail transit. Likewise, the location of high-density developments along suburban arterial roads assured their proximity to bus services with most-frequent headways. Also, from the late 1950s, suburban planners attempted to locate high-rise residential developments adjacent to retail concentrations in order to encourage reliance on walking for shopping purposes (Metro Toronto, 1966, plate 8). In the outer suburbs this juxtaposition had the added benefit of bringing high-residential-density areas close to public-transit service peaks (albeit by low outer-suburban norms),

\[\text{Graph showing dwelling starts.}\]

Figure 2. Dwelling starts (a) 1958–69; (b) 1970–79; (c) 1980–89; (d) 1990–2000.
because outer-suburban shopping centres often serve as bus-service hubs. In addition, raising walking levels figured prominently in the attempt by the City of Toronto since the mid-1970s to create a considerable amount of housing in and around the downtown area (City of Toronto, 1977).

More recently, two bold visions have attempted to further link high residential density with public-transit use and walking. In 1981, Metro Toronto adopted a nodal strategy, which proposed the clustering of retailing, employment, institutions, cultural, and recreational activities as well as high-density housing in compact environments (Metro Toronto, 1981). Consistent with a commitment to lessen automobile dependence, nodes were to be provided with high-quality public-transit services and offer a pedestrian-hospitable environment. With time, outer-suburban jurisdictions enthusiastically adhered to the nodal concept (Miller et al, 1997). The second vision surfaced in the early 1990s and was, in its early days, propelled by Metro Toronto (Metro Toronto, 1994). Labelled ‘Main Streets’, it aimed at transforming arterial roads bordered by one-storey commercial structures amply provided with surface parking, into high-density environments consisting of five-storey to six-storey apartment buildings with ground-level retailing. This concept was intended to raise substantially walking and public-transit use along these arterials. Recently, it has become a mainstay of the official plan of the newly amalgamated City of Toronto, which provides a blueprint for the accommodation of a large share of the anticipated growth of the metropolitan region within its territory through urban intensification (City of Toronto, 2002).

Some of these transportation-motivated land-use objectives were largely successful. (We concentrate here on their land-use dimension; their impact on transportation is the object of the following sections.) Inner-suburban and outer-suburban high-density housing tends to be found along arterials and in proximity to stores. And over the last decades, downtown Toronto and adjacent areas have attracted a considerable amount of housing (Nowlan and Steuart, 1991). Other objectives proved to be more elusive however. The redevelopment of the surroundings of subway stations was frequently stalled by neighbourhood protest and the low-rise zoning adopted in the 1970s in most City of Toronto neighbourhoods. The nodal policy has also faced problems. At the moment only one node, North York Centre, is living up to density, public-transit-use, and walking-level expectations (Filion, 2001). Finally, the Main Street strategy is kept in check by objections from residents living near arterials, interdepartmental dispute over parking requirements, and an absence of interest on the part of developers for the planned midrise structures (Armstrong, 1993; Lighthall, 2003).

Methodology

Our analysis of the relationships between density and modal shares relies on 1996 data, the latest year for which all required sources of information were available at the time of research. Demographic and socioeconomic statistics come from the census and journey data originate from the Transportation Tomorrow Survey (TTS).\(^{(2)}\) We have aggregated all our data at the scale of the census tract. Land-use information is derived from orthophotos, which also served to delineate the residential portion of each census tract, an essential step in the computation of net residential densities.

To achieve a measure of the quality of transit services within each census tract, we rely on a public-transit-service index \((i_{ts})\), which is computed as follows:

\[
i_{ts} = \frac{1}{100000} \frac{l_{s} f_{ts} s}{a_{ct}},
\]

\(^{(2)}\) In 1996, the TTS interviewed by telephone 115,193 households across the Toronto region about the journeys undertaken the previous day by each of their members (Data Management Group, 1997).
where \( l_t \) refers to the length of each public-transit line within a census tract and within a 500 m buffer surrounding it to account for services within walking distance from the tract \(^3\); \( f_{ht} \) refers to the frequency of public-transit services on each line. We look at non-rush-hour (between 10.00 am and 11.00 am) headways to exclude public-transit lines that operate exclusively during rush hours; \( s \) refers to the number of seats per vehicle; \( a_c \) refers to the surface area of a census tract (without the 500 m buffer) measured in square kilometres.

In the Toronto context, the \( i_t \) yields values ranging from 0 to 27 781 (on public-transit service indexes, see Rood, 1998; Zhao et al, 2002). A high score signifies the presence of subway or, occasionally, commuter-train services. Thanks to their speed, comfort, frequent headways, and avoidance of road congestion, these modes are competitive with the automobile. By contrast, low index values point to a skeleton bus service with half-hourly or hourly headways. \( i_t \) scores are thus a proxy for the quality of transit services.

