

Exploratory Analysis of Mobility of Care in Montreal, Canada

Léa Ravensbergen¹ , Juliette Fournier¹ , and Ahmed El-Geneidy¹ 

Transportation Research Record
2023, Vol. 2677(1) 1499–1509
© National Academy of Sciences:
Transportation Research Board 2022



Article reuse guidelines:

sagepub.com/journals-permissions
DOI: 10.1177/03611981221105070
journals.sagepub.com/home/trr



Abstract

“Mobility of care” refers to the daily travel required to complete care labor such as travel to the grocery store, or to escort children. Though past research has examined the distribution of individual types of household-serving travel, little research to date, especially in the North American context, has examined mobility of care which combines all travel required to fulfill a household’s care needs. This paper presents the results of an exploratory analysis of mobility of care drawing on the 2018 Montreal Origin–Destination Survey. Specifically, this paper explores *who* completes this type of travel and *how* this mobility is completed. Findings indicate that mobility of care comprises 28% of adults’ daily mobility. Further, women are found to complete more of this type of travel than men, especially women from lower-income households. The presence of children in the household further widens this gendered gap, though the number of children present does not alter this trend greatly. Mobility of care trips are shorter on average than other types of travel and are frequently completed as part of a trip-chain. Further, car use and walking are more frequently used for mobility of care than other types of travel, while the opposite is true for public transport and cycling. The use of public transport for mobility of care trips is greater amongst women than men, especially those living in lower-income households. Taken together, results highlight the importance for practitioners to explicitly address mobility of care in transport planning, and particularly in public transport planning.

Keywords

planning and analysis, sustainability and resilience, transportation and society, women’s issues in transportation, gender and women

Coined by Sánchez de Madariaga, “mobility of care” refers to all the travel required to perform care work, that is, the “unpaid work carried out by adults having responsibility for children and other non-physically autonomous individuals, as well as those activities needed for the upkeep of the home” (1). The concept was developed as a counterpart to mobility for paid employment. While care work tends not to receive monetary compensation, it is still labor that requires time, effort, and skill (1, 2). City and regional planning often invest in the physical infrastructure required to support economic development, but not necessarily in those needed to support care work—work that sustains and supports everyday life (1). Trips linked to care activities, such as grocery shopping and dropping off/picking up children, are essential and must be made regularly; however, mobility of care is less commonly explicitly considered in urban transport planning than mobility for paid employment.

Research on mobility of care builds on a large body of literature that spans many decades on household-serving

travel (3–12). However, while research on household-serving travel tends to consider individual household-serving trips, mobility of care combines these trips to show the full impact of care-related travel. Though considerations of different types of mobility of care trips is important, when household-serving trips are combined into mobility of care, it becomes clear that mobility of care comprise a large proportion of daily travel (13). In one study, the total number of trips made for the purposes of care was close to the total number of trips made for employment, at least amongst those within the age range of having children (13).

Sánchez de Madariaga argues that typical travel surveys do not allow for proper measuring of mobility of care (1). For instance, trips related to care can be

¹School of Urban Planning, McGill University, Montreal, Quebec, Canada

Corresponding Author:

Ahmed El-Geneidy, ahmed.elgeneidy@mcgill.ca

misclassified as trips for “shopping,” “visiting,” “leisure,” or “other.” Further, chained trips (when a stop is made between the home and the final destination) are often both poorly captured in travel surveys and often include care (e.g., grocery shopping on the way home from work). Finally, some surveys do not consider short trips (e.g., <1 km or <15 min), which can obscure mobility of care (1). These sources of bias embedded in typical travel surveys can result in the erasure of care trips, or their redistribution into other categories of travel behavior (13). Given this, reported trips in the 2018 Montreal Origin–Destination (OD) Survey are redistributed to quantify and explore mobility of care in Montreal, Canada.

Mobility of care may also warrant special consideration amongst transport planners aiming to reduce cities’ carbon footprints by discouraging travel by car for frequent trips and encouraging more sustainable travel modes. Preliminary research has found that this type of travel may be considered easier to complete by car than by more sustainable modes such as walking, cycling, and public transport because mobility of care tends to include carrying items (groceries, library books, etc.) or children (14). Therefore, a careful consideration of mobility of care is required in policies aiming to encourage sustainable mobility.

Mobility of care are also important when it comes to transport equity. Past research looking at the distribution of household-serving travel has found that it is disproportionately completed by women (6–9). Preliminary work examining mobility of care—the sum of all household-serving travel—has also found this trend (1, 13). Therefore, considerations of mobility of care may be integral to gender-mainstreaming in urban planning. This paper contributes to the nascent literature on mobility of care by presenting the results of an exploratory analysis in Montreal. Drawing on the 2018 Montreal OD Survey, this study quantifies mobility of care and examines *who* completes this type of mobility, as well as *how* people travel for care purposes.

Literature Review

Groundbreaking articles of the late 1970s helped transport research reject “neuter commuter” assumptions and led to the study of how men and women’s patterns of daily mobility differ in urban spaces (15, 16). One type of gendered travel pattern that emerged is the distribution of household-serving travel. For instance, ample research spanning many decades has found that women shoulder more responsibility for the travel needs of their children than men (3–5, 12). In one study, children were found to be at least five times more likely to travel with their mothers than with their fathers (8). Women have also been found to escort their grandchildren more than

men, and to complete the bulk of elder care, which would likely result in more travel for care purposes (9, 17). Studies have also found that women make more shopping trips and run more errands than men (3, 5–7). Finally, women have been found to be responsible for planning mobilities of care, even when a male partner undertakes them (10).

Of course, gender does not exist in isolation, but intersects with other aspects of difference such as class, race, age, and ability (18). Though many studies have found gendered discrepancies in household-serving travel, less research has examined how these travel characteristics vary across intersecting axes of identity (with important exceptions such as Mauch and Taylor who examine household-serving travel across gender and race, and Smart et al. who examine gender and sexuality) (3, 19). One part of this research gap is addressed in this paper by considering the distribution of mobility of care across gender and income.

