Pandemic-era behavioral changes and post-pandemic persistence in the high-density urban context of Hong Kong

Highlights:

1. Hong Kong's case highlights the distinctive nature of high-density urban context.
2. The prevalence of telecommuting cannot persist in Hong Kong.
3. Transportation patterns remain stable; public transit continues to be preferred.
4. Pick-up rather than food delivery persists as the main alternative to dining-in.
5. Online shopping and Internet usage have increased.

Abstract:

The COVID-19 pandemic was the most complex public health emergency in over a century. During the pandemic, daily behaviors globally shifted due to the health risks and the policies enacted to mitigate its spread. The permanence of these shifts, particularly after the pandemic subsided, has yet to be determined. The experience of Hong Kong showcases patterns of change that are emblematic of a high-density metropolis. To assess how the pandemic has modified the behaviors of Hong Kong's residents and the durability of these changes, we undertook a demographically representative survey from June to September 2022, with a subsequent follow-up in August 2023. This study constructs a panel dataset encompassing pre-pandemic,

pandemic, and post-pandemic periods to analyze shifts in behaviors such as telecommuting, transportation mode choices, dining habits, shopping practices, and Internet use. Our findings reveal several pandemic-induced behavioral trends that diverge from existing literature, offering new insights into behavioral change and its persistence as a result of global health and safety crises, particularly in a high-density urban context. These insights contribute to a deeper understanding of emerging norms in the post-pandemic era and enhance preparedness for future public health challenges.

Keywords:

Post-Pandemic, Behavioral Changes, Telecommuting, Travel, Consumption, Catering, Hong Kong

1. INTRODUCTION

The COVID-19 pandemic was the most complex public health crisis of the century. Over four years, the daily behavior of people around the world underwent substantial shifts in response to its potential health threats and the corresponding containment policies. In addition, the development and the spread of emerging information technology have further contributed to changes in everyday behavior (Mbunge et al., 2021; Mondal & Mitra, 2022).

The dramatic behavioral changes prompted by the pandemic have raised questions about their longevity and persistence as new post-pandemic norms. Findings from the US (Salon et al., 2021; Javadinasr et al., 2022) suggest that some of these changes, e.g. the increase in telecommuting, online shopping, biking and walking, are likely persist. However, the patterns of pandemic-induced behavioral change may vary considerably across regions, particularly when urban designs differ (Honey-Rosés et al., 2021). High-density metropolises may experience different behavioral changes than those observed in the broader US.

A substantial body of research has explored pandemic-induced behavioral shifts in metropolitan areas. For example, research from Tokyo suggests that teleworking rates remained low, and central urban areas did not experience a decline in activity (Sharifi & Lee, 2024), whereas New York and major cities in Europe experienced the opposite (Anacker, 2022; Wolff & Mykhnenko, 2023). Studies from Tehran, Wuhan, Osaka, and other cities, conducted during the pandemic, have reported increased social

distancing and other precautionary behavioral changes to reduce the risk of infection (Qian et al., 2020; Khavarian-Garmsir et al., 2021; Mizuno et al, 2021; Zarei et al., 2021). However, these and other similar studies in general are limited in two key respects: first, they provide limited insight into the persistence of these changes in the post-pandemic era, and second, they rarely focus on shifts in the daily behaviors of urban residents.

In light of these gaps, the objective of this study is to explore how Hong Kong residents' daily behaviors changed over the course of the pandemic, and the potential stickiness of these changes in a high-density urban context. We delineate a series of daily behavioral changes experienced by the populace of Hong Kong, in activities such as telecommuting, transportation mode choices, dining habits, shopping practices, and internet use. A comprehensive assessment encompasses five distinct chronological stages: the pre-pandemic period (T1), the first wave of Hong Kong's pandemic (T2), the fifth wave of Hong Kong's pandemic (T3), the normalization period (T4), and the post-pandemic period (T5).