We first explore correlates of travel behaviour among all census metropolitan area tracts in two multiple regressions, one examining their association with public-transit use and the other with modal shares of walking. (According definitions used by TTS, walking journeys include only trips to or from work or education destinations.) We then present descriptive statistics concerning high-density census tracts—those that have often been the object of high-residential-density policies and are thus most consistent with the object of this study. In order to include locations in the inner city, inner suburbs, and outer suburbs, we focus on the top 20% of tracts in each zone in terms of net residential density.\(^4\) To assist in the understanding of what differentiates high-density census tracts that post high rates of public-transit use or walking from those that do not, we divide tracts into four groups: (1) high density but not high public-transit use (HDNT), which comprises tracts that figure among the top 20% in terms of net residential density, but are not included among the 20% census tracts registering highest modal shares of public-transit use; (2) high density and high public-transit use (HDT), which includes census tracts that fall within the highest 20% for both density and public-transit use; (3) the high density but not high walking (HDNW) category encompasses tracts that are part of the highest 20% in terms of density but not walking level; (4) high density and high walking level (HDW), which includes tracts that belong in the top 20% in terms of both density and walking level. Overall, our selection based on density, transit-use, walking, and zonal criteria yields twelve categories of high-density census tracts: inner-city, inner-suburb, and outer-suburb HDNT, HDT, HDNW, and HDW categories. Figure 3 portrays the distribution of HDNT and HDT and figure 4 (over) of HDNW and HDW census tracts.

The next step involves two multiple regressions assessing the association between land-use and socioeconomic variables on the one hand, and public-transit patronage and walking level on the other, among high-density census tracts.

The analysis ends with a hierarchical cluster analysis of HDT and HDW tracts, using a distance measure. The cluster analysis describes the data according to an emergent typology, based on similarities within clusters.

\(^3\)This method is suitable for the measurement of accessibility to bus, streetcar, light-rail transit, and subway services because stops and stations are generally within 1 km of each other (thus within a walking distance from the median between stops and stations). The situation is different in the case of commuter train lines because of long distances between stations. In this case each station is allocated a 1 km value.

\(^4\)The inner city includes the former (that is, prior to the 1998 amalgamation of Metro Toronto jurisdictions into the new City of Toronto) City of Toronto and boroughs of York and East York, and the inner suburb comprises the former boroughs of Etobicoke, North York, and Scarborough. The outer suburb encompasses areas outside the new City of Toronto (previously, Metro Toronto) (see figure 1).
For each statistical model, variables with the strongest explanatory power were selected when colinearity occurred. In addition, for the cluster analysis, those variables that impeded the formation of clusters (such as modal shares) were excluded. Thus, there is variation in the range of variables considered in our different models. Meanwhile, apart from the first two multiple regressions, which rely on arcsine transformations of proportions, statistical analyses are based on census-tract ratios of zonal averages.

Our analyses use population data for all tracts of the Toronto census metropolitan area or from a subgroup consisting of high-density tracts within this region, as collected in the Statistics Canada Census and the TTS. No discussion of significance values is provided, as the census data are collected from all households (or in the case of the long census form distributed to 20% of households, presented as if they pertained to the entire population). And the TTS data comprise sample values expanded to population parameters with calculated expansion factors.

Density-distribution patterns
We now examine extant density distributions and journey patterns in order to detect the cumulative impact of policymaking and development trends, and assess the extent to which transportation objectives were met. In the present section we describe the results of our statistical analysis. Subsequent sections provide an interpretation of these findings and tie them back to circumstances emerging from the Toronto history of land-use and transportation policymaking.
To start with, we present the results of multiple regressions that measure the impact of net residential density, the $i_s$, household income, and persons per household, first on modal shares of transit use and then on modal shares of walking, at the scale of all census-metropolitan-area tracts (see tables 1 and 2).(5)

The first model (table 1) explains 41% of public-transit-use variance. As expected, the level of public-transit service is a relatively strong predictor of public-transit use, followed by household size. As household size increases, public-transit use decreases. This effect is primarily due to the greater presence of large households in areas dominated by single-family homes than in sectors with more dense housing types.

Table 1. Modal share of public-transit multiple-regression model (including all census tracts) ($R^2_{adj} = 0.41; N = 688$).

<table>
<thead>
<tr>
<th>Beta weights</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Public-transit service index</td>
<td>0.358</td>
</tr>
<tr>
<td>Net density</td>
<td>0.182</td>
</tr>
<tr>
<td>Mean household income</td>
<td>−0.161</td>
</tr>
<tr>
<td>Mean household size</td>
<td>−0.250</td>
</tr>
</tbody>
</table>

(5) Census tracts for which we were not able to derive a net residential density or $i_s$ were excluded from the analysis.
Household income is also negatively related to public-transit use, but this is not a strong predictor. Nor is net density, which has a slight positive effect on public-transit use. Results from the walking model are different (see table 2). The adjusted $R^2$ coefficient is lower (0.35) and it is the net residential density and $i_{ts}$ variables that perform most strongly as predictors of modal shares of walking. Most areas with high $i_{ts}$ scores are in the downtown and inner city, which offer environments that are more conducive to walking than those found in the suburbs.

