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Who is living a local lifestyle? Towards a better understanding of the 15-minute-city and 30-minute-city concepts from a behavioural perspective in Montréal, Canada

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ABSTRACT

Policy makers worldwide are increasingly embracing the idea of a "15-Minute City" or "30-Minute City" as part of their sustainable-development strategies. These planning concepts propose an urban environment where residents can meet their essential needs within a short trip from their home using active modes of travel. However, there is limited understanding about the replicability and usefulness of these concepts in influencing the travel behaviour of residents to meet the 15- or 30-minute-city reality. Drawing from a travel-behaviour survey and open-source geospatial data from Montréal, Canada, this article seeks to identify which groups of households are living a 15- or 30-minute city lifestyle to understand the compatibility of the x-minute city planning approach with the local North American context. Findings indicate that the 15- and 30-minute city paradigms provide goals that are hardly reachable in the context of a large North American city. Very few households are able to conduct all their daily travel within close proximity to their home, even if the built environment was substantially altered. These findings suggest that the x-minute city is not a one-size-fits-all model. The findings from this study can be of interest to transport professionals aiming to apply the x-minute city as it highlights the challenges associated to meeting such target in a North American context.

1. Introduction

Local and regional accessibility policies have been gaining momentum in the planning field in recent years, especially the concepts of "15-Minute City" and "30-Minute City." These concepts aim to enable urban residents to fulfil essential social functions (including living, working, commerce, healthcare, education, and entertainment) within 15 or 30 min from their homes by active travel (Moreno, Allam, Chabaud, Gall & Pratlong, 2021). The cited benefits of implementing this planning framework include reaching sustainable-mobility goals and improving the general wellbeing of urban populations (Allam, Nieuwenhuijsen, Chabaud & Moreno, 2022). The movement of the 15-minute city has emerged from historically older European regions, which were designed prior to the car-domination era (ibid). These regions have experienced population growth and expansions over the past decades with recent prioritization of car-oriented planning, which imposed large burdens on their population when it comes to travel time to reach desired destinations. As such, the 15-minute city has become a popular vision among some European decision makers, representing a reorientation toward local living. Reflected in various election campaigns, policymakers across the globe are discussing these initiatives, including the possibility of adopting it in North American contexts (Bruemmer, 2021; Gower & Grodach, 2022; TED Conferences, 2021). In regions where the automobile played a structural role in urban planning, the 30-minute city has emerged as an adaptation to the concept, yet these discussions remain largely limited to Australia and New Zealand (Levinson, 2019).

Given the rising interest in adopting the 15- and 30-minute cities in different contexts, what will these planning approaches look like on the ground in a range of urban environments? Is it possible for any city to apply these concepts and see results? While benefits of x-minute cities are widely shared, the concepts have also been challenged for their feasibility within existing built environment, affordability, and sociocultural constraints (Dunning, Calafiore & Nurse, 2021; Guzman, Arellana, Oviedo & Aristizábal, 2021). Moreover, though extensive research has been conducted on what built-environment features could potentially encourage the 15- or 30-minute city (Capasso Da Silva, King & Lemar, 2019; Gaglione, Gargiulo, Zucaro & Cottrill, 2022; Moreno et al.,

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2021), it remains unclear which groups of the population can achieve this lifestyle.

In this article, we test the practicality of the x-minute city goal in the Montréal metropolitan region (Canada). Our aim is to evaluate whether the 15-minute city planning approach championed by Carlos Moreno is an appropriate measure toward improving local accessibility within this context. The definition stipulates that all social functions, including work, food, health, education, culture, and leisure are conducted within a 15-minute travel time radius using walking and cycling modes (TED Conferences, 2021). In this study, we expand the definition to *include public transit* as an alternative mode given that it has been described as a 'quasi-active mode' (Ermagun & Levinson, 2017) and has proven important to promoting active living environments (Winters, Buehler & Götschi, 2017), especially in North American contexts (Crist et al., 2021; Daley et al., 2022). To accommodate the land use reality of the study area, we further expand Moreno's definition by testing a 30-minute threshold in addition to the 15-minute version, which has been promoted in newer cities.

Using existing travel behaviour data, we identify which groups of households are living a 15- or 30-minute city lifestyle and which built-environment and personal characteristics differentiate these groups from those maintaining longer travel distances. In line with the definition discussed previously, we conceptualize "15- and 30-Minute Households" as those whose trips do not surpass these respective travel-time thresholds and are all completed using active transport modes: walking, cycling, and/or public transit. Using disaggregate mobility data from a sample of 22,040 households from the 2018 Montréal Origin-Destination (O-D) survey, we estimate binary logistic models followed by a sensitivity analysis to assess the built-environment and household factors defining a 15- or 30-minute household using these active modes. Following these analyses, alternate definitions of x-minute city households are explored to test other ways of conceptualizing local accessibility metrics that are based on travel-time thresholds. First, trips to work and school destinations are excluded from the analysis to recognize the regional scale of employment and education. Second, households that conduct 65% or more of their trips with active modes in the travel time threshold are considered 15- and 30-minute households. This two steps analysis shows how far a North American city is from applying a modified 15 min and the 30 min city concepts, while the statistical models show the factors that can be used to achieve either of these concepts in practice through policy and planning tools.

2. Literature review

Sustainable urban mobility is increasingly being recognized as a high priority for policy makers and planners globally. While decades of car-centric policies have improved travel speeds, they have led to rising issues of urban sprawl, traffic congestion, greenhouse gas emissions, as well as air and noise pollution (Hickman & Banister, 2014; Meschik, 2012; Silva & Altieri, 2022). Rather than being the simple result of consumer preferences, research has demonstrated how car dependency has been fuelled through complex structural, political, economic, and socio-cultural dynamics (Doughty & Murray, 2016; Furness, 2010; Gopakumar, 2020; Sheller & Urry, 2000). Thus, efforts to phase-out carbon-intensive transport systems require both broad-based critical thinking as well as careful attention to the particularities of diverse urban, neighbourhood, and household dynamics (Soliz, 2021).