Our study does not aim to explicitly determine causal relationships but rather to examine the persistence of behavioral changes over time. To achieve this, we first present changes in daily behaviors across five distinct periods, using average values for each period and visualizing these changes with Sankey diagrams (Javadinasr et al., 2022). We further investigate whether these behaviors significantly differ before and after the pandemic by conducting t-tests between T1 and T5. Given that these behavioral changes might be transient as individuals continue adapting post-

pandemic, we also perform t-tests between T4 and T5 to assess the persistence of the observed changes. Furthermore, leveraging the panel data structure, paired sample t-tests are employed to evaluate the robustness of these results by accounting for individual-level variations (Derrick et al., 2017). Statistically significant differences in both t-tests provide compelling evidence of a shift in behavior. Additionally, the persistence of these behavioral changes is analyzed across different sociodemographic groups to further enhance the robustness and depth of the findings.

2. LITERATURE REVIEW

2.1 Behavioral changes amid the COVID-19 pandemic

The pandemic has significantly transformed working practices, notably through the widespread adoption of remote work and remote conferencing. Telecommuting offers key benefits, such as reducing commuting constraints, modernizing traditional work arrangements (Zhu, 2011; Zhu & Guo, 2022). Studies utilizing early data from the pandemic consistently suggest that the prevalence of working from home is likely to remain higher than pre-pandemic levels (Bick et al., 2020; Bartik et al., 2020; Dubey & Tripathi, 2020; Lee & De Vos, 2023). More recent research also supports the notion that remote or hybrid working, which gained popularity during the pandemic, will persist and may even become the norm in the post-pandemic era (Mayer & Boston, 2022; Salon et al., 2021; Salon et al., 2022; Mohammadi et al., 2023). However, none of these studies are based on observations from the post-pandemic period. Zhu and

Wang (2024) argue that the extent to which telecommuting becomes a mainstream practice depends largely on demographic characteristics and urban structure. As the pandemic wanes and travel behaviors stabilize into a new normal, there is a critical need for long-term data to evaluate the sustainability and permanence of post-pandemic telecommuting.

Travel, another daily behavior profoundly impacted by the pandemic, has also been extensively studied. Early research documented an overall decline in mobility, a shift in transportation preferences from public to private modes such as driving, and increased use of non-motorized options like walking and cycling (Abdullah et al., 2020; Brinkman & Mangum, 2020; Neuburger & Egger, 2020; Parady et al., 2020; Hunter et al., 2021). Later studies have reinforced these findings, suggesting that some of these changes may persist (Salon et al., 2021; Airak et al., 2023; Lee et al., 2023). However, the decline in mobility was less pronounced among individuals with lower education and income levels, likely due to their limited ability to work from home (Irawan et al., 2022 Politis et al., 2021). These shifts in transportation patterns and the increase in telecommuting have coincided with changing housing choices, specifically a migration from urban centers to suburbs and from high-rise buildings to low-rise structures (Patino, 2020). In essence, the pandemic has enhanced the appeal of remote residential communities while diminishing the trend of concentrated growth in central urban areas (Sharifi & Khavarian-Garmsir, 2020). However, Sharifi & Lee (2024) found that Tokyo's central area did not experience a significant decline during this period. Despite these insights, there remains a lack of data from the post-

pandemic period to confirm the long-term sustainability of these changes, underscoring the need for research to address this gap.

Changes in shopping and dining behaviors have also been a prominent focus of research during the pandemic. A global survey by McKinsey & Company highlighted emerging trends, including growth in online shopping and food delivery, a shift toward essential and value-based consumption, and the rise of a "homebody economy" driven by concerns about out-of-home services like restaurants and gyms (Arora et al., 2020). Consumers also exhibited more cautious buying habits and greater attention to health and hygiene. The survey noted that the pandemic disrupted normal consumption patterns, prompting consumers to explore new businesses and brands. Other studies have confirmed significant shifts in shopping and dining behaviors (Grashuis et al., 2020; Roggeveen & Sethuraman, 2020; Zwanka & Buff, 2021). Although some changes, such as increased interest in healthy foods and online shopping, may endure post-pandemic, a recent study from Japan (Inoue & Todo, 2023) suggests that the popularity of online shopping may not be sustainable, emphasizing the need for further research to validate these trends.

