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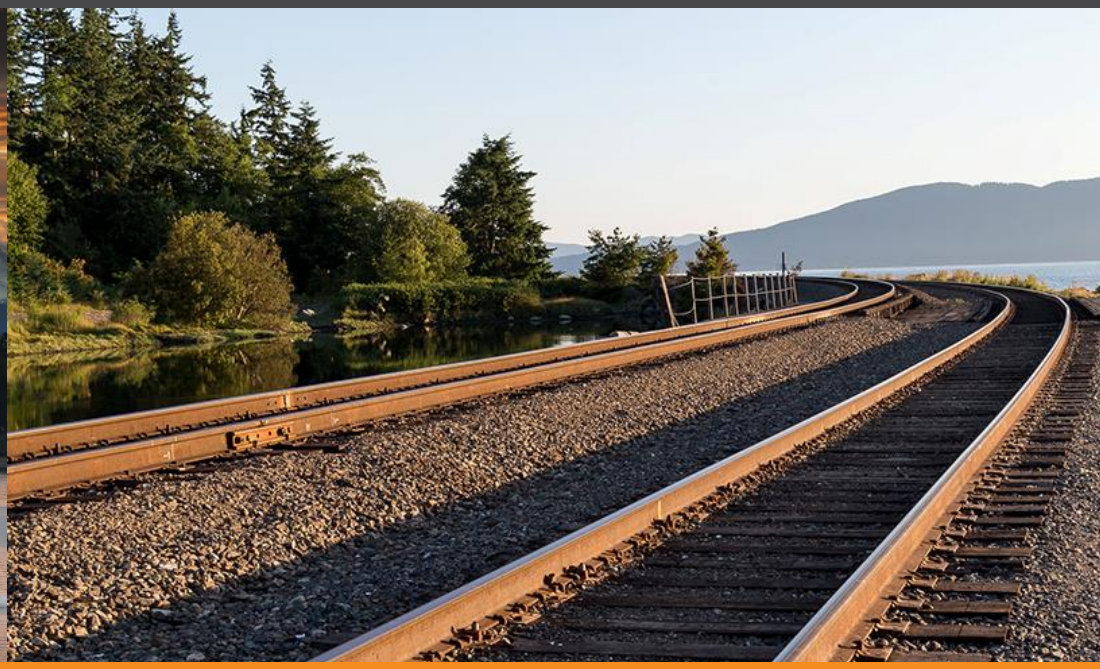
Whatcom Council of Governments (WCOG)

WHATCOM REGIONAL TRANSPORTATION STUDY

Analysis Report | April 10, 2019



PREPARED FOR:
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1.0 EXECUTIVE SUMMARY

The Whatcom Regional Transportation Study collected a rich set of demographic and travel behavior data from a representative sample of 1,451 households in the Whatcom Council of Government (WCOG) planning area. The study collected data from 3,000 persons, representing 62,955 trips across 13,107 complete person-days from September 25 to October 29, 2018.

	Households Surveyed	Weighted Households
	1,451	**83,475**
	Persons Surveyed	Weighted Persons
	3,000	**202,169**
	Complete Person-Days	Weighted Person-Days
	13,107	**202,169**

The study used innovative and representative sampling methods to provide a quality dataset, decreasing the nonresponse bias from low-income households and increasing the share of higher-education students. The study also used innovative data collection methods, leveraging smartphones to capture most of the travel data, resulting in higher and more accurate trip rates and more precise trip times, distances, and person-miles traveled (PMT).

This report summarizes responses for the study, evaluates the success of the sampling plan, and provides descriptive statistics for key questions in the survey and key travel behaviors from the travel diaries. Two of these analyses are highlighted here as they reflect the important and diverse data collected. These analyses are overall trip rates and mode shares as well as college student travel behavior.

1.1 OVERALL TRIP RATES AND MODE SHARES

The overall per person trip rate in the region was 4.7 trips per day on an average weekday (Monday–Friday) and travel of around 28 miles per person per day. This overall rate can be broken out by many categories, including home location, age, and travel mode.

Approximately 61% of trips in the final dataset were among residents of the City of Bellingham or the surrounding Urban Growth Areas. Residents in the rest of the county (excluding East Whatcom County, which was outside the study area) generally travel longer distances and for longer times than those living in the City of Bellingham and surrounding areas.

Those age 18 and under take the fewest trips per day (2.8 trips), followed by those over 65 (4.2 trips), those age 18–34 (5.1 trips), those age 35–64 (5.7 trips). Looking at mode shares, vehicle trips account for 80% of all trips and 91% of all person-miles. Walking has a 13% mode share and bike (3%) and transit (2.8%) have similar mode shares. Taxi and Transportation Network Companies (TNCs), such as Uber and Lyft, have a low 0.1% mode share. All other modes of travel are around one-percent combined; however, the mileage and trip rates for long-distance and airplane trips are not particularly well-represented in Table 1 (see footnotes).

Looking at the trip activity by geography, people living in Bellingham tend to make more trips (5.2 vs. 4.1 trips per day), but those trips are significantly shorter on average (4.2 vs. 8.6 miles). Given the large difference in trip distance, residents outside Bellingham spend 10% more time traveling per day than those who live in the city (97 vs. 88 minutes per day).

TABLE 1: TRAVEL BEHAVIOR FOR A "TYPICAL WEEKDAY" FOR CITY-COUNTY, AGE, AND TRAVEL MODE (WEIGHTED)[1]

Category	Person-Days of Travel[2]	Person Trips	% of Trips	Person Trip Rate	Person-Miles Traveled	Miles Per Person-Day	Miles Per Trip	Travel Time Per Person-Day (Minutes)	Travel Time Per Trip (Minutes)
Bellingham[3]	112,225	579,081	61.3%	5.16	2,450,403	21.8	4.2	87.9	17.0
Rest of county	89,944	365,601	38.7%	4.07	3,156,259	35.1	8.6	97.0	23.9
Under 18	42,546	122,338	13.0%	2.88	550,706	12.9	4.5	49.9	17.4
18–34	46,937	237,752	25.2%	5.07	1,617,273	34.5	6.8	103.0	20.3
35–64	77,800	437,175	46.3%	5.62	2,662,301	34.2	6.1	111.9	19.9
65 and over	34,886	147,417	15.6%	4.23	776,382	22.3	5.3	83.7	19.8
Walk	202,169	118,578	12.6%	0.59	85,300	0.4	0.7	8.8	15.1
Bike	202,169	28,553	3.0%	0.14	53,726	0.3	1.9	2.4	17.1
Car	202,169	753,468	79.8%	3.73	4,957,223	24.5	6.6	71.6	19.2
Taxi/TNC	202,169	1,170	0.1%	0.01	5,596	0.03	4.8	0.5	86.6
Transit	202,169	26,158	2.8%	0.13	319,072	1.6	12.2	5.5	42.9
School bus	202,169	6,278	0.7%	0.03	24,408	0.12	3.9	0.9	28.3
Other	202,169	10,477	1.1%	0.05	161,337	0.8	15.4	2.2	41.7
TOTAL	**202,169**	**944,682**	**100.0%**	**4.67**	**5,606,662**	**27.7**	**5.9**	**91.9**	**19.7**

[1] This table represents all trips fewer than 250 miles on complete weekdays, regardless of trip location. In-region trip rates and shares may vary slightly. Due to a handful of extremely long trips (many by plane), this table excludes 81 trips that were over 250 miles to avoid misrepresenting distances for ground-based travel.
[2] Person-days represent all persons living in households in the region, which equates to the regional population, excluding group quarters residents.
[3] This category is based on home location rather than trip destination location. "Bellingham" includes the Urban Growth Area of the city.

1.2 COLLEGE STUDENT RESPONSE AND TRAVEL

One of the unique attributes of this study was the college student oversample, described in detail on page 7. RSG invited more households (compared to the general population) in the census block groups that contained the highest proportions of college students in the region. This ensured that the large regional population of college students missed in previous survey efforts was fully accounted for.

Table 2 shows that higher-education students have higher trip rates (19% higher than non-higher education students), longer travel distance per day (43% higher), and a lower car mode share (68% vs 81%). The transit mode share is about 3.5 times that of non-college-students, with a travel distance 17 times that of nonstudents. Bike and walk mode shares and travel distances reveal around 65% higher travel distances per day. Car travel, which comprises most of the travel distance for both groups, is similar, at around 25 miles per day.

TABLE 2: HIGHER-EDUCATION STUDENT WEEKDAY TRAVEL BEHAVIOR SUMMARY[4]

	Travel Mode	Mode Share	Person Trip Rate	Distance per Day (miles)	Distance per Trip (miles)	Index – Trip Rate	Index – Dist. per Day	Index – Dist. per Trip
Not Higher-Education Students	Other	**1.1%**	0.05	0.9	16.3	–	–	–
	Walk	**11.8%**	0.54	0.4	0.7	–	–	–
	Bike	**2.9%**	0.13	0.3	1.9	–	–	–
	Car	**81.0%**	3.73	24.4	6.6	–	–	–
	Taxi	**0.1%**	0.01	0.0	4.9	–	–	–
	Transit	**2.2%**	0.10	0.7	6.4	–	–	–
	School Bus	**0.7%**	0.03	0.1	3.8	–	–	–
	TOTAL	**100.0%**	**4.60**	**26.7**	**5.8**	–	–	–
Higher-Education Students *(N = 496 weekdays from 165 persons)*	Other	**0.8%**	0.05	0.2	5.0	**88%**	**27%**	**31%**
	Walk	**19.1%**	1.05	0.7	0.6	**193%**	**166%**	**86%**
	Bike	**4.0%**	0.22	0.4	1.9	**164%**	**165%**	**100%**
	Car	**68.2%**	3.75	25.6	6.8	**101%**	**105%**	**104%**
	Taxi	**0.1%**	0.00	0.0	2.3	**50%**	**23%**	**46%**
	Transit	**7.7%**	0.43	11.4	26.9	**417%**	**1,750%**	**419%**
	School Bus	**0.0%**	0.00	0.0	13.0	**6%**	**22%**	**339%**
	TOTAL	**100.0%**	**5.49**	**38.3**	**7.0**	**119%**	**143%**	**120%**

[4] Index shows higher-education students compared to non-higher-education students (bottom half / top half of table).

1.3 REMAINDER OF REPORT

The remainder of this report evaluates the performance of the sample plan, describes the demographics of the persons in the dataset, describes the key travel behaviors that were captured, and summarizes the results of the Smart Trip questions.

Though the results in the project dataset are based on well-researched data collection methods, the distributions and summaries in this report have varying margins of error, depending on the sample sizes. Readers should interpret these charts accordingly and may refer to Section 5.7 for additional insights into margins of error.

2.0 SAMPLE PLAN EVALUATION

This section evaluates the performance of the sample plan, both in terms of the quantity of data collected and whether the oversampling approaches accomplished their objectives. Overall, this study targeted at least 1,150 households with complete travel surveys and obtained 1,451 households, which is 26% more households than expected. The address-based sample plan used compensatory oversampling to overcome expected lower response among low-income and ethnic minority and Native American households; it also used targeted oversampling to gather a higher volume of data among groups of interest (frequent walk/bike/transit users and college students). These different oversampling methods resulted in the following sample segments:

- General population (no oversampling = 1x invitation rate).
- Low-income, ethnic minority, and Native American populations (1.3x invitation rate).
- College students and high-frequency walk/bike/transit population (1.5x invitation rate).

The following sections analyze the overall effectiveness of this sample plan.

2.1 OVERALL RESPONSE

This study exceeded the target household size by nearly 26%, with an overall sample rate for this region of 1.8% (1,451 complete households/80,975 total households in the region). **All segments exceeded their household targets**.

Compensatory Oversample Evaluation

RSG recommended using geography-based compensatory oversampling for two primary groups, based on lower response rates from previous studies in similar regions:

- **Low-income households**: Comprised the top 10% of block groups ranked on the percentage of low-income households. The top 10% of block groups equated to those in which at least 39% of households have annual household incomes below $25,000[5] (11 block groups).
- **Ethnic minority and Native American households**: Comprised block groups in which at least 35% of households report being an ethnic minority or Native American. WCOG provided RSG with a list of block groups for this segment (five block groups).

[5] Based on ACS table B19001.

Based on experience in household travel surveys, it was estimated that an oversample rate of 130% (relative to the general population) would be needed to generate a sample size for these groups commensurate with the other population subgroups in the study. In practice, the low-income subsegment responded at a rate of 2.9% and the ethnic minority and Native American subsegments responded at 2.8%, so sampling these groups in a single segment was appropriate. Figure 1 shows the response rates for both groups were below the general population (and the lowest overall).

Although the compensatory oversample segment did have the lowest response rate, it was not far below the general population. The final sample rate for the compensatory oversample segment exceeded the general population segment and exceeded its goal.

Targeted Oversample Evaluation

Based on WCOG's interest in gathering data from college students and residents who frequently commute to work by walk/bike/transit (WBT), RSG used targeted oversampling for two groups:

1. **Higher education**: Comprised the top 10% of block groups on the percentage enrolled in higher education. The resulting set of block groups had at least 22% of individuals are enrolled in undergraduate, graduate, or professional school[6] (11 block groups).
2. **Walk/bike/transit users**: Comprised the top 10% of block groups on the percentage of those not commuting by car; specifically, those in which at least 24% of workers age 16 and over commute to work via transit, bicycle, walking, or "other" means[7] (11 block groups).

Like the compensatory oversampling strategy, RSG combined the two targeted groups into a single sampling segment at a rate of 150% (relative to the general population). As shown in Figure 1, the targeted higher-education/WBT segment responded at a higher rate than the general population (and the highest overall), so the final sample rate exceeded the expected rate of 2.07% (Figure 2).

The approach used to identify higher-education students was particularly effective, with nearly four times the share of higher-education students compared to the general population (Figure 3). The block groups included in the targeted oversample segment had higher shares of students to begin with, but the oversampling efforts increased the number of higher-education students by 24, which represents about 15% of the total higher-education students in the final dataset.

[6] Based on ACS table B14007. Note – the population for this table excludes individuals under age 3.
[7] Based on ACS table B08301. "Other means" excludes car, truck, van, taxi, motorcycle, and work from home.