To concentrate more narrowly on those census tracts that have been affected by high-residential-density policies, we now turn to characteristics of the HDNT, HDT, HDNW, and HDW census tracts in the three urban zones. Referring to tables 3 and 4 (over), we first realize that our method has led to the selection of census tracts where net residential densities are considerably above the norm for their respective urban zone. The only exception to this rule among the twelve groups of high-density tracts is the outer-suburban HDW category. The overrepresentation of apartments and row houses follows this same pattern; outer-suburban HDW tracts, which register a 68% presence of single-family homes, alone break ranks. With the exception of this category, HDT and HDW tracts record higher densities than their HDNT and HDNW counterparts.

Inner-suburban and outer-suburban HDNT and HDT categories conform to expectations regarding the relationship between the public-transit service and public-transit modal shares. In both cases, the $i_{ts}$ for HDT categories is considerably higher than it is for HDNT tracts. In the inner city, however, it is the HDNT category that posts the highest $i_{ts}$. Modal-split figures clarify this apparent anomaly. Walking levels are much higher in the inner-city HDNT than in its HDT category. The reason for higher walking and lower public-transit use in the inner-city HDNT category, despite superior public-transit services of HDNT tracts, is the presence of many of these tracts in or near the downtown area. The core is where public-transit-service concentration is highest, but many of its residents walk to destinations rather than patronize transportation.

Having identified physical and public-transit-service variables that differentiate our two categories of census tracts, we now turn to socioeconomic distinctions. In all categories the proportion of low-income households exceeds zonal averages, and both household and personal incomes are below zonal norms. This situation can be accounted for by the type of housing found in high-density areas. In all cases the highest concentration of low-income households, and in most instances the lowest household and personal incomes, are recorded in HDT tracts, which thus contain high proportions of captive public-transit riders. Generally, the HDNT—HDT discrepancy between these variables exceeds that registered between HDNW and HDW tracts. Although inner-city and inner-suburban HDW tracts post a higher presence of low-income households and lower income levels than HDNW tracts do, this is not the case in the outer suburbs. Consistent with the outer-suburban HDW housing profile, lower-income households are less prevalent than in their HDNW counterparts.

**Table 2.** Modal share of walking multiple-regression model (including all census tracts) ($R^2_{adj} = 0.35; N = 688$).

<table>
<thead>
<tr>
<th>Beta weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public-transit service index</td>
</tr>
<tr>
<td>Net density</td>
</tr>
<tr>
<td>Mean household income</td>
</tr>
<tr>
<td>Mean household size</td>
</tr>
</tbody>
</table>
Table 3. Characteristics of high-density-not-high-public-transit-use (HDNT) and high-density-and-high-public-transit-use (HDT) census tracts.