Though a large body of work has examined household-serving travel, research has only recently begun to consider mobility of care. While household-serving travel tends to consider individual household-serving trips separately, Sánchez de Madariaga argues that this can result in the systematic under-representation of mobility of care (1). Therefore, work on mobility of care combines these trips to show the full importance and significance of care-related travel. Further, Sánchez de Madariaga argues that many trips made for care are mistakenly considered to be made for leisure or for personal interest because of the ways in which travel surveys are designed (1). For example, the category “shopping” in the 2018 Montreal OD Survey (used in this paper) captures shopping trips made for both leisure and care. This lack of distinction between shopping made for unpaid care work and for leisure is an example of how gender bias can be built into planning methods—in this case, travel surveys. In fact, Sánchez de Madariaga argues that mobility of care is under-quantified, undervalued, and rendered invisible because of gender bias in the way travel data are gathered, interpreted, analyzed, and visually represented (1). The aim is to counter such biases in this paper by quantifying gendered patterns of all household-serving trips, that is, mobility of care.

Research that explicitly considers mobility of care (and not individual household-travel trips) has examined the challenges—as well as the opportunities—of completing this type of travel by bicycle (20–22). Other research has examined mobility of care amongst older adults, some of which considers the burden of this mobility on both care recipients and care givers (23, 24). Finally, an Australian paper argues that major transport investments are built and planned to benefit commuting patterns, a prioritization that hinders child-friendly mobility

Table 1. Study Sample

	Study sample (25–60 years old)	2018 Montreal Origin–Destination (OD) Survey sample (total)	Montreal population (2016 census)
Size	2.2 million	4.47 million	4.122 million
Average household size	3 people/household	3 people/household	3 people/household
Gender	50.5% female 49.5% male	51.1% female 48.9% male	51.2% female 48.8% male
Average age	43 years	40 years	40.5 years
Income			
<\$30,000	14%	21%	21%
\$30,000–\$59,999	23%	28%	28%
\$60,000–\$89,999	23%	20%	20%
\$90,000–\$119,999	18%	14%	14%
\$120,000–\$150,000	10%	7%	6%
>\$150,000	12%	10%	11%

and mobility of care (25). However, beyond foundational pieces by Sánchez de Madariaga, and Sánchez de Madariaga and Zucchini, little work has quantified mobility of care, and none of it is set in the North American context (1, 13). Further, the trip characteristics of this mobility has yet to be examined. Also, while women have been found to complete more mobility of care than men, little work exists on how the distribution of mobility of care varies across gender and other axes of identity, a research gap recently outlined by Grant-Smith et al. (25). These research gaps are addressed in this study by quantifying mobility of care in a North American city and exploring who completed this care across gender and incomes, as well as how they made care trips. In doing so, research considering the gendered division of household-serving travel is built on by exploring what new insights can be gained when considering mobility of care as a whole.

Data and Methods

This study uses data from the 2018 Montreal OD Survey—the most recent publicly available edition (26). Conducted every 5 years since 1970, the Montreal OD Survey is a large-scale travel survey completed by a random sample of 5% of the Montreal population. For the results to be representative of Montreal's population, unique weights are attributed to every respondent. These weights have been used in this analysis to simulate the trips of all Montrealers.

When completing the OD Survey, respondents provide information on their household (location, number of residents, car ownership, income) and their household's occupants (age, gender, driver's license ownership, etc.), and are asked to detail each resident's travel behavior over the preceding 24 h weekday period (origin,

destination, time of departure, motive, and mode for each trip). The OD Survey contains more than 360,000 trips.

The analysis for this study focuses on trips conducted by individuals between 25 and 60 years old. This age range was not chosen to represent working-aged adults, instead this age group was selected because people in this age range are more likely to perform care labor, rather than benefit from others' care. In fact, the analysis of mobility of care by Sánchez de Madariaga and Zucchini focused on individuals aged 30 to 45 years (13). This analysis expands on Sánchez de Madariaga and Zucchini's approach by considering a larger age range (13). Table 1 compares the sample used in this study with that of the full 2018 OD Survey and Montreal (based on the 2016 Canadian census) and shows how the sample is representative of the full OD Survey and the city, especially with regard to household size, gender, and age.

The first step of the analysis involved quantifying mobility of care from the OD Survey. Sánchez de Madariaga and Zucchini's method was followed to redistribute trips in the OD Survey into mobility of care (13). Specifically, two thirds of trips labeled as "shopping," one third of trips with the motive "visiting someone," and all the trips with motive "health," "pick up someone," and "accompany someone" are considered mobility of care. Though this method provides only an approximation of mobility of care, previous research supports its accuracy. Namely, Sánchez de Madariaga and Zucchini developed a travel survey that was explicitly designed to capture mobility of care (13). This survey asked specifically about trips for childcare purposes (categorized into escorting to different destinations, to enable different child-centred activities), for care of other dependents (including escorting to different destinations and to complete different types of activities), and for unpaid home-related activities. This survey was

distributed in Madrid, and its results show that the original approximation method used by Sánchez de Madariaga and Zucchini closely resembles measured mobilities of care (13).

Once care trips were identified, an analysis was made of how they were distributed across gender, income, and presence of children in the household. Although gender is more complex than the male/female binary, Montreal's OD Survey only allows these two options. Therefore, these over-simplistic categorizations had to be relied on in this paper. In every case where men and women's mobility were compared, Chi-square tests were conducted to measure the level of significance. The decision was made to identify male-female differences in all types of households (i.e., single-parent, and multi-parent [i.e., 2+ adults, regardless of sex/gender composition] households). This was done to avoid heteronormative assumptions about two-parent households. When assessing how the presence of children influenced mobility of care, only children 12 years of age and under were considered, because previous research has found that children in this age range are more dependent on their parents to meet their travel needs (27). Indeed, 12 years of age is commonly used as a cut-off in the North American literature on children's independent mobility (28–30).