2.2 Pandemic-related studies in Hong Kong

Pandemic-related studies in Hong Kong have explored diverse topics, including the built environment (Huang et al., 2020; Liao et al., 2021), public health interventions (Zhu & Tan, 2021; Zhu et al., 2023) and vaccination (Shah et al., 2022; Xiao et al., 2022). While these studies offer valuable insights, many fail to address the long-term

persistence of pandemic-induced behavioral changes.

The built environment has played a critical role in shaping the risk and spread of COVID-19 in Hong Kong. Huang et al. (2020) examined the relationship between the built environment and pandemic risks, while Liao et al. (2021) developed a community vulnerability index using socioeconomic and demographic data to analyze its correlation with case numbers during the city's three epidemic waves. Yip et al. (2021) and Kan et al. (2021) further identified built environment and demographic factors—such as transport links, high-density buildings, and mixed land use—as key contributors to virus transmission in areas visited by confirmed cases. These findings highlight the importance of urban planning in mitigating pandemic risks. Zhu and Tan (2021) also evaluated the effectiveness of compulsory home isolation in controlling the spread of COVID-19, emphasizing the interplay between public health interventions and environmental factors.

The pandemic significantly disrupted mobility patterns in Hong Kong. Zhang et al. (2021) used MTR card data to document steep declines in travel, with reductions of 42%, 81%, and 99% in trips to shopping areas, amusement venues, and border crossings, respectively. Chan et al. (2021) utilized map-based direction requests and location history data to show that residents voluntarily restricted their mobility even prior to government-imposed social distancing measures. Our study builds on this research by incorporating population-representative survey data to examine additional dimensions of travel behavior during the pandemic.

The pandemic also prompted notable changes in consumption and lifestyle habits. Chen et al. (2021) observed a sharp decline in overall consumption during the first 12 weeks of the pandemic, including a significant reduction in dining out. Instead, residents shifted toward home cooking, take-out, and increased consumption of fruits and vegetables, though fast food consumption remained stable. Delina et al. (2023) highlighted shifts toward more sustainable behaviors, such as improved hygiene, healthier lifestyles, reduced non-essential consumption, and a greater appreciation for local nature. These findings align with global trends and suggest that some changes, such as healthier eating habits and online shopping, may persist post-pandemic.

Several studies have explored the social and behavioral responses of Hong Kong residents during the pandemic. Du et al. (2023) analyzed collective behaviors during the initial outbreak, focusing on the interplay of emotions, perceptions, and online interactions in 2020. Liu et al. (2024) utilized a social sensing geospatial dataset to examine changes in public events across different phases of the fifth wave of COVID-19. Lee and De Vos (2023) investigated the factors driving the adoption of remote work, and Delina et al. (2023) linked the pandemic to broader sustainability-related behavioral shifts.

Although existing studies provide valuable insights into pandemic-related behaviors, many lack long-term data to assess the sustainability of these changes. For example, shifts in mobility, consumption, and lifestyle habits have been well-documented, but their persistence remains uncertain. Our research aims to fill this gap by analyzing longitudinal data to provide a deeper understanding of the lasting impacts of the

pandemic on Hong Kong residents' daily behaviors.

3. METHODS

3.1 Case study area: Hong Kong

Hong Kong, as one of the most densely populated cities in the world, represents a critical case for studying pandemic-induced behavioral changes in an ultra-high-density urban environment (Zhu et al., 2023). Additionally, Hong Kong's extensive reliance on public transportation, robust digital infrastructure, and established cultural habits provide a valuable lens for understanding behavioral adaptation in a metropolitan area where physical distancing and private transport are less feasible.