<table>
<thead>
<tr>
<th>Percentage or value</th>
<th>inner city</th>
<th>HDNW census-tracts</th>
<th>HDW census-tracts</th>
<th>Census-tracts ratio (inner city = 1.00)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inner city</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of census tracts</td>
<td>192</td>
<td>26</td>
<td>18</td>
<td>0.14 / 0.09</td>
</tr>
<tr>
<td>Population</td>
<td>908120</td>
<td>131400</td>
<td>94829</td>
<td>0.15 / 0.10</td>
</tr>
<tr>
<td>Net residential density</td>
<td>12234</td>
<td>40157</td>
<td>43278</td>
<td>3.28 / 3.54</td>
</tr>
<tr>
<td>Detached and semidetached housing (%)</td>
<td>34.78</td>
<td>20.22</td>
<td>5.27</td>
<td>0.58 / 0.15</td>
</tr>
<tr>
<td>Row housing (%)</td>
<td>3.89</td>
<td>4.52</td>
<td>4.11</td>
<td>1.16 / 1.06</td>
</tr>
<tr>
<td>Duplex housing (%)</td>
<td>3.88</td>
<td>2.48</td>
<td>1.34</td>
<td>0.64 / 0.34</td>
</tr>
<tr>
<td>Apartment building, ≥ 5 storeys (%)</td>
<td>36.94</td>
<td>54.90</td>
<td>72.32</td>
<td>1.49 / 1.96</td>
</tr>
<tr>
<td>Apartment building, &lt; 5 storeys (%)</td>
<td>19.82</td>
<td>17.12</td>
<td>16.64</td>
<td>0.86 / 0.84</td>
</tr>
<tr>
<td>Public-transit-service index (iₚ)</td>
<td>5158</td>
<td>7594</td>
<td>6508</td>
<td>1.47 / 1.26</td>
</tr>
<tr>
<td>Auto driver (%)</td>
<td>43.70</td>
<td>38.35</td>
<td>34.18</td>
<td>0.88 / 0.78</td>
</tr>
<tr>
<td>Auto passenger (%)</td>
<td>12.19</td>
<td>11.06</td>
<td>9.87</td>
<td>0.91 / 0.82</td>
</tr>
<tr>
<td>Local public-transit (%)</td>
<td>29.67</td>
<td>29.52</td>
<td>41.14</td>
<td>1.00 / 1.39</td>
</tr>
<tr>
<td>GO commuter transit (%)</td>
<td>0.12</td>
<td>0.14</td>
<td>0.11</td>
<td>1.17 / 0.88</td>
</tr>
<tr>
<td>Walk (%)</td>
<td>9.77</td>
<td>15.04</td>
<td>10.72</td>
<td>1.54 / 1.1</td>
</tr>
<tr>
<td>Cycle (%)</td>
<td>2.62</td>
<td>3.12</td>
<td>2.03</td>
<td>1.19 / 0.78</td>
</tr>
<tr>
<td>Proportion of low-income households (%)</td>
<td>29.18</td>
<td>32.85</td>
<td>46.27</td>
<td>1.13 / 1.59</td>
</tr>
<tr>
<td>Mean household income ($)</td>
<td>53201</td>
<td>44174</td>
<td>32772</td>
<td>0.83 / 0.62</td>
</tr>
<tr>
<td>Mean personal income ($)</td>
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<td>2.19</td>
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<td>0.97 / 0.92</td>
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<tr>
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<td>28.86</td>
<td>33.79</td>
<td>31.71</td>
<td>1.17 / 1.10</td>
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<tr>
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<td>37.89</td>
<td>37.08</td>
<td>37.02</td>
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<tr>
<td>Age 65+ years (%)</td>
<td>12.59</td>
<td>11.65</td>
<td>10.88</td>
<td>0.93 / 0.86</td>
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1378 P Filion, K McSpurren, B Appleby
Table 3 (continued).

<table>
<thead>
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<td>Apartment building, &lt; 5 storeys (%)</td>
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<td>1 042</td>
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<td>26.71</td>
<td>29.89</td>
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<td>Mean personal income ($)</td>
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<td>78.25</td>
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<td>Mean household size</td>
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<tr>
<td>Age 0–19 years (%)</td>
<td>25.16</td>
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<td>Age 65+ years (%)</td>
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Table 3 (continued).

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<td>2.37</td>
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<td>0.30</td>
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<td>22.78</td>
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Table 4. Characteristics of high-density-not-high-walking (HDNW) and high-density-and-high-walking (HDW) census tracts.

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<th>Percentage or value</th>
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<th>HDW census-tracts</th>
<th>Census-tracts ratio (inner city = 1.00)</th>
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<td>HDNW</td>
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<td>32 303</td>
<td>53 113</td>
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<td>Detached</td>
<td>34.78</td>
<td>16.34</td>
<td>10.91</td>
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<tr>
<td>and semidetached</td>
<td>Row housing</td>
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<td>1.65</td>
<td>7.77</td>
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<td>2.72</td>
<td>1.08</td>
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<td>60.63</td>
<td>64.20</td>
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<td>0.93</td>
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<td>41.87</td>
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<td>11.43</td>
<td>9.46</td>
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<td>35.83</td>
<td>32.56</td>
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<td>0.12</td>
<td>0.14</td>
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<td>Walk (%)</td>
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<td>7.30</td>
<td>20.76</td>
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<td></td>
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<td>1.67</td>
<td>3.93</td>
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<td></td>
<td>Proportion</td>
<td>29.18</td>
<td>37.10</td>
<td>40.29</td>
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<td>39 076</td>
<td>39 800</td>
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<tr>
<td>size</td>
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<td>37.33</td>
<td>36.71</td>
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<td>Age 65+ years (%)</td>
<td>12.59</td>
<td>12.27</td>
<td>10.13</td>
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Table 4 (continued).

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<td>17.00</td>
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<td>Local public-transit (%)</td>
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Table 4 (continued).

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<th>HDW census-tracts</th>
<th>Census-tracts ratio (outer suburb = 1.00)</th>
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<td>67.36</td>
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<tr>
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<td>45.97</td>
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<td>0.96</td>
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<tr>
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<tr>
<td>Mean household size</td>
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<td>7.76</td>
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</table>
Age-group distributions do not paint as clear a picture as the one portrayed by income. The 20–34 years age group is over-represented in all categories and the 35–64 years age group is below the norm everywhere except in two cases where it is at the zonal average or slightly exceeds this value. The 0–19 years age group is well above zonal averages in HDT and HDW inner-suburban tracts and the elderly category scores high in outer-suburban HDT tracts.

