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Telecommuting and Travel Behaviour: A Survey of White-Collar Employees in Adelaide, Australia

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Abstract: COVID-19 prompted a significant number of employees to shift to remote work for the first time, potentially reshaping future work patterns. This study examines the post-COVID impacts on telecommuting, commuting behaviour, travel activities, and lifestyles in the city of Adelaide, South Australia. A multivariate nominal logistic regression analysis of 305 post-restriction survey responses revealed that home distance from the CBD, industry, occupation, and income significantly influence post-COVID telecommuting trends. Individuals living over 20 kilometres from the CBD, those in professional or managerial roles, and higher-income earners (>125k) are more prone to regular telecommuting, highlighting the impact of commute lengths, job flexibility, and financial resources on the ability to work remotely. The study revealed a higher adoption of telecommuting post-COVID, with more individuals working from home and telecommuting more often each week. This led to reduced usage of private cars and public transport, indicating a decrease in overall travel frequency. Respondents also adopted flexible work schedules, resulting in fewer peak-hour commutes, which would have resulted in lower congestion and emissions and led to more sustainable travel practices. The study also investigated future telecommuting perspectives, revealing a preference for remote work 3–4 days a week. Some respondents who initially could not telecommute have since considered it feasible and want to adopt it. Notably, about 25% of respondents would even change jobs for flexible, home-based work arrangements. The study's results suggest that remote work frequency may influence individuals' future house location preferences. These findings offer valuable insights for sustainable transport and urban planning considerations in the post-COVID era.

Keywords: mode choice; residential choice; COVID-19; travel demand; travel behaviour; teleworking; telecommuting

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1. Introduction

COVID-19's impact on urban transportation is unprecedented. Lockdowns and social distancing disrupted daily routines, offering a valuable chance to explore remote work in the post-COVID era. The effectiveness of telecommuting or working from home as a policy to reduce overall travel distances, commuting time, and transportation-related issues such as congestion and pollution was investigated extensively before the pandemic [1–4]. Research has indicated that telecommuting reduces the overall number of trips, particularly during peak periods, and produces positive environmental outcomes [5,6]. Telecommuting reduced annual vehicle-miles-travelled (VMT) by approximately 0.8%. Despite modest impacts, it proved more cost-effective than public transport in reducing private vehicle trips while maintaining the same level of reduction [7]. However, other studies showed that people who engaged in remote work tended to cover a greater distance when traveling for personal reasons [8–10].

Other scholars have focused on studying telecommuting behaviour, including factors such as demographic status, family structure, economic conditions, car ownership, preference for face-to-face interaction, lifestyle, and residential and job locations. They used

both qualitative and quantitative analyses to understand aspects like telecommuting opportunities, choices, frequency, and preferences [1,11–13]. In the aftermath of the pandemic, decision-makers continue to face a deep challenge in understanding how the COVID-19 pandemic habits, particularly working from home, are likely to influence people's future travel behaviour and the impacts these would have on transport demand. Several key questions remain unanswered regarding the post-pandemic era and the evolution of individuals' work patterns, habits, lifestyles, and travel preferences. These questions pertain to the extent of adoption of new work patterns, the sustainability of habits developed during the pandemic, and the anticipated changes in people's lifestyles and travel preferences. There are various potential implications that need to be considered. The demand for public transport may significantly decrease; the evolution of on-demand shared mobility (such as transportation network companies) may undergo significant changes; there might be an increased reliance on telecommuting and online shopping, which could trigger suburbanisation; and changing lifestyles may lead to a more car-oriented activity-travel pattern. In such circumstances, many ongoing or approved urban transportation projects, including infrastructure and policy initiatives, may be at risk of under-delivering if the travel demand is reduced in future years. This understanding is vital for offering guidance to transportation authorities and urban planners as they create new travel-demand forecasting models, which are crucial for constructing resilient and sustainable cities in the aftermath of the pandemic. The work reported in this paper was focused on the city of Adelaide, South Australia, where there is a lack of previous studies examining the effects of COVID-19 on travel demand and travel behaviour. Specifically, this study examines the impacts of the pandemic on telecommuting and commuting behaviours, travel activities, and lifestyles. Additionally, the study investigates the factors that influence the availability and choice of telecommuting opportunities post-pandemic. The following research questions (RQs) were identified and examined in this study:

- RQ1: What impact has the COVID-19 pandemic had on telecommuting behaviour 18 months from the start of the pandemic?
- RQ2: What factors influence the adoption behaviour and opportunities for telecommuters?
- RQ3: What are the impacts of telecommuting on travel demand?
- RQ4: How does telecommuting vary across different socio-economic strata in Adelaide?
- RQ5: What does the future hold for telecommuting in Adelaide?

These research questions guided the investigation into understanding the various aspects related to telecommuting, its effects during the pandemic, its impact on travel behaviour, and the factors that shape telecommuting opportunities. Ultimately, the study aims to provide insights into the future of telecommuting in Adelaide. The remaining sections of this article adhere to a systematic structure. Section 2 encompasses a comprehensive review of the existing literature, emphasising the research gaps that currently exist. Section 3 offers a detailed description of the survey implementation process, including data collection, sample selection, and data analysis techniques. The outcomes of the analysis, addressing the research questions, are presented in Section 4. Finally, Section 5 provides an extensive discussion, exploring the policy implications derived from the findings and proposing potential future research endeavours.

2. Literature Review

The impacts of the COVID-19 pandemic and the strategies employed to control its transmission have been the subject of extensive research in different regions over the past few years [14]. Researchers have also examined how travel can contribute to the transmission of the virus [15] and how policymakers in the transportation sector should respond [16,17]. Additionally, scholars have shown interest in investigating the effects of telecommuting on work–life balance, particularly in the non-transportation literature [18], as well as the strengths, weaknesses, and associated policies related to working from home [19]. However, the focus of this research is on the relationship between COVID-19,

telecommuting and transportation. Consequently, the literature review is divided into two distinct sections that extensively explore various relevant studies aligning with the specific research objective.

2.1. Travel Behaviour and Implications for the Future

Changes in preferences for travel modes and patterns have been observed during COVID-19, as highlighted by several previous studies [20–23]. Due to the high risk of virus exposure, individuals have been inclined to cancel their recreational trips and avoid using public transport [24,25]. In response to the limitations and risks associated with public transport, alternative arrangements such as private cars, bicycles, walking, telecommuting, online shopping, and remote learning gained prominence [26–30]. In Australia, a study was carried out in three phases in 2020 to investigate the effects of COVID-19 on the frequency of public transport trips [31]. A Poisson regression model was developed in the study to examine the relationship between the number of public transport trips and various socioeconomic characteristics and attitudes towards public transport usage. The findings suggest that individuals concerned about public transport before COVID and during the first (March 2020) and second (June 2020) data collection periods usually made more weekly trips, suggesting that greater exposure is driving attitudes towards hygiene and risk. Moreover, individuals who were more concerned about hygiene on public transport exhibited higher tendency of not making public transport trips in the post-COVID era, indicating a shift towards increased usage of private cars. In India, a hybrid choice model was developed to examine the impacts of COVID awareness on modal shift [32]. The results indicated a notable shift in modal choices, with a preference for personal vehicles over public transport due to heightened COVID awareness and concerns regarding public transport safety. The findings also highlighted that respondents were more inclined to resume using public transport after the lockdown if specific COVID preventive measures were implemented. The pandemic resulted in a significant reduction in travel demand around the world [33,34]. Public transport was particularly affected as individuals became aware of the airborne nature of the virus and consequently chose to minimise their use of public transport to mitigate the risk of contracting the virus. Zhang et al. found that rail transport passenger demand levels were reduced by about 50% [35]. The shift away from public transport persisted, as evidenced by a substantial reduction in public transport trips in twenty metropolitan areas in the US, ranging from 40% to 80% [36]. Factors contributing to this decline included concerns about contracting the virus through close contact on mass transport, stay-at-home orders, and changes in public transport service levels, which collectively resulted in a 75% decrease in public transport usage [37].

The effects of the COVID-19 pandemic on transport systems are not confined to the short-term, as they are expected to have enduring consequences. A study from Europe highlighted that even in the post-pandemic period, the impacts will persist, with a projected 40% decline in public transport trips [38]. This reduction will primarily stem from changes in trip frequencies, as more individuals continue to embrace telecommuting; the remainder of the decline would result from a modal shift, predominantly towards private cars. These long-term implications signify a shift in travel behaviour and mode preferences that are likely to persist beyond the end of the pandemic. The impacts on transport behaviour may extend beyond surface-level changes and affect deeper layers of travel behaviour. For instance, one study deployed a combination of observations, survey data, and modelling techniques to demonstrate that New York City was anticipated to experience a substantial 142% increase in car trips compared to pre-pandemic levels [39]. Another study in Boston, USA projected that public transport utilisation will only reach 73% of pre-COVID levels, resulting in a decrease in both the quantity and quality of mass transportation systems [40]. This reduction in public transport trips raises concerns regarding equity, particularly for low-income segments of society who heavily rely on these services. This situation also presents an opportunity to promote alternative transport modes, such as active transport, which are more sustainable and do not pose an increased risk of virus exposure. However,

the same study also found that 18% of individuals who previously did not own cars have since made the decision to purchase one due to concerns about the increased risk of contracting the virus while using public transport. In developing countries, other studies show a shift from public transport to private cars, with travel patterns like online shopping less prevalent during the pandemic due to limited e-commerce infrastructure [41,42].

2.2. Telecommuting Behaviour

A pre-pandemic study found that individuals became more inclined towards increased work flexibility in terms of location after being exposed to such opportunities [43]. COVID-19 provided this opportunity and several researchers have investigated this impact. In India, the preferences for remote work among a limited sample of commuters in March 2021 was examined using logistic regression [44]. The study considered various household characteristics and identified factors such as inadequate internet connectivity and disruptions caused by other household members as significant predictors of a preference for limited remote work. A study conducted in Toronto, Canada area, involving 1000 travellers indicated that people preferred to work from home if they had adequate access to home office essentials (e.g., desk, chair, computer monitor) [45]. In another study, a hybrid choice model incorporating latent variables was utilised to examine the likelihood of individuals opting for remote work instead of commuting to the office [46]. Using data from Chile in March 2020, their study included latent variables for health and economic concerns. Results showed higher health concerns among females, lower-income individuals, and older residents, positively impacting the likelihood of working from home (WFH). Individuals with lower income, lack of secondary education, and self-employment were more likely to have increased economic concerns, which in turn decreased the likelihood of engaging in remote work. Type of occupation was also found to have a significant role in predicting telecommuting, both before and during COVID-19 [47].

In Australia, two studies conducted surveys in Melbourne during the summer of 2020 and aimed to assess the overall influence of remote work on future travel demand [48,49]. The study revealed that access to remote work technology and support from employers had a crucial role in determining the likelihood of sustaining remote work arrangements. Interestingly, attitudes were found to have no significant impact on long-term preferences for remote work. As restrictions were gradually lifted and the perceived public health threat diminished, working arrangements began to stabilise. In another study, latent variables were incorporated as additional factors in a model designed to investigate the frequency of weekly commuting trips [50]. Surprisingly, the study's findings revealed a counterintuitive pattern individual who showed a strong preference for remote work but actually commuted more frequently than those without such a preference. This unexpected result challenges conventional wisdom, suggesting a complex desire for a balanced approach that integrates both remote work and in-office duties. One possible explanation for this phenomenon could be that those inclined towards remote work value the occasional office visits more highly, perhaps for social interaction, collaboration opportunities, or other workplace benefits that remote work cannot fully replicate. The results also highlighted the impact of public concerns about hygiene and COVID-19 safety on public transport (due to crowding) on individuals' commuting decisions. Lastly, a model was developed to analyse the choice between working from home and commuting, considering factors such as the specific day of the week and time of day [51]. The likelihood of working from home (WFH) was analysed using a mixed multinomial logit model, considering several factors such as socioeconomic characteristics, modal attributes (e.g., time and cost), day of the week and time of day, and attitudinal variables like concerns about using public transport. The results of the model revealed important factors that impacted the probability of WFH versus commuting throughout the week. These findings were used to develop a mapping equation, which facilitated the creation of a comprehensive origin-destination (OD) matrix that helped identify spatial variations in WFH prevalence across different OD pairs within the study area.

The study above provides a comprehensive framework for modelling working from home, but it was developed during a period marked by significant changes and uncertainties due to COVID-19. This context may lead to an overestimation of the capacity for working from home; for example, certain professionals that temporarily shifted to telecommuting, like clerical staff or receptionists, have since returned to onsite work. Additionally, it overlooks professionals who have the option but choose not to work from home, and those willing to telecommute but who are constrained by their employer's policies. In addition, the special case of the city and the severity of its restrictions may have an impact; these studies were conducted in Sydney and Melbourne, which experienced different levels and types of restrictions compared to Adelaide. This disparity in pandemic response measures makes it challenging to apply the findings directly to the context of Adelaide.