As a part of the movement for sustainable-urban transitions, the notion of the 15-minute city has been gaining traction as a means of creating higher-density, mixed-use neighbourhoods that help to enhance local resiliency and social wellbeing (Caselli, Carra, Rossetti & Zazzi, 2022; Moreno et al., 2021; Pozoukidou & Chatziyiannaki, 2021). From this perspective, each neighbourhood unit should provide efficient access to quality-of-life amenities and fulfil essential social functions, including living, working, commerce, healthcare, education, and entertainment within a 15 min travel time threshold by active modes of transport (Hosford, Beairsto & Winters, 2022; Moreno et al., 2021). By prioritizing active modes—especially cycling and walking—this concept is seen as fostering a paradigm shift in contemporary urban planning, supporting healthier travel patterns and social interactions (Allam et al., 2022). In this sense, the 15-minute city is often regarded as the contemporary manifestation of the classic "human scale," prioritizing neighbourhood liveability along with people's time and collective wellbeing (Abdelfattah, Deponte & Fossa, 2022; Weng et al., 2019). Although similar paradigms (such as the neighbourhood-unit concept) have been used since the 1920s (Kissfazekas, 2022), the notion of the 15-minute city has gained popularity among policy makers in recent years, with added attention to enhancing positive social, environmental, and public-health outcomes (Allam et al., 2022).

Notwithstanding the promise of planning for the 15-minute city, the concept has recently been subject to critical questioning by various researchers. By prioritizing neighbourhood efficiency, does this model neglect the mobility needs of people with disabilities and those who cannot afford to stay in dense urban areas (Zivarts, 2021)? Is the concept simply a utopian buzzword, or does it have the potential to generate substantive changes to improve urban environments and social wellbeing (Gower & Grodach, 2022; Herbert, 2021)? What are the risks that this movement will spark neighbourhood transformations that lead to gentrification and social displacement, thus exacerbating urban inequalities (Dunning et al., 2021)? Furthermore, given that the concept was adapted primarily from older European cities, to what extent can 15-minute cities be replicated in different global contexts (Guzman et al., 2021)? While examples of 5, 15, 20, and 30-minute cities abound (Di Marino, Tomaz, Henriques & Chavoshi, 2022; Gaglione et al., 2022; Hosford et al., 2022; Levinson, 2019; Peters, 2019), what thresholds should be used to guide new planning interventions, and how might these targets need to be modified across diverse urban realities? Furthermore, with several urban-mobility scholars calling for an expanded understanding of active travel to include 'quasi-active modes,' notably public transit and other intermodal options (Agyeman & Cheng, 2020; Ermagun & Levinson, 2017; Sagaris & Arora, 2016; Sagaris, Tiznado-Aitken & Steiniger, 2017), how can x-minute-city research help to integrate these insights into urban-planning frameworks?

Indeed, there is compelling evidence that the concept of the 15–30-minute city requires greater attention to residents' actual needs, lived experiences, neighbourhood characteristics, and socio-economic conditions (Calafiore, Dunning, Nurse & Singleton, 2022; Guzman et al., 2021; Logan et al., 2022; Olsen et al., 2022). As Richard Dunning and colleagues propose, working towards x-minute cities will require "planning for the possible in the context of the existing" (2021, p. 157). This process should not preclude the goals of creating more sustainable, mixed-use, and higher-density cities, but rather requires moving beyond tokenistic discourse about x-minute cities, towards greater engagement with unique urban and neighbourhood contexts (ibid.).

While critical and socially engaged thinking on x-minute cities is on the rise, surprisingly little attention has been given to actual household dynamics and travel behaviour in these discussions. Thus, this paper builds on the literature attending to the relationship between household characteristics and transport planning (Chidambaram & Scheiner, 2020; Habib, 2014; Hawkins, Weiss & Habib, 2021) to better nuance analyses and planning interventions aimed at fostering the x-minute city. Studies on travel behaviour have long commented on the need to account for the unique social, economic, and demographic trends that result in changing household dynamics and travel patterns (Clark, Huang & Withers, 2003; Surprenant-Legault, Patterson & El-Geneidy, 2013; White, 1988). For example, research on walkability measures and their relationship to actual observed travel patterns has found that walkability indexes do not have the same correlation with travel behaviour for all individuals and households (Manaugh & El-Geneidy, 2011). By bringing together this literature on the relationship between household characteristics and transport planning with recent theorizing on 15–30-minute cities, we hope to help move the conversation beyond utopian thinking about ur-

ban sustainability, towards more contextualized strategies grounded in people's actual travel experiences, neighbourhood characteristics, and household realities.

3. Data and methods

In this paper we define households who are living the 15- or 30-minute city lifestyle as those households who are conducting all their travel to their desired daily destinations within a 15- or 30-minute travel-time radius from their home and are using active modes of transport (walking, cycling, and/or public transport) to reach them. To do so, we use the 2018 Montréal Origin-Destination (O-D) survey. The O-D survey is administered every 5 years by the regional public transport planning authority in the Montréal metropolitan region, collecting a travel diary record from a 5% random sample of Montréal-area households covering the most recent weekday. Each observation in the O-D survey represents a trip made by an individual on the survey day from a specific household. All trips made by the entire household on the same day are recorded and coded to enable aggregation to the person or household level.

3.1. Data cleaning

We restricted our analysis to households whose trips consisted of O-D pairs within Montréal's metropolitan area boundary. Trips with missing O-D information or those that reported modes other than walking, cycling, public transit, and/or car (driving or passenger) were removed since accurate travel times could not be estimated except for these modes. Travel times for each trip were measured between the respondent's home location and the trip destination, based on the mode used to reach the destination. This approach helps correct for potential trip chaining, wherein the trip origin and destination are far from the home location, to capture a true travel time radius of all destinations from the home location.