[Figure 1. Pandemic timeline in Hong Kong and study periods]

Figure 1 shows the timeline of the pandemic in Hong Kong; the daily number of mortalities caused by the pandemic; the distribution of the five time periods of our study; and important pandemic-related events, including relevant policy changes. This study considers the second half of 2019 as the baseline period (T1) before the pandemic. The first wave (T2) hit Hong Kong in February 2020 and lasted until April. During this period, the Hong Kong Government primarily aimed at curtailing the entry of COVID-19 cases from abroad. Measures included the selective closure of border points, such as the Hong Kong-Macau Ferry Terminal, near-total restriction of entry by non-residents, and a mandatory 14-day quarantine for arrivals (Hartley & Jarvis, 2020). Compliance was monitored with an electronic wristband system,

synchronized with a dedicated mobile application (Wong et al., 2020b). Failure to adhere to quarantine rules was a criminal offense. In addition, the Hong Kong Government adopted a series of domestic restrictions aimed at minimizing viral transmission within the community, including closing indoor entertainment facilities, work-from-home arrangements for civil servants, and mandatory social distancing in restaurants (Chan et al., 2021). Although a full lockdown was never enacted, these policies proved effective in significantly mitigating the spread of the pandemic (Chan et al., 2021; Hartley & Jarvis, 2020).

The impact of COVID-19 on Hong Kong was minimized due to strong containment measures and previous experience against SARS (Chan et al., 2021; Matus et al., 2023; Wong et al., 2020a; Wong et al., 2020b). However, the situation changed dramatically with the arrival of the highly transmissible Omicron BA.2 variant, leading to Hong Kong's most intense infection wave in early 2022 (T3). The Hong Kong Death Registry recorded 9,291 COVID-19 related deaths in 2022 (HKSAR Government, 2023a), nearly all during this wave. The Hong Kong Government responded with its strictest restrictions. Infected persons were required to undergo 14-day isolation arrangement in community isolation facilities or at home (HKSAR Government, 2022a). The use of LeaveHomeSafe, a vaccine status verification app, became mandatory for entering restaurants, shopping malls, and supermarkets (HKSAR Government, 2022b). Other businesses including fitness centers, cinemas, and event premises, were required to suspend operation (HKSAR Government, 2022c). Moreover, evening dine-in services at restaurants were banned, while

takeaway services and deliveries were allowed. The Hong Kong Government also appealed to employers to allow flexible work arrangements, encouraging employees to work from home (HKSAR Government, 2022d).

Starting April 21, 2022, as the COVID-19 threat started to diminish, the Government began a phased easing of restrictions, including allowing evening dining and reopening fitness centers, signaling a move towards normalcy. However, certain measures remained, like mandatory home isolations and LeaveHomeSafe, due to the still significant number of COVID-19 cases. Our study therefore considers this transition period as the normalization phase (T4), which bridges the gap between pandemic and post-pandemic phases. On January 8, 2023, the LeaveHomeSafe system ceased, and on March 1, the mask mandate was lifted, ending the requirement for masks indoors, outdoors, and on public transport. These steps marked the end of the COVID-19 pandemic in Hong Kong and the beginning of the post-pandemic era (T5).

3.2 Survey and data collection

The data is drawn from a household-level survey, built upon the infrastructure of the Hong Kong Panel Study of Social Dynamics (HKPSSD), targeting a representative sample of Hong Kong residents (Wu, 2016). This survey collected comprehensive data on behavioral patterns, including telecommuting, daily transportation mode choices, catering behavior, shopping behavior and internet-usage behavior. The study encompasses a comprehensive assessment across five distinct chronological stages:

the pre-pandemic period (T1), the first wave of Hong Kong's pandemic (T2), the fifth wave of Hong Kong's pandemic (T3), the normalization period (T4), and the post-pandemic period (T5). Data for the first three stages are based on the retrospective responses from respondents.