2.3. Survey Methodology

To address the limitation in the literature mentioned in the last section, a comprehensive survey of travel behaviour in response to COVID-19 was developed.

2.4. Target Audience

The survey's goal is to gather data from individuals who currently work from home or have the potential to do so. The COVID-19 restrictions created unique opportunities for remote work. We considered a filtering question asking if respondents have worked from home since the pandemic's start. However, this overlooks those who were unemployed or made redundant during this period, despite being capable of remote work. Additionally, the relevance of a COVID-like context will diminish over time, making this approach less applicable for future scenarios.

One study categorized occupations as either suitable or unsuitable for remote work. However, this approach may not entirely align with our survey, as the suitability of job roles for remote work can differ within the same occupation and across various regions. For example, while an IT specialist in a tech firm may have the flexibility to work remotely, an IT professional in healthcare may need to be physically present on-site [52]. Recognizing that remote work is often associated with white-collar jobs, the study reviewed how criteria for such employees have been established. Traditional surveys targeting white-collar workers typically concentrate on specific business sectors [53] or use subjective task-based criteria [54] like intellectual versus physical labour. Yet, this method can be problematic. For example, a bank teller's role involves physical tasks not requiring extensive knowledge, challenging the typical white-collar classification.

In this study, we propose an approach: defining white-collar employees in a transport modelling perspective based on their option to work from home. Therefore, the ability to telecommute effectively distinguishes white-collar roles, offering a contemporary and operationally relevant criterion for defining this workforce segment in the context of transport modelling.

The survey was crafted with the above definition of white-collar employees in the context of transport modelling in mind. It also aimed to address the limitations highlighted in the last paragraph of the previous section. Two key questions were employed:

> "Are you currently working in a job where you can do part or all your work tasks from home?"
>
> If respondents selected "no" then the following question was triggered:
>
> "Can you work from home if government and health authorities stated that everyone who can work from home must work from home?"

This dual-question framework aims to accurately identify the telecommuting potential among different workforce segments.

This approach acknowledges the potential for selection bias based on perceived ability. However, by introducing a two-tiered questioning system, the study aims to mitigate this by capturing those who might initially underestimate their work-from-home capabilities by asking a follow-up question that emulates a lockdown scenario, encouraging respondents to reconsider their telecommuting potential in such a context.

Meanwhile, to mitigate overestimation, this methodology allows us to track responses from those initially indicating their job was not suitable for telecommuting, assessing their current work-from-home options and frequency. Additionally, by analysing their industry, occupation, and other socio-demographics, this methodology can differentiate between current, potential, and non-telecommuters due preference or policy. This distinction is crucial for creating accurate production and attraction matrices in strategic transport models and for formulating future scenarios.

All genders and people from all cultural and socio-economic backgrounds were targeted. Respondents had to be employees, workers, or business owners who had a fixed job address outside home that they could commute to. Even though the survey company initially targeted individuals living in Greater Adelaide based on their records, a question about their current home postal code was included to ensure that all responses came from Greater Adelaide. This allowed for the exclusion of respondents who provided a postal code outside of Greater Adelaide.

2.5. Study Area

The Australian city of Adelaide was chosen because the city experienced moderate restrictions during the pandemic, and because it is a relatively small metropolitan area compared to where most of the studies were conducted. This allowed us to study the flexible working arrangements in a more neutral context. To understand the changes in travel behaviour, the following presents a summary of the major events and restrictions that occurred in Adelaide between 2020 and 2022.

- 15 March 2020: Public health emergency declared in South Australia.
- 22 March 2020: "Major emergency" declared.
- 24 March 2020: State borders closed.
- 16 November 2020: Significant restrictions reintroduced due to outbreak.
- 18 November 2020: Six-day lockdown announced, followed by eight days of "significant restrictions".
- 21 November 2020: Lockdown ends.
- 28 June 2021: Restrictions reintroduced, including mandatory masks, indoor entertainment limits, and licensed premises rules.
- 19 July 2021: Level 4 restrictions implemented due to a positive case, banning indoor dining and personal care services.
- 20 July 2021: Seven-day lockdown due to Delta variant cluster, with limited reasons to leave home and school and construction closures.
- 21 November 2021: South Australia opens borders after reaching 80% vaccination, shifting to suppression strategy.

Figure 1 presents the timeline of the development of the COVID-19 cases in Adelaide from the start of the pandemic until August 2022. The survey reported in this paper was conducted in August 2022, 10 months after South Australia opened its borders and 10 months before the head of the UN World Health Organization (WHO) declared an end to COVID-19 as a public health emergency.

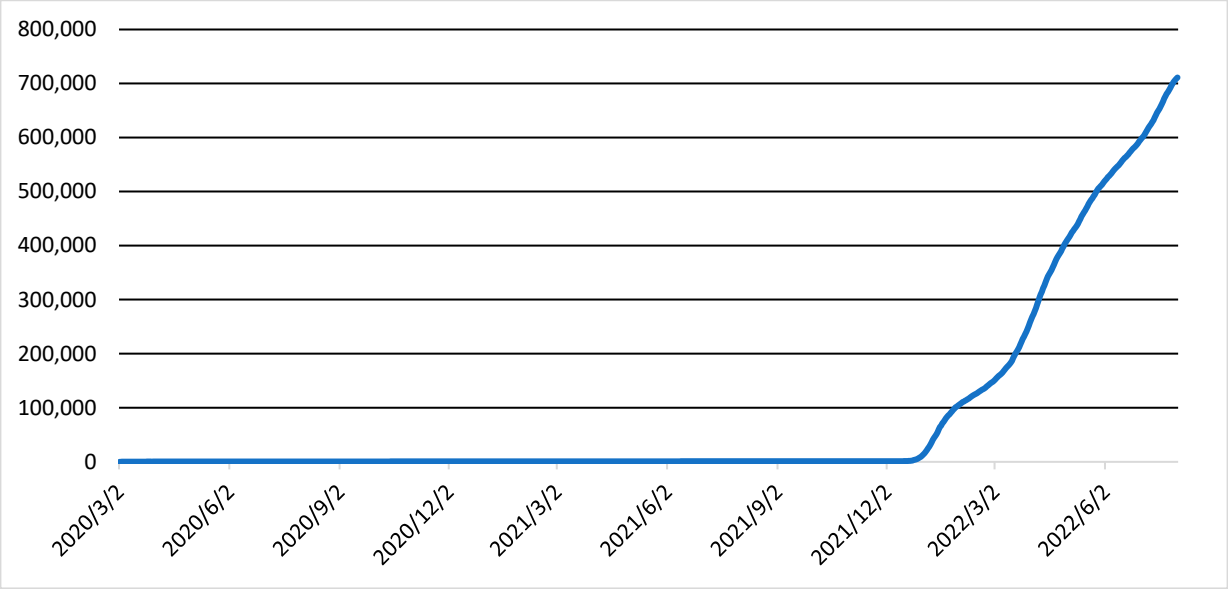

Figure 1. COVID-19 cumulative cases in South Australia.

2.6. Data Collection

Participation in this survey involved completing an online web-based questionnaire aimed at exploring the changes in participants' travel behaviours and the need for travel before COVID compared to the day of the survey, when Adelaide allowed workers to return to their offices, and as travel and work restrictions were being removed or eased. The survey comprised three main sections with 5–15 questions in each section in addition to a section for general feedback at the end of the survey. The survey took approximately 15–20 min to complete.

The survey was distributed via The Online Research Unit, a reputable Australian agency specialising in data collection and panel management. Out of these, 310 respondents met the eligibility criteria, fully completed the survey, and submitted their responses. To ensure a sample that accurately mirrors the population in both geographic and demographic terms, we established quotas in line with the workforce data from the 2021 Census in Greater Adelaide.

A preliminary survey analysis was conducted to establish the characteristics (socio-demographics and land-use characteristics) of participants and their travel behaviours (number of trips, trip purposes, mode choice, destination choice, etc.). The results are summarised for each question in Table 1, which shows various demographics and characteristics of the surveyed population. In terms of gender, 52% of respondents identified as male and 48% as female. The age distribution shows a mean age of 45, with the highest percentage of respondents in the 40–44 age group. The mean numbers of children and cars per household and the household size were 1.6, 1.8, and 2.5, respectively. Around 75% of respondents were employed full-time, and the mean income was $89,773 Australian Dollar (AUD), with the highest percentage of respondents falling into the AUD 100k–125k income range. As for education levels, 36% of respondents held a bachelor's degree, followed by 22% with a graduate certificate/graduate diploma. It is important to acknowledge that the study's sample consisted exclusively of individuals who could work from home if required.

Table 1. Summary of survey statistics.

Item	Percent/Mean	Item	Percent/Mean
Gender		Industry	
Male	52%	Education and Training	12%
Female	48%	Arts and Recreation Services	1%
No. of Children	1.6	Information Media and Telecommunications	6%
No. of Cars	1.8	Manufacturing	7%
Household Size	2.5	Mining	2%
Age	45	Transport, Postal and Warehousing	4%
18–25	1%	Retail Trade	4%
26–29	6%	Accommodation and Food Services	2%
30–34	10%	Professional and Technical Services	17%
35–39	13%	Public Administration and Safety	8%
40–44	16%	Wholesale Trade	3%
45–49	11%	Financial and Insurance Services	7%
50–54	15%	Administrative and Support Services	5%
55–59	12%	Health Care and Social Assistance	9%
60–64	11%	Construction	2%
>65	6%	Electricity, Gas, Water, and Waste Services	2%
Income	AUD 89,773	Other	7%
AUD 19k–40k	6%	Rental, Hiring, and Real Estate Services	1%
AUD 40k–60k	10%	Occupation	
AUD 60k–80k	16%	Professional (e.g., engineering, health, IT)	36%
AUD 80k–100k	19%	Sales, clerical, administrative	15%
AUD 100k–125k	21%	Managerial position	28%
AUD 125k–150k	13%	Technician or trade	2%
>150k	16%	Academic staff or student	7%
Education		Community and personal service	3%
Bachelor's degree	36%	Other	6%
Graduate cert/Dip	22%	Machinery operator or driver	1%
High school	14%	Employment Status	
Master's degree	15%	Full time	75%
Trade school	4%	Part time and casual	25%
Doctoral degree	9%		

3. Results

The forthcoming sections are dedicated to the presentation and discussion of the results. During the survey, respondents were prompted with multiple questions designed to produce a comparative analysis of their behaviours pre-COVID restrictions and as of the survey timeframe, which was August 2022. This latter period is referenced in the figures as "post-COVID" for consistency and because all COVID-19 related restrictions were removed.

3.1. Telecommuting Behaviour

The survey's design incorporated a dual-question filter to gauge the potential for remote work among respondents. The initial question probed whether their current job included tasks that can be performed from home. A follow-up query was presented to those who responded negatively, asking if they could work from home under government or health mandates. This design aims to minimize underestimation or overestimation of remote work capabilities by prompting respondents to consider their telecommuting feasibility under extraordinary circumstances, akin to a lockdown.

Figure 2 shows that there is a consistent pattern among respondents regarding their telecommuting capability. Those who initially answered "No" to the ability to work from home but indicated "Yes" when faced with a government mandate scenario, largely did not report any frequency of working from home, aligning with their stated restrictions—either from their employer or the nature of their job, as shown in Figure 3. Figure 4 confirms that there was no indication of overestimation from those who answered "Yes", as none of them reported a complete lack of telecommuting options or a "Never" frequency. Interestingly,

casual telecommuting, defined as less than once a month, was noted among those with employer restrictions or a personal preference against working from home, indicating occasional remote work in special circumstances. These findings help delineate the boundaries of remote work practices within the surveyed population.