FIGURE 1: RESPONSE RATE, BY SAMPLE SEGMENT (UNWEIGHTED) (=NUMBER COMPLETED/NUMBER INVITED)

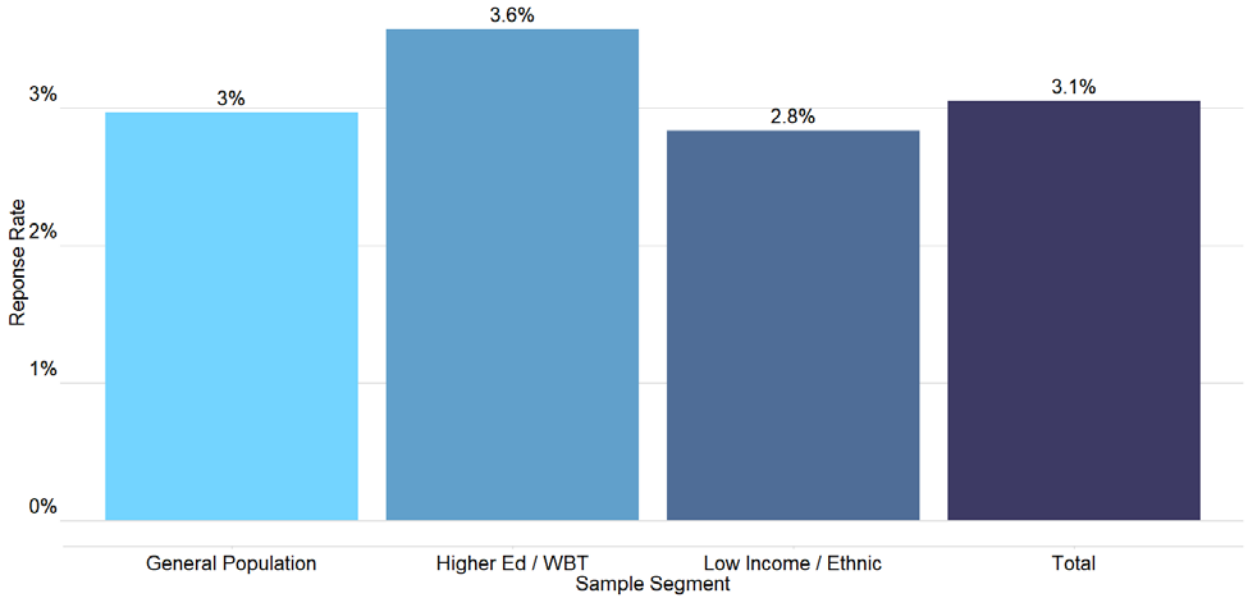


FIGURE 2: SAMPLE RATE, BY SAMPLE SEGMENT (UNWEIGHTED) (=NUMBER COMPLETED/TOTAL NUMBER OF HOUSEHOLDS)

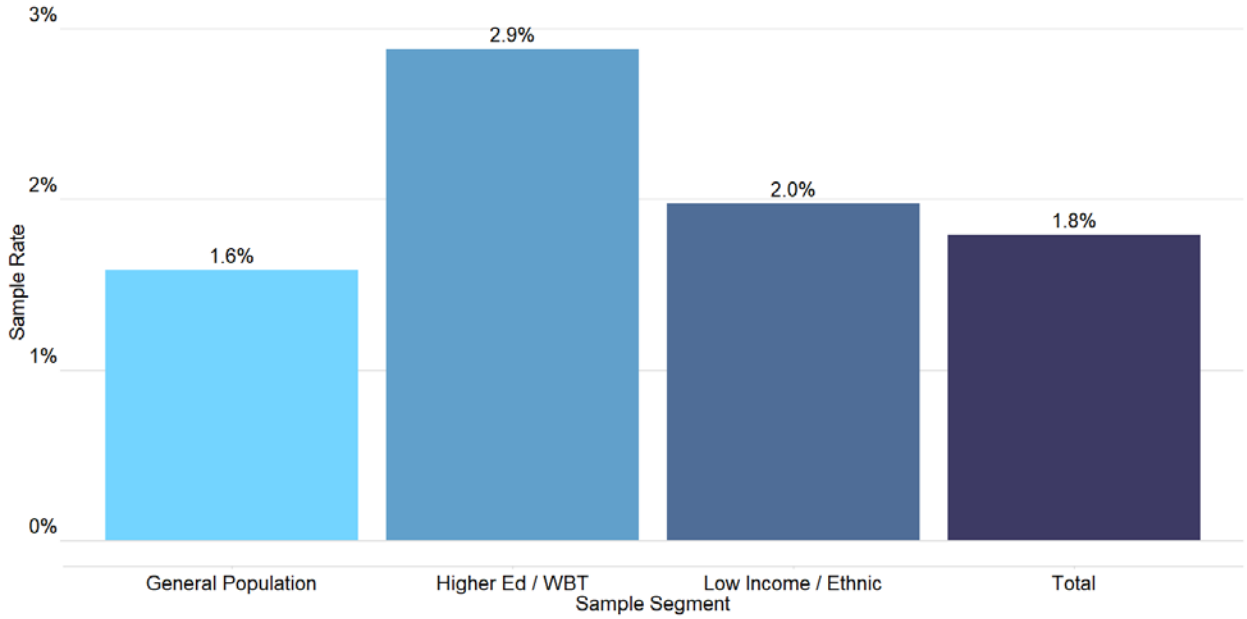
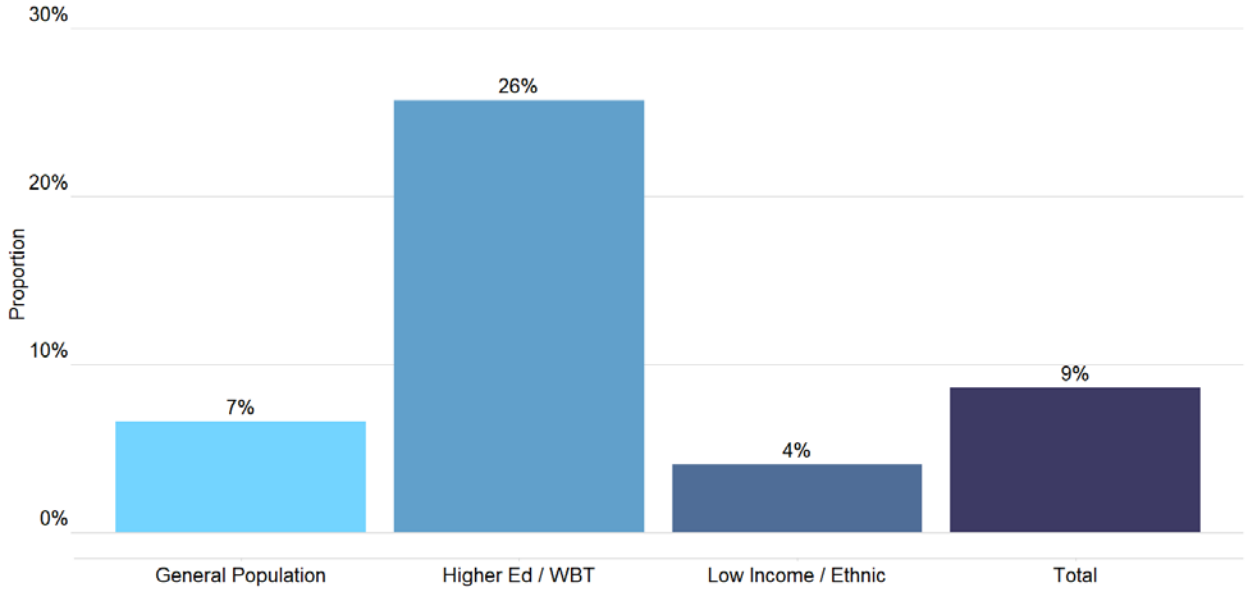


FIGURE 3: COLLEGE STUDENTS AS SHARE OF ALL PERSONS, BY SAMPLE SEGMENT (UNWEIGHTED)



Summary

Overall, the sample plan was effective in reaching (and exceeding) the study targets by nearly 26%. Aside from overall sample success, each individual segment surpassed its targets, which contributed to a more representative dataset with higher volumes of WCOG's travel behaviors of interest (e.g., college student travel, WBT).

3.0 DEMOGRAPHIC SUMMARY

This section analyzes the demographic composition of the final, weighted dataset. Unless otherwise noted, all analyses use weighted data. Weighted data means that the individual sample trip records have been assigned multipliers (weighting factors) so that, cumulatively, the variation in subgroup sample sizes is adjusted to align with the actual subgroup population sizes observed in the American Community Survey (ACS) data for the region. For an evaluation of how closely the *unweighted* dataset matched the ACS data for the region, please see the separate memo on the data weighting approach.

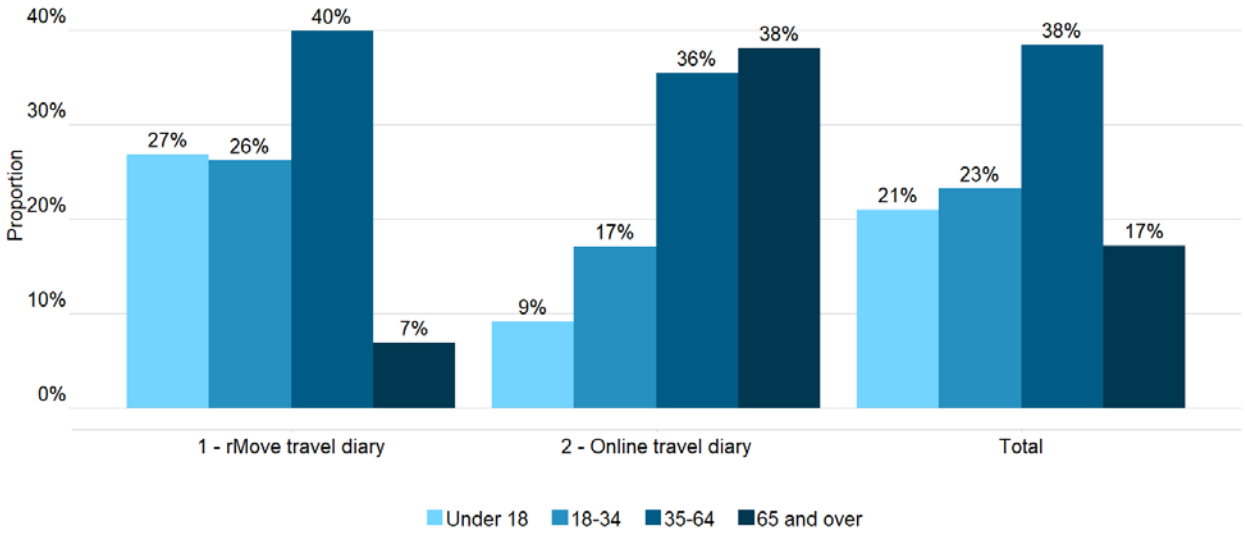
3.1 DEMOGRAPHICS, BY PARTICIPATION GROUP

Understanding the demographic differences between smartphone-users and non-smartphone-users helps illustrate how the design and methods used in this study shaped the response and the resulting dataset. (Using smartphones for the travel diary was determined at the household level; all adults were required to own their own smartphones to use the rMove™ smartphone app.)

Approximately 60% of the unweighted households used the rMove smartphone app to complete their travel diaries, and the remaining 40% of households completed their travel diaries online. Given the high share of households that used rMove to complete the study, the resulting dataset is both high quality and high quantity. On average, rMove households completed 5.4 travel days, with an unweighted person trip rate of 4.6 trips per day. Online diary households completed only one travel day, with an average unweighted person trip rate of 3.1.

The most noticeable difference between groups is that online diary participants have more than five times the share of persons over 65 (38% vs. 7%) compared to rMove households. Similarly, households using rMove have three times the share of those under 18 (27% vs. 9%), and about 50% greater share of persons age 18–34 (26% vs. 17%) (Figure 4). These differences are important to adjust for because age is a meaningful determinant of travel behavior. Household income is far less predictive of smartphone ownership (and thus group assignment) than age, especially after controlling for age.

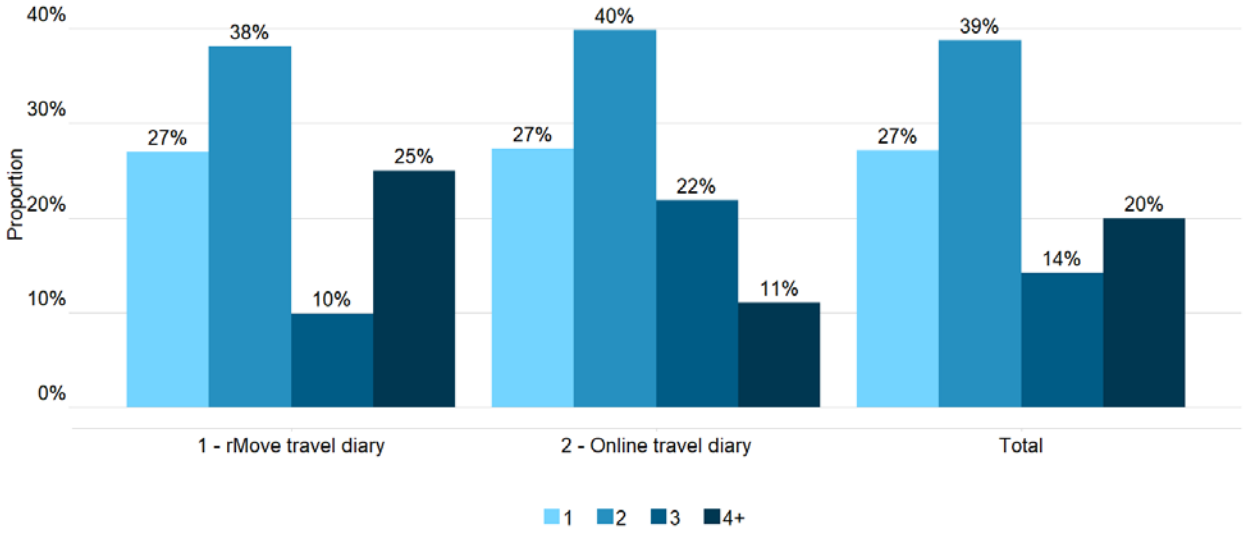
FIGURE 4: PERSON AGE, BY PARTICIPATION GROUP



Participation, by Household Size

The distribution of household sizes between participation groups is similar for one- and two-person households, but noticeably different for households with three or more people (Figure 5). Households with three people were most often three-adult households (as opposed to households with children). In these cases, the likelihood that at least one adult does not have a smartphone—the key requirement for rMove participation—was higher than in one- and two-person households. The share of children in households with four or more people was much higher than in three-person households, so the increased number of people did not affect the likelihood of all adults having smartphones as clearly as in three-person households. Approximately two-thirds of all households are one- or two-person households.