A sample of addresses provided by the Hong Kong Statistics Department was used to collect responses from 3,039 households, with one member from each household participating, from June to September 2022. The sampling was weighted by district population to reflect the broader Hong Kong population. Families invited to participate in the survey were sent a letter containing a QR code that directed them to the questionnaire. Upon completing the survey, respondents were rewarded with a HK$50 voucher as a token of appreciation for their time and input. The follow-up survey was deployed in August 2023 to the initial participants, resulting in 1,365 responses. Online consent was acquired from every participant in the survey. The study used the Qualtrics response quality audit algorithm to remove low-quality responses. The questionnaire is available as online supplementary material.

This study constructed an unbalanced five-phases panel dataset, to leverage all the responses from the two rounds of survey. This study also focused on the subset of 1,365 individuals who completed the follow-up survey, thereby facilitating the construction of a robustly balanced five-period panel dataset. This approach enabled the paired sample t-test, utilized as a robustness check and to reduce biases associated with attrition.

The reliance on retrospective self-reporting may introduce some recall bias, yet this approach is typical in extensive household surveys due to its cost-effectiveness and convenience. Retrospective self-reporting is a commonly used method in research, particularly when conducting studies during challenging circumstances like the COVID-19 pandemic (e.g., Hipp et al., 2020; Luo et al., 2021; Wu et al., 2023). The retrospective approach in a post-pandemic setting can offer more convincing insights than predictions based on stated intentions (Salon et al., 2021), which can be heavily influenced by unpredictable external factors. Moreover, the follow-up survey in August 2023 mitigates some of the potential drawbacks of relying solely upon retrospective questions and enhances the robustness of the analyses (Hipp et al., 2020; Beckett et al., 2001). To ensure the quality of responses, the data collection uses the Qualtrics response quality audit algorithm to filter out low-quality data.

[Table 1. Summary statistics of survey sample socio-demographics]

Table 1 indicates that the demographics of both survey rounds differ moderately from those of the general Hong Kong population, as reported in the 2021 Population Census. Specifically, the sample on average: 1) skews younger; 2) are more educated; 3) have higher personal incomes; and 4) have a higher proportion of local birth in Hong Kong. This discrepancy is unavoidable due to the self-selected nature of the sampling methodology. To reduce some self-selection bias, the sample for distributing the questionnaire was stratified based on the population weighting of the 18 districts in Hong Kong.

The attrition in the follow-up survey is typical, with 1,365 responses received, a response rate of 44.92%. The demographic summary statistics of the samples from both rounds are generally consistent. The follow-up survey respondents are marginally younger, with 4.5 per cent more respondents aged 30-39 compared to the initial survey, in addition to slightly higher levels of education.

3.3 T-test and paired t-test

This analyzes a dataset collected through two sequential survey iterations, including both two-sample tests that permit the inclusion of all observations, and paired statistical tests to leverage the panel nature of the data. The two-sample test used was the independent, difference in proportion t-test, which compared sample proportions across time periods using all observations. The paired test was the McNemar's test, the paired counterpart to the difference in proportion test, which could identify significant changes in proportions using only observations that were repeated in T5.

We apply the paired sample t-test and McNemar's test to account for the panel nature of the dataset (Fralick et al., 2017.; Ruxton, 2006; Tango, 1998). The analyses of paired observations help to control for intra-subject variability and can in some cases detect significant changes more effectively than non-paired techniques. Conversely, the independent sample t-test is suitable for the comparison of means between two independent or non-associated groups. This approach does not recognize any inherent pairings within the dataset, rendering it less appropriate for repeated measures or matched designs (Zimmerman, 2004). However, independent sample tests allow for

the inclusion into the analyses of respondents who did not respond to the latter round of the survey, whereas the paired tests require that respondents without repeated observations be excluded.

The paired sample t-test advances the assessment by focusing on the discrepancies between paired observations, thereby adjusting for confounders that may influence the results (Derrick et al., 2017). This refinement over the independent sample t-test, which presupposes homogeneity of variances across groups and overlooks individual distinctions, mitigates the effects of subject variability. Consequently, the paired sample t-test generally necessitates a more modest sample size to attain equivalent statistical potency as compared to the independent sample t-test (Chakraborti, 2010). Since both independent and paired sample tests have drawbacks and advantages in this study, one should be considered robustness checks for the other. The most robust results are those for which both tests indicate significant differences.