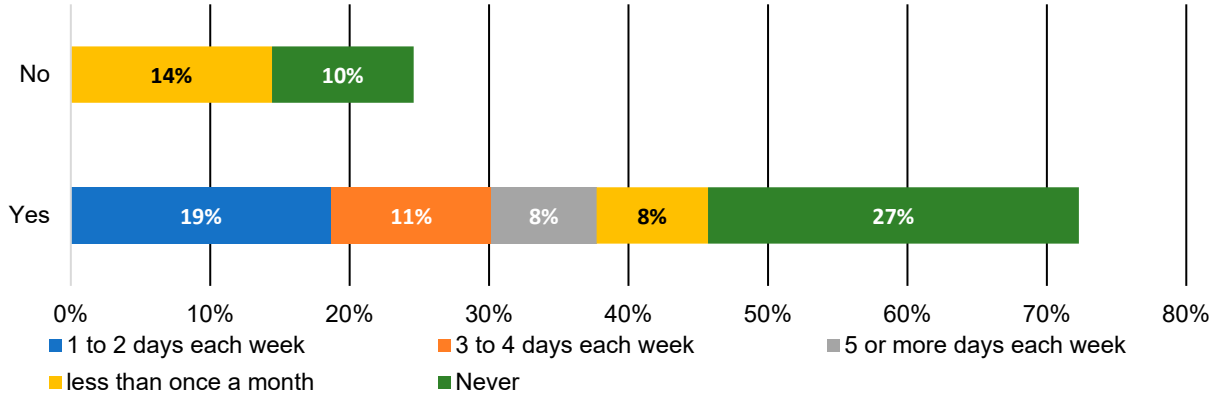

Figure 2. Perceived ability and frequency of working from home.

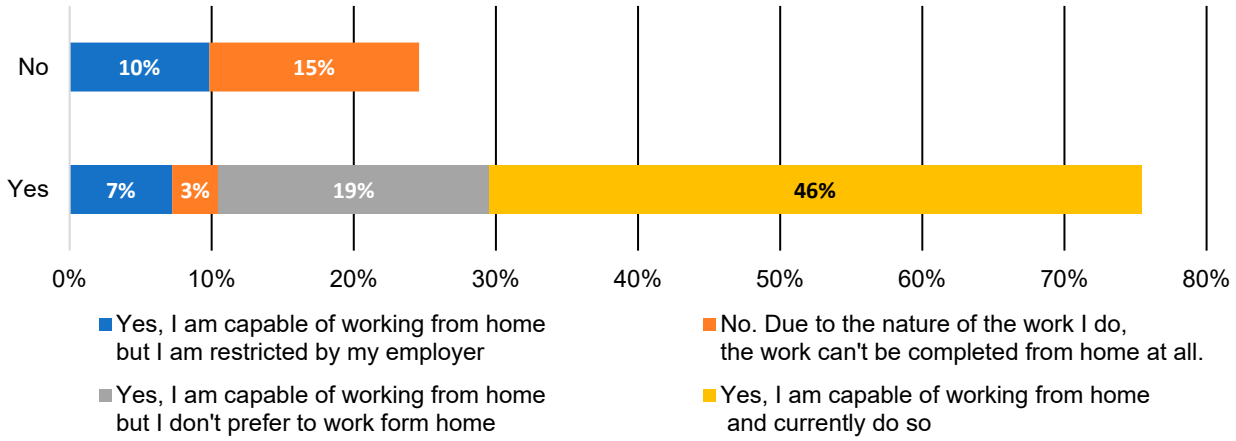

Figure 3. Perceived ability and option of working from home.

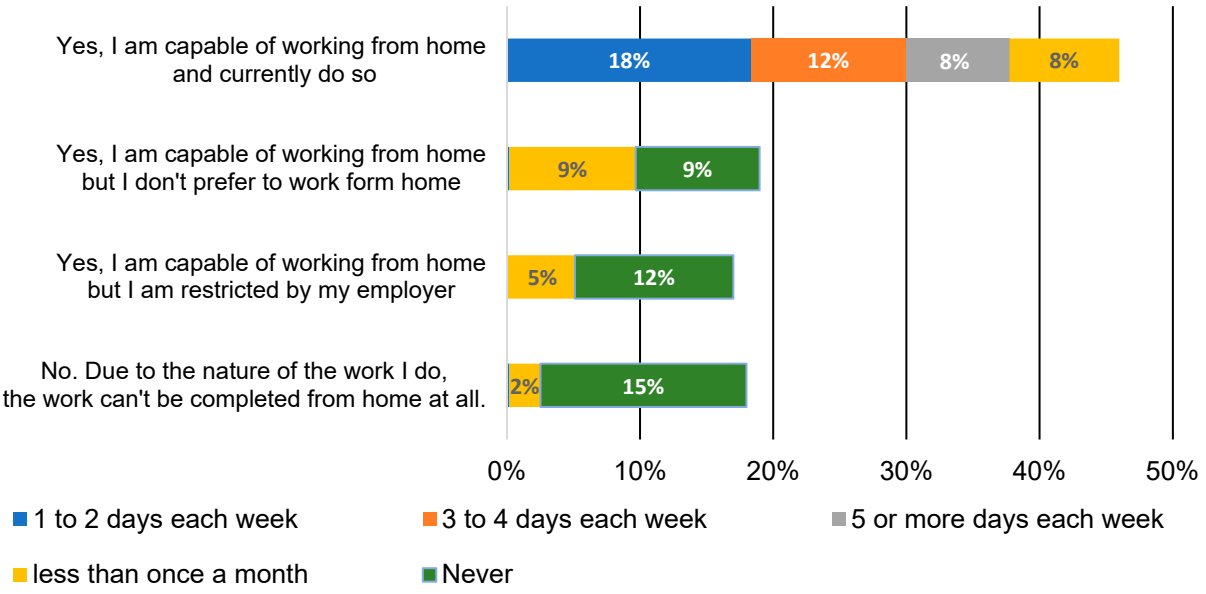

Figure 4. Telecommuting option and frequency.

Additionally, it is important to point out that approximately 17% of individuals who indicated their jobs could be conducted from home were nonetheless restricted from telecommuting by their employers. This underscores the pivotal role that employer and managerial attitudes will have in shaping telecommuting practices in the post-pandemic world.

These statements in Figure 4 were further investigated in the regression analysis. Figure 5 illustrates the survey design and the four dependent variables that will be used in the analysis: contingency telecommuting, non-telecommuter by choice, non-telecommuter by policy, and regular telecommuter. The dependent variables were established as follow:

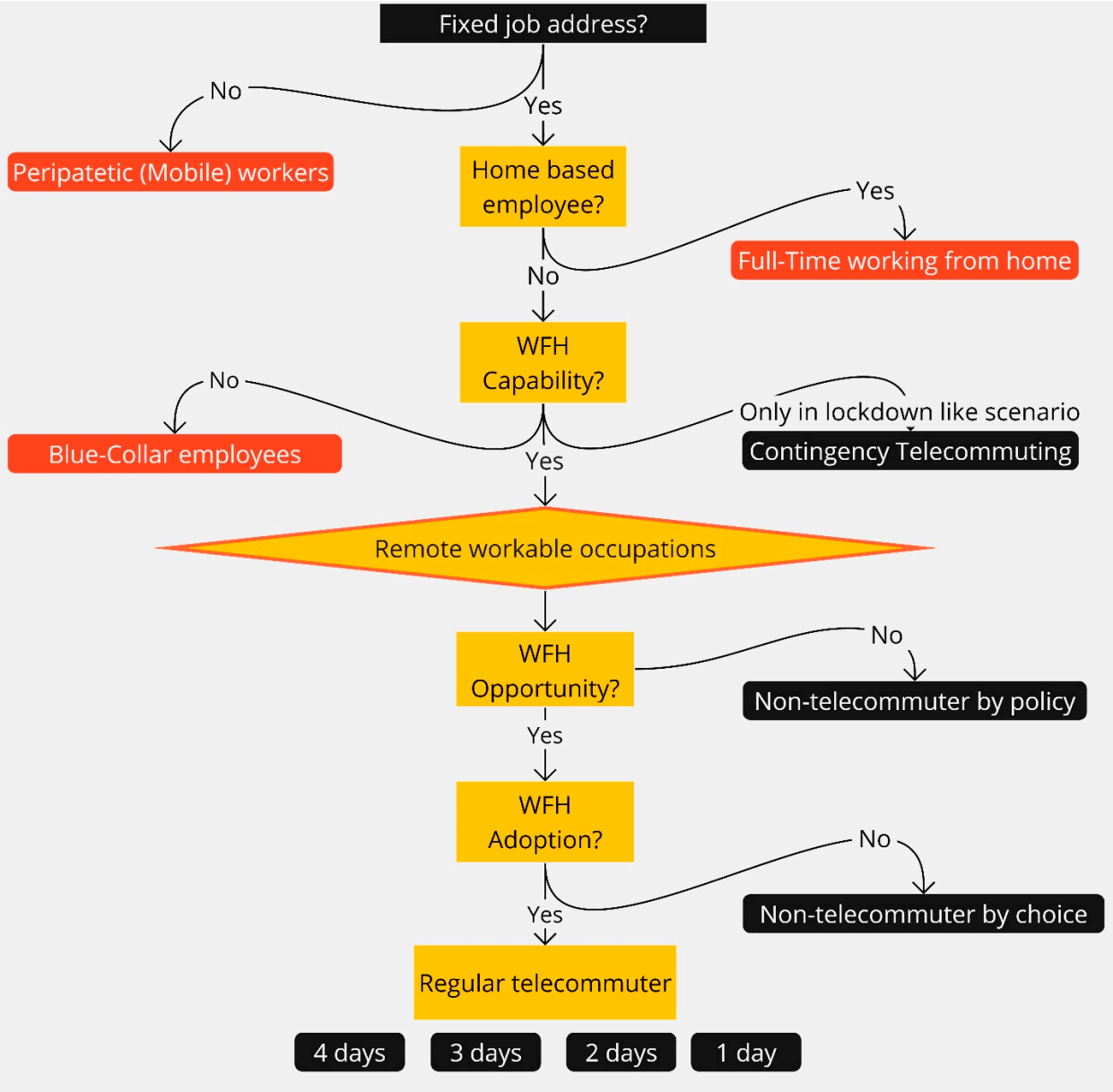

Figure 5. Survey design and telecommuting variables.

Capability: Can the job be done remotely?

Opportunity: Is the employee allowed by their employer to work remotely?

Adoption: Has the employee chosen to work remotely given the capability and opportunity?

As part of data pre-processing, the one-hot encoding technique was implemented on some of the categorical variables. This method transforms categorical variables into binary vectors, creating new columns for each category, with values of 0 or 1. Meanwhile, certain

variables—specifically household size, number of children, and number of cars—were considered as discrete ordinal. These were represented under individual columns with values constituting whole numbers such as 1, 2, or 3, each representing the respective counts in each category.

A variance inflation factor (VIF) assessment was conducted and it highlighted issues of multicollinearity among several variables, prompting us to reevaluate their inclusion. Specifically, we discovered a high degree of multicollinearity between the "distance to work" variable and "travel time" and "distance to CBD". This close relationship suggested that these variables contributed similar information regarding commuting patterns, which could distort the analysis. To maintain the integrity of our statistical model and ensure accurate interpretation of the results, we decided to exclude the "distance to work" variable from further analysis. Additionally, the variable "Ind_Administrative_and_Support_Services" was identified as having multicollinearity with "Ocu_Clerical_administrative" and was therefore removed. The analysis also determined that household size exhibited multicollinearity with the number of children in the household, leading to the exclusion of the household size variable from the analysis. The multinomial regression analysis uses a reference category to make result interpretation easier. The reference category serves as a baseline against which the effects of other categories are evaluated. The reference category, often the one with the lowest occurrence in the dataset, was deliberately omitted from the analysis. This exclusion is a standard statistical procedure that aids in averting multicollinearity, a situation where two or more variables in the model are highly correlated.

The final independent variables were selected using the random forest-recursive feature elimination algorithm (RF-RFE) [55] to avoid overfitting and to follow the common rule of thumb of 10–20 observations per independent variable [56]. RF-RFE is a variable selection technique in machine learning that enhances model performance by systematically removing less important features. It involves using random forest, training a model on all available features, and then evaluating the importance of each feature [57]. Features are ranked based on their importance, and the least important ones are pruned from the dataset. This process is repeated iteratively, where in each step one or more of the least significant features are removed and the model is retrained on the remaining features. The cycle continues until a predetermined number of features is reached.

The modelling results for each telecommuting choice are presented in Table 2, where the "B" column represents the estimated logistic regression coefficients for each feature and the "S.E" column shows the standard error of the coefficients (a smaller standard error would suggest that the estimate of the parameter is more precise and reliable). In Table 2, the "*p*-value" column represents the statistical significance of each coefficient (if the *p*-value is small (typically $\leq$0.05), it indicates strong evidence against the null hypothesis). Exp(B) is the odds ratio which indicates by how much the odds of the outcome (in this case, being able to work from home) increase for each unit increase in the predictor (independent variable), while holding other independent variables constant.