In tables 5 and 6 we regress selected variables from the high-density census tracts of tables 3 and 4 against levels of public-transit use and walking. (Left-out variables

<table>
<thead>
<tr>
<th>Beta weights</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age group</strong></td>
</tr>
<tr>
<td>20–34 years</td>
</tr>
<tr>
<td>35–64 years</td>
</tr>
<tr>
<td>65+ years</td>
</tr>
<tr>
<td><strong>Housing type</strong></td>
</tr>
<tr>
<td>single and semidetached</td>
</tr>
<tr>
<td>row house</td>
</tr>
<tr>
<td>duplex</td>
</tr>
<tr>
<td>high-rise</td>
</tr>
<tr>
<td>low-rise</td>
</tr>
<tr>
<td><strong>Income level</strong></td>
</tr>
<tr>
<td>mean household income</td>
</tr>
<tr>
<td>Mean household size</td>
</tr>
<tr>
<td>Net density</td>
</tr>
<tr>
<td>Public-transit-service index ((i_{t}))</td>
</tr>
</tbody>
</table>

Note. Values are based on each census tract’s ratio of its respective zone average. The number of census tracts is lower than that on tables 3 and 4 because of the exclusion of tracts with an incomplete range of information (especially those with a zero \(i_{t}\) value).

<table>
<thead>
<tr>
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</thead>
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</tr>
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</tr>
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</tr>
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</tr>
<tr>
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<td>Net density</td>
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<td>Public-transit-service index ((i_{t}))</td>
</tr>
</tbody>
</table>

Note. Values are based on each census tract’s ratio of its respective zone average. The number of census tracts is lower than that on tables 3 and 4 because of the exclusion of tracts with an incomplete range of information (especially those with a zero \(i_{t}\) value).
demonstrated lesser explanatory power than, and high covariability with, those we selected.) The public-transit use and walking models confirm the existence of important distinctions between the correlates of these two types of journey, first exposed in two multiple regressions involving all census tracts (tables 1 and 2). There is first a substantial difference in the performance of the two high-density models. The adjusted $R^2$ of the public-transit model is well above that of the walking model. Moreover, if the presence of high-rise apartment units registers the highest beta weight in the public-transit-use regression, it is the concentration of the 20–34 years age group that occupies the equivalent position in the walking model. With an important proportion of high-rise building occupants aged between 20 years and 34 years, there is a great deal of similarity between these two measures. The 35–64 years age group and to a lesser extent the 65+ years age group are predictors of public-transit use, whereas it is the 20–34 years age group along with the 65+ years age group that are related to walking level. As regards housing, although three dwelling types record a positive relationship with public-transit use (high-rise and low-rise apartments and duplexes), associations between housing form and walking are either very weak or negative. Household size is a stronger predictor of public-transit use than walking as is, expectedly, the $i_t$. But the performance of density is more robust in the walking model (as already indicated in tables 1 and 2).

Findings from cluster analyses demonstrate the existence of different ways of achieving high public-transit use and walking levels. Table 7 shows that, if high public-transit patronage generally involves a combination of high-rise buildings, an elevated residential density and $i_t$, as well as a strong presence of low-income households (clusters 1 and 3), such transportation outcomes can equally result from an overrepresentation of children and teenagers and low-income households in an environment with abundant row housing and a relatively weak $i_t$ (cluster 2). Table 8 (over) shows that the dominant configuration of variables favourable to walking consists of a high proportion of high-rise apartments and an overrepresentation of individuals aged 20–34 years (clusters 1 and 4). The cluster analysis suggests two supplementary ways of achieving such an outcome. One entails a strong presence of children and teenagers