To further control the impact of demographic factors on behavioral and preference changes, we supplemented the t-tests with subgroup analyses in Appendices. Specifically, we categorized respondents into eight groups based on gender, income, education, and age: (1) male, (2) female, (3) income > HKD 30,000 , (4) income < HKD 30,000 , (5) age: 45 years and above, (6) below 45 years of age , (7) education: bachelor's degree and above, and (8) below bachelor's degree. These subgroup analyses allow us to examine whether behavioral changes are similar across different demographic categories and further ensure robustness in our findings.

4. RESULTS

4.1 Telecommuting and online meeting

The findings show that while telecommuting temporarily surged during the pandemic, this did not persist in the subsequent normalization and post-pandemic periods (Table 2A & Figure 2). Conversely, the adoption of online meetings has endured. The proportion of Hong Kong residents engaging in or having the option of telecommuting increased during the pandemic and peaked amidst the fifth wave. However, this proportion reverted to pre-pandemic levels during the normalization phase and further declined to significantly less than the pre-pandemic rate. This result differs from the dominant patterns observed in the US (Salon et al., 2022). It may be attributed, in part, to the unique circumstances surrounding the social turmoil in Hong Kong during 2019 (Shek, 2020; Zhou et al., 2022). However, pinpointing the exact reason necessitates additional research.

[Figure 2. Telecommuting and online meeting behavioral changes]

The proportion of workers authorized to engage in remote work arrangements decreased concurrently with a decline in the frequency of telecommuting (Table 2A). When examining the subset of employees with the option to WFH (Table 2B), low-frequency telecommuting behavior remained stable from the normalization phase, descending from the peak observed in T3, and did not exhibit a statistically significant deviation from the pre-pandemic level.

[Table 2. Changes and persistence in telecommuting and online meeting behaviors across periods]

In contrast, the case of frequent telecommuters did not show the same stability. The proportion of working from home at least three days a week increased with the COVID outbreak, peaking during the fifth wave (Table 2B), then dropped in the post-pandemic period (T5) to below pre-pandemic levels, though not significantly. However, the significant difference between T5 and T4 suggests a continuing post-pandemic decline.

Furthermore, the follow-up survey posed a question to participants regarding their interest in persisting with telecommuting. While 13.65% of respondents did not want to continue telecommuting, and 28.20% were uncertain, a majority of 58.15% affirmed their desire to maintain the practice of working from home. Notably, the proportion of respondents expressing a continued interest in telecommuting is close to the percentage of those who had the option to work from home and engaged in such practices at least once per week in T5 (63.53%). This result suggests that the overall decline in telecommuting shown in Table 2A may stem primarily from employers eliminating the option of working from home.

In the usage of online meetings, the trends for both low-frequency users (one day a week) and high-frequency users (three days a week) were similar to the overarching trends in telecommuting (Table 2A). There were notable and persistent downturns following the peak in period T3. Though decreasing, the incidence of low-frequency usage of online meetings in the post-pandemic era remained significantly greater than pre-pandemic levels. However, the trajectory warrants examination in future studies to determine whether it continues to decrease to pre-pandemic levels.

In contrast, for respondents with telecommuting options, the prevalence of online meetings was more persistent. Both high-frequency and low-frequency online meeting use was significantly higher in the post-pandemic period than pre-pandemic levels, and did not differ significantly from the normalization phase, suggesting a steadier state (Table 2B). Figure 2 depicts a notable increase in the acceptance of video calling as a suitable alternative to in-person meetings. The positive attitude has risen since the outbreak of the pandemic and has not returned to initial levels, highlighting the stickiness of this value change and associated behavioral adaptations.