Then, the ways in which residents complete this type of mobility was analyzed. Here, travel mode, trip duration, and whether the trip was part of a chain or not were investigated. Travel mode was provided in the OD Survey. For the analysis, the travel mode was categorized into one of four categories: car, public transportation, walking, and cycling. Trips that were made driving or as a passenger are considered car trips. Trips made by public transit were either made by metro, bus, or train (the public transit options in Montreal). Trip duration, on the other hand, was generated using the R statistical software program *r5r* (31). The OD Survey provided each journey's departure time. All trips were generated on the same date, a random non-holiday weekday in 2018 meant to represent typical travel conditions. For car trips, local speed limits were obtained from Open Street Maps. Because this did not include congestion, a linear regression model was calculated based on a sample month of trips (February 2020) in Montreal with congested times generated by the Google API to apply a congestion factor. For public transit trip durations, public transit providers operating during the OD Survey time period's General Transit Feed Specification (GTFS) feeds were acquired from the Open Mobility Website. Finally, trip chains were defined based on spatial location. Trip-chains are defined as instances where a succession of trips (at least two) occurred where the first trip begins, and the last trip ends, at the home location. For example, a parent accompanying their child from home

to school in the morning, then going directly to work, followed by picking up groceries on their way home from work was considered a chain of three trips (accompanying someone, work, and shopping).

Results

This results section contains two sub-sections. The first quantifies mobility of care and explores who completes these trips. The second examines how these trips are completed, by exploring trip mode and length, and whether the trips are part of a chain or not.

Who Completes Mobility of Care?

Following the method put forward by Sánchez de Madariaga and Zucchini, results indicate that 28% of daily trips comprise mobility of care (Figure 1) (13). When the sample is expanded to the population of Montreal adults aged between 25 and 60 years old, mobility of care represents 915,000 daily trips. Mobility of care therefore comprise three times the number of trips than those for leisure and only 20% less than those for work. This result confirms Sánchez de Madariaga's argument that mobility of care represents a significant and important proportion of daily mobility and deserves to be explicitly considered in transport planning (1). The bulk of care trips (60%) involve escorting others (accompanying someone or picking someone up). Of these trips, men made 41.8%, leaving the rest, 58.2%, to women. These results confirm that mobility of care is not distributed equally amongst men and women, a trend that was expected given that past work has found that individual types of household-serving labor are also completed more frequently by women (3–12).

Figure 2 highlights the distribution of men and women's travel by trip purpose. Though all trip purposes vary by gender at $p < 0.05$, major differences exist when it comes to work and mobility of care. Namely, mobility of care represents 32% of women's daily mobility and 25% for men. Travel to and from work, on the other hand, comprises 52% of men's mobility, compared with 44% of women's mobility.

According to Sánchez de Madariaga and Zucchini's method, mobility of care is comprised of four different types of trips: accompany/pick up someone, shopping, health, and visiting (13). Figure 3 demonstrates that women consistently complete more of this type of travel, regardless of purpose ($p < 0.05$ for all mobility of care trip purposes). Further, the largest gender gap exists for health-related trips (65% completed by women and 35% completed by men). The smallest gap was found for trips to "visit someone" (54% completed by women and 46% by men).

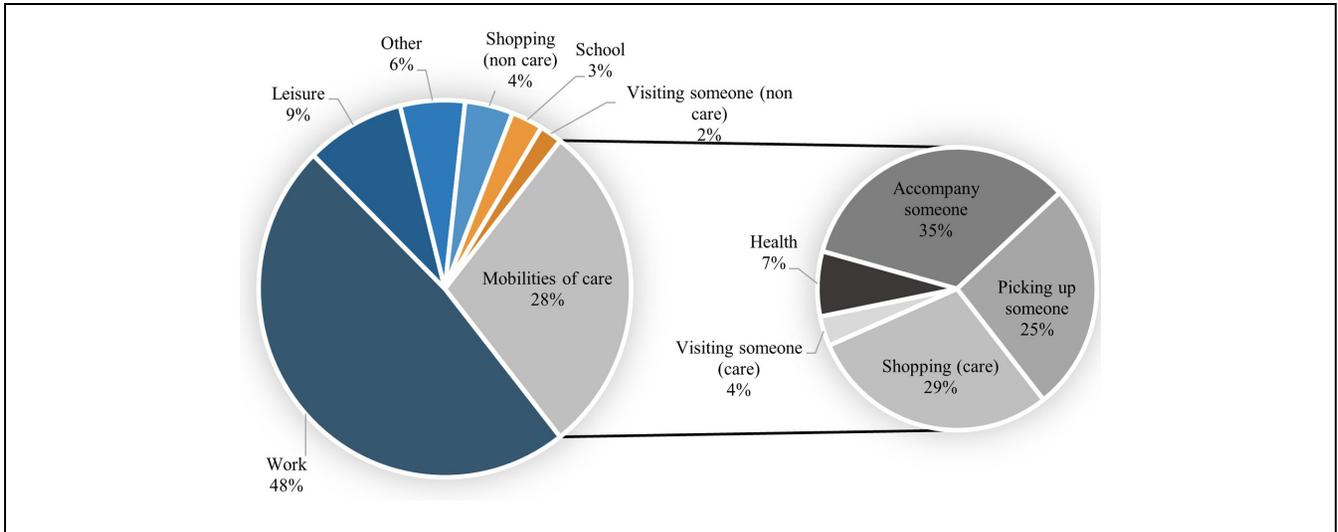


Figure 1. Summary of daily mobility (adults between 25 and 60 years old).