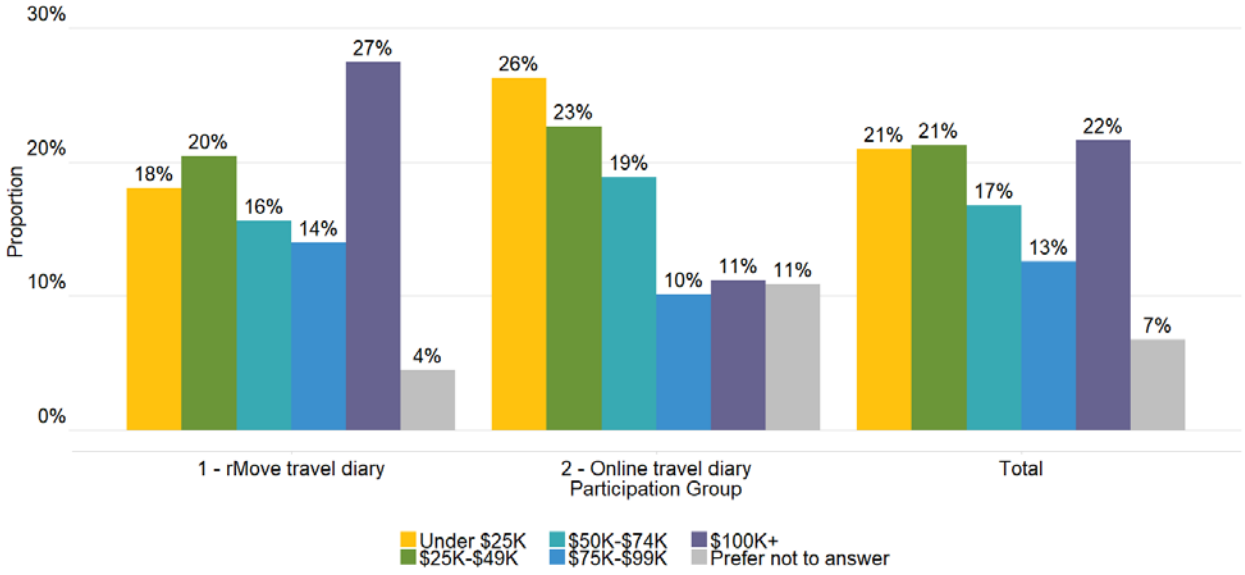
FIGURE 5: HOUSEHOLD SIZE, BY PARTICIPATION GROUP



Participation, by Household Income

In general, higher-income households used rMove more (Figure 6). Respondent households earning $100k or more annually had 2.5 times more rMove use than the online diary (27% vs. 11%). They also have larger household sizes (Figure 5) and higher shares of employed persons (Figure 8), both of which correlate with higher incomes.

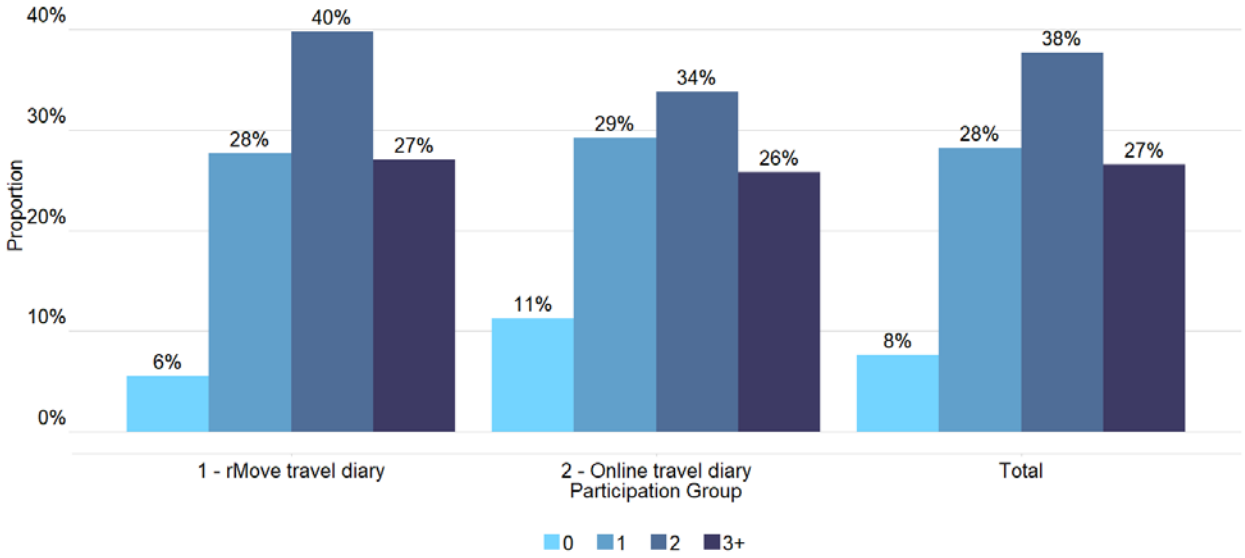
FIGURE 6: HOUSEHOLD INCOME, BY PARTICIPATION GROUP



Participation, by Household Vehicles

On average, rMove households have more cars than online diary households (1.9 vs. 1.6 cars, respectively). The total weighted average for all households in the study was about 1.8 cars per household. Online diary households are almost twice as likely as rMove households to not have a car, but the proportion is still small (11% vs. 6%). This is especially interesting because of the larger share of younger adults (age 18–34) using rMove and because younger or college-aged adults are typically less likely to own vehicles in other regions.

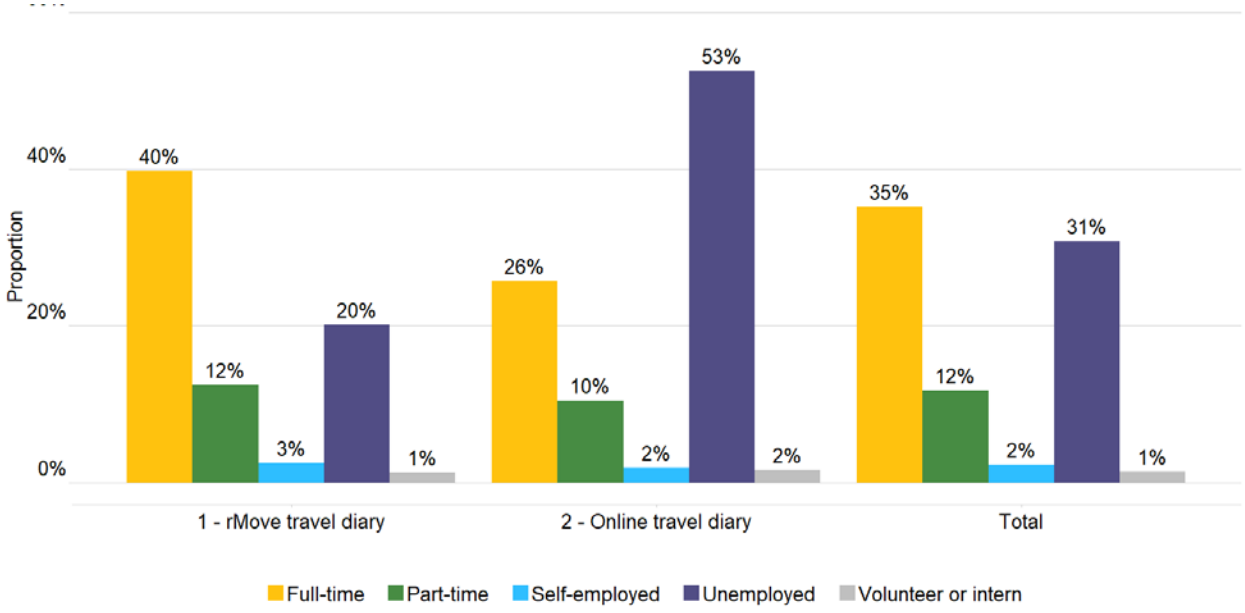
FIGURE 7: HOUSEHOLD VEHICLES, BY PARTICIPATION GROUP



Person Employment Status, by Participation Group

As noted, online travel diary users included over five times as many participants over age 65 as the rMove segment, resulting in about 53% more full-time employment in the rMove segment compared to the online diary segment. The share of unemployment (including those who are retired) in the rMove segment is less than half that in the online diary segment (20% vs. 53%) (Figure 8).

FIGURE 8: PERSON EMPLOYMENT, BY PARTICIPATION GROUP

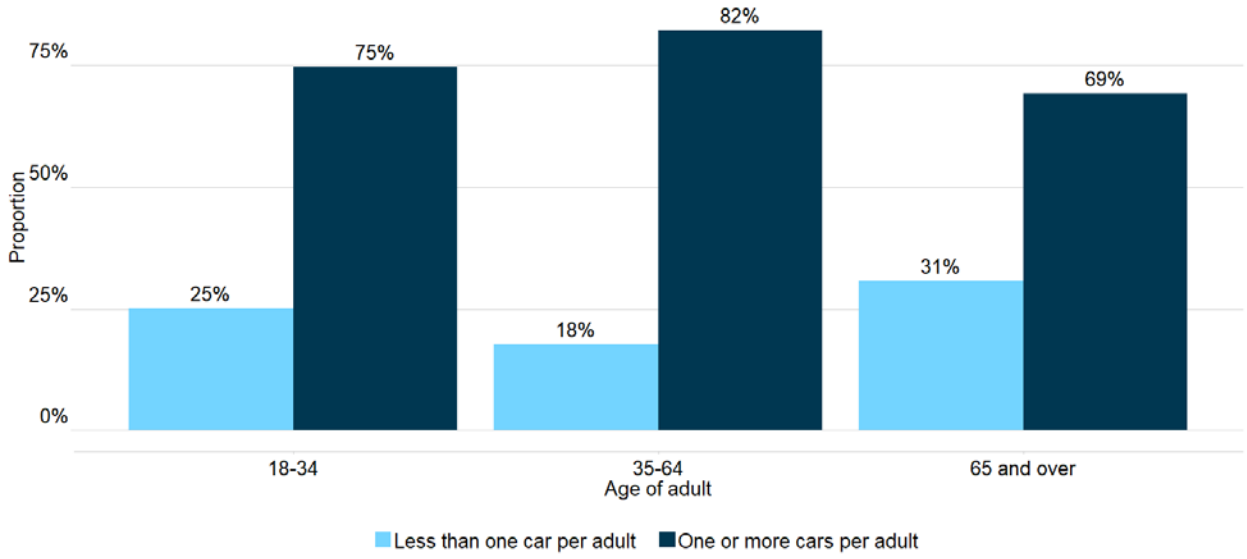


3.2 VEHICLE OWNERSHIP

One of WCOG's interests in this study was to assess current, popular assertions that younger people are increasingly less likely to own or drive cars. Figure 9 shows that the share of households with householders[8] under 35 years old are almost 40% more likely to have less than one car per adult than households with householders age 35–64. Households with a head of household age 65 or older are the most likely to have less than one car per adult (31% of households). The majority of all age brackets have at least one car per household adult.

Figure 10 shows the share of zero-vehicle households by person age (rather than the aggregated bin in Figure 9). The 18–24-year-old age group is at least twice as likely to live in a zero-vehicle household compared to all other age groups, even though the share of licensed drivers is not significantly lower than other age groups (82% for 18–24 years vs. 88–98% for older age groups) (Figure 11).

FIGURE 9: VEHICLES PER HOUSEHOLD ADULT, BY AGE OF HOUSEHOLDER



[8] Consistent with the ACS, the "householder" is the person to whom the relationship of all other members is recorded (i.e., the first person in the household to complete the Part 1 survey).

FIGURE 10: SHARE OF ZERO-VEHICLE HOUSEHOLDS, BY HOUSEHOLDER AGE

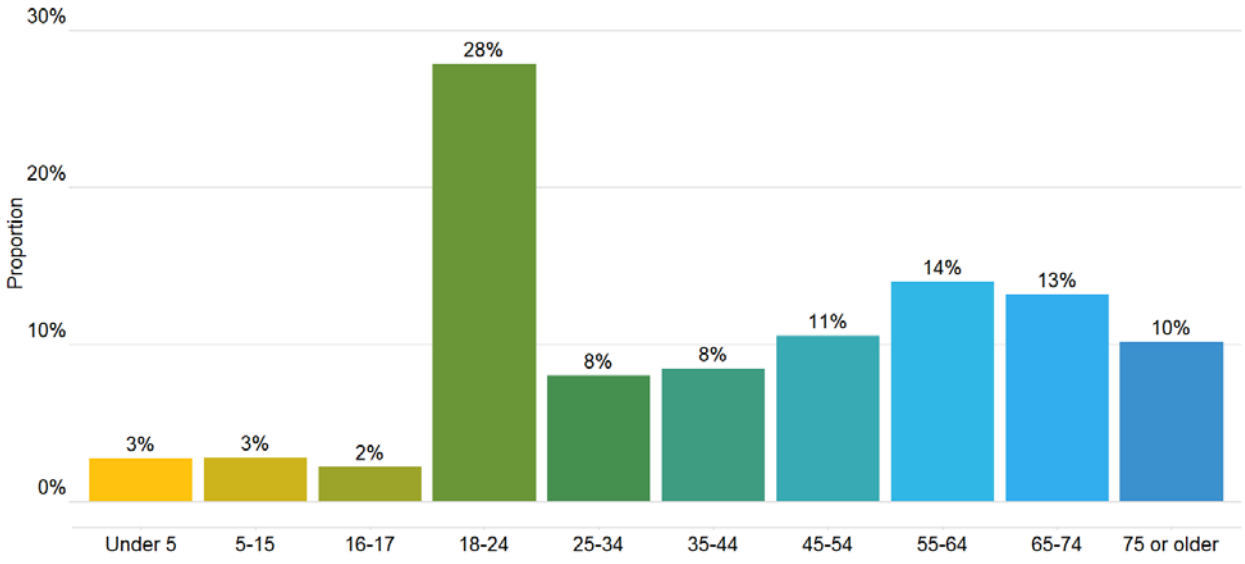
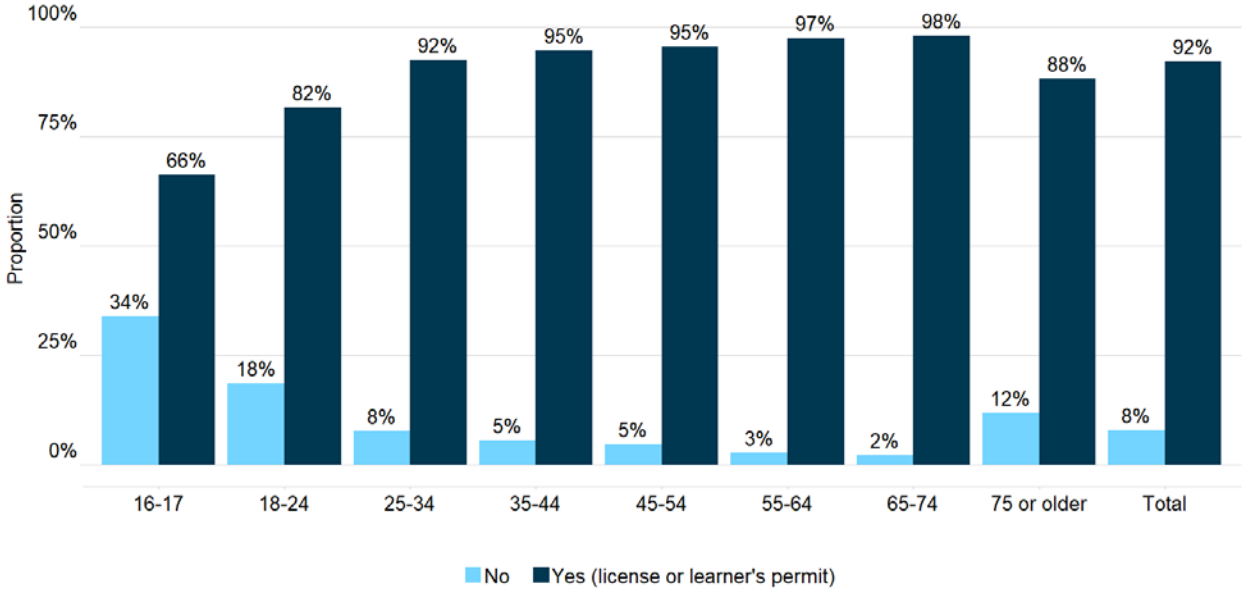