Network routing for each home-destination pair were calculated using the r5r package in R, supported by OpenStreetMap (OSM) utilizing its sidewalk, cycling, and roadway networks. A speed of 4.5 km/h was used to estimate walking travel time and 16 km/h for cycling (Bastos Silva, Cunha & Silva, 2014; El-Geneidy, Krizek & Iacono, 2007). We assembled General Transit Feed Specification (GTFS) data for all public transport agencies providing service in the study area, with feeds downloaded from OpenMobilityData we calculated travel times by public transport trips using the r5r routing tool (Pereira, Saraiva, Herszenhut, Braga & Conway, 2021). Since the public transport routing procedure relies on schedules from the GTFS, r5r was programmed to measure travel time based on the departure time reported for each trip. The OSM network and GTFS files were downloaded from 2019 and public transport trips were simulated on a typical weekday schedule of April 23rd, 2019. To our knowledge no significant road network changes or public transport service adjustments occurred between the time of the survey and the date the travel time routing data was sourced. It is important to note that congested car travel time was not calculated for this analysis since the goal of the study is to identify households living the 15- or 30-minute lifestyle while exclusively using active modes of transport. For this reason, households with car users were not considered to be living the 15- or 30-minute lifestyle.

With relevant travel times calculated, all trips in the sample (n = 147,274) were then aggregated to the household level for further analysis (n = 50,904). The maximum travel time recorded for each household and the modes used for all trips were utilized to determine whether the household classifies as a 15-minute household or a 30-minute household. To capture daily travel behaviour consisting of a range of trip types, a household was excluded from the sample if it had less than two trips recorded in the survey, and/or if school and work were the only destinations visited by all members of the household. Households were also removed from the sample if their survey results were missing key demographic information such as income that are needed for the analysis. The final cleaned sample consisted of 87,328 trips reported by 22,040 households.

3.2. Statistical models and variables

As a central aim of our research is to learn the personal and neighbourhood factors contributing to a household living the 15- or 30-minute city lifestyle based on all of their trips, we used a binary logistic regression to unravel the characteristics that differentiate these households from those with longer travel times. A multilevel binary logistic model was also tested with census tracts as the higher level of analysis. However, when comparing the multilevel model to the binary logistic model, the LR test ($p = 0.31$) indicated that it is not needed. For the purposes of this analysis, a 15- or 30-minute household is defined as one whose daily trips (a) do not surpass the respective travel-time threshold and (b) are completed using only active modes (walking, cycling, and/or public transit).

Two groups of explanatory variables, household characteristics and built-environment factors, were included in the models. For the former, sociodemographic information by household was pulled from the O-D survey. Variables included per capita annual income, a binary indicator of household vehicle access, and household size by age and occupation status. For the purposes of modelling, the household composition is indicated by seven variables that count mutually exclusive categories of individuals which comprise households: children (age <5), students (age 5–12), students (age 13–18), students (age 19+), full-time workers, retirees, and other. This disaggregated representation of household size allowed us to pinpoint the influence that household members in varying life stages may have on the ability to meet daily needs within 15- and 30-minute travel-time thresholds.

The built-environment factors included two measures of local and regional accessibility, the ease of reaching destinations, around each household (Handy, 2020; Manaugh & El-Geneidy, 2012). The first is WalkScore, a popular measure of local accessibility by active modes that has been proven reliable in predicting walking behaviour in the Montréal context (Manaugh & El-Geneidy, 2011). This measure reflects neighbourhood-level walkability as an index produced through a gravity-based assessment of amenities within 1-mile of each location. In our analysis, household home locations were spatially joined to postal code-level WalkScore values. To capture the varying impact of WalkScore, four dummy variables were generated in line with the official WalkScore groupings: car dependent (score 0–49), somewhat walkable (score 50–69), very walkable (score 70–89), and walker's paradise (90–100) (Walk Score, 2022).

A public transport gravity-based accessibility measure is the second built-environment metric, defined as the quantity of jobs reachable within the region's from a location and weighted by a gaussian-fit decay function derived from the Census 2016 commuting flows (Palacios & El-geneidy, 2022). Travel time calculations for job accessibility by public transport were produced using the r5r package in R for every minute between 8:00 am and 9:00 am then averaged to account for variation in scheduling and waiting time (Pereira et al., 2021). Job location data was obtained from Statistics Canada (Statistics Canada, 2018). To highlight the policy relevance of this study, a sensitivity analysis was developed after discussing the statistical models showing the odds of different household structures in achieving the 15- or 30-minutes city lifestyle while varying the local accessibility levels.

3.3. Samples for alternate 15- and 30-minute city definitions

Two additional samples were prepared to reclassify the same households based on definitions of 15- and 30-minute cities that are less rigid compared to the expectation that all household travel is conducted within the travel time radius. The first sample excludes all work and

Table 1
Descriptive statistics of independent variables grouped by 15- and 30-minute households.

Variable		Variable Description	Mean (Std. Dev.)			
			15-min *households*	*Non-15*-min *households*	*30*-min *households*	*Non-30*-min *households*
Household Characteristics						
Income (per capita)	*[$10,000/year]*	Respondent's annual household income, divided by household size	3.38 (2.52)	3.78 (2.62)	3.56 (2.68)	3.78 (2.62)
Household vehicle access	*[1 = yes]*	Access to a household vehicle	0.4 (0.49)	0.91 (0.29)	0.37 (0.48)	0.93 (0.25)
Household Composition						
Children (age <5)	*[count]*	Number of children under the age of 5	0.06 (0.25)	0.15 (0.44)	0.09 (0.35)	0.15 (0.44)
Students (age 5–12)	*[count]*	Number of students between the ages of 6 and 12, inclusive	0.16 (0.52)	0.34 (0.71)	0.18 (0.54)	0.34 (0.71)
Students (age 13–18)	*[count]*	Number of students between the ages of 13 and 18, inclusive	0.04 (0.25)	0.19 (0.51)	0.06 (0.29)	0.2 (0.52)
Students (19+)	*[count]*	Number of students ages 19 or older	0.08 (0.32)	0.15 (0.42)	0.12 (0.39)	0.15 (0.42)
Full-time workers	*[count]*	Number of full-time workers	0.4 (0.63)	1.08 (0.88)	0.61 (0.74)	1.09 (0.88)
Retirees	*[count]*	Number of retired individuals	0.69 (0.74)	0.52 (0.76)	0.55 (0.72)	0.52 (0.77)
Other household members	*[count]*	Number of other household members	0.3 (0.58)	0.26 (0.51)	0.28 (0.53)	0.26 (0.5)
Built Environment						
WalkScore	*[1–100]*	WalkScore of home location	84.9 (18.5)	59.6 (27.3)	87.2 (15)	58.3 (27)
Transit accessibility to jobs	*[1 = 10,000 jobs]*	Gravity-based accessibility to jobs	42.5 (18.7)	21 (19.4)	45.4 (16.4)	19.9 (18.8)
Percent of Sample			1.8%	98.2%	6.0%	94.0%

school trips to evaluate x-minute household status based on each household's non-education and employment destinations. It is understood that work and school destinations tend to assume a more regional scale relative to home locations as individuals seek opportunities that best align with their needs. Moreover, travel for work and school purposes is often more inflexible than other purposes, as their destinations cannot easily be changed (Schwanen & Dijst, 2003). As such, these destinations often span beyond the neighbourhood vicinity and may conflict with our evaluation of local accessibility to other destinations such as leisure, shopping, health, etc. For this sample, work and school trips were filtered out based on the trip type variable included in the Montreal O-D survey. The resulting sample included 55,642 non-work and non-school trips reported among 22,040 households.