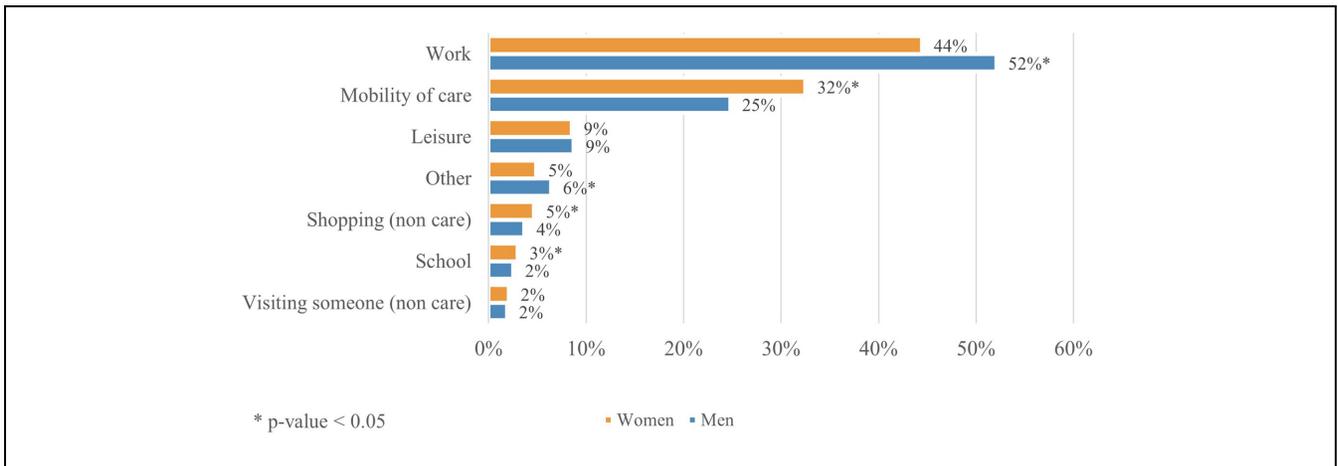


Figure 2. Daily mobility trip purpose by gender.

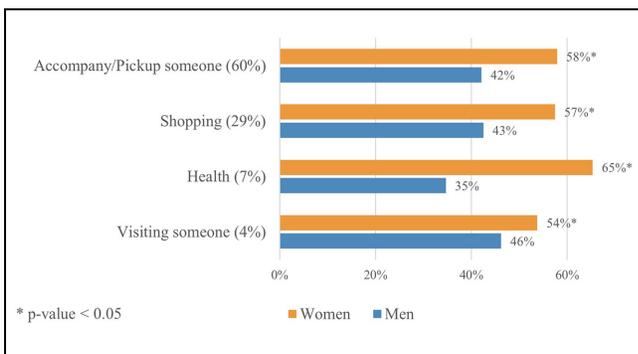


Figure 3. Gendered division of mobility of care trip purposes.

The exploratory analyses revealed that gender was not the only social factor that influences the distribution

of mobility of care. Indeed, the intersection of gender and income revealed an interesting pattern. Namely, as household income increases, the division of care trips becomes more equitable (Figure 4). In lower income households (\$60,000 and lower), women complete 50% more care trips than men. This gap reduces to 22% in households earning \$150,000 or more. It is important to note that, at all income gradients, even the highest and most equitable, women still complete more of this travel than men ($p < 0.05$). This result add an intersectional dimension to the gendered trend, something recent work has called for (25).

Finally, the presence of children in the household was also found to influence the proportion of daily travel that comprises mobility of care (Table 2). In fact, having at least one child in the household doubles the share of mobility of care trips (20% to 42%, $p < 0.05$). A



Figure 4. Proportion of care trips between gender by household income.

Table 2. Percentage of Daily Trips Dedicated to Care by Number of Children (≤12 years) and Household Income

	All incomes (%)	≤\$59,999* (%)	\$60,000–\$150,000* (%)	≥\$150,000* (%)
Households without children	19.78	22.18	18.91	18.67
Households with at least one child [‡]	42.22	45.40	42.04	39.97
1 child households	37.79	40.81	37.53	35.40
2 child households	44.81	49.05	44.44	42.63
3+ child households	47.12	49.07	47.25	43.34

*Differences between incomes are statistically different (p-value < 0.05).

[‡]Differences between having at least one child and without children are statistically different (p-value < 0.05).

gradient in mobility of care exists whereby additional children in the household result in higher shares of mobility of care. In fact, care trips represent 38% of adults’ mobility in households with one child. A second child increases this share to 45% (an increase of 7 percentage points). However, the presence of more than three children only increases this share by 2 percentage points. Therefore, when considering mobility of care as a whole, the proportion of daily trips dedicated to care does not increase linearly with the number of children in the household. Instead, the proportional increase in mobility of care gets smaller with each additional child. This result is perhaps unsurprising, as households with cars may opt to buy more groceries in the same number of trips when additional children result in larger household needs.

Children were also found to influence the gendered distribution of mobility of care (Table 2). Simply put, the gendered distribution of mobility of care gap widens when there are children in the home. Compared with households without children, women in households with one child complete more of the mobility of care (5 percentage points more) while men do less (5 percentage

points less) resulting in a 10 percentage point difference in care trips (p < 0.05). Interestingly, the number of children in the household does not influence this gendered division greatly. In fact, the burden of care trips on women does not change significantly when there is one or three children in the household (61.39% versus 61.75%).

Again, income plays a role here: households with children and the highest incomes have the smallest gendered gaps in mobility of care, while those with the lowest incomes have the largest (Table 3). Indeed, women living in households with at least one child under 12 and a household income under \$60,000 make 68% of the care trips. Women living in households with at least one child under 12 but in households earning \$150,000 or more make fewer mobility of care trips (58%). Income also influences the share of care trips in daily mobility. In households with higher incomes, mobility of care represents a lower portion of adults’ daily mobility, no matter the number of children. For example, in households with at least one child, care trips share decreases from 45.50% in households with lower incomes to 40% in households with higher incomes (Table 2).