### Table 7. High-density and high-public-transit-use (HDT) census-tract clusters.

<table>
<thead>
<tr>
<th>Variables</th>
<th>HDT cluster 1 (49 census tracts)</th>
<th>HDT cluster 2 (8 census tracts)</th>
<th>HDT cluster 3 (8 census tracts)</th>
<th>Average for HDT census tracts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 0–19 years</td>
<td>0.93530</td>
<td>1.37504</td>
<td>0.96764</td>
<td>0.99340</td>
</tr>
<tr>
<td>Age 20–34 years</td>
<td>1.11766</td>
<td>1.06471</td>
<td>1.31994</td>
<td>1.13604</td>
</tr>
<tr>
<td>Age 35–64 years</td>
<td>0.96311</td>
<td>0.87183</td>
<td>0.87608</td>
<td>0.94116</td>
</tr>
<tr>
<td>Age 65+ years</td>
<td>1.07377</td>
<td>0.60393</td>
<td>1.00444</td>
<td>1.00741</td>
</tr>
<tr>
<td>Family households</td>
<td>0.89743</td>
<td>1.13920</td>
<td>0.84217</td>
<td>0.92039</td>
</tr>
<tr>
<td>Single and semidetached</td>
<td>0.48209</td>
<td>0.31810</td>
<td>0.01312</td>
<td>0.40419</td>
</tr>
<tr>
<td>Row housing</td>
<td>0.67346</td>
<td>5.12262</td>
<td>0.21707</td>
<td>1.16488</td>
</tr>
<tr>
<td>Duplex</td>
<td>0.87058</td>
<td>0.12737</td>
<td>0.14688</td>
<td>0.69003</td>
</tr>
<tr>
<td>High-rise apartment</td>
<td>2.22607</td>
<td>1.45804</td>
<td>4.66401</td>
<td>2.43159</td>
</tr>
<tr>
<td>Low-rise apartment</td>
<td>1.10210</td>
<td>0.28909</td>
<td>0.72851</td>
<td>0.95606</td>
</tr>
<tr>
<td>Low-income households</td>
<td>1.53588</td>
<td>1.70631</td>
<td>2.20971</td>
<td>1.63979</td>
</tr>
<tr>
<td>Net residential density</td>
<td>2.47649</td>
<td>2.94808</td>
<td>7.95286</td>
<td>3.20855</td>
</tr>
<tr>
<td>Public-transit index</td>
<td>1.81664</td>
<td>1.13364</td>
<td>1.98700</td>
<td>1.75354</td>
</tr>
</tbody>
</table>

Note. Values are based on each census tract’s ratio of its respective zone average. The number of census tracts is lower than that on tables 3 and 4 because of the exclusion of tracts with an incomplete range of information (especially those with a zero $i_t$ value).
An imperfect coordination of density with transit services and walking environments

In some cases, our findings appear to be contradictory. For example, one of the multiple regressions that include all census tracts yields a negative relationship between household size and public-transit use (see table 1), whereas one of the regressions that concentrate exclusively on high-density tracts reveals a positive association between these two variables (table 5). An explanation for this apparent paradox is that the first model captures the coincidence between increasing household size and declining public-transit use, as we move from the inner city to the outer suburb, whereas the second model is sensitive to the public-transit reliance of large households living in high-density housing. The income of these households is generally low and they tend to contain age groups associated with high public-transit use. A similar apparent inconsistency concerns the reduced impact of residential density on public-transit use in one of the high-density regression models. The explanation here may simply be that in the high-density model much of the variability associated with density is appropriated by the high-rise-apartment-dwelling variable.

Still, results generally point in a common direction. They indicate associations between the \( i_t \), density, and public-transit use, as well as between density and walking levels. Findings also expose the relationship of other variables (housing type, income, and household size), the spatial distribution of which is sensitive to land-use policies, with modal shares of public-transit use and walking. In some measure, these relationships mirror successful attempts at using high-residential density distribution to alter journey patterns. Perhaps the two most fruitful initiatives in this regard have been the clustering of high residential density around certain subway stations and the high walking levels generated by downtown residential developments (see figures 3 and 4).

<table>
<thead>
<tr>
<th>Variables</th>
<th>HDW cluster 1 (22 census tracts)</th>
<th>HDW cluster 2 (10 census tracts)</th>
<th>HDW cluster 3 (6 census tracts)</th>
<th>HDW cluster 4 (6 census tracts)</th>
<th>Average for HDW census tracts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 0–19 years</td>
<td>0.86779</td>
<td>0.97197</td>
<td>1.29583</td>
<td>0.99405</td>
<td>0.96706</td>
</tr>
<tr>
<td>Age 20–34 years</td>
<td>1.16533</td>
<td>1.16742</td>
<td>1.03031</td>
<td>1.32571</td>
<td>1.16926</td>
</tr>
<tr>
<td>Age 35–64 years</td>
<td>0.98831</td>
<td>0.91546</td>
<td>0.87960</td>
<td>0.90146</td>
<td>0.94508</td>
</tr>
<tr>
<td>Age 65+ years</td>
<td>0.90892</td>
<td>0.86815</td>
<td>0.80768</td>
<td>0.57257</td>
<td>0.83998</td>
</tr>
<tr>
<td>Single and semidetached row housing</td>
<td>0.36727</td>
<td>0.93248</td>
<td>0.80179</td>
<td>0.06668</td>
<td>0.51399</td>
</tr>
<tr>
<td>High-rise apartment</td>
<td>0.95963</td>
<td>1.12625</td>
<td>5.56646</td>
<td>0.31269</td>
<td>0.53748</td>
</tr>
<tr>
<td>Low-rise apartment</td>
<td>0.60235</td>
<td>0.93730</td>
<td>0.74051</td>
<td>0.13953</td>
<td>0.63420</td>
</tr>
<tr>
<td>Low-income households</td>
<td>1.89961</td>
<td>0.21545</td>
<td>0.54782</td>
<td>2.36463</td>
<td>1.39592</td>
</tr>
<tr>
<td>Net residential density</td>
<td>0.43553</td>
<td>4.09964</td>
<td>1.27055</td>
<td>0.85284</td>
<td>1.43906</td>
</tr>
<tr>
<td>Public-transit index</td>
<td>1.38114</td>
<td>1.24422</td>
<td>1.53057</td>
<td>1.62665</td>
<td>1.40388</td>
</tr>
<tr>
<td></td>
<td>3.26641</td>
<td>2.02026</td>
<td>2.15447</td>
<td>10.16015</td>
<td>3.77162</td>
</tr>
<tr>
<td></td>
<td>1.66622</td>
<td>1.39199</td>
<td>1.09139</td>
<td>1.91813</td>
<td>1.84900</td>
</tr>
</tbody>
</table>