The second alternative sample defines 15- or 30-minute city households as such if 65% or more of the household's trips are completed using active modes within the travel time threshold. Under the assumption that household members may choose to travel to longer-distance destinations despite closer options being available, it may be an unreasonable expectation to measure local accessibility based on an exclusive travel time radius. The 65% benchmark was selected because it reflects a household's trip majority for those that have as few as three total trips recorded. This sample includes the same number of households (n = 22,040) and trips (n = 87,328) as the original sample.

4. Results

4.1. Descriptive statistics

Our preliminary analysis shows that a minority of households in Montréal are living the 15- and 30-minute city lifestyles (Table 1). Among the 22,040 Montréal households analysed, 1.8% conduct all their daily activities within 15 min from their home using active transport (walking, cycling, and/or public transport), and 6% within 30 min. Households living a 15- and 30-minute city lifestyle tend to have fewer people than those who are not. This distinction is slightly more pronounced when comparing households within and outside of the 15-minute travel-time threshold to the 30-minute one.

For the built-environment variables, WalkScore and public transport accessibility to jobs are higher for 15- and 30-min households (Fig. 1), with a bigger change in WalkScore observed between households within and outside of the 30-minute city compared to the 15-minute ones. These preliminary findings suggest that the 15-minute city lifestyle is more related to household composition, whereas the 30-minute city lifestyle is more closely linked to the built environment.

4.2. Model results

Our binary logistic model results allow us to assess the impact of household and built environment characteristics on the probability that all household's trips will fall within a 15-minute or a 30-minute travel-time threshold and using active modes of transport (cycling, walking, and/or public transport). The odds ratios presented in Table 2 for both models reflect the relative importance of each variable on this probability. First, in terms of income, the models indicate that an increase of $10,000 in a household's per capita income results in an 8% decrease in the probability of being a 15-minute household, and a 6% decrease in the probability of being a 30-minute household, while keeping all other variables constant at their mean value. Thus, while the effect of income is significant, and lower income households are more likely to belong to these local accessibility groups, the effect is also relatively small. On the other hand, vehicle ownership has a considerably higher effect. A household that owns one or more vehicles is 78% less likely to be a 15-minute household, and 87% less likely to be a 30-minute household, while keeping all other variables constant at their mean.

Both models also attempt to explain the impact of household composition on the probability of staying within the 15- and 30-minute travel-time thresholds while only using active modes of transport. To simplify the interpretation of individual characteristics in the model, Fig. 2 presents the varying effects of the number of individuals with certain characteristics on the probability of a household being characterized as a 15- or 30-minute household. Each additional household member which has a statistically significant effect, negatively affects the probability of being a 15- or 30-minute household. This effect varies based on the age and status of this additional household member. Thus, larger households are less likely to stay within the assessed thresholds regardless of their specific composition, especially for 15-minute households, if all other variables are kept constant.

Retirees have the smallest effect on the probability of being a 15-minute household, meaning that a household comprised of only one retiree would be the most likely to have a 15-minute travel radius while only using active modes of transport. This is followed by the "other household member" category (non-employed and non-students) and students of 13 to 18 years of age. Finally, students over 18 years old and full-time workers have the largest effect, meaning that they are the least likely to stay within a 15-minute threshold. For the probability of being