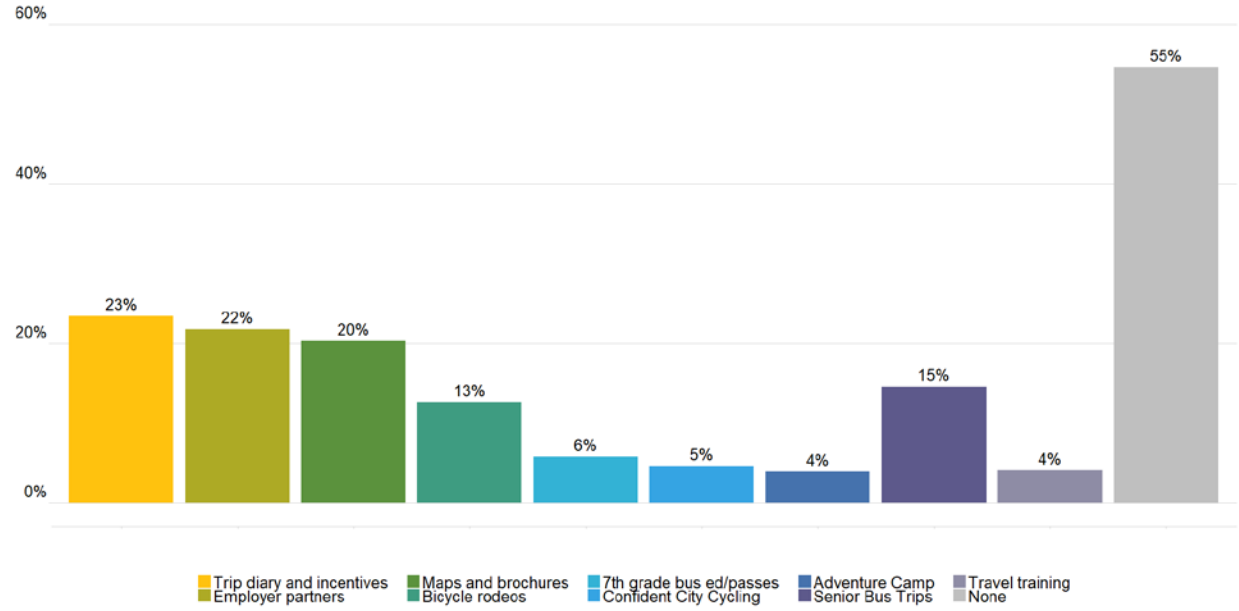
FIGURE 11: DRIVER'S LICENSE POSSESSION, BY PERSON AGE



4.0 REGIONAL QUESTION RESPONSE SUMMARY

The study included several questions specific to the Whatcom region, including a question to help WCOG understand residents' awareness of the various Smart Trips programs. This question was asked at the household level (meaning only one household member responded). Forty-five (45%) percent of weighted respondents were aware of at least one Smart Trips program (Figure 12). The question's text is also included below.

FIGURE 12: SUMMARY OF SMART TRIP AWARENESS, BY PROGRAM (SELECT ALL THAT APPLY)



Whatcom Smart Trips is a local program that encourages people of all ages to make more of their trips by walking, bicycling, sharing rides, and riding the bus. For more information about this program, call Whatcom Smart Trips at 360-756-TRIP (8747).

Which Whatcom Smart Trips programs are you aware of?

Please select all that apply.

- o Trip diary and incentives (e.g., Smart Trips Discount, Milestone rewards, monthly/quarterly prize drawings)
- o Smart Trips employer partners
- o Smart Trips maps and brochures
- o Bicycle rodeos at elementary schools
- o 7th grade bus education and bus passes
- o Confident City Cycling classes
- o Smart Trips Adventure Camp for teens
- o Senior Bus Trips
- o Travel training for all, including people with mobility challenges
- o None of the above

5.0 TRIP ANALYSIS

This section describes the travel data collected during this study. The metrics used include distributions (e.g., mode share, trip purpose share), trip rates (e.g., 4.7 trips per person-day), and maps. These metrics are often segmented by important variables, such as household income, age, or employment status. Additionally, these travel metrics are frequently broken out by whether a household used rMove versus the online travel diary. This was done because the method of data collection can affect the data collected. Smartphone-based data generally has higher and more accurate trip rates because the data is collected passively, removing the requirement for participants to remember every trip during their travel periods.

5.1 TRIP RATES AND COUNTS

One of the most notable differences between participation groups and data collection modes is the difference in trip counts. While the trip rates between groups were fairly similar (average of 4.82 trips per complete weekday among online diary participants versus an average of 4.74 trips per complete weekday among rMove participants), online participants reported a much higher share of 0- and 2-trip days than rMove participants (whose phones collected their travel in real time) (Figure 13). Online diary participants (who were required to remember all of their travel) also reported fewer short-distance trips than rMove participants (46% of trips under 2 miles for rMove versus 40% of trips under 2 miles for online) (Figure 14). (These are the distributions after making bias corrections for trip rates to the online diary data, as described in the separate weighting memo.)

FIGURE 13: COUNT OF PERSON TRIPS ON COMPLETE WEEKDAYS, BY PARTICIPATION GROUP (UNWEIGHTED)

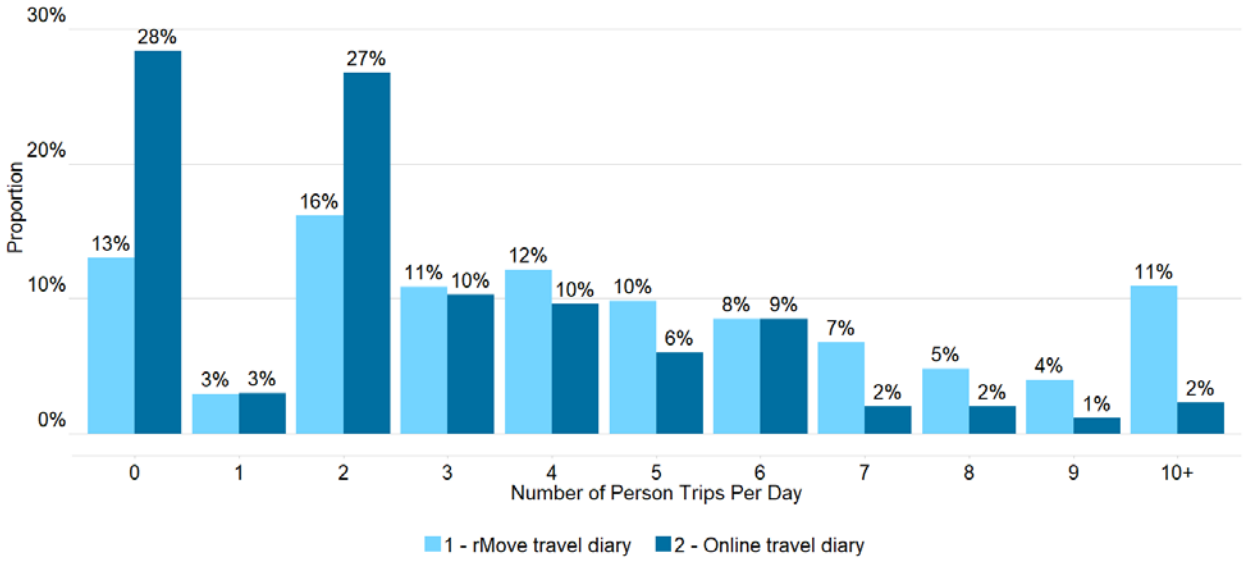
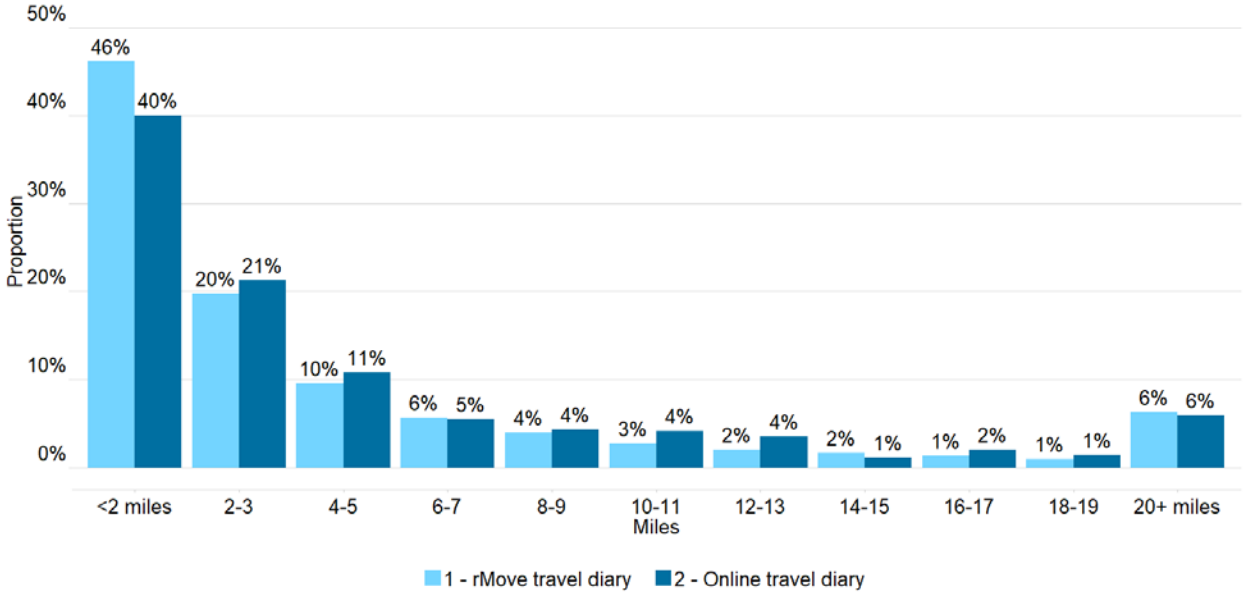
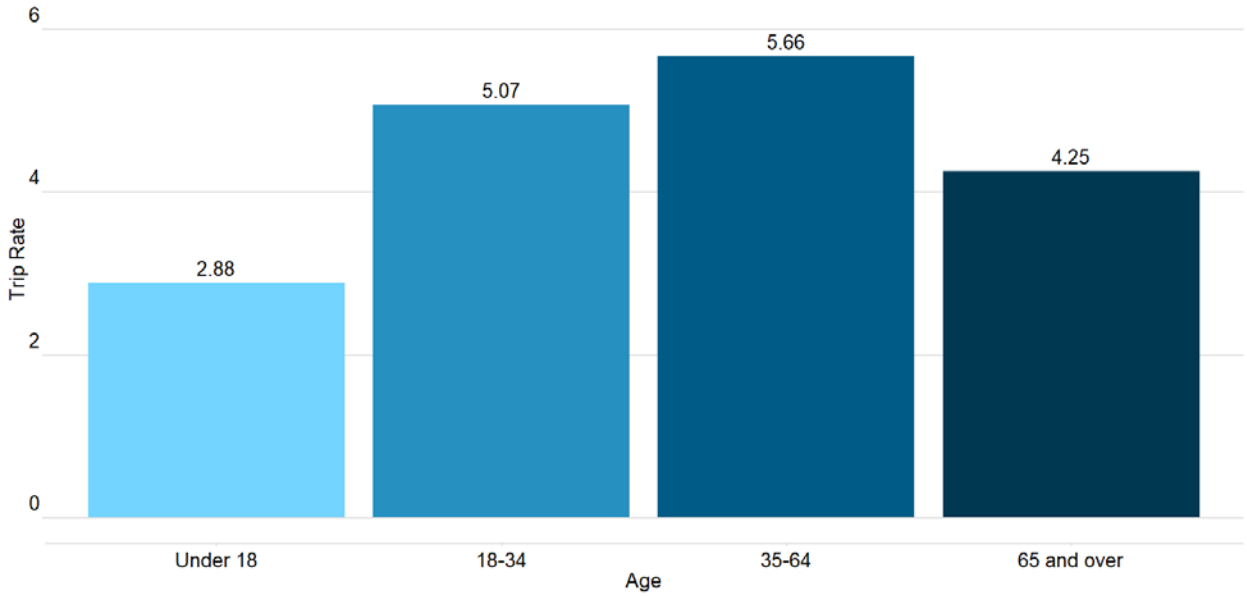


FIGURE 14: TRIP DISTANCE, BY PARTICIPATION GROUP



Trip rates vary considerably by age, as shown in Figure 15. The oldest age group (65 and over) makes about 1.2 fewer trips than those age 18–64 while the youngest age group (under 18) makes about 2.5 fewer trips per day than those age 18–34. Trip reporting for children experiences underreporting of trips, even with smartphone-based data collection; this is a known issue among household travel surveys of all types and designs.

FIGURE 15: PERSON TRIP RATE, BY AGE



In looking at trip rates by travel mode (Figure 16) and destination purpose (Figure 17), 79% of trips are by car (equal to 3.73 trips per day), followed by walk trips at 13% (0.59 trips per day). Going home is the most frequent trip purpose, with participants going home about 1.3 times per day. Like other regions, errands are the next most common trip type (0.82 trips per day) followed by work trips (0.52 trips per day).