Table 3. Gendered Distribution of Mobility of Care by Presence of Children (≤ 12 years) and Household Income

	All incomes		<\$60,000		\$60,000–\$150,000		\geq \$150,000	
	Women* (%)	Men (%)	Women* (%)	Men (%)	Women* (%)	Men (%)	Women* (%)	Men (%)
Households without children	55.15	44.85	55.68	44.32	53.97	46.03	51.58	48.42
Households with at least one child	60.30	39.70	64.68	35.32	59.26	40.74	56.66	43.34
1 child households	61.39	38.61	67.76	32.24	58.21	41.79	57.98	42.02
2 child households	58.96	41.04	64.22	35.78	58.28	41.72	55.72	44.28
3+ child households	61.75	38.25	59.03	40.97	64.69	35.31	56.96	43.04

*Differences between men and women are statistically different (p-value < 0.05).

Table 4. Mode Share of Work and Care Trips by Gender (%)

	Car			Public transportation			Walking			Cycling		
	Care trips	Work trips	All trips	Care trips	Work trips	All trips	Care trips	Work trips	All trips	Care trips	Work trips	All trips
Men	83.3*	75.8*	75.5*	5.0	17.6	14.4	9.6	3.5	6.9	1.5*	2.5*	2.2*
Women	81.6	73.4	73.9	6.4*	20.0*	15.6*	10.6*	4.5*	8.3*	0.8	1.5	1.3
Total	82.3	74.7	74.7	5.8	18.7	15.0	10.2	4.0	7.6	1.1	2.0	1.8

*Differences between men and women are statistically different (p-value < 0.05).

How are Care Trips Made?

With regard to mode share, mobility of care trips are more frequently made by car and by foot than by public transport or by bicycle (Table 4). The greatest discrepancy is observed for walking, a mode used more than twice as frequently for mobility of care than for commuting (10.2% versus 4.0%). Car use is 7.6 percentage points higher for care trips than for work trips, regardless of gender. However, public transport use for care trips is 2.5 times lower than for work trips and cycling for care trips is almost two times lower for than for work trips. Women were found to complete a greater proportion of both work and care trips by transit and a lower proportion by car than men ($p < 0.05$). Men not only cycle more than women for all trips ($p < 0.05$); this gap is greater for care trips (1.5% versus 0.8%).

Though public transport is less commonly used for mobility of care than cars or walking, Figure 5 demonstrates income disparities in public transport use for this type of travel. Namely, as income increases, the use of public transport for care trips decreases. This is most pronounced for adults living in households with incomes lower than \$30,000 per year. These lower-income residents use public transport for mobility of care almost three times as much those earning higher incomes (14% versus 5%). Further, no matter the household income, women use public transport to complete care trips more than men ($p < 0.05$). While this gendered division in public transport use for mobility of care exist across all

income groups, the disparity is far larger amongst lower income households where women make more (5 percentage points more) care trips using public transport than men (16% versus 11%).

In relation to trip duration, care trips were found to be shorter than all other trips. In fact, Montrealers spend an average of 16 min by car (congestion time taken into account) to complete care trips compared with the average duration of all other trips, which is 25 min. This trend was identified for trips using public transport as well, where the average trip for care purposes was 6 min shorter than those for all other purposes (36 versus 42 min). Differences in trip length by gender and the presence of children in the household are not reported here as none were identified.

Over half of mobility of care trips (59.55%) are part of a trip chain, that is, people frequently combine travel for care with travel for other purposes. When comparing care trips made as part of a chain and those not part of a chain, it becomes evident that completing care trips in chains increases the use of car, bike, and public transport (Table 5). This trend is starkest for car use which increases by 7 percentage points. With regard to walking, care trips are twice as likely to be made solely for care purposes than as part of a chain (only 6.79% of care trips made by foot were part of a chain, while 15.11% were not).

Gendered differences in mode share were identified as well (Table 5). For instance, 16.44% of women's work trips are part of a chain which includes at least one care

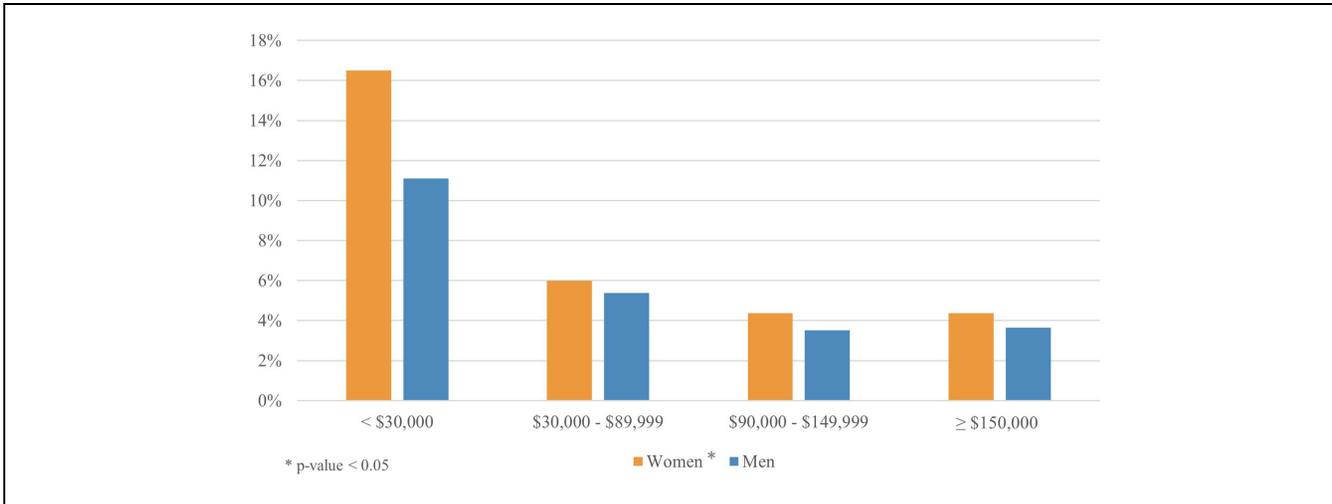


Figure 5. Share of public transport used for care trips by income and gender.