[Figure 3. Attitude on the statement: "video calling is a good alternative to in-person business meetings”]

The analysis of behavioral changes in telecommuting and online meeting frequency across different subgroups (Appendix A.1) indicate that the direction and significance of behavioral changes in telecommuting were similar across all subgroups. However, there was substantial variation among subgroups in online meeting frequency. Specifically, older individuals, those with lower levels of education, and men exhibited relatively smaller changes in online meeting behavior. In contrast, women experienced a more pronounced decrease in online meeting frequency after the pandemic subsided. Additionally, high-income and highly educated groups have maintained a significantly higher increase in online meeting frequency during the post-pandemic period compared to the pre-pandemic period.

4.2 Daily travel behavior

Contrary to shifts observed elsewhere, our findings suggested that the transportation habits of Hong Kong residents remained relatively stable throughout the pandemic and its subsequent periods. Although marginal reductions in the utilization of public transportation occurred in some periods, mainly due to people traveling less overall and more people working from home (Figure 4f), public transport continued to overwhelmingly dominate.

Before the pandemic, 74.66% of workers in Hong Kong, a typical ultra-high-density metropolis driven by public transportation, commuted using public transit (Table 3A). This was followed by walking and private car usage, while only 2.85% worked from home. Amid the pandemic, the most significant changes occurred in the use of public transport and the adoption of working from home (WFH), with only slight changes in the rates of walking and using private vehicles. The increase in telecommuting during T2 and T3 approximately corresponded to the decline observed in public transit usage, suggesting a potential compensatory relationship. During the normalization period, the proportion of respondents working from home substantially decreased from its pandemic peak while public transportation usage returned to near pre-pandemic levels. In the post-pandemic period, there is no longer a statistically significant difference in the commuting patterns of Hong Kong workers compared to the pre-pandemic period, suggesting that pandemic-induced changes in transportation choices are not sticky.

Hong Kong residents' commuting mode choices displayed considerable stability, even amidst the peak of the pandemic, when we exclude the influence of telecommuting

growth (Table 3B). Only minor declines in the use of public transportation occurred during periods T2 and T3, together with a small increase in the proportion of private vehicle usage. Again, the differences in the usage rates of all commuting modes in the post-pandemic period compared to the latter half of 2019 were largely insignificant, which underscores the consistency of commuting patterns among Hong Kong residents.

[Table 3. Changes and persistence in daily transportation modes across periods]

The non-work travel patterns of Hong Kong residents also demonstrated considerable stability, but with somewhat more fluctuation amid the pandemic (Table 3C), compared to commuting travels. During the first and fifth waves, public transport use decreased by about 5% from the pre-pandemic level, while other modes of travel experienced increased usage, particularly walking and private car travel.

From the normalization period onwards, most transport choices returned to approximately pre-pandemic levels by the post-pandemic period (Table 3C), though paired sample t-tests comparing T5 with T1 indicated that public transport usage in the post-pandemic phase was still significantly lower than before the pandemic. However, this finding, together with the increase in taxi/ ride-hailing, is not corroborated by the independent sample t-test, suggesting that such discrepancy may be attributable to selection bias within the follow-up survey cohort.

[Figure 4. Daily travel behavioral changes]

Figure 4 shows the changes in frequency of major transportation modes and daily

travel time, over the five time periods, noting that no distinction is made here regarding whether the trip is for commuting purposes or not. Consistent with our results above, the frequency of public transit use declined to a nadir at T3, the peak of the pandemic, but recovered in the post-pandemic period to the late-2019 level as infections receded (Figure 4a). In contrast to the decline in the proportion of private vehicles as the primary mode during the post-pandemic period, the frequency of carpooling (i.e., driving or riding in a private vehicle with at least one other person in the car) increased (Figure 4b). The frequency of taxi/ ride-hailing as well as driving alone remained stable over the five periods (Figure 4c & 4d). Time spent walking for transportation trips by Hong Kong residents declined during the pandemic, but as the pandemic waned, it rose to a level higher than that before the pandemic (Figure 4e). Figure 4f illustrates the decrease in time spent on transportation by Hong Kong residents during the pandemic and the increase in the proportion of people who worked exclusively from home, changes that subsided in the post-pandemic period.