FIGURE 16: PERSON TRIP RATE, BY TRIP MODE

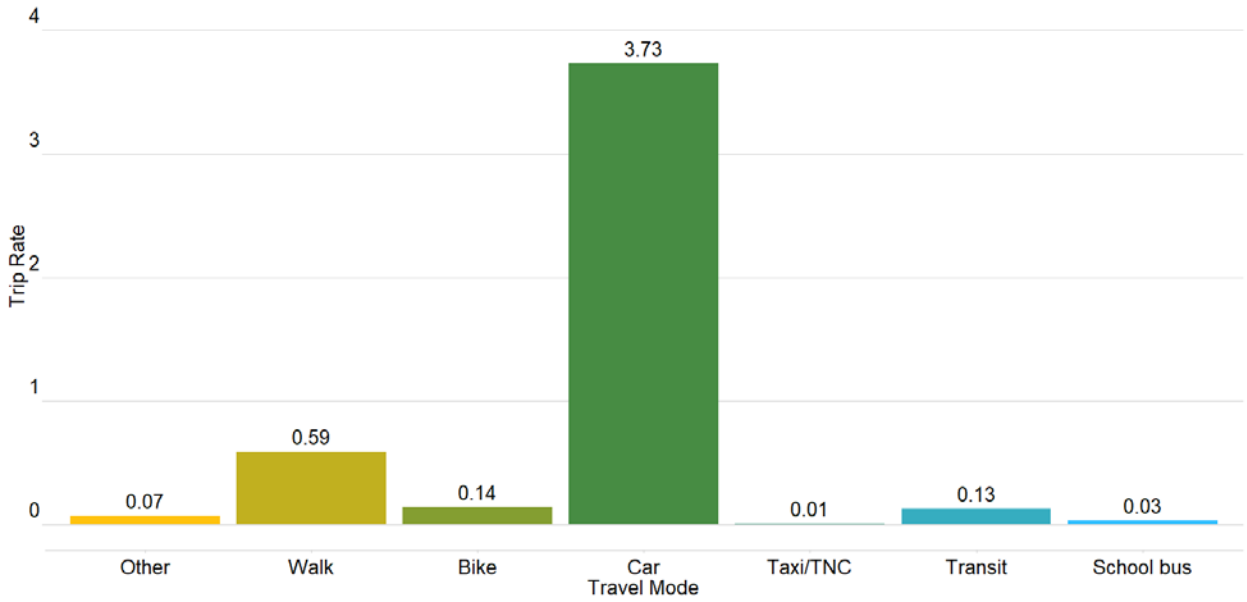


FIGURE 17: PERSON TRIP RATE, BY TRIP PURPOSE

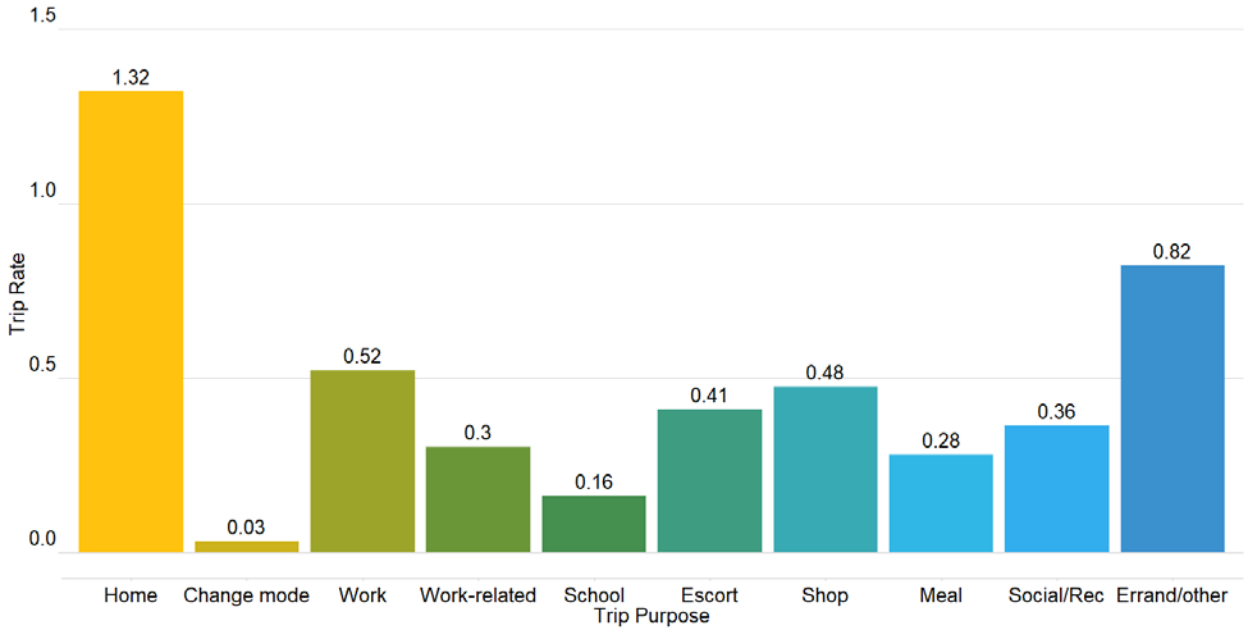


Table 3 shows the difference in trip rates among key demographics in the region. Overall, trip rates are lowest among students, retirees, and participants in non-family households.

TABLE 3: TRIP RATES, BY STUDENT STATUS, RETIREMENT, HOUSEHOLD TYPE

	Person-Trip Rates Among Low-Income Households (Less than $50,000)	Person Trip Rates Among Unemployed Participants (Age 18+)
Students	4.7	4.0
Nonstudents	5.2	4.5
Age 65+ and not working[9]	4.5	4.2
All other persons	5.7	4.6
Family Households	5.1	4.5
Nonfamily Households[10]	4.9	4.0

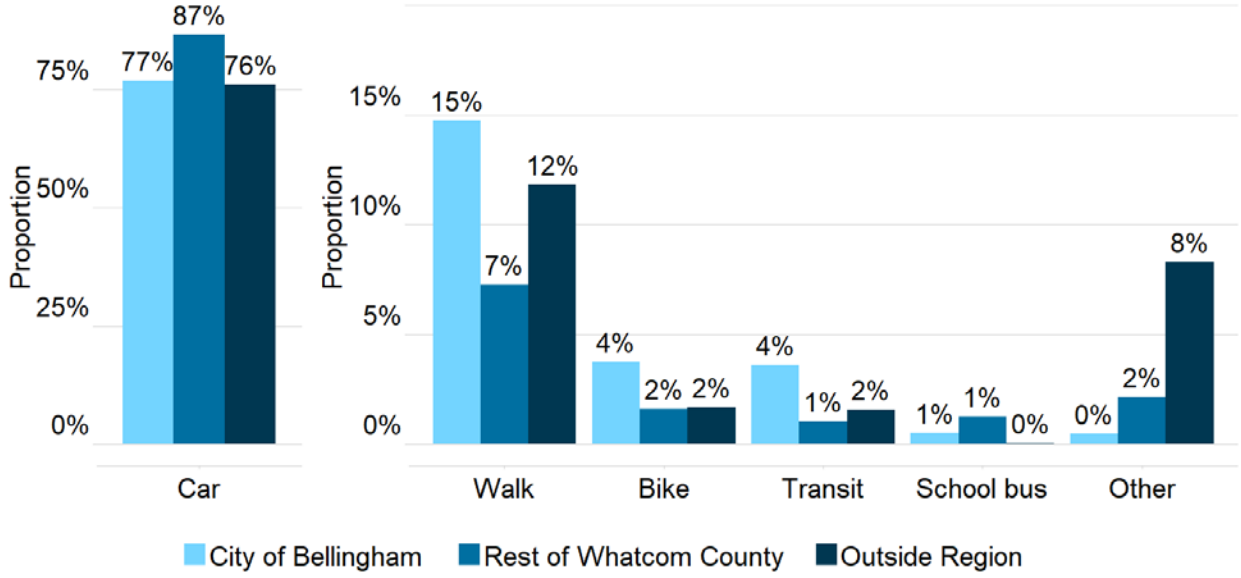
5.2 TRIPS, BY TRIP MODE

Analyzing trip mode helps understand regional travel behavior, and this study captured over 40 unique mode types. This detailed list of modes was recoded to eight primary categories (mode type) for ease of understanding and analysis, as shown in the charts in this report. (The following analyses exclude taxi/TNC modes—about 0.1% of weighted trips—for simplicity.)

Over three-quarters of trips in the study region are made by car (Figure 18). Walk trips, which are often more common in urban areas, have twice the mode share in the City of Bellingham compared to the rest of the county. Transit is also far more common (4% vs 1% mode share) in Bellingham than in the less-urban areas. As mentioned in the Executive Summary, the most common identified "other" mode is "airplane/helicopter," which explains the significantly higher "other" mode share outside the study region.

[9] The survey did not directly ask retirement status. This analysis uses "not currently employed" participants age 65 and over as proxy.
[10] Family households are those with two or more people with a familial relationship, consistent with the Census.

FIGURE 18: TRIP MODE, BY DESTINATION REGION (EXCLUDES TAXI/TNC)



As in most regions, walk and transit trips comprise a significantly higher share of all trip modes among low-income households compared to higher-income households. Households with annual incomes below $25,000 complete about 20% of their trips by walking compared to about 11% of trips among households with annual incomes of $25,000 or more. This pattern is even more pronounced among transit trips (~10% share among households with incomes below $25,000 compared to 1.4% among households with higher reported incomes) (Figure 18). The relationship between college students and walk and transit use should be further explored.

FIGURE 19: TRIP MODE, BY HOUSEHOLD INCOME (EXCLUDES TAXI/TNC)

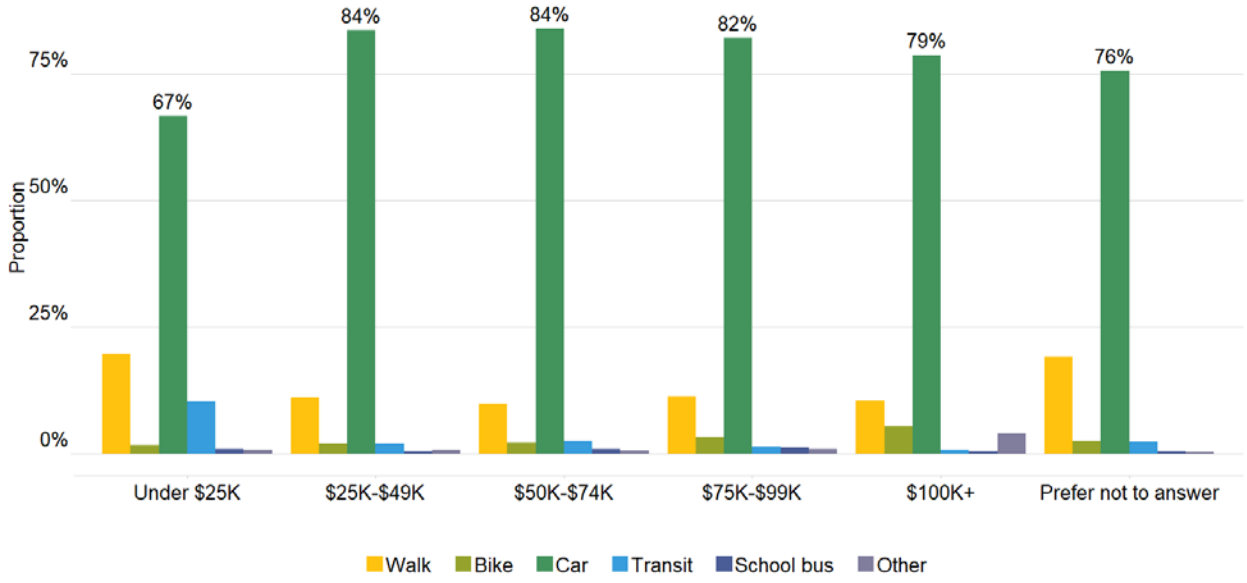
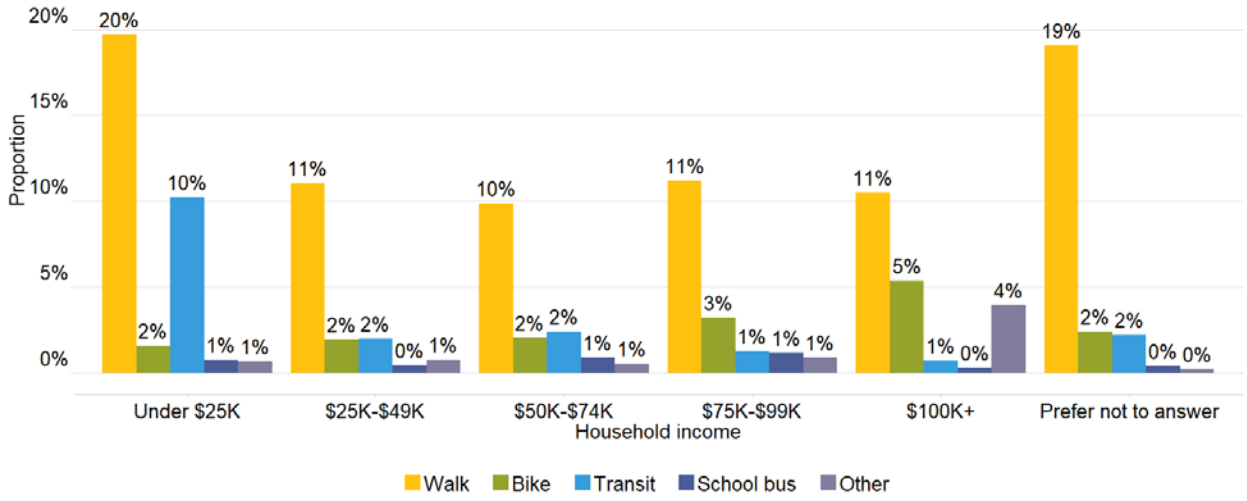
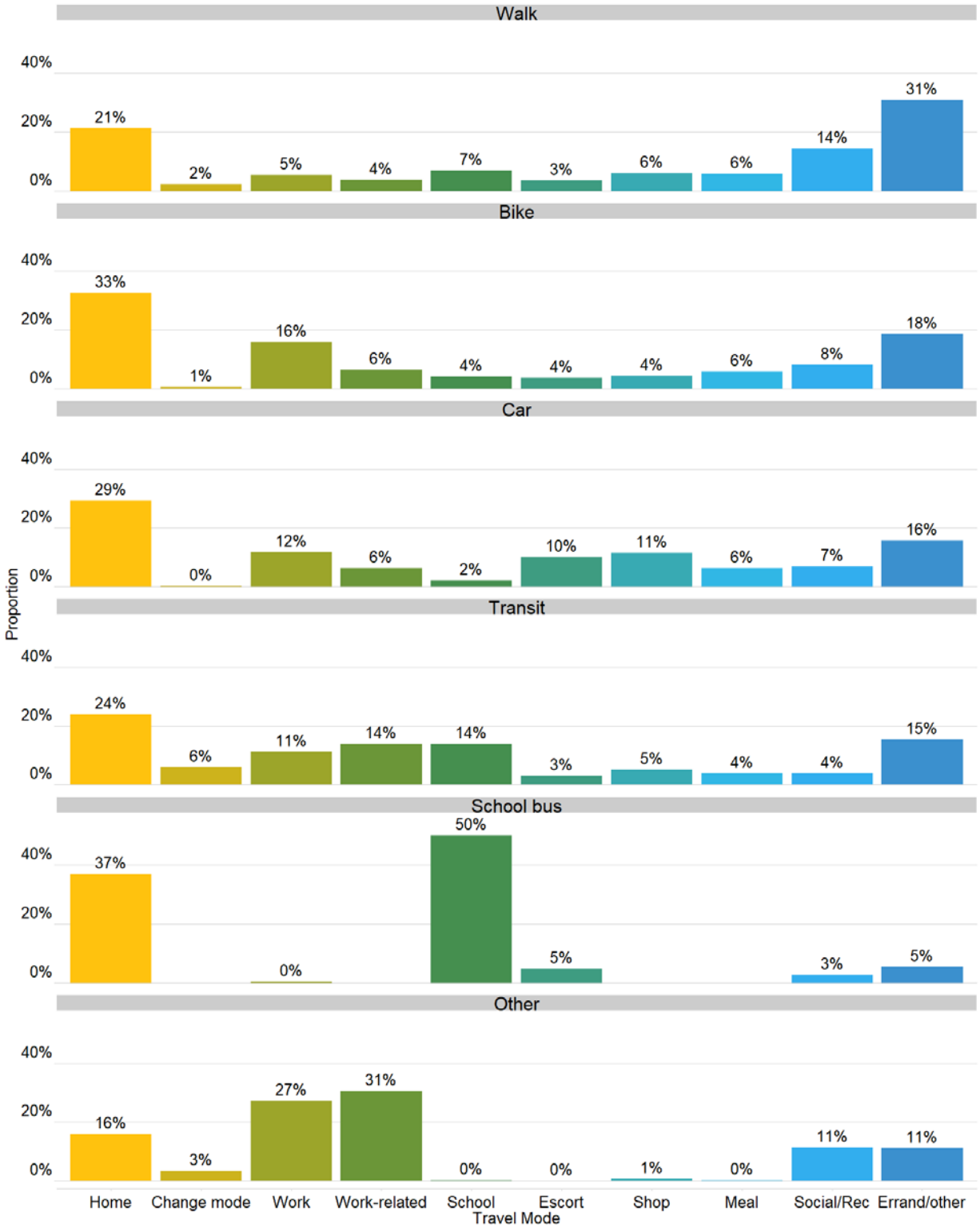