Note. Values are based on each census tract’s ratio of its respective zone average. The number of census tracts is lower than that on tables 3 and 4 because of the exclusion of tracts with an incomplete range of information (especially those with a zero \( i_t \) value).
At the same time, however, $R^2$ coefficients are not very robust. One reason for these low values is unexplained variability in our models, caused by the presence of an incomplete range of independent variables. Because we are operating at the aggregate level, lifestyles, preferences, and values are imperfectly measured through income, household size, and dwelling type combined. But weak to moderate relationships can also be attributed to an imperfect coordination of density with transit services and walking-conducive settings. Indeed, differences in public-transit use and walking levels between HDNT and HDT and between HDNW and HDW tracts indicate that favourable conditions characterized by high density and $i_a$ and the presence of other supportive variables do translate into higher proportions of public-transit and pedestrian journeys.

Beyond these general findings, our methods have also disclosed variability in how high public-transit patronage and walking can be achieved. In our zonal-based descriptive statistics, the outer-suburban HDW category stands out because only in this zone do high-walking census tracts register a lower density and higher presence of single and semidetached units than in HDNW tracts. This exception may be accounted for by the higher contribution of youth’s journeys to the walking level of outer-suburban HDW tracts than to that of HDW tracts located in the two other zones. Moreover, cluster analyses have demonstrated that high modal shares of public-transit use or walking can be associated with different housing types, density levels, and age-group distribution.

There is yet another particularity which, although not disclosed by the cluster analyses, is revealed by a comparison of different spatial groupings of HDT census tracts. In five inner-city HDT census tracts, located close to nondowntown subway stations, there are proportions of low-income households that are below the inner-city norm and household and personal incomes that approximate this value. The explanation for this departure from the common association between low income and public-transit use rests in public-transit-oriented lifestyle choices. Some people, with more than sufficient financial resources to drive, choose to live in tracts that are exceptionally well provided with public-transit services in order to be able to rely on this form of transportation. This observation resonates with the tendency for the HDT-census-tract low-income ratios to increase from the inner city to the outer suburbs as public-transit-service quality declines. As expected, transit journeys in sectors with poor service levels are nearly exclusively made by captive users.

**Successes and failures of high-residential-density policies**

We now reconnect with the Toronto policy narrative to cast light on the decisionmaking processes behind our statistics. We examine the impact of policies on the amount, form, and distribution of high-density developments, at three spatial scales: microscale, mesoscale, and macroscale. The predominant microscale consequence of policies guiding high-density residential developments has been the early generalization of the tower-in-the-park formula. The availability of this formula, which enjoyed global acceptance over postwar decades, was fortuitous, for it improved the acceptability of such developments in the face of the vigorous opposition of nearby residents. The tower-in-the-park model indeed lowered the overall density of high-rise developments, brought additional green space to districts hosting such developments and buffered high-rise buildings from surrounding low-rise neighbourhoods. Also at the microlevel, we witness a rigid separation of dwelling types, which resulted in the location of high-density housing along arterials.

To highlight mesoscale factors that encourage walking, we compare the situation prevailing in high-density suburban census tracts with that in HDW tracts located in and around downtown Toronto. In these core tracts, walking amounts to 23.7%
of all journeys. The wide discrepancy between downtown and suburban high-density tracts can be explained by the presence of a much broader range of activities (including a vast employment pool) in downtown Toronto than in, or close to, suburban tracts (Nowlan and Steuart, 1991). In central Toronto, walking is further abetted by the presence of numerous commercial streets offering a stimulating walking environment as well as by a higher incidence of high-density developments that relate to the street, in contrast to the near-exclusive reliance on the tower-in-the-park model in the suburbs. Meanwhile, drivers in downtown Toronto are confronted with congestion, narrow streets, frequent intersections, and costly parking.