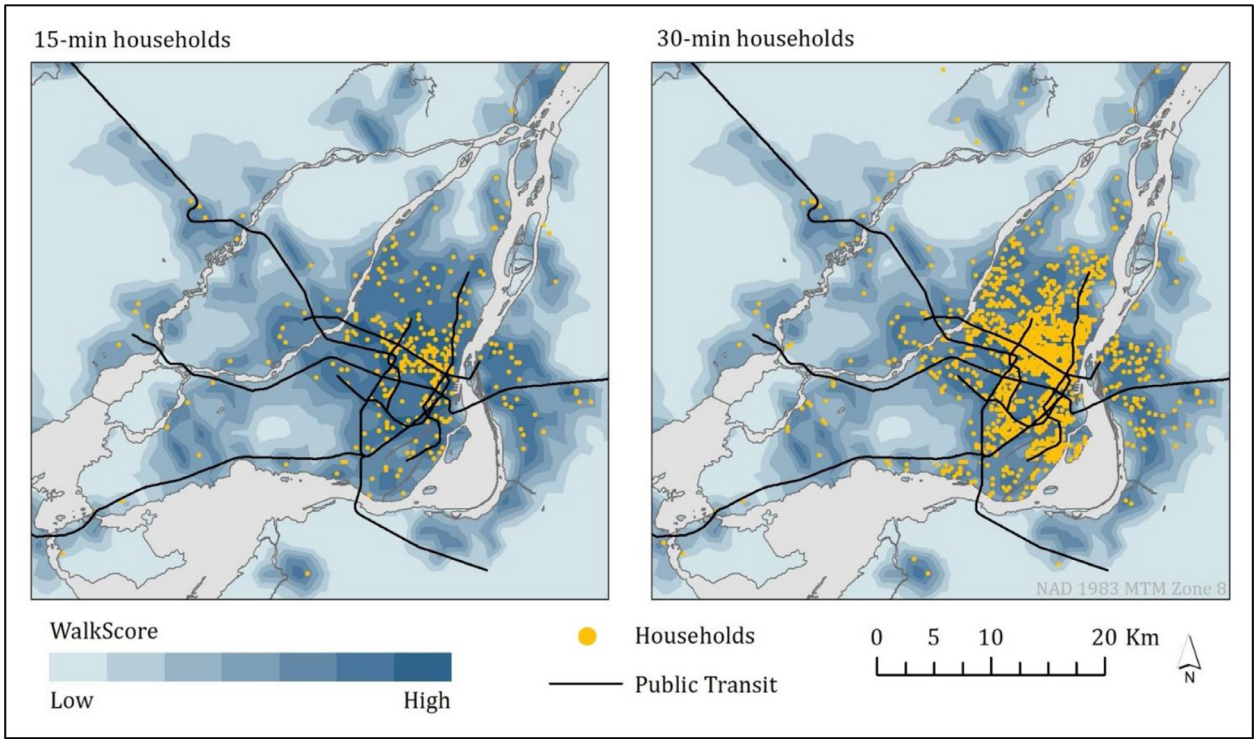

Fig. 1. 15- and 30-min household home locations and neighbourhood WalkScore.

Table 2
Model results for 15-minute and 30-minute households.

Predictors	**15-min households**		**30-min households**	
	Odds Ratio	*CI*	*Odds Ratio*	*CI*
Intercept	0.05 ***	0.03 – 0.09	0.08 ***	0.06 – 0.13
Household Characteristics				
Income (per capita)	0.92 **	0.88 – 0.97	0.94 ***	0.91 – 0.96
Household vehicle access	0.22 ***	0.17 – 0.29	0.13 ***	0.11 – 0.15
Household Composition				
Children (age <5)	0.71	0.46 – 1.03	0.92	0.76 – 1.11
Students (age 5–12)	1.14	0.91 – 1.40	1.05	0.92 – 1.19
Students (age 13–18)	0.52 **	0.32 – 0.77	0.60 ***	0.48 – 0.75
Students (19+)	0.39 ***	0.26 – 0.56	0.59 ***	0.49 – 0.71
Full-time workers	0.34 ***	0.26 – 0.42	0.54 ***	0.47 – 0.61
Retirees	0.78 *	0.62 – 0.98	0.90	0.78 – 1.04
Other household members	0.74 *	0.57 – 0.96	0.80 **	0.68 – 0.94
Built Environment				
WalkScore (50–69)	1.77 *	1.02 – 3.16	1.71 **	1.17 – 2.54
WalkScore (70–89)	2.38 **	1.40 – 4.19	2.34 ***	1.63 – 3.44
WalkScore (90–100)	4.33 ***	2.34 – 8.26	4.24 ***	2.81 – 6.50
Transit accessibility to jobs	1.02 ***	1.01 – 1.03	1.04 ***	1.03 – 1.04
Observations	22,040		22,040	
R^2 (McFadden)	0.25		0.36	
AIC:	3050.73		6442.21	
BIC:	3162.74		6554.22	

* $p<0.05$ ** $p<0.01$ *** $p<0.001$.

a 30-minute household, “other household members” have a relatively small effect, followed by students over the age of 13. Similar to the 15-minute households, full-time workers have the largest effect, suggesting that work-related responsibilities interfere with the ability to live within a 30-minute travel-time threshold while only using active modes of transport.

Children under 5 years of age and students from 5 to 12 years of age have no statistically significant effect on the probability of a household having a 15-minute or 30-minute travel-time threshold. This means that a household belonging to one of these two travel-time categories is more related to the presence of adults and students over 13 years of age in the household, as younger children show no additional effect.

The models also shed light on the relevance of the built environment on the likelihood that a household will belong to one of the 15- or 30-minute household categories. In this context, the household location’s WalkScore has a strong and statistically significant effect on the odds of a household being a 15- or 30-minute one. Compared to households located in areas with the lowest WalkScore values, of 0 to 49, households located in areas with a WalkScore of 50 to 69 are 1.77 times more likely to be a 15-minute household and 1.71 times more likely to be a

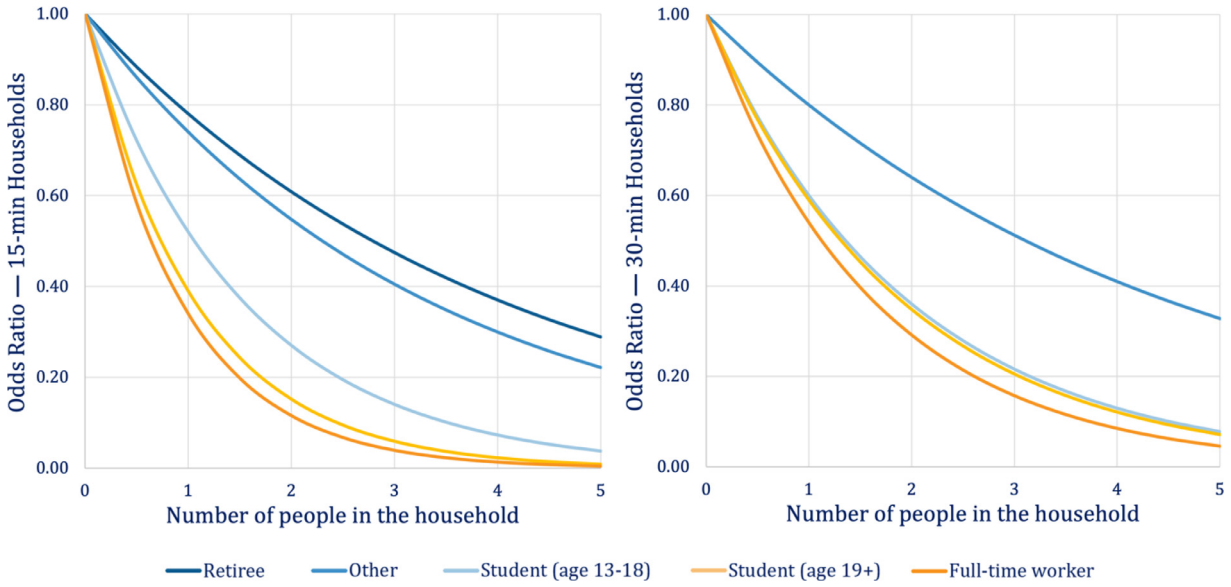

Fig. 2. Odds ratios for 15-minute and 30-minute households by number of household members.