Several significant factors were identified for non-telecommuters by choice, based on a *p*-value of less than 0.05. This group represents individuals who have the option to telecommute but opt not to. For this category, living within 0–5 km of the central business district (CBD) emerged as a highly significant factor (B = 3.49, $p = 0.01$), with an odds ratio of 32.86 when compared to the reference category of contingency telecommuters. This suggests that individuals living very close to the CBD are significantly more likely not to choose telecommuting compared to those who telecommute under exceptional circumstances. Those who mainly travel by bus are more inclined to be non-telecommuters by choice (B = 1.73, $p = 0.08$, odds ratio = 5.65) in comparison to individuals who telecommute solely under exceptional circumstances. This trend indicates a possible preference or necessity for these individuals to be present at their place of work. Moreover, the tendency to choose bus travel might suggest that the bus system in Adelaide is seen as a comfortable and dependable mode of transportation. This perception could make commuting by bus a more attractive and feasible daily option, especially when compared to the reference category

of tram users, for individuals in this group. Regarding occupational roles, individuals in managerial positions were found to be significantly more inclined to choose not to telecommute (B = 2.12, $p = 0.01$, odds ratio = 8.33). This suggests that managers may have job responsibilities or personal preferences that predispose them to working on-site. Additionally, the significant odds ratio implies that managers might possess more autonomy in their decision-making regarding their work location, facing fewer restrictions in choosing whether to work from home or the office. Income level appeared as a non-significant factor for non-telecommuters by choice, with higher-income individuals (>125k) slightly more likely to be non-telecommuters by choice (B = −0.48, $p = 0.35$, odds ratio = 0.62), but again this was not statistically significant.

In the same multivariate nominal logistic (MNL) model, distinctive factors were identified for individuals who are non-telecommuters due to employer restrictions. This category includes those who could potentially telecommute but are not permitted to do so by their employer. When looking at occupational categories, academic staff or students are particularly affected by employer restrictions on telecommuting. They are significantly more likely to be non-telecommuters due to employer policies (B = 2.41, $p = 0.01$, odds ratio = 11.18) compared to the contingency telecommuters. This could be due to the nature of academic work, which often requires on-site presence for activities such as teaching, laboratory work, or other in-person responsibilities. Moreover, managerial positions also show a significant effect (B = 0.65, $p = 0.41$, odds ratio = 1.91), suggesting that while managers are more likely to have the autonomy to work from home, they might also face company policies that limit this option. This is a lower odds ratio than seen in the non-telecommuter by choice category, implying that while managers have a higher likelihood of being non-telecommuters, the effect of employer policy is less pronounced in this occupational group.

Within the multivariate nominal logistic (MNL) framework, analysing the factors influencing regular telecommuters—those who telecommute at least once a week—yields intriguing insights. Regular telecommuters are distinguished from those who telecommute under exceptional circumstances only. One notable finding is the significant impact of living more than 20 km from the central business district (CBD). Individuals in this category are significantly more likely to be regular telecommuters (B = 1.13, $p = 0.03$, odds ratio = 3.08) compared to the reference group. This suggests that the greater the distance from the CBD, the higher the propensity to telecommute regularly, possibly due to longer commute times and the convenience that telecommuting offers. Occupational roles also play a pivotal role in regular telecommuting. Notably, those in professional scientific and technical services are significantly more likely to telecommute regularly (B = 1.65, $p < 0.01$, odds ratio = 5.19), underscoring the flexibility and possible work-from-home compatibility of such jobs. Additionally, managerial positions also show a high likelihood of regular telecommuting (B = 1.20, $p = 0.05$, odds ratio = 3.33), suggesting that managerial duties can often be fulfilled remotely, aligning with the trend towards more flexible working arrangements in such roles. Regarding income, individuals earning more than 125k are more likely to be regular telecommuters (B = 0.71, $p = 0.06$, odds ratio = 2.04), hinting at a correlation between higher income levels and the likelihood of telecommuting. This may reflect the nature of higher-paying jobs that often offer greater flexibility or the ability for these individuals to create a conducive environment for telecommuting at home.

In the context of contingency telecommuting, a significant finding emerges indicating a higher propensity for individuals in clerical/administrative roles to opt for contingency telecommuting over regular telecommuting (B = −1.21, $p = 0.03$, odds ratio = 0.29). The negative odds ratio of 0.29 suggests that those in clerical/administrative positions are approximately 3.45 times more likely to engage in contingency telecommuting compared to regular telecommuters. This interpretation stems from the negative sign of the odds ratio, indicating a reduced likelihood, leading to the calculation (1/0.29) resulting in a multiplier of approximately 3.45.

Table 2. Multinomial logit model results for classifying telecommuters.

Item	Y = Non-Telecommuter by Choice			Y = Non-Telecommuter by Employer Policy			Y = Regular Telecommuter		
	B	*p*-Value	Odds Ratio	B	*p*-Value	Odds Ratio	B	*p*-Value	Odds Ratio
CBD_0–5 km ***	3.49	0.01	32.86	−0.81	0.22	0.44	0.17	0.78	1.18
CBD_5–10 km *	-	-	-	-	-	-	-	-	-
CBD_10–15 km **	-	-	-	-	-	-	-	-	-
CBD_15–20 km *	−0.20	0.85	0.82	−1.02	0.14	0.36	−1.01	0.12	0.36
CBD_>20 km ***	1.08	0.23	0.93	−0.55	0.37	0.58	1.13	0.03	3.08
CTT_<20 min *	−0.53	0.47	0.59	0.96	0.02	2.62	0.03	0.95	1.03
CTT_20–40 min *	−0.66	0.39	0.52	0.43	0.57	1.54	−0.72	0.21	0.49
CTT_40–60 min **	-	-	-	-	-	-	-	-	-
CTT_>60 min *	0.35	0.65	1.42	0.82	0.31	2.26	0.07	0.91	1.07
Mod_Car *	1.05	0.21	2.87	0.65	0.35	1.91	0.06	0.92	1.06
Mod_Tram **	-	-	-	-	-	-	-	-	-
Mod_Bus *	1.73	0.08	5.65	−0.67	0.47	0.51	0.25	0.72	1.29
Mod_Train *	1.92	0.06	6.81	0.51	0.56	1.67	0.36	0.63	1.43
Mod_Active *	0.30	0.76	1.34	0.14	0.85	1.15	0.61	0.29	1.84
Cty_further *	0.28	0.66	1.33	0.50	0.41	1.65	0.18	0.71	1.19
Cty_closer *	0.43	0.55	1.53	0.92	0.16	2.52	0.42	0.43	1.53
Cty_same **	-	-	-	-	-	-	-	-	-
Rsn_Rnd_tele_Family *	-	-	-	-	-	-	-	-	-
Rsn_Rnd_tele_Weather *	-	-	-	-	-	-	-	-	-
Rsn_Fixed_Tele *	-	-	-	-	-	-	-	-	-
Emp_PT_and_ST *	-	-	-	-	-	-	-	-	-
Emp_FT_and_+1PT *	-	-	-	-	-	-	-	-	-
Emp_Casual_or_RT **	-	-	-	-	-	-	-	-	-
Ind_Education_and_Training *	-	-	-	-	-	-	-	-	-
Ind_Arts_and_Recreation_Services *	-	-	-	-	-	-	-	-	-
Ind_Information Media_and_Telecommunications *	-	-	-	-	-	-	-	-	-
Ind_Manufacturing *	-	-	-	-	-	-	-	-	-
Ind_Mining **	-	-	-	-	-	-	-	-	-
Ind_Transport_Postal_and_Warehousing *	-	-	-	-	-	-	-	-	-
Ind_Accommodation_and_Food_Services *	-	-	-	-	-	-	-	-	-
Ind_Trade *	-	-	-	-	-	-	-	-	-
Ind_Public_Administration_and_Safety *	-	-	-	-	-	-	-	-	-
Ind_Financial_and_Insurance_Service s*	1.15	0.25	3.17	0.86	0.37	2.37	0.61	0.48	1.84
Ind_Administrative_and_Support_Services *	-	-	-	-	-	-	-	-	-
Ind_Health_Care_and_Social_Assistance *	-	-	-	-	-	-	-	-	-
Ind_Construction *	-	-	-	-	-	-	-	-	-
Ind_Electricity_Gas_Water_and_Waste_Services *	-	-	-	-	-	-	-	-	-
Ind_Rental_Hiring_and_Real_Estate_Services *	-	-	-	-	-	-	-	-	-
Ind_Professional_Scientific_and_Technical_Services ***	0.49	0.51	1.63	0.64	0.35	1.90	1.65	0.00	5.19
Ocu_Professional_e.g.,_Engineering_Health_IT_etc *	1.22	0.12	3.37	0.47	0.48	1.60	0.39	0.45	1.48
Ocu_Clerical_administrative ***	−1.52	0.13	4.56	−1.15	0.26	0.32	−1.21	0.03	0.29
Ocu_Sales_workers *	-	-	-	-	-	-	-	-	-
Ocu_Academic_staff_or_student ***	1.22	0.26	3.40	2.41	0.01	11.18	1.04	0.18	2.83
Ocu_Managerial_position ***	2.12	0.01	8.33	0.65	0.41	1.91	1.20	0.05	3.33
Ocu_Community_and_personal_service *	-	-	-	-	-	-	-	-	-
Ocu_Machinery_operator_or_driver **	-	-	-	-	-	-	-	-	-
Ocu_Technician_or_trade *	-	-	-	-	-	-	-	-	-
Edu_BSc_and_above *	-	-	-	-	-	-	-	-	-
Edu_Below_BSc **	-	-	-	-	-	-	-	-	-
Age_20–35 **	-	-	-	-	-	-	-	-	-
Age_35–50 *	-	-	-	-	-	-	-	-	-
Age_50+ *	-	-	-	-	-	-	-	-	-
HHS_1 *	-	-	-	-	-	-	-	-	-
HHS_2 *	-	-	-	-	-	-	-	-	-
HHS_3+ *	-	-	-	-	-	-	-	-	-
Kid_0 *	-	-	-	-	-	-	-	-	-
Kid_1 *	−0.42	0.53	0.66	0.53	0.38	1.70	0.60	0.24	1.82
Kid_2 *	−0.78	0.19	0.46	−0.68	0.21	0.50	−0.39	0.38	0.68
Kid_3+ **	-	-	-	-	-	-	-	-	-
Car_0 **	-	-	-	-	-	-	-	-	-
Car_1 *	−0.04	0.94	0.96	−0.16	0.73	0.85	0.20	0.61	1.22
Car_2 *	-	-	-	-	-	-	-	-	-
Car_3+ *	-	-	-	-	-	-	-	-	-
Inc_10k–60k *	-	-	-	-	-	-	-	-	-
Inc_60k–125k *	-	-	-	-	-	-	-	-	-
Inc_>125	-	0.35	0.62	−0.43	0.37	0.65	0.71	0.06	2.04

*: dropped by RFE or VIF; **: dropped to be a reference; ***: *p*-value is significant <0.05; Car: no. of cars; HHS: no. of household members; Ind: industry; Oc: occupation; Edu: education; Inc: income; Rsn: main reason for telecommuting; EmpPT: part-time employment; EmpFT: full-time employment; Kid: no. of kids; Mod: main commuting mode; Cty: possible future house location; CTT: commuting time; CBD: distance from CBD to home; Work: distance from work to home.

Figure 6 lists the top reasons for working from home for those who indicated a positive frequency of working from home. The reasons included personal choices such as needing to be home to do other chores, followed by having a pre-agreed schedule with the employer or manager. Adverse weather conditions were also a factor for some people in their daily choices. Interestingly, a significant percentage of respondents indicated that they work from home when they must do drop-off and pick-up trips. This suggested that flexible

working arrangements, such as working from home, can help individuals balance work and personal responsibilities.

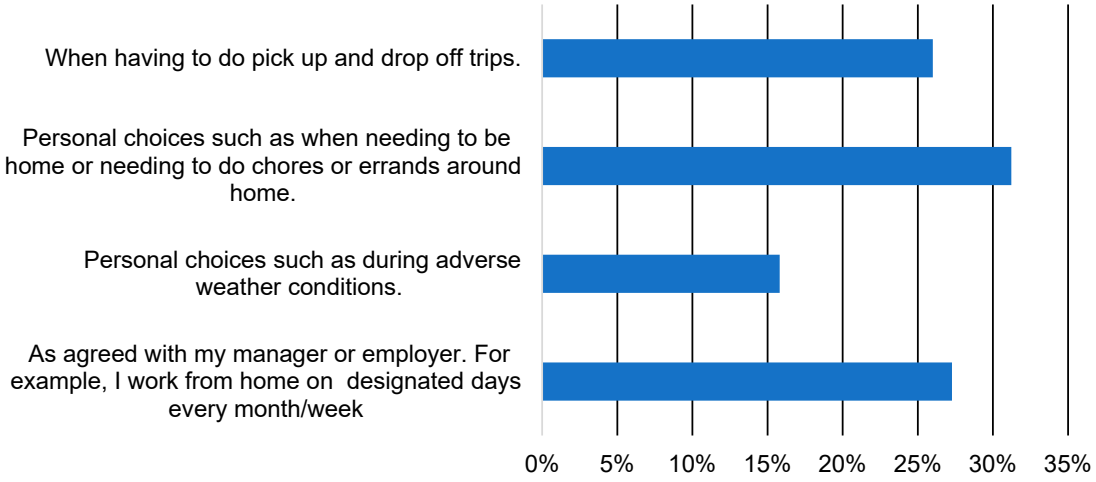

Figure 6. Factors impacting telecommuting decision.