The premier density-related objective at a macroscale involved the matching of high residential density with quality public-transit services, in order to raise public-transit use and lessen dependence on the automobile. But the strategy was impeded by difficulties in redeveloping areas close to subway stations, locales registering some of the highest public-transit-service indexes. Of the fifty-one nondowntown subway and light-rail transit stations, only thirteen (26%) are in or close to high-density census tracts. The weak correspondence between high residential density and subway stations can also be related to the routing of the Spadina subway line, where four stations occupy the median of an expressway. Long bus headways nearly everywhere in the outer suburbs are a further factor of dissociation between density and high-level public-transit services. Juxtaposing high-residential-density developments and the best public-transit services available within a given zone, such as in outer-suburban bus hubs, has limited effect if even these services are of poor quality. In any event, in the outer suburbs and, to a lesser extent, inner suburbs, where activities tend to be dispersed, the presence of nearby public-transit services does not guarantee access to one’s destinations. Destinations may indeed be located in areas with, at best, minimal public-transit services or require several transfers along infrequent routes.

There are instances where high-density developments were sited with blatant disregard for public-transit availability. Two examples from the inner suburbs illustrate such situations. In the case of eight HDNT census tracts, which post very-low public-transit-service indexes (mean zonal ratio of 0.47) and register above-average income and concentration of the elderly, the siting of high-density developments was clearly influenced more by proximity to natural amenities than to transit services. These developments overlook ravines, large parks, or Lake Ontario. At the other end of the income scale, it is the availability of cheap land that determined the location of many large suburban public-housing projects. Today the census tracts containing these projects present the apparent paradox of a relatively low $i_t$, accompanied by high levels of public-transit use. The coordination of high residential density with quality services was particularly neglected in times of housing shortages when high-density development was encouraged wherever sites were available.

It is, however, the predominant distribution pattern of high-density areas that is above all responsible for the imperfect match between public-transit use and density. The scattering of pockets of high density, in large part a consequence of compromises between pro-high-density and anti-high-density development camps, curtails the positive impact density can have on public-transit systems, because it forces public-transit services to traverse large expanses of low-density development to reach density peaks.

In sum, the findings in this paper confirm that on its own density has a weak effect on modal shares. In accord with the literature on the relationship between land use and transportation, we have shown that to be effective, residential density must be associated with other factors (for example, Badoe and Miller, 2000, page 260). We have demonstrated that density must be distributed in a fashion that maximizes its positive impact on public-transit services. It must be close to quality services and provide them
with sufficient ridership to warrant frequent headways and reserved lanes in the case of bus services, or the introduction of rail transit. To raise walking levels, density produces the best results when near large concentrations of activities and as part of an environment conducive to walking. Findings have identified other factors, associated to various degrees with density, that have an impact on modal shares of public-transit use and walking: income, household size, and life cycle. It has also been possible to make inferences on the effect of lifestyles, attitudes, and values.

The policy process occasionally achieved alignments of variables favourable to public-transit use and walking. This was the case of the frequent association of public-transit use with high density and low income or, more exceptionally, with high density, average income, public-transit-oriented attitudes, and quality services provided by inner-city subway stations. And an alignment of high density, proximity to downtown, a pedestrian-hospitable environment, and, we could conjecture, the presence of individuals with an affinity for an urban rather than suburban lifestyle, led to elevated modal shares of walking. But compromises resulting from the policymaking process often hampered the assemblage of variables conducive to public-transit use and walking, in large part by disjointing residential density and quality public-transit services.

Most suitable to the alignment of variables conducive to public-transit and walking would probably be the Main Street strategy, advanced in Metro Toronto and City of Toronto official plans since 1994 (Metro Toronto, 1994; City of Toronto, 2002). It would generate corridors of sustained density along upgraded public-transit lines as well as pedestrian-hospitable environments with street-facing retailing. The Main Street model would, thereby, substitute connectivity to the fragmentation produced in part by the presence of pockets of tower-in-the-park developments. Resulting environments would lure individuals with a taste for urban life. But lessons from density-related planning in Toronto compel us to anticipate probable consequences of politically driven compromises on the form and patterning of high-density developments. We can accordingly predict a watering down of the Main Street concept resulting from attempts at making the intensification of arterial roads palatable to nearby residents.

Conclusion
By North American standards, Toronto performs well in terms of residential density and public-transit use, even if it has lost some of its lead in these matters over the last few decades. Yet, better coordinated public transit and density, and the addition of additional factors which are supportive of walking and public-transit use, would have further elevated modal shares of walking and public-transit use. The Toronto metropolitan region has generated high-density developments but has not been able to derive as many transportation-related advantages from these developments as it could have, hence the title ‘wasted density’.

Through this paper we have confirmed the need to combine different variables for high residential density to yield its full transportation benefits. We have also demonstrated the difficulty of achieving the coordination needed for the alignment of such variables in the conflict-ridden world of land-use policymaking. The effectiveness of strategies intended to maximize the impact of high residential density on walking and transit has been seriously disrupted by the near systematic opposition of neighbourhood organizations to high-residential-density developments and by interjurisdictional discord. Resulting compromises have allowed high-density developments to take place, but often in forms and locations that impaired their positive effects on walking and public-transit use.
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