30-minute household while keeping all other variables constant at their mean. Households living in neighbourhoods with a WalkScore between 70 and 89 are 2.38 times more likely to be a 15-minute household and 2.34 times more likely to be a 30-minute household when compared to households residing in neighbourhoods with the lowest WalkScore. Finally, households living in areas with the highest WalkScore, with scores of 90 to 100, are 4.33 times more likely to be a 15-minute household and 4.24 times more likely to be a 30-minute household compared to those households residing within the lowest values, while keeping all other values constant at their means.

The probability of being a 15-minute household increases by 2% for every additional 10,000 jobs (weighted based on the gravity decay function) that can be reached by public transit in the region's mean commute time from the household location, while keeping all other variables constant at their mean. On the other hand, the probability of being a 30-minute household increases by 3% for every additional 10,000 jobs that can be reached. These results show that not only local accessibility is relevant for households to live a 15- or 30-minute city lifestyle, but public transit accessibility as well.

4.3. Sensitivity analysis

To better understand the implications of the all-trips model results, we propose a sensitivity analysis based on 8 household profiles:

- 1 adult ("other household member": non-employed and non-student), with no car
- 1 student, with no car
- 1 worker and 1 student (13–18), with no car
- 2 adults, with a car
- 1 worker, with a car
- 1 worker, 1 student (19+), 1 student (13–18), with a car
- 1 worker and 1 student (13–18), with a car
- 2 workers and 1 student (13–18), with a car

These 8 household profiles with varying compositions and car ownership only include household members that showed statistically significant effects on both models presented in Table 2. For the sensitivity analysis, we predict the probability that each of these household profiles will be a 15- or a 30-minute household for varying WalkScore levels, while fixing per capita income and public transport accessibility levels at their respective mean values. This analysis allows for evaluation of which household structures are more likely to lead to 15- and 30-minute households, as well as to assess the relevance of varying local accessibility levels for these profiles, a strategy that is being heavily promoted in the 15-minute city literature (Allam et al., 2022; Moreno et al., 2021). Further, we calculate this likelihood for all Montréal households in the sample while varying WalkScore levels. Fig. 3 presents the results of the sensitivity analyses. The percentages for each household profile can be interpreted either as the probability that each profile would be a 15- or 30-minute household, or as the share of each household profile that only makes trips within the assessed travel-time thresholds using active modes of transport.

The household structure with the highest share of 15-minute households is composed of 1 non-employed, non-student adult with no private vehicle. For this household structure, the share of 15-minute households would be 15% when located in a neighbourhood with a WalkScore of 90 or above. However, all other profiles have shares of under 10% meeting the 15-minute household status, and all profiles with more than one person in the household have shares of under 5%. These results illustrate how having to perform work activities and having larger households strongly restricts the possibility of staying within a 15-minute threshold. Improving the local accessibility levels for all areas in the Greater Montréal Metropolitan region to the highest WalkScore levels (90 to 100) would lead to only 2.7% of all households attaining a 15-minute travel-time radius that relies on active modes of transport only. This represents an increase of only 0.9% in the number of households relative to the existing 1.8% 15-minute households currently experiencing this lifestyle.

Compared to 15-minute households, the share of households that would stay within the 30-minute travel-time threshold is higher for all profiles. In this case, the profile with the highest probability is also 1 non-employed, non-student adult with no car, for which the share would be 33.2% when located in a neighbourhood with a WalkScore of 90 or more. This is followed by other profiles without a private vehicle, all of which have a share of over 10% when located in the highest WalkScore level. On the other hand, all profiles with at least one car have shares of less than 7% of 30-minute households. Finally, for the current Montréal population, 8.0% of households would be categorized as a 30-minute household if local accessibility was improved to WalkScore levels of 90 or more. This represents an increase in 2.0% of households compared to the existing 6.0% 30-minute households in the Greater Montréal Area.

These sensitivity analysis results provide insights into the feasibility of the 15-minute and 30-minute city planning approaches in the North American context, as well as into the potential planning measures that

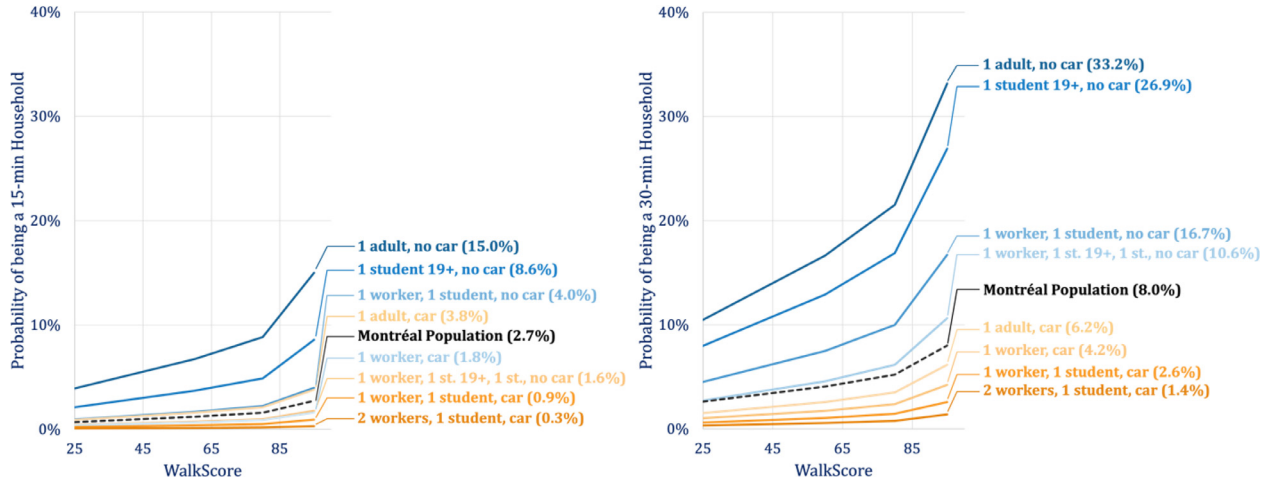

Fig. 3. Sensitivity analysis results.

Table 3
Percent of households that meet different versions of x-minute city concepts.