Figure 7 shows the change in frequency of telecommuting. About 30% of telecommuters had no experience of telecommuting before the pandemic. This suggests the pandemic may had introduced 30% of the sample to the working from home phenomenon for the first time. In addition, the percentage of workers who telecommuted 3–4 days each week increased from 6% before the pandemic to 26% after the pandemic, indicating that more workers shifted to full-time or near-full-time remote work after the pandemic. The most common telecommuting frequency before the pandemic was 1–2 days each week (21% of respondents), which could suggest that this option was popular among workers who wanted some flexibility and balance between home and office work. Interestingly, the most preferred telecommuting frequency after the pandemic was also 1–2 days each week (but a much larger percentage, around 41% of respondents), which could indicate this option remained attractive for workers who could not or did not want to telecommute daily.

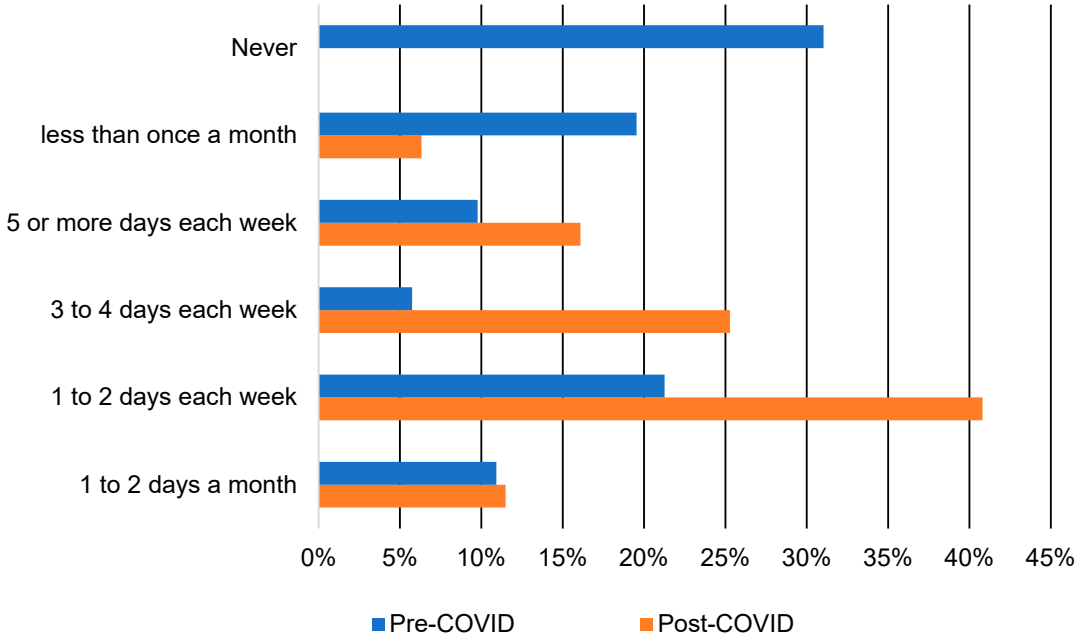

Figure 7. Change in frequency of telecommuting.

Figure 8 shows that post-COVID telecommuting was more frequent among higher-income groups than lower-income groups. For example, 66% of people who earned more than AUD 100k telecommuted 3 to 4 days each week, while only 2% of people who earned AUD 40k or less telecommuted. Higher-income workers may have more autonomy, motivation, and resources to work from home effectively, while lower-income workers may face more challenges, such as lack of space, equipment, or support. Figure 9 also shows that post-COVID telecommuting is less frequent among the lowest and highest income groups than the middle-income groups. For example, only 22% of people who earned more than AUD 100k telecommuted less than once a month, while 40% of people who earned AUD 60k–80k telecommuted. This may be attributed to the fact that the lowest and highest-income workers have more extreme preferences or constraints regarding telecommuting, while middle-income workers have more balanced or mixed views. Income by telecommuting frequency.

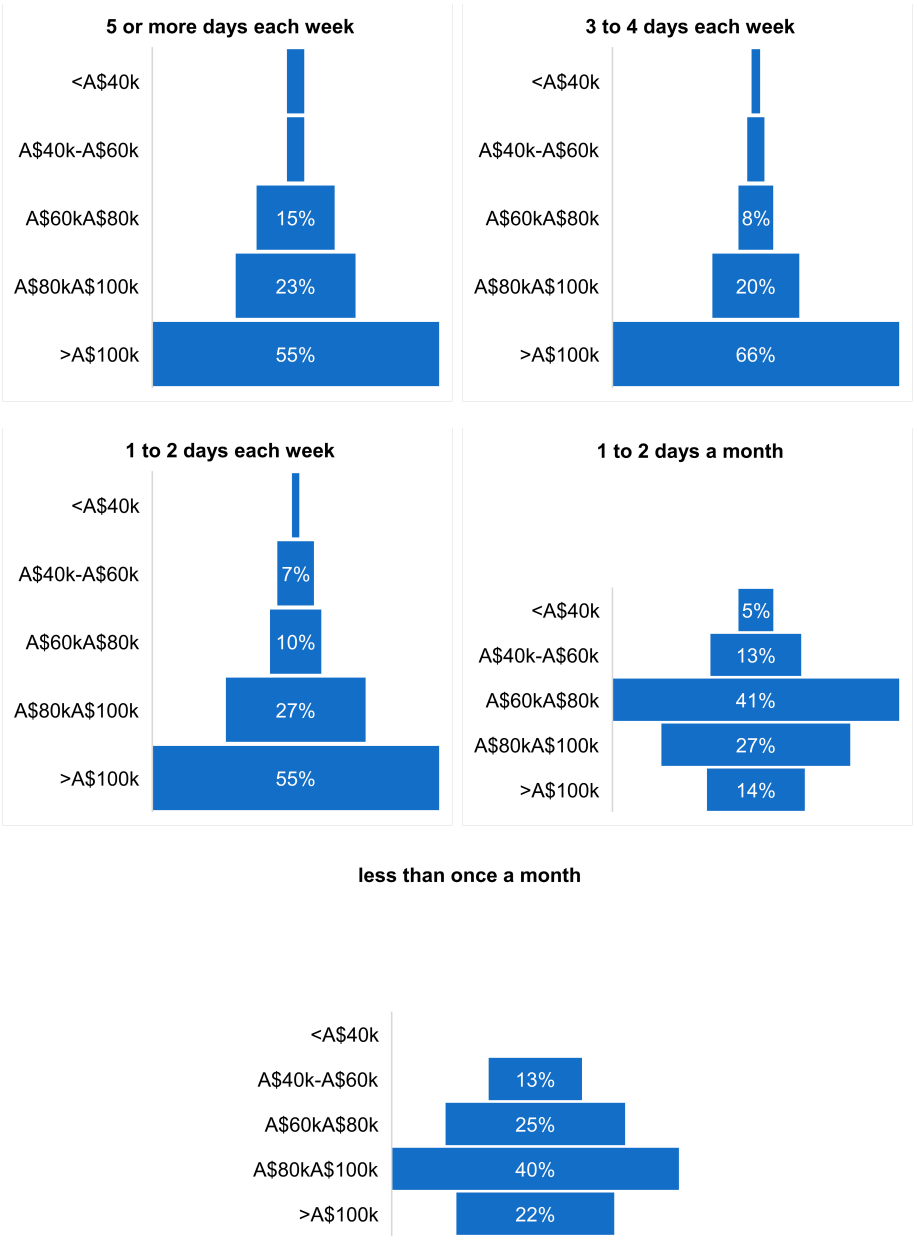

Figure 8. Post-COVID telecommuting frequency by income.

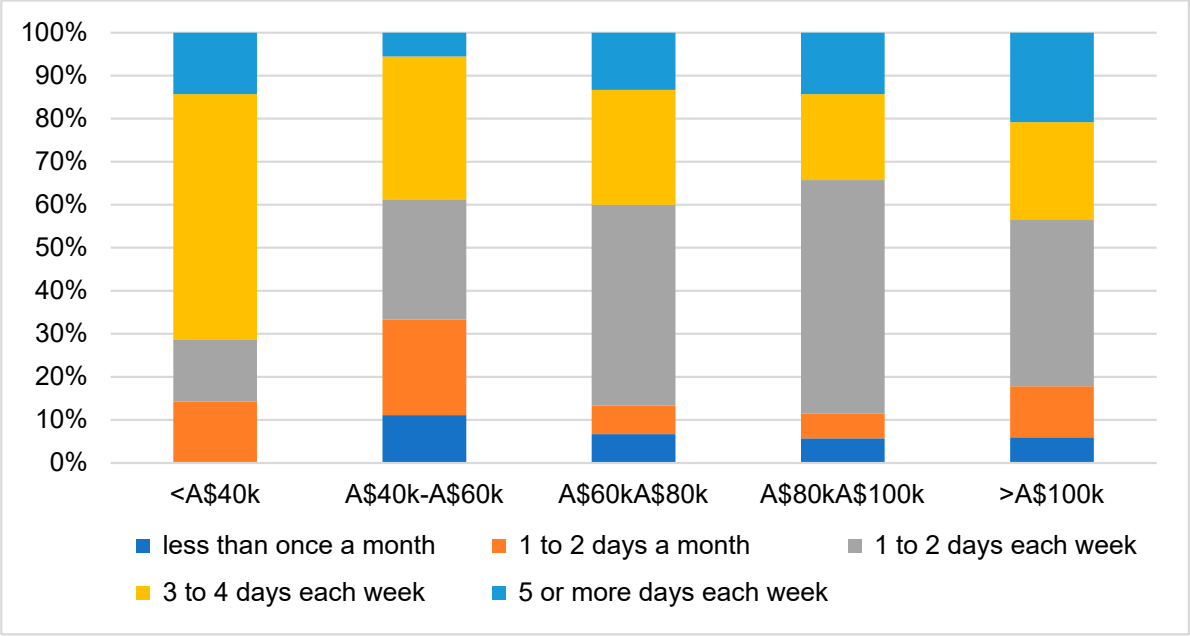

Figure 9. Post-COVID income by telecommuting frequency.

Figure 9 displays the relationship between income levels and telecommuting frequency. Notably, there is a distinct pattern for individuals working from home five days a week: their proportion increases with increasing income. Conversely, for those who telecommute less than once a month, their proportion decreases as income goes up. For other telecommuting frequencies, no consistent trend is evident.

3.2. Changes in Work and Commuting Behaviour

In the survey, respondents were asked to indicate how late they could afford to arrive to work, with different time intervals provided ranging from the need to be on time to flexible arrival times of up to 60 min. Respondents were asked to reflect on this question as it related to them before and after COVID. The findings, provided in Figure 10, show that when comparing current versus pre-COVID conditions, there was a considerable reduction in the percentage of individuals who had to be at work on time at a specified time, and an increase in the percentage of individuals who could afford to arrive late.

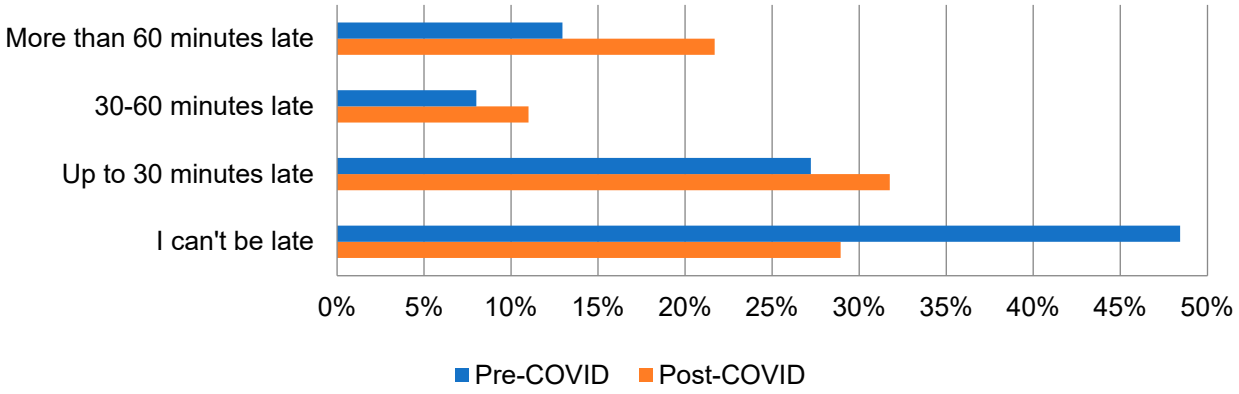

Figure 10. Work arrival flexibility.