FIGURE 20: TRIP MODE, BY HOUSEHOLD INCOME (EXCLUDES CAR/TAXI/TNC)



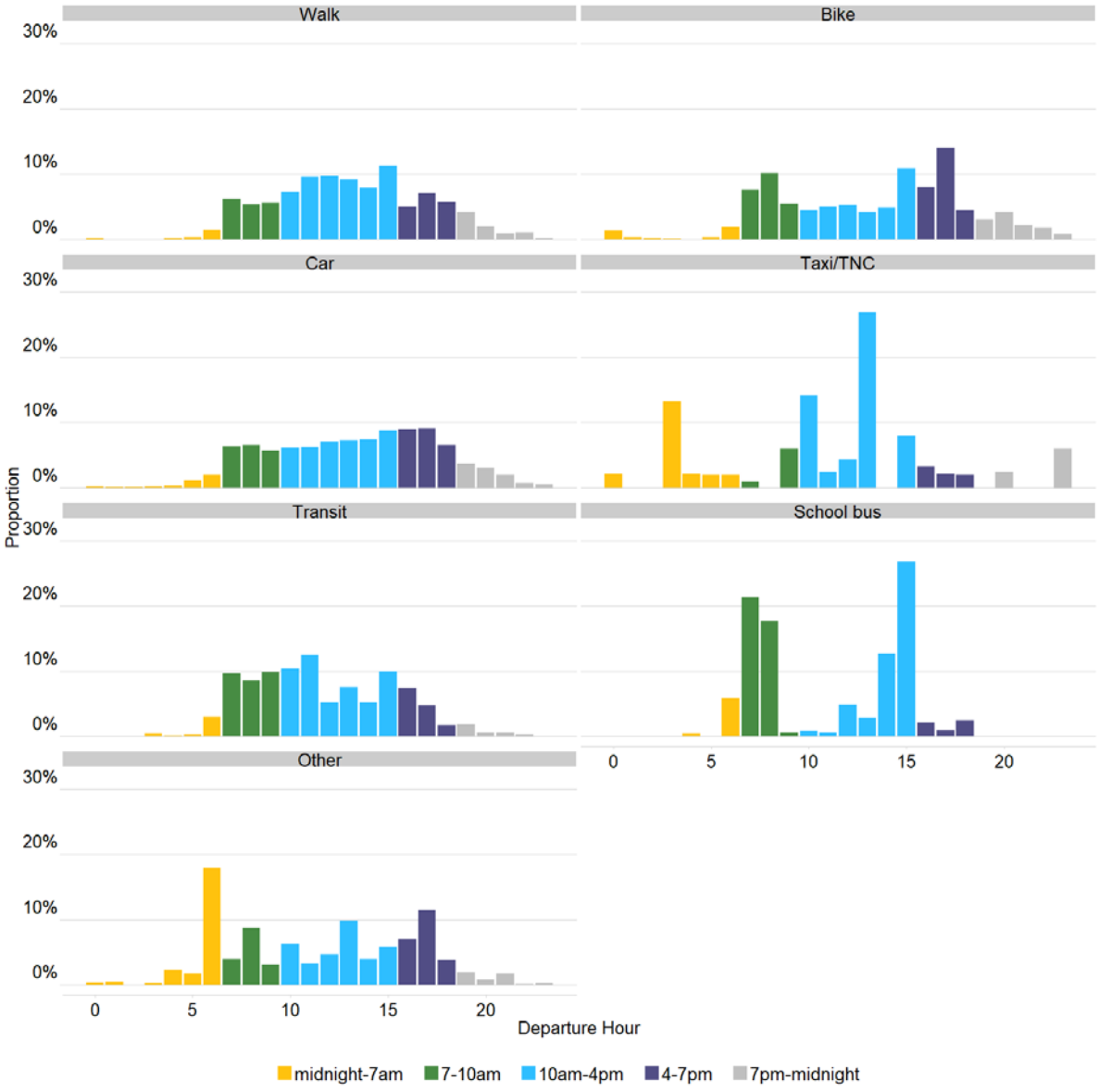
Looking at trip modes by trip purpose highlights the different ways people travel depending on their trip purposes (Figure 21). For almost all modes, the most common trip purpose is going home. The logical exceptions are walk trips (most common is social/recreation) and school bus (most common is going to school). The most frequently identified “other” mode was air travel, which explains the high rates (58%) of work/work-related travel. The mode with the most concentrated purpose is school bus, where “home” or “school” comprise 58% of all school bus trips.

FIGURE 21: TRIP MODE, BY TRIP PURPOSE



Looking at travel mode by time of day, two peaks occur during typical work commute hours, but the distribution of trips throughout the day varies greatly by mode. Bike and transit trips see steeper AM and PM peaks. School bus trips are the most peaked between 7:00 a.m. to 8:00 a.m. and again from 3:00 p.m. to 4:00 p.m. Walk and car travel is relatively evenly distributed across the day. Taxi/TNC travel has the most irregular distribution, partially due to the small sample size. “Other” travel modes spread widely throughout the day and into the night or early morning, which more likely reflects travel out-of-town or extended trips via airplane.

FIGURE 22: TRIP MODE, BY TIME OF DAY



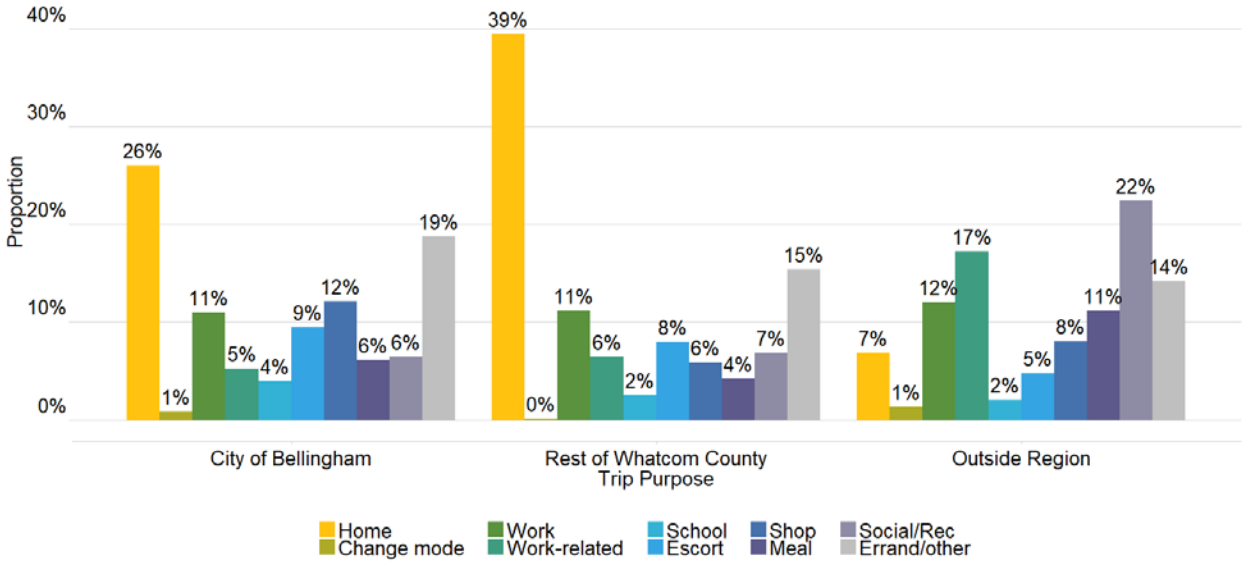
5.3 TRIPS, BY TRIP PURPOSE

As noted, the most common trip purpose is going home (Figure 17). Figure 23 shows that this is the most common trip purpose[11] in the study region, but the most common purposes outside the

[11] Like the rest of the report, this section uses linked trips for all figures. The methods used for trip linking are dependent on both mode type and dwell time between modes. In some cases, the dwell time is high enough that a trip with a purpose of "change mode" is not linked to the next trip. Therefore, "change mode" is still included as a purpose in linked trip analyses, although the volume is very low among linked trips overall.

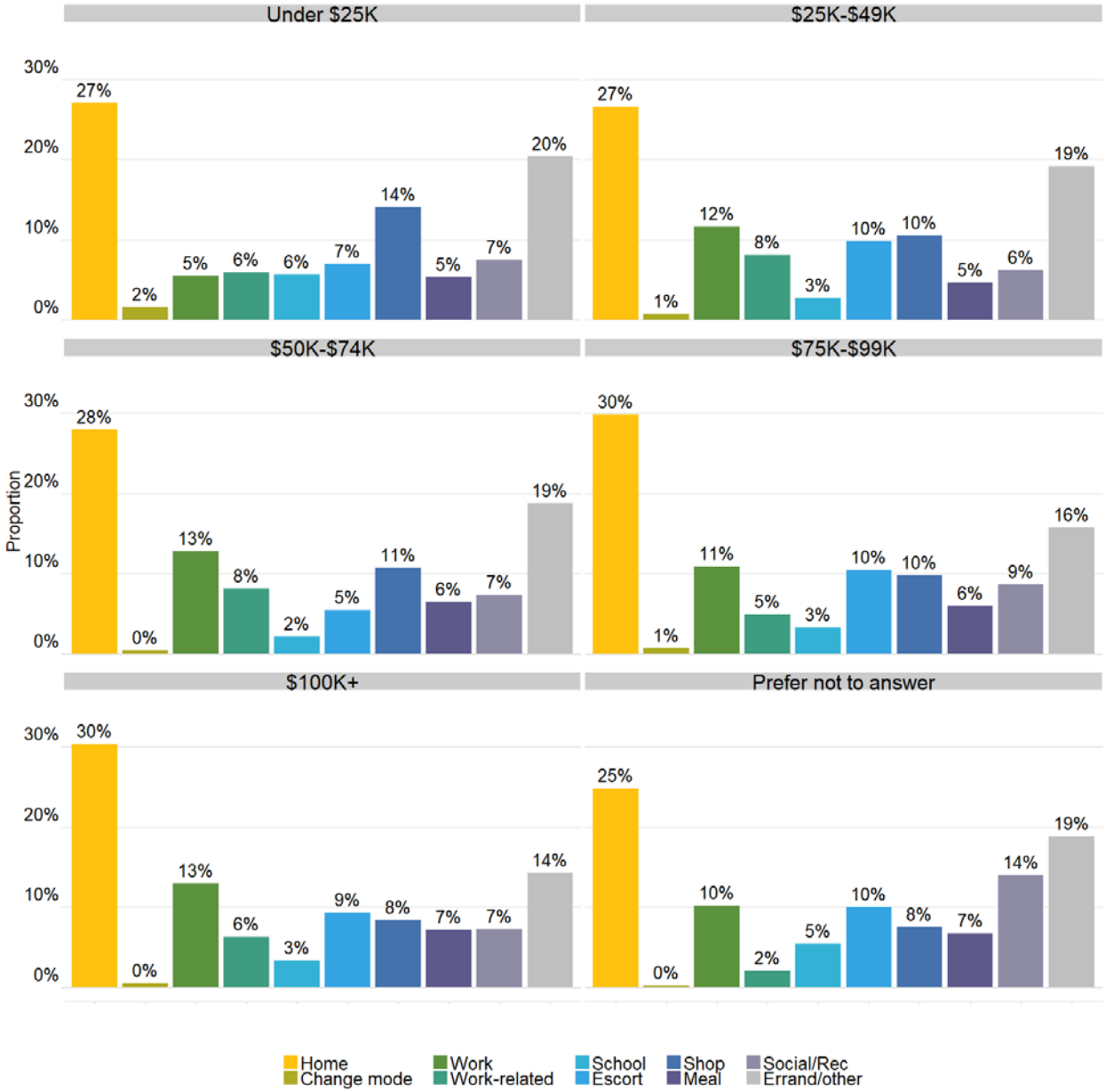
region are work, social/recreation, and errands/other. This relates to the higher “other” mode shares for work/recreation purposes, which were often airplane modes.

FIGURE 23: TRIP PURPOSE, BY REGION



Although the distribution of trip purposes is mostly consistent by income, lower-income households tend to take fewer work/work-related trips and more school, shop, and errand/other purpose trips than higher-income households. For example, about 11% of trips among participants with household incomes below $25,000 had a work or work-related purpose compared to 19% of trips among households with higher reported incomes (Figure 24).