Table 5. Mode Share of Chained and Not-Chained Care Trips (%)

	Care trips not part of a chain				Care trips part of a chain			
	Car	Public transport	Bike	Walk	Car	Public transport	Bike	Walk
Men	79.07*	4.21	1.41*	14.41	86.18*	5.49	1.58*	6.31
Women	77.38	5.50*	0.65	15.62*	84.44	7.05*	0.94	7.12*
Total	78.09	4.96	0.97	15.11	85.28	6.40	1.21	6.79

*Differences between men and women are statistically different (p-value < 0.05).

trip compared with 12.28% for men. Consequently, women more frequently achieve at least one care trip on their way to (or from) work. When completing care trips as part of a chain, men were more likely to use a car while women were more likely to use public transport and walk, though the latter difference is minor ($p < 0.05$).

Discussion and Conclusion

This paper quantifies mobility of care—the travel required to perform unpaid labor for care purposes—in Montreal and explores who carries out this mobility as well as how this type of travel is completed. In doing so, it builds on the existing literature on household-serving travel and aims to counter the tendency for this type of travel to be under-represented in transport research by considering all mobility of care trips as a whole. Drawing on the 2018 OD Survey, results indicate that mobility of care makes up a significant portion of daily travel. Indeed, 28% of Montreal adults’ daily trips comprise mobility of care. This represents almost one million trips (915,000) made every day and is the second most common form of travel after commuting to and from work (48% of daily mobility). Though shopping and escorting children may not seem to make up a significant portion

of daily travel on their own, this study highlights, as Sánchez de Madariaga stipulated, the significance of care responsibilities on daily movement when considered as a whole (1). This result highlights the importance of formally incorporating this type of mobility into transport research and planning.

Further, it is found that the division of mobility of care is inequitable. Results support previous work that has found that women complete the bulk of household-serving trips and mobility of care (1, 6–9, 13). In Montreal, it is found that 58.2% of all daily mobility of care trips are completed by women. In other words, adult women complete 150,060 more daily care trips than men. This inequality was also found proportionally where mobility of care was found to represent 32% of women’s daily trips compared with 25% of men’s trips. These findings are consistent with the time working-aged (25–54 years old) men and women spend per day fulfilling paid (5 versus 3.9 h) and unpaid (2.6 versus 3.8 h) work in Quebec (32). Therefore, a correlation appears to exist between time spent in paid and unpaid labor, and time spent traveling for that labor.

The presence of children in the household was also found to influence mobility of care. Namely, the gendered distribution of this type of travel is more

inequitable in households with children than those without. This finding is supported by previous work finding that mothers escort their children at far higher rates than fathers (8). Interestingly, women do a greater proportion of mobility of care when there are children in the household, but the number of children present barely changes this division of mobility of care. Therefore, having children seems to be the determining factor in the distribution of mobility of care, rather than the number of children present in the household. In one study, the probability of a mother escorting their child changes little when there are one or two children in the home, but the additional child increases the probability that the father completes escort trips (12).

Beyond identifying a gendered distribution in mobility of care, it is also found that gender intersects with other aspects of identity to influence participation in this form of travel. Namely, when considering the distribution of mobility of care across gender and income, it became apparent that the gendered gap in the distribution of mobility of care was twice as large in low-income households than high-income households. While this gendered gap was largest in households earning less than \$60,000, an income gradient in the distribution of care work exists whereby men and women's participation in this mobility narrows as income increases. This result is supported by Han et al.'s research that found that gender equity in escorting is more likely when both parents work full time and are highly educated (12). This income gradient was also found when considering the distribution of mobility of care in households with and without children. Taken together, women from lower income households do a greater proportion of mobility of care, especially when children are present in the household.

Statistical modeling can be used in future work to parse out the impact of different explanatory variables (gender, income, household structure, car ownership, etc.) on the distribution of mobility of care. Future work can also examine why income influences the gendered distribution of mobility of care. Perhaps higher income households can afford hiring help to complete mobility of care. Other work has examined the outsourcing of escorting children and found that this is more common in households with one child than those with multiple children, and in households with older children (12). It is interesting to note that this outsourced labor would likely be completed by women from lower-income households—a dynamic explored in other research (2, 33).

These results highlight the importance of considering gender in an intersectional way: the mobility experiences of women vary across other axes of social difference. Because only gender and income are considered in this paper, the authors call for more research to consider how

the distribution of mobility of care varies not only by income, but by other identities including race and ethnicity, age, and (dis)ability. Further, analyzing how mobility of care varies across different age segments of the population could be insightful. For instance, examining older adults' mobility of care might be of interest, as retirement, or the discontinuation of the commute to work, may result in a greater proportion of a person's daily travel compromising mobility of care. Previous work has found that gendered divisions exist amongst grandparents in escorting children (9). Examining how mobility of care is distributed across age in multigenerational households would also be an interesting research endeavour.

Further, while this paper highlights the uneven distribution of mobility of care across gender and income, it does not explore the social factors underpinning this inequality. Future research examining why this type of travel falls disproportionately on women—especially women from lower-income households—is needed. For instance, research could examine the socialization of care labor. Further, this paper relies on the male/female gender binary, a categorization that was self-reported in the OD Survey. Because gender is not a simple binary, the authors call for more research examining the ways in which mobility of care is distributed across more varied gender identities.

Beyond examining who completes mobility of care, an analysis was also made of how this type of mobility is completed. Travel by car was found to be the most common mode used to complete mobility of care. In fact, the proportion of trips completed by car for mobility of care was greater than that completed for work purposes. Further, an even greater proportion of mobility of care is completed by car when completed as part of a trip chain. Given that the bulk of mobility of care (89% of total) comprises accompanying someone, picking someone up, or shopping for care purposes (Figure 1), and that these trips involve carrying items (i.e., shopping) or escorting people (accompanying or dropping off), perhaps they are considered easier to complete by car than by other modes. Indeed, support for this hypothesis has been found in a recent Spanish study (14).