These results suggest a shift towards greater flexibility in work schedules, likely due to the pandemic's impact on work culture. The trend is also consistent with findings in Figure 11 which show that the number of people commuting to work during peak hours (7 am–9 am) decreased from 77% before COVID to around 61% at the time of the survey.

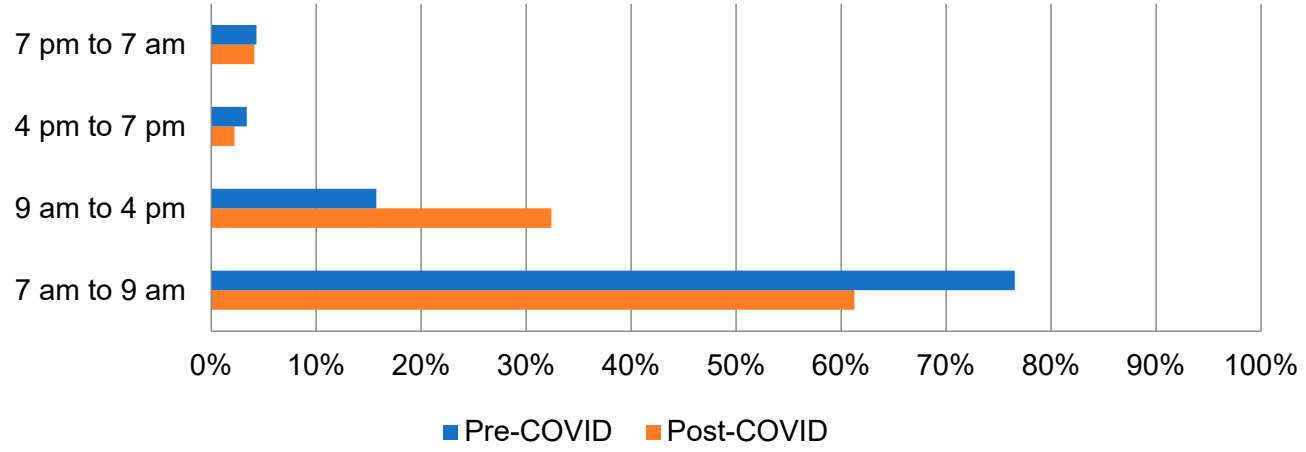

Figure 11. Time of commuting to work.

This was accompanied by a corresponding increase in the percentage of individuals who travelled to work during off-peak hours (9 am–4 pm). The number of people commuting to work during overnight hours (7 pm–7 am) remained unchanged at 4%. This is likely because these work hours were typically reserved for essential jobs. When considering the time when people left work to go home (Figure 12), the results suggest that flexibility in work schedules did not affect the time people left their workplace compared to before COVID.

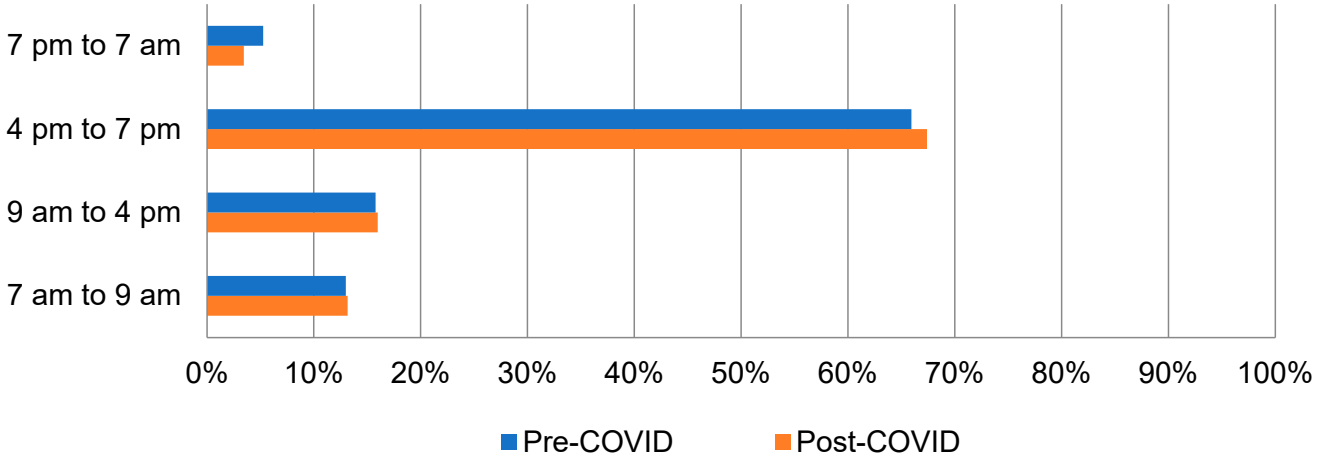

Figure 12. Time of leaving work.

The number of commuting trips by car and public transport are shown in Figure 13. The data shows that prior to COVID-19, private cars were the most preferred mode of transport, with 43% of respondents using private cars for five or more days per week. This decreased to 31% after the pandemic, which could be attributed to the increase in remote work arrangements, which reduced the need for commuting to work. Similarly, the number of people using public transport for five or more days per week decreased from 12% before the pandemic to only 6% after the pandemic. This change may also be attributed to work from home arrangements in addition to people's concerns about catching the virus on public transport. These results indicate that people's overall travel frequency using private cars and public transport decreased after the pandemic at the time of undertaking this survey.

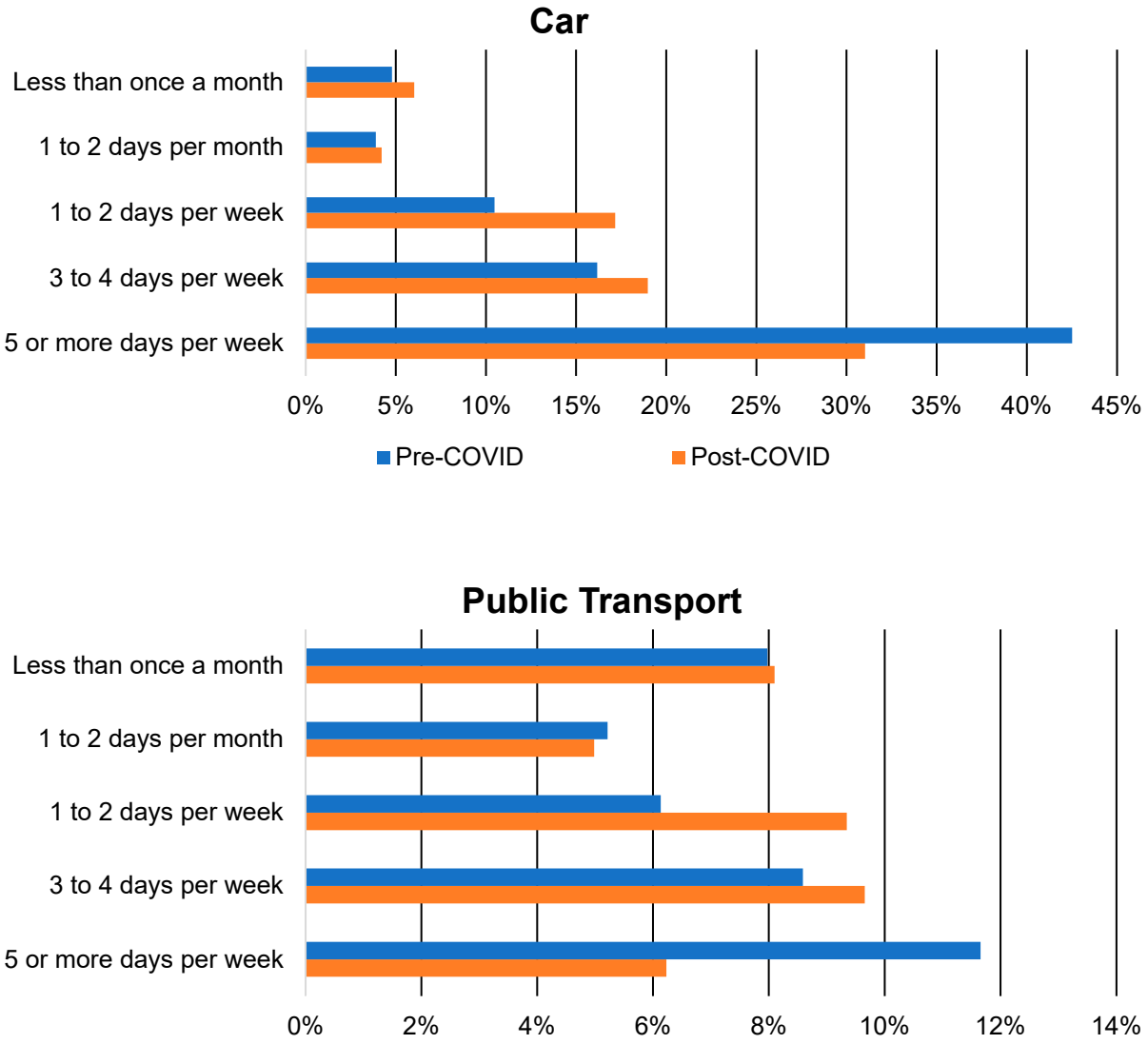

Figure 13. Changes in number of commuting trips by car and public transport.

3.3. Future Telecommuting Behaviour

This section discusses respondents' decisions and responses related to opportunities for working from home in the future.

3.3.1. Telecommuting Frequency

Figure 14 compares the number of days respondents would like to work from home in the future compared to their current preferences. The diagram shows most respondents currently work from home 1–2 days a week (39% of respondents), while in the future, most respondents indicated they would prefer to work from home 3–4 days a week (41% of respondents). This suggests that many respondents have found the experience of working from home to be positive and are now looking to increase the amount of time spent working remotely.

Another remarkable shift is that the percentage of respondents who currently work from home 1–2 days a month (16% of respondents) is higher than the percentage of respondents who would like to work from home 1–2 days a month in the future (only 4% of respondents). This suggests that while some workers may have found occasional remote work to be helpful in the past, they now prefer to have more flexible remote work options. The percentage of respondents currently working from home five or more days a week (21% of respondents) is lower than the percentage of respondents who would like to work

from home five or more days a week in the future (25% of respondents). This suggests that some workers who were not previously able to work from home full-time have found it to be a viable option and would like to continue doing so in the future.

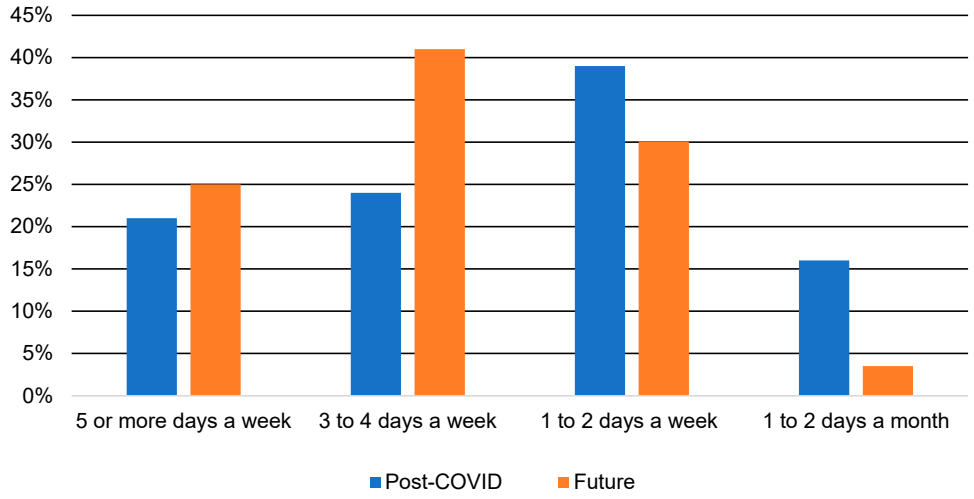

Figure 14. Comparison between current and future potential telecommuting frequency.