	Percent of Montréal households			
Trips that conform to the x-minute city definition	15-min households	Non-15-min households	30-min households	Non-30-min households
100% of trips	1.8%	98.2%	6.0%	94.0%
Non-work and non-school trips	5.9%	94.1%	11.1%	88.9%
65% of trips	4.3%	95.7%	10.4%	89.6%

can be taken to move toward these goals. First, we can conclude that the expectation that households will be able to perform all their trips in 15 min or less while only using active modes of transport is unrealistic for most existing household structures, even if local accessibility was considerably increased. More specifically, households with employed members are much more likely to perform trips with a duration of more than 15 min, which shows the current incompatibility of the 15-minute city paradigm with the distribution of working activities. Additionally, households with more than one person are also highly unlikely to remain within the 15-minute threshold, meaning that more complex household structures tend to be less compatible with a 15-minute-city lifestyle. The 15-minute city planning approach, as defined by maintaining all trips within 15 min of the home, does not only provide a difficult goal to reach for North American cities, but it is more related to household-structure characteristics, which are not within the scope of planning and policy interventions and less with the built environment.

On the other hand, while the 30-minute city lifestyle is also strongly related to household structure, the probability of being a 30-minute household is higher for a variety of household profiles. This includes households with workers and a larger number of members, meaning that the expectation that all of a household's trips could be performed in 30 min or less by active modes is not contradicting the necessity of commuting for work or the needs of more complex household structures as much as the 15-minute travel time threshold. Our findings also show that the goal of encouraging the 30-minute city lifestyle can be achieved through planning policy interventions, such as increasing local and regional accessibility around households. While this is in line with previous studies (Boisjoly, Wasfi & El-Geneidy, 2018; Manaugh & El-Geneidy, 2015), we have also found that households that own one or more cars are considerably less likely to live the 30-minute-city lifestyle. This means that to aim for the 30-minute-city and encourage more local and active lifestyles, built-environment interventions should be accompanied by travel-demand management policies aiming to reduce car ownership.

4.4. Alternate 15- and 30-minute city definitions

Both the 15- and 30-minute city lifestyles in which all trips are conducted using active modes within the given travel time threshold are not achievable by most people in Montréal. With only a 0.9% increase in the number of households meeting the 15-minute standard when WalkScore is increased to the highest levels across the Greater Montréal area, and a 2% increase for the 30-minute standard, the metric used to determine x-minute city eligibility is far too strict. Furthermore, this definition of local accessibility does not account for natural variations in travel behaviour that include trips to destinations in different neighbourhoods of a city. Conducting all travel within a certain travel time may not be realistic or desirable and may instead reflect a constrained mobility experience.

These results point to a need for more contextually appropriate parameters for the x-minute city that can lead to benefits for a greater proportion of people. In this study, Moreno's 15-mincute city definition was already expanded from its original conceptualization to include public transit as an acceptable mode and allow for a larger travel time radius of 30 min, even with such expansion the number of households living these lifestyles were limited and the planning interventions that can be applied on the ground are also limited to a large extent. Two further expansions are explored below.

In the first of the two alternative definitions, 15- and 30-minute households were reclassified using only non-work and non-school trips. This analysis provides another perspective into travel-time trends while recognizing the regional nature of employment and education opportunities. For the second alternative definition, households meet the 15- and 30-minute city status as long as a minimum of 65% of their trips were conducted within the travel time and using active modes. Table 3 shows that when these modifications are applied, a higher proportion of households meet the standard. Excluding trips to work and school destinations leads to 11.1% of households conducting their trips using active modes within a 30-minute travel time radius of their home.

Table 4
Model results for 15-minute and 30-minute households for non-work and school trips.

Predictors	**15-min households**		**30-min households**	
	Odds Ratio	*CI*	*Odds Ratio*	*CI*
Intercept	0.04 ***	0.03 – 0.06	0.13 ***	0.10 – 0.16
Household Characteristics				
Income (per capita)	0.95 ***	0.92 – 0.97	0.94 ***	0.92 – 0.96
Household vehicle access	0.31 ***	0.27 – 0.36	0.15 ***	0.13 – 0.17
Household Composition				
Children (age <5)	1.02	0.88 – 1.17	0.92	0.82 – 1.04
Students (age 5–12)	1.18 ***	1.08 – 1.29	1.07	0.99 – 1.16
Students (age 13–18)	0.82 **	0.70 – 0.95	0.84 **	0.75 – 0.95
Students (age 19+)	0.86	0.74 – 1.00	0.94	0.83 – 1.06
Full-time workers	1.04	0.93 – 1.15	1.01	0.92 – 1.10
Retirees	0.74 ***	0.64 – 0.85	0.81 ***	0.72 – 0.90
Other household members	0.90	0.78 – 1.04	0.97	0.87 – 1.09
Built Environment				
WalkScore (50–69)	1.66 ***	1.24 – 2.24	1.79 ***	1.41 – 2.27
WalkScore (70–89)	2.92 ***	2.20 – 3.90	2.66 ***	2.11 – 3.37
WalkScore (90–100)	5.18 ***	3.70 – 7.29	4.61 ***	3.51 – 6.09
Transit accessibility to jobs	1.02 ***	1.02 – 1.03	1.03 ***	1.03 – 1.04
Observations	22,040		22,040	
R^2 (McFadden)	0.19		0.30	
AIC:	8036.86		10,812.88	
BIC:	8148.87		10,924.89	

* $p<0.05$ ** $p<0.01$ *** $p<0.001$.

Table 5
Model results for households with 65% or more trips meeting the 15-minute and 30-minute definition.