Results also show that public transport is proportionally used twice as frequently for work trips than for mobility of care. Future work can examine the distribution of mobility of care across different types of public transport. For instance, perhaps bus use is more common for this type of travel than subway or light rail because of the closer distances between bus stops. Results also indicate that care trips are shorter than those for other purposes. Short trips are often put forward as ideal trips to complete using sustainable modes such as public transport. This highlights the importance of including

considerations of this type of mobility in sustainable transport planning. Further, the use of public transport for care trips was highest amongst lower-income households. Given that traveling by public transport is less expensive than by car, this may indicate that those who use public transport for mobility of care do so for cost-saving purposes rather than out of convenience. Indeed, low-income women may be dependent on transit, even if they are poorly served by transit. High-income women may also be able to afford living in walkable neighborhoods with good transit connectivity. This highlights the importance of making public transport the easiest and most convenient choice for these short care trips.

In this research it was not only found that mobility of care comprises a significant proportion of individuals' daily travel, but that women, and low-income women in particular, complete a greater proportion of these trips. Mobility of care trips likely differ from other trips. It was found that they are shorter than the average trip to work, and they likely also take place closer to the home, in the company of children, and/or involve carrying items (e.g., groceries). Therefore, it is important that practitioners explicitly consider this significant form of travel with unique needs in transport planning. For instance, rather than focus on the trip to work as the de facto destination in travel models, researchers can instead explore modeling with care-locations destinations.

Further, people use public transport less, and cars and active modes more, to complete mobility of care than the commute to work. Therefore, public transport practitioners, in particular, should plan for this type of travel. This might involve reconsidering where public transit routes and stops are located to improve accessibility to locations where care activities occur. Indeed, access to jobs is the usual destination used when generating accessibility metrics. Perhaps shifting toward different types of destinations, such as locations where care takes place (e.g., daycares, grocery stores, schools), would result in accessibility metrics that better represent women's travel needs.

Additionally, payment systems that charge two fares when passengers trip chain disproportionality financially burden women, especially low-income women, as they complete mobility of care (an already unpaid form of labor). Charging fares according to travel time rather than travel routes (e.g., one fare for every 2 h travelling on the system rather than every continuous trip) would make trip-chaining using transit more cost effective. Further, public transit designs that accommodate children, strollers, and carried items might make mobility of care using public transport more convenient and encourage people to complete this travel by public transport. Doing so would not only promote sustainable travel in the city; it would also benefit women, and low-income

women in particular, who complete the bulk of mobility of care. Increased attention to and considerations of mobility of care may answer recent calls to integrate gender equity in urban planning (34, 35).

Acknowledgments

The authors would like to thank Pegah Nouri from the Autorité Régionale de Transport Métropolitain (ARTM) for providing access to the OD Survey used in the analysis.

Author Contributions

The authors confirm contribution to the paper as follows: study conception and design: L. Ravensbergen, J. Fournier, A. El-Geneidy; data collection: J. Fournier; analysis and interpretation of results: L. Ravensbergen, J. Fournier, A. El-Geneidy; draft manuscript preparation: L. Ravensbergen, J. Fournier, A. El-Geneidy. All authors reviewed the results and approved the final version of the manuscript.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was funded by the Natural Sciences Research Council of Canada (NSERC) project number RGPIN-2018-04501.

ORCID iDs

Léa Ravensbergen  <https://orcid.org/0000-0003-3259-6673>
 Juliette Fournier  <https://orcid.org/0000-0003-2770-0931>
 Ahmed El-Geneidy  <https://orcid.org/0000-0002-0942-4016>

References

1. I. Sánchez de Madariaga (ed.). Mobility of Care: Introducing New Concepts in Urban Transport. In *Fair Shared Cities: The Impact of Gender Planning in Europe* (M. Roberts ed.), Routledge, London, 2013.
2. Gilow, M. "It's Work, Physically and Logistically": Analyzing the Daily Mobility of Employed Mothers as Domestic Mobility Work. *Journal of Transport Geography*, Vol. 85, 2020, p. 102693.
3. Mauch, M., and B. Taylor. Gender, Race, and Travel Behavior: Analysis of Household-Serving Travel and Commuting in San Francisco Bay Area. *Transportation Research Record: Journal of the Transportation Research Board*, 1997. 1607: 147–153.
4. Craig, L., and T. van Tienoven. Gender, Mobility and Parental Shares of Daily Travel With and for Children: A Cross-National Time Use Comparison. *Journal of Transport Geography*, Vol. 76, 2019, pp. 93–102.