3.3.2. Attitudes towards Job Changes for Remote Work Arrangements

Figure 15 presents the respondents' answers to a hypothetical question about whether they would change their job if their employers do not allow them to work from home. Most of the respondents (47% of respondents) said they would not change their job for an alternative position that allows them to work from home. This could indicate that they do not see remote work as a priority or a benefit, or that there are other factors that influence their job choice, such as salary, career growth, or company culture. Around 25% of respondents indicated, however, that they would change their jobs for an alternative that allows them to work from home. Similarly, this could imply that they value remote work as a desirable option and are willing to switch jobs for it. A smaller proportion of the respondents (15%) were uncertain whether they would change their jobs, which could reflect their mixed feelings or opinions about remote work and its advantages and disadvantages. It could also mean they are unsure about their future career plans.

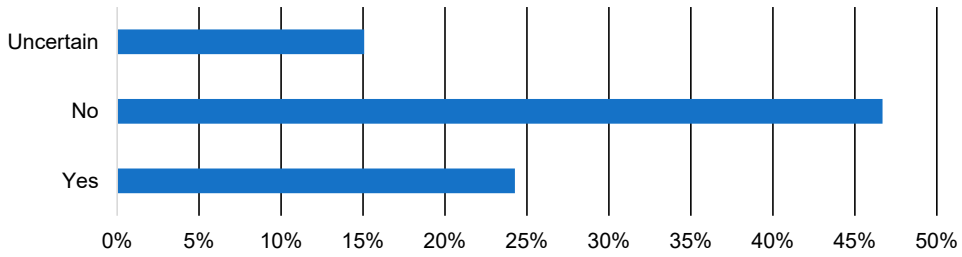

Figure 15. Attitudes towards job changes for remote work arrangements.

3.3.3. Work-from-Home Day Preferences

Figure 16 shows respondents' preferred commuting days based on five levels of commuting frequencies. The data show that most people who worked from home tended to do so on Mondays and Fridays, with the highest percentage of people working from home on Fridays. The data also show that those who worked from home 1–2 days each week tended to spread out their work from home days, with the highest percentages occurring on Mondays, Wednesdays, and Fridays. On the other hand, those who worked from home 3–4 days per week tended to work from home mostly on Mondays, and those who worked from home 5 or more days each week tended to work from home mostly on

Mondays and Fridays. This suggests that people who work from home less frequently (i.e., 1–2 days per month or less than once a month) have less structured schedules. For example, on days that they worked from home, they may do so on a more random or ad-hoc basis, with the highest percentage of work-from-home occurring on random days (51% of respondents). In contrast, those who worked from home more frequently (3–4 days per week or 5 or more days per week) had more structured schedules with most of their work-from-home days occurring on specific days of the week (e.g., Mondays, Wednesdays, or Fridays). In contrast, those who worked from home less frequently may have more flexibility in their schedules and may be able to work from home on a more ad-hoc basis when it is convenient for them.

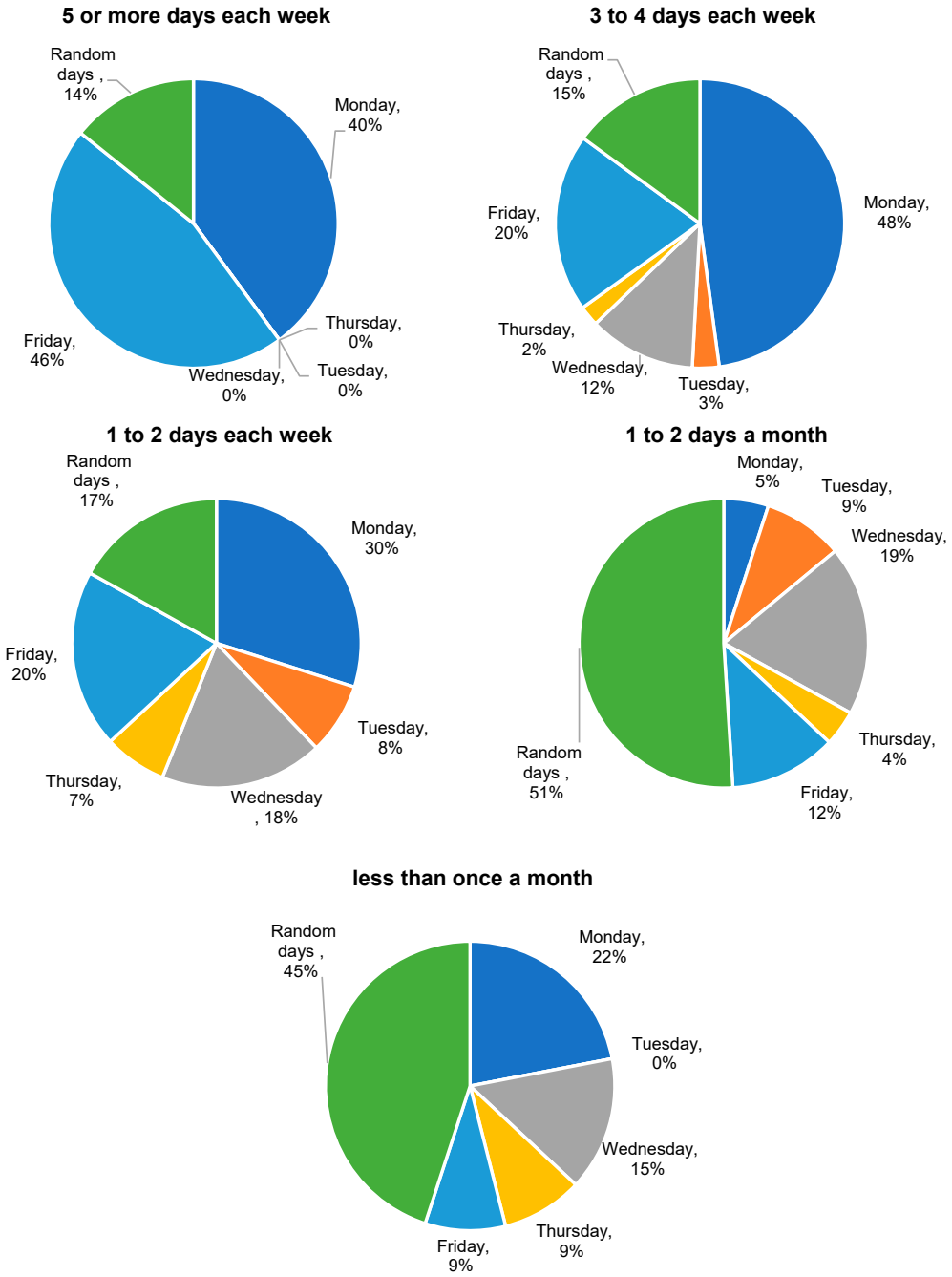

Figure 16. Telecommuting frequency and work-from-home day preferences.

3.3.4. Residential Location

Figure 17 shows that the frequency of working from home has a strong influence on house location decision making. In general, the more often people worked from home, the more likely they were to consider living further away from the city and the less likely to consider living closer to the city or to consider that working from home would not affect their house location. The data also show that there is a significant difference between the groups that worked from home 3–4 days each week and 5 or more days each week. The former group had the highest percentage of people who would consider living further away from the city (65% of respondents), while the latter group had the lowest percentage of people who would consider living closer to the city (22% of respondents). This suggests that the more frequently people work from home, the more likely they are to consider living further from the city. However, there seems to be a threshold beyond which this trend does not continue. The data suggest that people who worked from home less frequently (1–2 days a month or less) believed that working from home does not affect their house location decisions compared to those who work from home more frequently (1–2 days each week or 3–4 days each week). This could imply that they have other factors that determine their house locations, such as family, lifestyle, or budget. It could also mean they do not see working from home as a long-term option and expect to return to the office in the future.

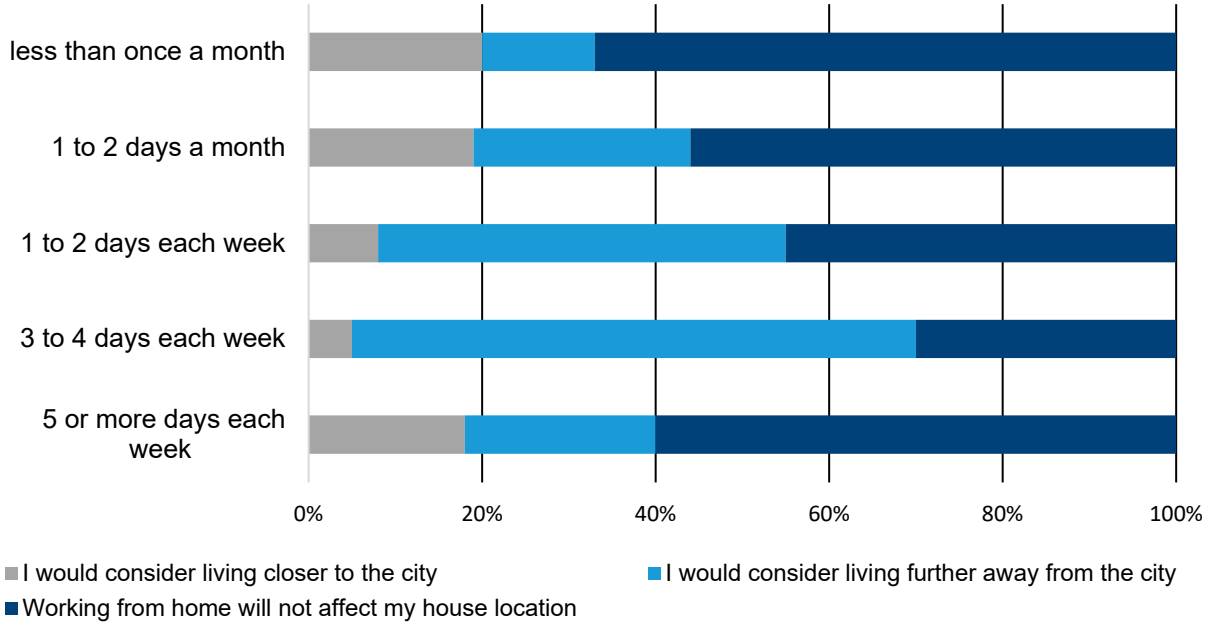

Figure 17. Influence of telecommuting frequency on residential location.

It is critical to acknowledge that the relationship between telecommuting and residential choices is complex and potentially bidirectional, where the convenience of working remotely can influence where people choose to live and vice versa. This interaction is further complicated by self-selection bias, as individuals may choose their living environment based on their telecommuting preferences or job requirements, leading to skewed data interpretations. Recognizing these intricacies is crucial, as the evolving preferences for residential locations and telecommuting reflect a mix of personal lifestyle choices, job demands, and socio-economic factors. This nuanced understanding highlights the need for urban planning and policymaking to adopt a comprehensive approach that accommodates the diverse and changing needs of a workforce leaning towards more flexible and remote working arrangements.

3.4. Change in Non-Commuting Behaviour

Figure 18 shows the frequency distribution of car trips and active trips (walking or cycling) for leisure and shopping purposes, before and after COVID-19. Starting with car trips for leisure, there is a decrease in the number of respondents who took car trips less than once a month, and an increase in respondents who took car trips 1–5 times a month and 2–4 times a week. This may indicate that respondents were seeking more recreational activities outside their homes after COVID-19. Car trips for shopping decreased in frequency, especially in the 2–4 trips a week and 5+ trips a week categories. This shift suggests that people are reducing the frequency of their shopping trips and consolidating them into fewer, longer trips or shifting to online shopping. This is also the case for active shopping trips, where the frequency of the 2–4 trips a week and 5+ trips a week declined after COVID. However, active trips for leisure have increased in frequency, especially in the 2–4 trips a week and 5+ trips a week categories. This may indicate that people are more health-conscious or enjoy outdoor activities more after COVID, or that they have more free time or flexibility in their schedules, allowing them to enjoy more leisurely travel.