FIGURE 24: TRIP PURPOSE, BY HOUSEHOLD INCOME



Looking at trip purposes by time of day highlights the patterns in when participants make certain types of trips (Figure 25). Trips to work and school are heavily skewed toward the morning hours while trips home occur more in the afternoon and evening. Errand/other- and shop-purpose trips are relatively uniform across the day, without distinct peaks. All other trip purposes show some level of bimodal distributions. Escort trips peak during both the morning and afternoon hours when parents are dropping kids off at school and after-school activities. Meal trips peak midday for lunch and in the evening for dinner.

FIGURE 25: TRIP PURPOSE, BY TIME OF DAY

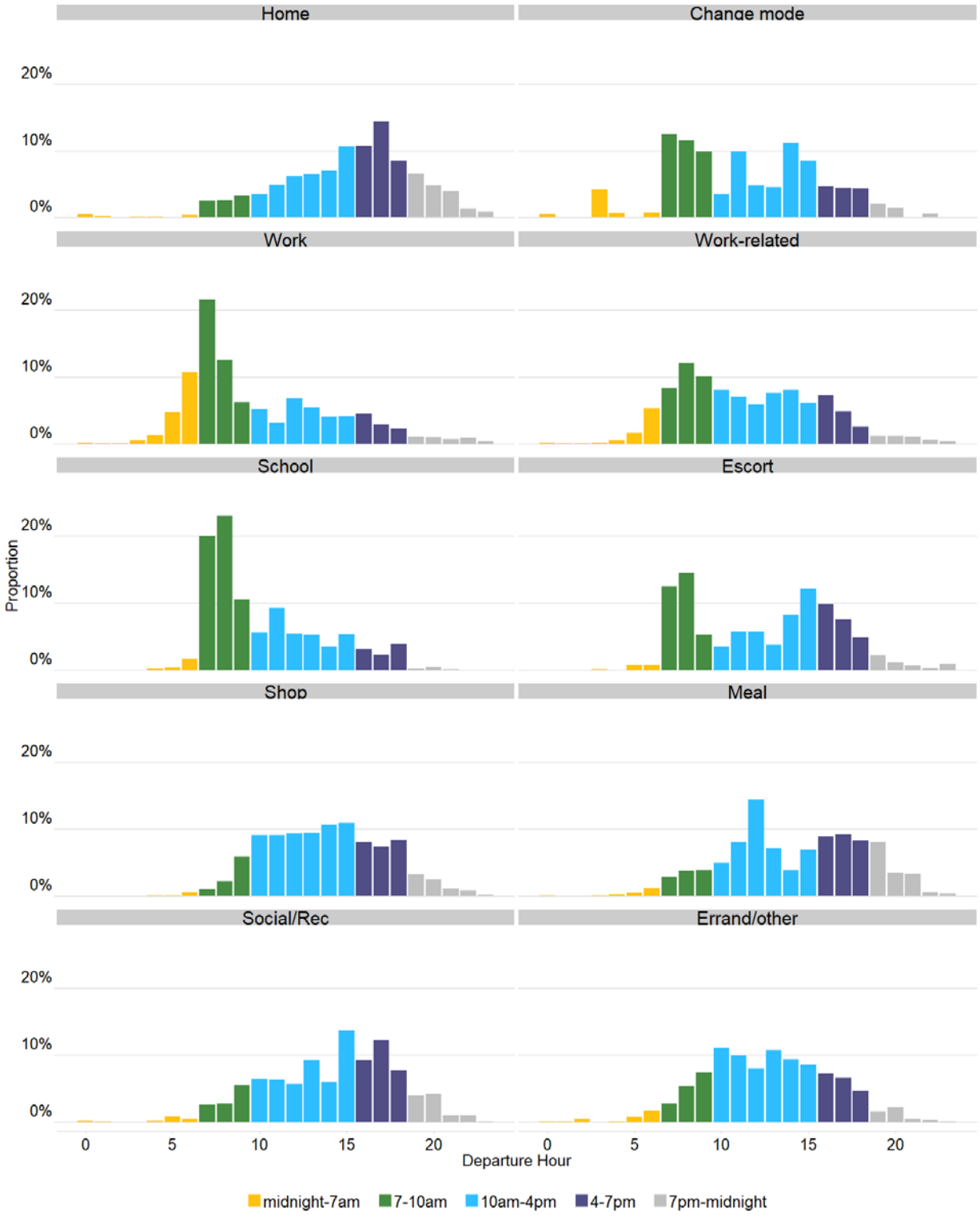


TABLE 4: WEEKEND TRIP COUNTS ON COMPLETE DAYS BY DESTINATION REGION (UNWEIGHTED)

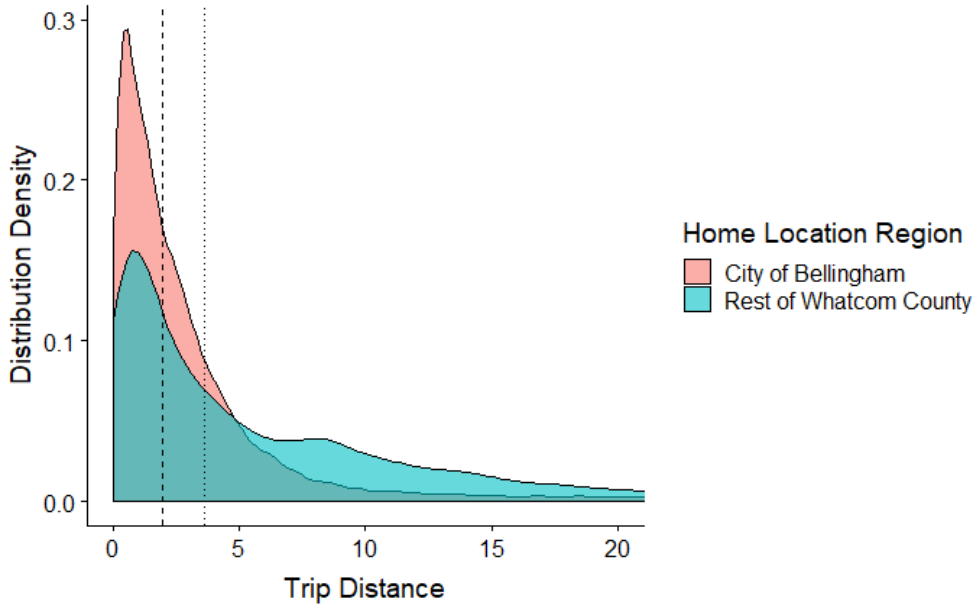
Destination Region	Weekend trip count (Fri.–Sun.)	Most frequent purpose excluding "home"
City of Bellingham	11,522	Errand/Other (18%)
Rest of Whatcom County	5,005	Errand/Other (18%)
East Whatcom	50	Social/Recreation (54%)
Island County	29	Social/Recreation (39%)
King County	337	Social/Recreation (37%)
San Juan County	98	Social/Recreation (48%)
Skagit County	454	Social/Recreation (24%)
Snohomish County	199	Social/Recreation (24%)
British Columbia	199	Social/Recreation (24%)
Other	1,060	Social/Recreation (44%)

5.4 TRIPS, BY TRIP DISTANCE

Trip distances are a unique attribute of most travel behavior studies because of their extreme range. Whereas most trips are under five miles, and often less than one mile, some trips stretch for hundreds or thousands of miles. Figure 26 shows (unweighted) the distribution of trips up to 20 miles split by the reported home-location region. The median trip distance for those living in the City of Bellingham was approximately two miles (the dashed line in the figure), while the median trip distance for persons living outside the city was 3.6 miles (the dotted line). The average distances, as reported in Table 1, were 4.2 miles and 8.6 miles, respectively.

RSG also looked at commute trips by duration at current residence, but the analysis did not show any meaningful difference among durations.

FIGURE 26: TRIP DISTANCE, BY HOME LOCATION REGION (UNWEIGHTED)



5.5 VEHICLE OCCUPANCY FACTORS

Vehicle occupancy factors help illustrate the typical travel party size for different types of vehicle trips, which are important inputs to estimates of vehicle miles traveled and per-person greenhouse gas (GHG) emissions for vehicle travel. These factors can also help compare the relative passenger capacities of different modes of travel (e.g., bus, rail, and car capacity).

The national figure for average vehicle occupancy capacity, across all types of vehicle trips, is 1.70, according to the Federal Highway Administration (FHWA) using 2016–17 data from the National Household Travel Survey.[12]

The overall figure for vehicle occupancy for Whatcom County, using the same approach as FHWA and the data this study collected, is 1.61 persons per vehicle trip. Examination of the data by trip purpose shows some intuitive trends (Figure 27). For example, work and work-related trips are the lowest occupancy trips, between 1.17 trips and 1.32 trips. Trips with an "escort/pickup/drop-off" purpose have an average occupancy of 2.2. Trips for meals and shopping were also above average occupancy, with 1.95 and 1.77 people per trip, respectively. Trips home, being the largest single category of trips, are right around the average at 1.59 people per vehicle trip.

[12] Average Vehicle Occupancy Factors for Computing Travel Time Reliability Measures and Total Peak House Excessive Delay Metrics. Federal Highway Administration, April 2018. Available at: https://www.fhwa.dot.gov/tpm/guidance/avo_factors.pdf.

FIGURE 27: AVERAGE VEHICLE OCCUPANCY (AVO), BY DESTINATION PURPOSE

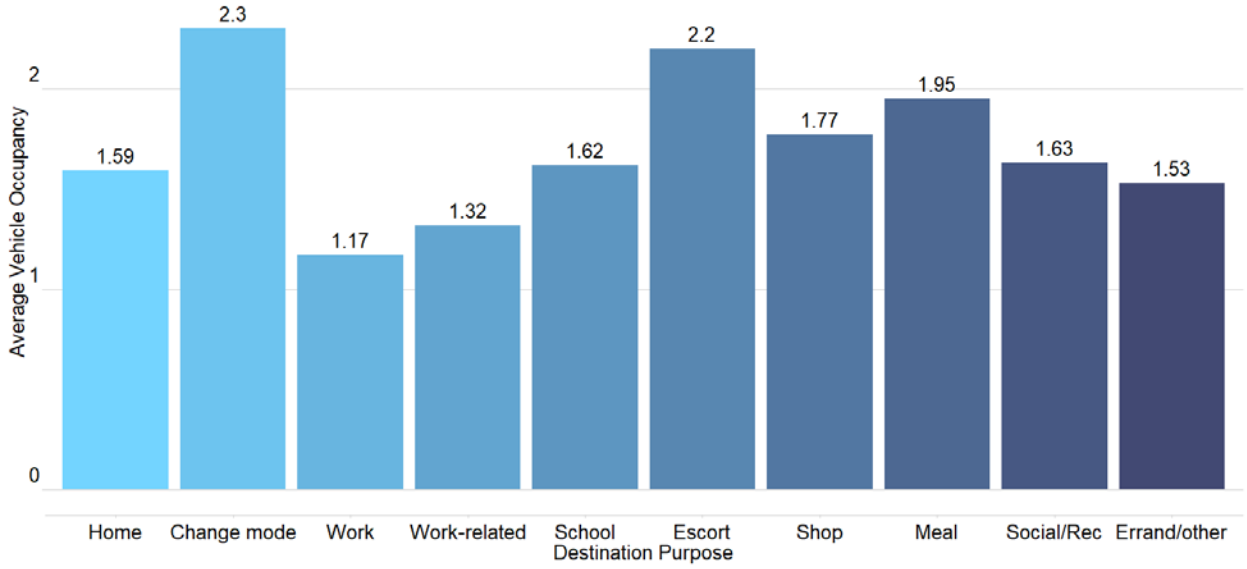


Table 5 shows the vehicle occupancy rates by travel mode. Transit and bike trips have the highest rate of single-occupancy (about 70% of all trips by respective mode). Walk, Car, and Taxi/TNC have similar occupancy distributions, though walk trips are slightly more skewed toward single-occupancy.

TABLE 5: VEHICLE OCCUPANCY RATE BY TRAVEL MODE

Mode	Travel Party Size (Persons)			Weighted Trips
	1	2	3+	
Walk	60.5%	19.9%	19.6%	118,661
Bike	69.5%	20.4%	10.1%	28,553
Car	55.3%	25.0%	19.7%	753,989
Taxi/TNC	54.2%	27.0%	18.8%	1,170
Transit	71.5%	8.5%	20.0%	26,158
School bus	31.5%	6.4%	62.0%	6,278
Other	58.9%	23.7%	17.4%	14,357
Total	**56.7%**	**23.6%**	**19.7%**	**949,166**

5.6 GEOGRAPHIC COVERAGE

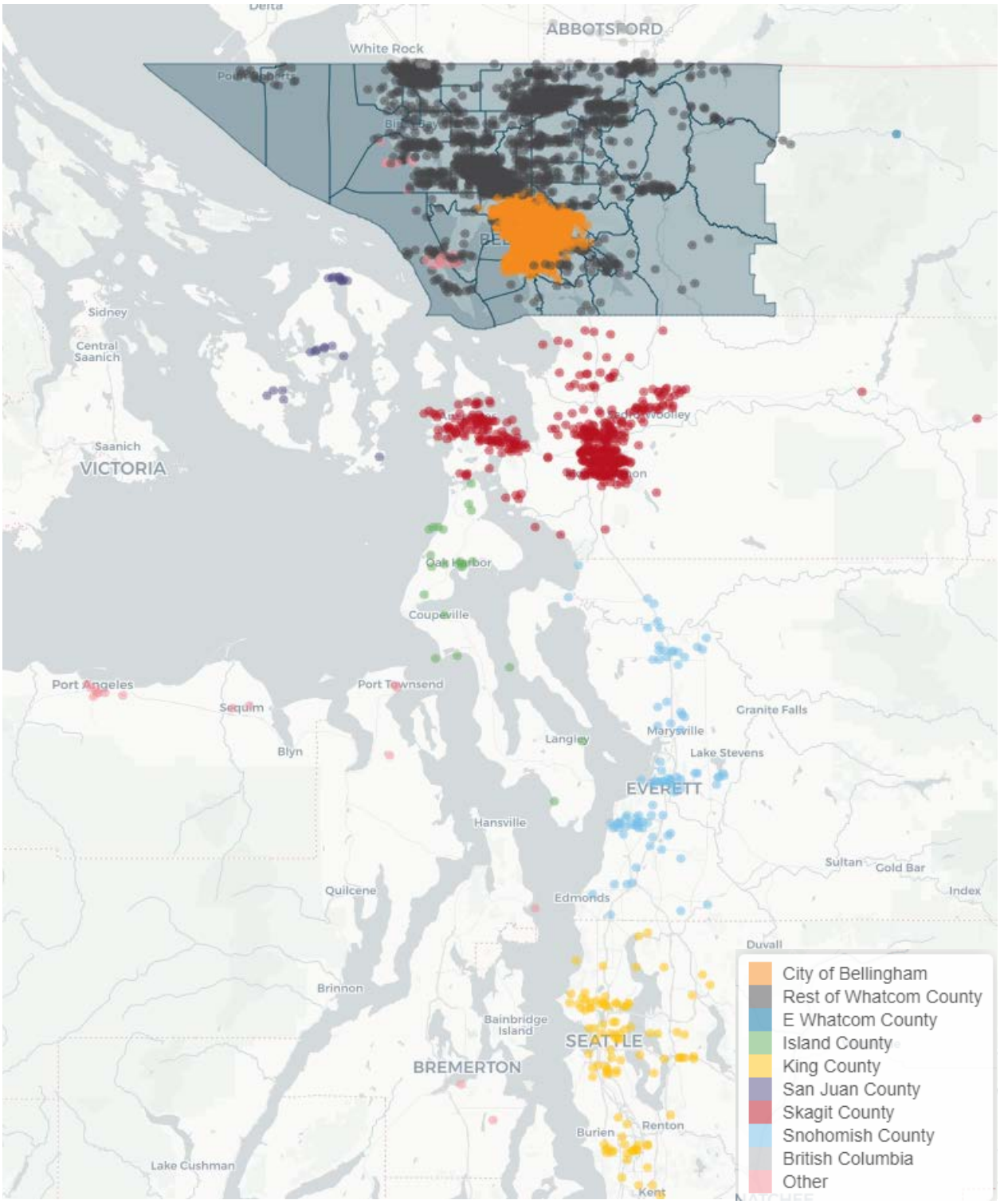
This project captured a dataset that represents the travel behavior of residents of Whatcom County, including over 8,000 complete travel days on weekdays and 35,000 trips. Table 6 shows the distribution of work and work-related trips for the study. Nearly 60% of work trips are to a destination in the City of Bellingham, with another ~27% to a destination in the rest of Whatcom County, totaling 86% of work and work-related trips in the county overall.