5. Taylor, B., K. Ralph, and M. Smart. What Explains the Gender Gap in Schleppling? Testing Various Explanations for Gender Differences in Household-Serving Travel. *Social Science Quarterly*, Vol. 96, No. 5, 2015, pp. 1493–1510.
6. Root, A. Women, Travel, and the Idea of ‘Sustainable Transport’. *Transport Reviews*, Vol. 20, No. 3, 2000, pp. 369–383.
7. Sweet, M., and P. Kanaroglou. Gender Differences: The Role of Travel and Time Use in Subjective Well-Being. *Transportation Research Part F: Traffic Psychology and Behaviour*, Vol. 40, 2016, pp. 23–34.
8. McDonald, N. Exploratory Analysis of Children’s Travel Patterns. *Transportation Research Record: Journal of the Transportation Research Board*, 2006. 1977: 1–7.
9. Plyushteva, A., and T. Schwanen. Care-Related Journeys Over the Life Course: Thinking Mobility Biographies With Gender, Care and the Household. *Geoforum*, Vol. 97, 2018, pp. 131–141.
10. Schwanen, T. Gender Differences in Chauffeuring Children Among Dual-Earner Families. *The Professional Geographer*, Vol. 59, No. 4, 2007, pp. 447–462.
11. Schwanen, T. I., M. P. Kwan, and F. Ren. The Internet and the Gender Division of Household Labour. *The Geographical Journal*, Vol. 180, No. 1, 2014, pp. 52–64.
12. Han, B., J. Kim, and H. Timmermans. Task Allocation and Gender Roles in Dual Earner Households: The Issue of Escorting Children. *Travel Behaviour and Society*, Vol. 14, 2019, pp. 11–20.
13. Sánchez de Madariaga, I., and E. Zucchini. Measuring Mobilities of Care, a Challenge for Transport Agendas. In *Integrating Gender Into Transport Planning* (C. Scholten, and T. Joelsson eds.), Palgrave Macmillan, Cham, 2019.
14. Maciejewska, M., and C. Miralles-Guasch. “I Have Children and Thus I drive”: Perceptions and Motivations of Modal Choice Among Suburban Commuting Mothers. *Finisterra*, Vol. 110, 2019, pp. 55–74.
15. Rosenbloom, S. The Need for Study of Women’s Travel Issues. *Transportation*, Vol. 7, No. 4, 1978, pp. 347–350.
16. Giuliano, G. Public Transportation and the Travel Needs of Women. *Traffic Quarterly*, Vol. 33, 1979, pp. 607–616.
17. Smith, P. Elder Care, Gender, and Work: The Work–Family Issue of the 21st Century. *Berkeley Journal of Employment and Labor Law*, Vol. 25, No. 2, 2004, pp. 351–399.
18. Crenshaw, K. Demarginalizing the Intersection of Race and Sex: A Black Feminist Critique of Antidiscrimination Doctrine, Feminist Theory and Antiracist Politics. *University of Chicago Legal Forum*, Vol. 1989, 1989, p. 139.
19. Smart, M., A. Brown, and B. Taylor. Sex or Sexuality? Analyzing the Division of Labor and Travel in Gay, Lesbian, and Straight Households. *Travel Behaviour and Society*, Vol. 6, 2017, pp. 75–82.
20. Ravensbergen, L., R. Buliung, and S. Sersli. Vélomobilities of Care in a Low-Cycling City. *Transportation Research Part A: Policy and Practice*, Vol. 134, 2020, pp. 336–347.
21. Sersli, S., M. Gislason, N. Scott, and M. Winters. Riding Alone and Together: Is Mobility of Care at Odds With Mothers’ Bicycling? *Journal of Transport Geography*, Vol. 83, 2020, p. 102645.
22. Montoya-Robledo, V., L. M. Calero, V. B. Carvajal, D. Galarza Molina, W. Pipicano, A. J. Peña, C. Pipicano, et al. Gender Stereotypes Affecting Active Mobility of Care in Bogotá. *Transportation Research Part D: Transport and Environment*, Vol. 86, 2020, p. 102470.
23. Croucher, K., R. Gilroy, M. Bevan, and K. Attuyer. The Mobilities of Care in Later Life: Exploring the Relationship Between Caring and Mobility in the Lives of Older People. *Ageing and Society*, Vol. 41, No. 8, 2021, pp. 1788–1809.
24. Werner, S., G. Auslander, N. Shoval, T. Gitlitz, R. Landau, and J. Heinik. Caregiving Burden and Out-of-Home Mobility of Cognitively Impaired Care-Recipients Based on GPS Tracking. *International Psychogeriatrics*, Vol. 24, No. 11, 2012, pp. 1836–1845.
25. Grant-Smith, D., N. Osborne, and L. Johnson. Managing the Challenges of Combining Mobilities of Care and Commuting: An Australian Perspective. *Community, Work & Family*, Vol. 2, No. 2, 2016, pp. 201–210.
26. Agence métropolitaine de transport. *Enquête Origine–Destination, 2018*. ARTM, Montréal, 2018.
27. Zwerts, E., D. Janssens, and G. Wets. How the Presence of Children Affects Parents’ Travel Behavior. Presented at 86th Annual Meeting of the Transportation Research Board, Washington, D.C., 2007.
28. Cervesato, A., and O. Waygood. Children’s Independent Trips on Weekdays and Weekends: Case Study of Québec City. *Transportation Research Record: Journal of the Transportation Research Board*, 2019. 2673: 907–916.
29. Villanueva, K., B. Giles-Corti, M. Bulsara, G. Trapp, A. Timperio, G. McCormack, and K. Van Niel. Does the Walkability of Neighbourhoods Affect Children’s Independent Mobility, Independent of Parental, Socio-Cultural and Individual Factors? *Children’s Geographies*, Vol. 12, No. 4, 2014, pp. 393–411.
30. Riazi, N., S. Blanchette, F. Trudeau, R. Larouche, M. Tremblay, and G. Faulkner. Correlates of Children’s Independent Mobility in Canada: A Multi-Site Study. *International Journal of Environmental Research and Public Health*, Vol. 16, No. 16, 2019, p. 2862.
31. Pereira, R. H. M., M. Saraiva, D. Herszenhut, C. K. V. Braga, and M. W. Conway. r5r: Rapid Realistic Routing on Multimodal Transport Networks With R5 in R. *Transport Findings*, 2021, p. 1262. <https://doi.org/10.32866/001c.21262>.
32. Statistique Canada. Moyenne de temps consacré en heures par jour à diverses activités par groupe d’âge et sexe, 15 ans et plus, Canada et provinces. Tableau 45-10-0014-01. Province ou territoire, Canada, 2017.
33. Estévez-Abe, M., and B. Hobson. Outsourcing Domestic (Care) Work: The Politics, Policies, and Political Economy. *Social Politics*, Vol. 22, No. 2, 2015, pp. 133–146.
34. Damyanovic, D., and B. Zibell. Is There Still Gender on the Agenda for Spatial Planning Theories?: Attempt to an Integrative Approach to Generate Gender-Sensitive Planning Theories. *DisP - The Planning Review*, Vol. 49, No. 4, 2013, pp. 25–36.
35. Scholten, C., and T. Joelsson. *Integrating Gender Into Transport Planning: From One to Many Tracks*. Springer International Publishing, Cham, 2019.