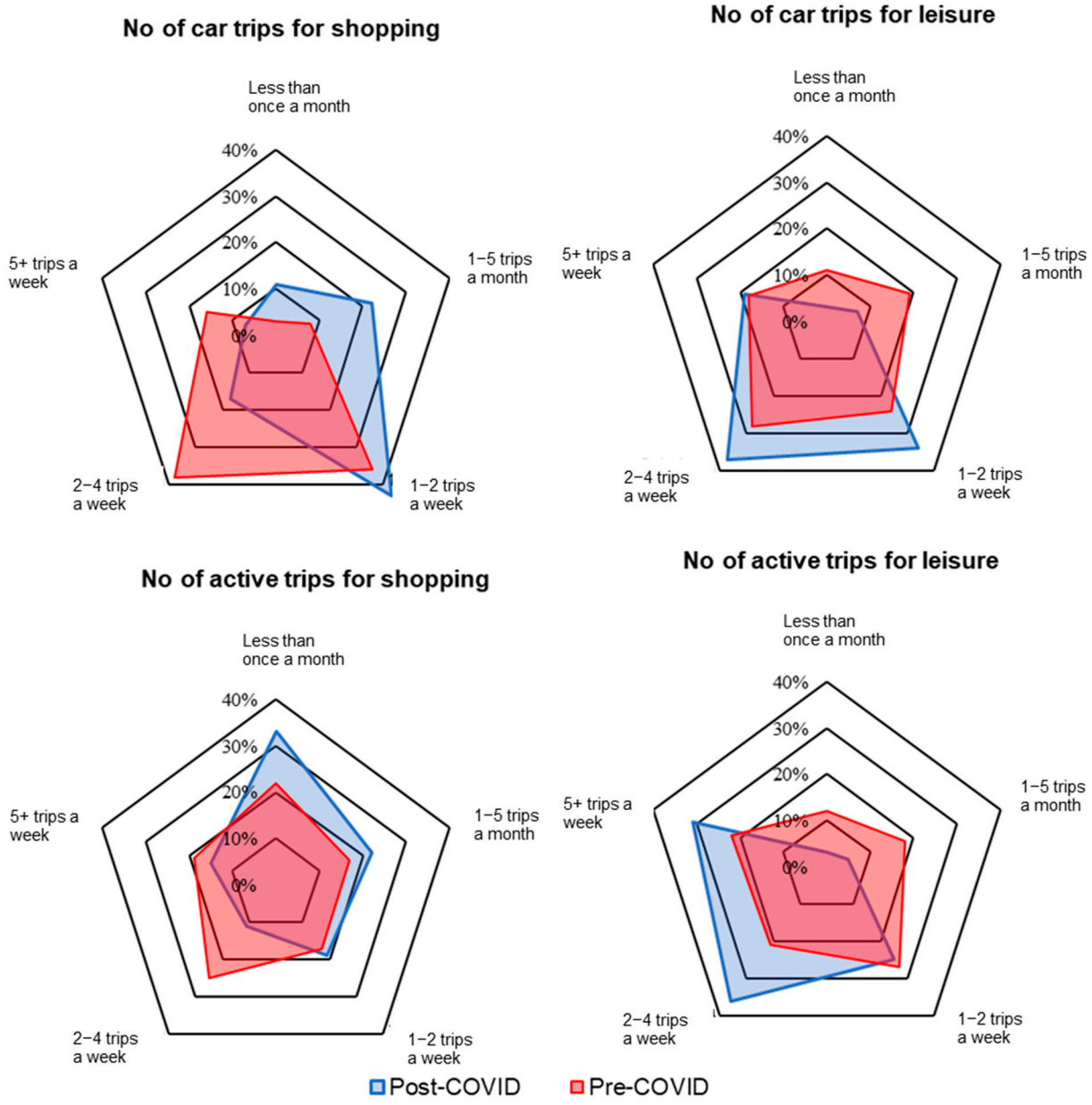

Figure 18. Changes in non-commuting trip frequency.

4. Discussion

The study was developed to provide answers to the research questions listed earlier in this paper. To answer RQ1 relating to the impact of COVID on telecommuting behaviour, the data reveal a surge in telecommuting prevalence following the COVID-19 pandemic. Prior to this global event, only 31% of respondents possessed and exercised the option to work from home, in contrast to 57% post-pandemic. Despite the augmentation in the proportion of individuals with the ability to work remotely, certain employers mandated office presence for their workforce. This circumstance was reported by 30% of respondents pre-pandemic, and by a reduced 8% of respondents at the survey period. Additionally, an appreciable segment of respondents cited the infeasibility of remote work due to the specific requirements of their job roles. This segment slightly declined from 17% before the advent of COVID-19 to 14% at the time of data collection; nonetheless, it continues to represent a substantial fraction of the workforce.

As for RQ2, the leading motivations behind choosing to work from home, personal reasons topped the list, such as accomplishing household tasks. A pre-agreed remote work schedule with employers or managers was another strong motivator, along with inclement weather conditions. Remarkably, many respondents indicated their choice to work from home was influenced by school drop-off and pick-up duties, suggesting that flexible working arrangements could indeed assist individuals in maintaining a work–life balance.

The study found that this transition towards telecommuting has induced a variety of modifications in travel demand and behaviour among the Adelaide respondents. This was investigated to address RQ3. A prominent effect observed is the decrease in frequency of commuting trips by private cars and public transport. The reduction in commuting trips suggests a decrease in overall travel frequency after the pandemic. The greater flexibility in work schedules experienced by the respondents resulted in a decrease in the number of employees commuting during peak hours. This shift has the potential to alleviate traffic congestion and reduce the strain on transportation infrastructure during peak periods. Furthermore, the study revealed a decrease in car trips for shopping and an increase in active trips for leisure. The decrease in car trips for shopping may indicate a consolidation of shopping activities, where individuals make fewer but more efficient trips to fulfil their shopping needs. This behaviour can contribute to reduced travel distances, fuel consumption, and congestion associated with shopping-related trips. Additionally, the increase in online shopping may have led to a reduction in car trips altogether, further contributing to a decrease in travel demand and associated environmental impacts. The study also found an increase in active leisure trips, which might reflect a heightened interest in outdoor activities; this might have been influenced by the increased flexibility and autonomy that telecommuting offers. This suggests a positive shift towards sustainable modes of transportation. This shift aligns with efforts to promote active mobility options such as walking and cycling, which have numerous health and environmental benefits. Encouraging active travel can lead to improved public health, reduced carbon emissions, and enhanced urban liveability.

RQ4 concerned the relationship between socio-demographic characteristics and working from home. The findings from a multivariate nominal logistic (MNL) model suggest that telecommuting patterns in Adelaide vary significantly across different socio-economic strata, influenced by factors such as distance from the CBD, occupational roles, and income levels. Individuals living more than 20 km from the CBD are more likely to be regular telecommuters, likely due to the longer commute times making telecommuting a more convenient option. Those in professional, scientific, and technical services, along with managerial positions, show a higher propensity for regular telecommuting, reflecting job flexibility and the potential for remote work within these roles. Furthermore, higher-income individuals, earning more than 125k, are more likely to telecommute regularly, suggesting that greater financial resources may facilitate the creation of a conducive telecommuting environment at home.

To address RQ5, which aimed to examine future attitudes and implications of telecommuting for Adelaide, the results showed a significant proportion of respondents had expressed a desire for increased telecommuting, particularly working from home for 3–4 days per week in the future. This finding suggests that the shift towards telecommuting is likely to persist even after the pandemic subsides. This also suggests that telecommuting has positively influenced individuals' work–life balances, providing them with greater flexibility and autonomy over their work schedules. Despite that, the results showed that some employees are constrained from autonomously deciding to telecommute and are obligated to return to their office workplaces, which is consistent with current tensions between employers and employees in cities around the world (Shields, 2021). The frequency of working from home also appears to influence individuals' preferences for their house location in the future, indicating the potential impact of telecommuting on commuting patterns and urban sprawl. As more individuals express a desire for increased telecommuting, it may impact urban development patterns, such as a potential shift towards suburban or rural areas. This finding has important implications for urban planners and policymakers, who need to consider the changing dynamics of residential location preferences and adapt future planning strategies accordingly. The analysis also revealed that individuals who worked from home 3–4 days each week tended to have more structured schedules, with most of their work-from-home days occurring on specific days of the week, such as Mondays, Wednesdays, and Fridays. In contrast, those who worked from home less frequently (1–2 days per month or less than once a month) had less structured schedules and worked from home on a more ad-hoc basis when it was convenient for them. This pattern suggests that these individuals coordinated their work-from-home days with other activities, such as childcare or household chores, which also occurred on a regular schedule. The results also showed that telecommuters exhibited a tendency to plan their telecommuting schedules ahead of time, resulting in varied weekly commuting patterns based on the frequency of telecommuting. This created an uneven distribution of commuting patterns throughout the week and highlighted that telecommuting plans were typically medium-to-long-term in nature, which contradicts the underlying assumptions of conventional travel-demand forecasting models. However, these results can be used to inform the development of predictive models that can estimate the number of telecommuting days per week and determine which specific days of the week should be prioritised for telecommuting.

5. Policy Implications and Future Research Directions

Distance from the CBD significantly affects the propensity to telecommute, with those living farther away more inclined to embrace telecommuting. This observation underscores the importance of integrating telecommuting strategies within sustainable transport models and urban planning. By acknowledging how shifts in telecommuting patterns can influence demand for public transport and road use, planners can better address sustainability goals, reducing carbon emissions and minimizing urban sprawl. Furthermore, the current tax frameworks in many jurisdictions incentivize telecommuting by allowing individuals to claim deductions for home office expenses but not for commuting costs. This discrepancy highlights an area where policy adjustments could promote more sustainable commuting behaviours. For example, if transport authorities were to enable individuals to claim expenses for commuting by public transport, it could serve as a powerful incentive to bolster public transport demand. Such a policy shift could lead to a more sustainable and efficient use of the transport system, aligning with broader environmental objectives by encouraging a shift away from car dependency towards more eco-friendly commuting options.

It is also crucial to acknowledge another layer of complexity, as the results also suggested that individuals who work from home more frequently may use the time saved from commuting for additional recreational trips. While this shift reduces congestion during peak hours, it does not necessarily decrease overall emissions and pollution. The potential increase in recreational travel could offset the environmental benefits gained by reducing

daily commutes. This observation necessitates further investigation to quantify the net impact of telecommuting on emissions and pollution comprehensively.

The correlation between high income levels and a greater likelihood of telecommuting suggests that financial resources play a role in the feasibility of remote work. This disparity indicates a need for policies that democratize access to telecommuting, ensuring that individuals across all income levels can benefit from the flexibility it offers. Providing support for home office setups or co-working spaces in diverse neighbourhoods can help bridge this gap, ensuring that telecommuting is an accessible option for more workers.

The nuanced relationship between geographical proximity to the central business district (CBD) and telecommuting preferences underlines a critical challenge in sustainable urban planning. Individuals living closer to the CBD are often less inclined to telecommute, attracted by the convenience, amenities, and vibrancy of urban centres. This dynamic emphasizes the importance of designing urban and transport policies that encourage mixed-use developments, integrating residential and commercial spaces to reduce the reliance on commuting to the CBD. By enhancing public transportation and making it a more viable option for those living farther from the CBD, cities can potentially increase the appeal of telecommuting by providing reliable and sustainable alternatives to personal vehicle use. Adopting such strategies not only accommodates diverse commuting preferences but also supports sustainable urban growth. These measures can help mitigate congestion in CBD areas, lower carbon emissions, and promote a more balanced and environmentally friendly urban development paradigm.

The impact of employer restrictions on telecommuting, notably among academic staff and students, highlights the intersection of institutional policies and the nature of specific job functions. This situation calls for organizations, especially educational institutions, to reconsider telecommuting policies, ensuring they align with the realities of academic work while leveraging technology to facilitate remote access to educational resources. Tailoring policies to support telecommuting where feasible can help balance the need for physical presence with the benefits of remote work, thereby enhancing flexibility and productivity.

While the paper highlighted the significant increase in telecommuting and the potential long-term impacts on travel behaviour, there are several arguments that could be proposed for further discussion and exploration:

- Environmental considerations: The paper discussed the positive implications of telecommuting for reducing congestion and spreading peak travel demand. While these benefits are significant, it is essential to also consider the environmental impacts holistically. Telecommuting relies on the use of technology, which requires energy and resources for production and maintenance. Additionally, employees working from home may consume more energy for heating, cooling, and other utilities. A comprehensive analysis should include a life-cycle assessment of telecommuting, considering both direct and indirect environmental effects, to accurately evaluate its overall sustainability.
- Urban development and land use: The study indicated that frequent telecommuting may influence residential location decisions, leading individuals to choose locations further away from city centres. This aspect requires further exploration in terms of its impact on urban development and land-use patterns. While telecommuting can reduce the need for commuting, it may also contribute to urban sprawl, increased transportation demand for non-work trips, and changes in land-use dynamics. Understanding the long-term implications of telecommuting on urban development is crucial for sustainable urban planning and transportation infrastructure design.

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Informed Consent Statement: Informed consent was obtained from all survey participants.

Data Availability Statement: The source survey data used in this study are not publicly available in compliance with privacy provisions stipulated in the research ethics approval. Only high-level aggregated data, similar to those included in this paper, are available from the corresponding author upon request.

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