Figure 28 plots all these trip destinations on a map (with some random noise added to obscure actual trip ends). The trip ends are colored by region, with black and orange representing work locations in Whatcom County and the City of Bellingham, respectively, and the gray shaded area indicating the portion of Whatcom County that was sampled for this project. The map shows a wide dispersion of workplaces for residents of Whatcom County, extending north to Vancouver, south to Seattle and Tacoma, east to eastern Whatcom County, and west to Port Angeles.

TABLE 6: WORK AND WORK-RELATED TRIPS, BY DESTINATION REGION (UNWEIGHTED)

Trip Destination Region	Work & Work-Related Trips	Work & Work-Related Trips %
City of Bellingham	3,815	59.7
Rest of Whatcom County	1,713	26.8
E Whatcom County	2	--
Island County	22	0.3
King County	94	1.5
San Juan County	22	0.3
Skagit County	434	6.8
Snohomish County	76	1.2
British Columbia	60	0.9
Other	156	2.4
TOTAL	**6,394**	**100.0**

FIGURE 28: MAP OF WORK AND WORK-RELATED TRIP DESTINATIONS



5.7 MARGINS OF ERROR

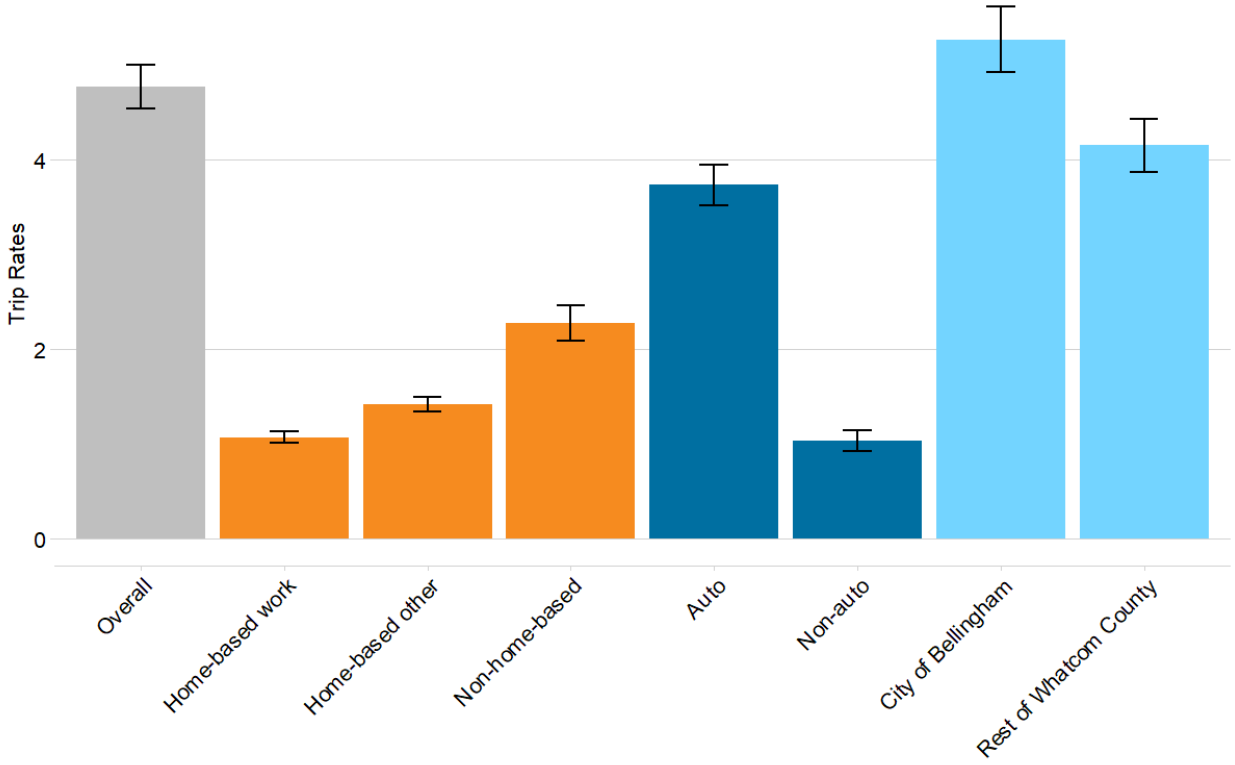
This study collected a relatively high sample rate for the region at 1.8% (many regions target a sample of 0.5% or higher). The margins of error for this study are mostly based on the total sample size of 1,451 households and 3,000 persons. Figure 29 and Table 7 show the standard errors and 95% confidence intervals for several key person trip-rate statistics. The overall person trip rate is 4.77 ± 0.23 at 95% confidence (this includes all trips on complete travel days, unlike Table 1, which filtered out trips over 250 miles). The margins of error are relatively low across the major trip purposes and by travel mode, since these figures are based on the entire sample of about 3,000 persons. The margins of error for the different home-location geographies are somewhat larger; this is because each of these statistics only uses a portion of the overall sample (1,557 persons in the city, 206 for the city Urban Growth Areas, and 1,224 for the rest of Whatcom County). The Urban Growth Area margin of error is particularly large given the much smaller sample size for that region. All these margins of error should be taken as indicative of the range of variance for estimates using this dataset.

Finally, these margins of error are conservative and likely overestimate the true variance of estimates using this dataset. The unique design of this study, where some households collected data for up to seven days (including up to five weekdays), is not fully factored into these margins of error.

TABLE 7: STANDARD ERRORS FOR KEY TRIP-RATE STATISTICS

Category		Trip Rate	Standard Error (SE)	95% Confidence Half-Interval (= SE*1.96)
Overall	Overall	4.77	0.12	0.23
Trip Purpose	Home-Based Work (HBW)	1.08	0.03	0.06
	Home-Based Other (HBO)	1.42	0.04	0.08
	Non-Home Based (NHB)	2.28	0.09	0.18
Travel Mode	Auto	3.73	0.11	0.21
	Other/Nonauto	1.04	0.06	0.11
Geography	City of Bellingham, without the UGA	5.27	0.17	0.33
	City of Bellingham, Urban Growth Area (UGA)	5.25	0.66	1.29
	Rest of Whatcom County	4.15	0.14	0.28

FIGURE 29: 95% CONFIDENCE INTERVALS FOR KEY PERSON TRIP-RATE STATISTICS



6.0 TRAVEL DAY ANALYSIS

Part of the travel diary gathered travel day summary information, including travel replacement activities such as shopping online and teleworking.

The survey asked employed participants to report the frequency with which they telework. About 10% of respondents reported working from home one or more days per week. Among those 10%, about half reported working from home for 15 minutes or more on at least one travel day. Among the 90% who reported teleworking *less* than one day per week, 18% worked at least 15 minutes on at least one travel day. Figure 30 shows the total distribution of self-reported and observed telework frequency on all household-complete travel days. (Note: Online diary participants only reported one day of travel, which may not have captured the day they typically telework, if at all.)

Participants reported personally purchasing something online on about 7% of days with complete survey data. Related, 86% of participants did not report any package deliveries on their travel days (Figure 31). Among those who did report deliveries, deliveries at home were reported most frequently (on 11% of weekdays).

FIGURE 30: SELF-REPORTED TYPICAL TELEWORK FREQUENCY (TWO CATEGORIES) BY ACTUAL TELEWORK HOURS (FOUR CATEGORIES), FOR AN AVERAGE WEEKDAY

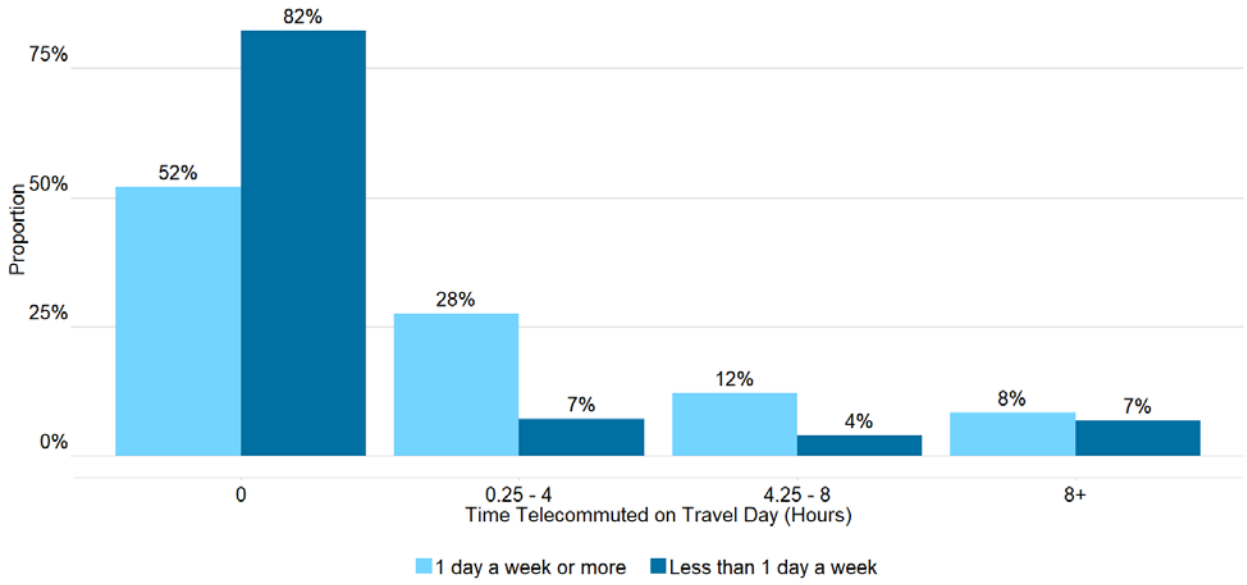
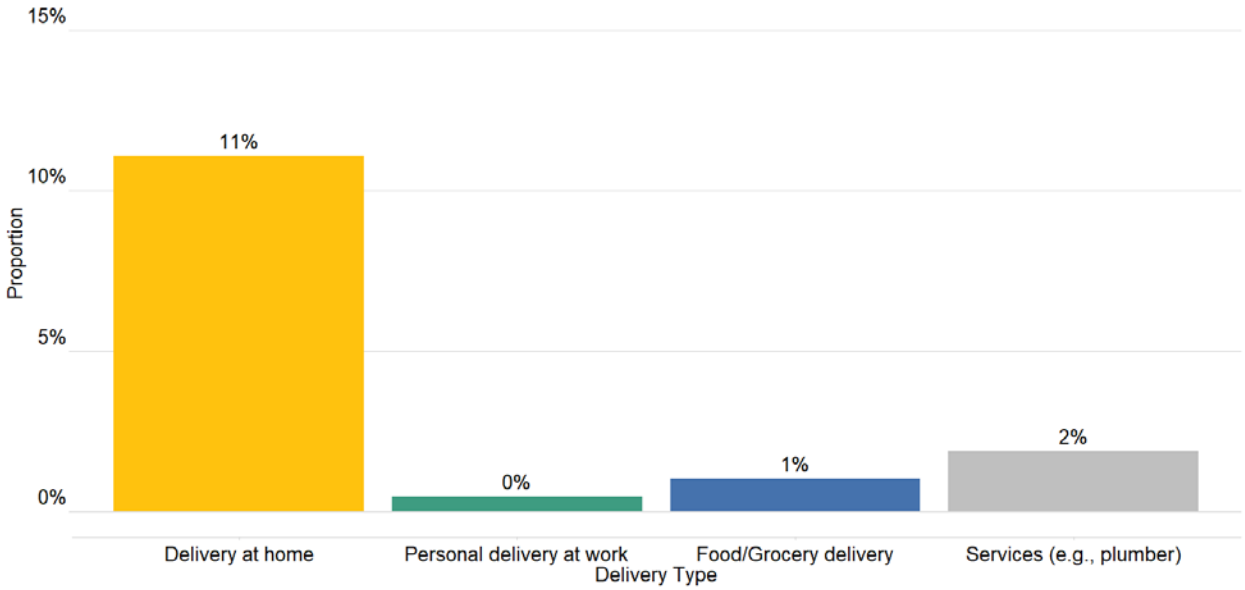


FIGURE 31: DELIVERY SUMMARY: PERCENTAGE OF ADULTS WHO REPORTED DELIVERIES OR SERVICES, REPRESENTATIVE OF AN AVERAGE WEEKDAY



7.0 CONCLUSION

The Whatcom Regional Transportation Study used innovative methods to deliver a high-quality and representative dataset. The study design used innovative sampling methods to achieve a less-biased and larger sample of 1,451 households and 3,000 persons. Additionally, the study used modern research methods to collect data online and by smartphone, reducing nonresponse error and measurement biases while significantly increasing the quantity and quality of data. The study captured important data to support WCOG's travel demand modeling, planning, and other activities.