Predictors	**65% 15-min households**		**65% 30-min households**	
	Odds Ratio	*CI*	*Odds Ratio*	*CI*
Intercept	0.03 ***	0.02 – 0.06	0.08 ***	0.06 – 0.10
Household Characteristics				
Income (per capita)	0.93 ***	0.90 – 0.96	0.96 ***	0.94 – 0.98
Household vehicle access	0.28 ***	0.24 – 0.33	0.13 ***	0.12 – 0.15
Household Composition				
Children (age <5)	1.38 ***	1.19 – 1.60	1.18 **	1.04 – 1.33
Students (age 5–12)	1.80 ***	1.64 – 1.98	1.50 ***	1.39 – 1.62
Students (age 13–18)	0.69 ***	0.56 – 0.84	1.02	0.90 – 1.15
Students (19+)	0.60 ***	0.49 – 0.74	0.87	0.76 – 1.00
Full-time workers	0.65 ***	0.57 – 0.74	0.80 ***	0.73 – 0.88
Retirees	0.95	0.81 – 1.11	1.00	0.89 – 1.12
Other household members	1.00	0.85 – 1.18	1.01	0.90 – 1.15
Built Environment				
WalkScore (50–69)	1.54 *	1.07 – 2.24	1.83 ***	1.39 – 2.41
WalkScore (70–89)	3.03 ***	2.16 – 4.30	2.84 ***	2.19 – 3.71
WalkScore (90–100)	5.49 ***	3.67 – 8.28	5.30 ***	3.92 – 7.23
Transit accessibility to jobs	1.02 ***	1.02 – 1.03	1.04 ***	1.03 – 1.04
Observations	22,040		22,040	
R^2 (McFadden)	0.22		0.34	
AIC:	6159.69		9779.13	
BIC:	6271.69		9891.14	

* $p<0.05$ ** $p<0.01$ *** $p<0.001$.

Around 10.4% of households meet the 30-minute city status when only 65% of trips need to occur within the 30 min of the home. These alternate definitions provide examples of some methods for creating x-minute city parameters that reflect more local travel behaviour.

4.5. Modelling alternative definitions of x-minute city

For the first alternative definition the 15- and 30-minute households were reclassified and modeled using only non-work and non-school trips among the same 22,518 households (Table 4). This analysis provides another perspective into travel-time trends while recognizing the regional nature of employment and education opportunities. Findings from this analysis reflect similar results compared to the model that included all trips, with a few distinctions.

Firstly, the number of full-time workers became non-significant and weak toward influencing households' travel-time thresholds when trips to work were excluded. This is a notable difference compared to the models accounting for all trips, yet it has a consistent implication that trips to employment destinations generally take longer than 15 and 30 min. The impact of other household members remained relatively consistent, with the exception of students 5–12 years of age positively impacting 15-minute households, and students over the age of 19 positively impacting 30-minute households. This supports our earlier inclination that university students are likely to live in households that maintain a travel-time radius between 15- and 30-minutes.

In terms of built environment factors, the effect of WalkScore follows the same pattern between both sets of models with a higher magnitude influence when work and school trips are excluded. Transit accessibility to jobs remains significant and positive toward predicting 30-minute

households, while for the 15-minute threshold this variable becomes slightly less significant. This definition provide transport professionals with more evidence that achieving the 15-minute and 30-minute city is more reachable if you exclude work and that changes in the built environment will have a stronger effect.

The second alternative is to set a threshold of the number of trips to be under 15 min and 30 min, the current alternative definition sets it at 65% of all trips. This alternative was modeled using the same sample of 22,518 households (Table 5). The model is generally consistent with the previous models, except for the highest WalkScore showing a much stronger impact of the built environment compared to previous models. In other words, providing an alternative definition that expands the 15 min or 30 min constraints to partially include the majority of trips, 65% and above in this case, provides professionals with more tools to reach these goals compared to the original 15-minute or 30-minute definitions.

5. Conclusion

As political interest in adopting 15–30-minute city concepts gains momentum, policy makers must confront questions of how and for whom will this goal come to fruition. This research responds to this need by evaluating the current reality of local accessibility in Montréal to test the practicality of setting targets based on Carlos Moreno's popular concept of the 15-minute city. This study has shown that even when the 15-minute city planning paradigm is expanded to include public transit and to be defined by a larger travel time radius, the concept provides goals that are hardly reachable in the context of a large North American city. The main reason for this is that maintaining 100% of travel within a 15- or 30-minute travel time radius is not compatible with a wide variety of household structures. In this sense, increasing the number of households that are living the 15- or 30-minute city lifestyle is less related to planning or policymaking and more with varying household structures and their specific needs, which are not possible to modify through transport policy interventions. Therefore, striving for a city in which everyone conducts the entirety of their travel within 15 or 30 min from their home is not a useful target. This goal does not accommodate the actual variability of real travel behaviour and is more constricting than it is opportunistic. Cities interested in implementing an x-minute city planning approach must think critically about designing a framework that is both feasible and desirable in the local context.

This study has demonstrated the importance of accounting for household dynamics and travel behaviour in assessing the feasibility of policies aimed at fostering local lifestyles. However, due to the use of O-D survey data, there are some limitations in our analysis. For instance, the identification of 15- and 30-minute households was limited to using a one-day travel diary per household member, which doesn't allow to account for variability in travel between days. Additionally, the analysis was limited to using modelled travel time instead of observed travel time, which may introduce bias into the results. Finally, we could not account for the effect of residential self-selection on households' resulting travel patterns. For these reasons, future research on this topic would need to be conducted by using multiple-day activity-travel data which may be obtained, for instance, through GPS data. While this study used actual travel from an O-D survey, future studies can incorporate data from other sources to account for un-met transport needs to have a more nuanced understanding of the 15-minute or 30-minute city. Additional research can incorporate different measures of accessibility such as accessibility to healthcare by public transit and to retail jobs. Our preliminary analysis has shown these to be highly correlated with accessibility to all jobs by public transit.

Further research is also needed to assess these dynamics across other urban environments to examine the extent to which planning interventions aimed at fostering 15–30-minute cities are within reach, and how to tailor these approaches to best meet the needs of the target populations. Qualitative research is also needed to better understand residents' experiences and perceptions of their local neighbourhoods, including considerations of the comfort and adequacy of facilities for walking, cycling, and public transport, as well as the extent to which local amenities meet residents' needs and wants. Greater research and public engagement are also needed to explore the intersections of x-minute-city frameworks and issues of urban (in)justice, including potential changes to housing prices and affordability as well as the need to better integrate the perspectives of people with disabilities and other underserved groups in urban-policy discussions. By taking local particularities seriously, we hope to help move beyond one-size-fits-all approaches to the x-minute city, towards more contextualized strategies grounded in people's actual needs, lived experiences, and household realities.

Declaration of Competing Interest

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

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