Our subgroup analyses for both commuting (Appendix A.2) and non-work (Appendix A.3) transportation modes further demonstrates that the stability of Hong Kong's transportation patterns was similar across different subgroups. The only notable difference was observed in walking for commuting purposes, such that males, high-income groups, younger groups, and highly educated groups exhibited an increasing proportion of walking.

4.3 Dining and Retail

During the pandemic, a marked reduction occurred in dining in restaurants alongside a pivot to alternative dining options: food-delivery and, even more so, pick-up services. Shopping consumption tendencies also shifted; while in-store shopping has persisted, online shopping increased among Hong Kong residents. However, dining and retail consumption behaviors in the post-pandemic period have continued to significantly change away from pandemic-era extremes during the normalization period, indicating that post-pandemic steady states have yet to be observed. Ongoing monitoring therefore is essential to determine whether these behavioral shifts have resulted in new norms.

[Figure 5. Catering and Shopping Behavioral Changes]

The proportion of respondents who dined in restaurants fell during the initial wave and decreased further during the pandemic's peak (Figure 5a), likely due to a combination of voluntary behavior changes over infection concerns and government restrictions on dining hours, restaurant capacity, and table size. Although the prevalence of dining in a restaurant at least once a week has since recovered to pre-pandemic levels, the prevalence of more frequent dining-in remains significantly below the per-pandemic rate (Table 4. A). However, statistical tests comparing T5 and T4 indicate that respondents' dine-in behaviors were likely still rebounding in 2023.

Use of pick-up services and to a lesser extent delivery both experienced substantial increases by the fifth wave (Table 4. A). By the post-pandemic period, however, the

prevalence of delivery orders had returned to pre-pandemic levels from their pandemic-era peaks (Figure 5c), though it may yet to have reached a post-pandemic steady state. In contrast, pick-up orders have maintained a higher prevalence post-pandemic compared to pre-pandemic levels (Figure 5b). However, the significant changes in dining behavior from T4 to T5 suggest that habits were still shifting in 2023, so pick-up orders may also at some point return to pre-pandemic levels like dining-in and delivery.

Additionally, our subgroup analyses of changes and persistence in catering behaviors (Appendix A.4) suggest that females, low-income groups, younger groups, and highly educated groups exhibited significantly lower frequencies of dining in restaurants after the pandemic compared to the pre-pandemic period, highlighting differences among subgroups. In contrast, for food pick-up and food delivery behaviors, the subgroups demonstrated similar trends of change, with variations only in the degree and significance of these changes.

[Table 4. Changes and Persistence in Catering, Shopping and Internet Usage Behaviors Across Periods]

Our investigation into Hong Kong's shopping consumption patterns has identified a nuanced shift in which residents have increasingly turned to online shopping, while maintaining their in-store shopping routines. The prevalence of weekly in-store grocery shopping remained relatively constant throughout the pandemic and returned to late 2019 levels by the T4 normalization period (Table 4. B). The prevalence of in-store shopping three times a week decreased during the pandemic but returned to pre-

pandemic levels afterwards, indicating the persistent preference for physical stores for essential items. Notably, by the post-pandemic period, weekly in-store shopping was significantly greater than the pre-pandemic rate, suggesting not just a rebound but also possible growth in conventional shopping practices.

Although there was a slight downturn in in-person shopping during the pandemic's peak, the adoption of online shopping for groceries experienced a marked increase, with post-pandemic levels surpassing those reported for 2019 (Table 4. B). Similarly, the prevalence of online shopping for non-grocery items also increased, albeit by a somewhat smaller margin. This shift toward digital purchasing points to a significant change in consumer shopping habits, with a sustained preference for online platforms continuing even after the pandemic. However, the t-tests comparing T4 and T5 were statistically significant, suggesting that the prevalences of online shopping behaviors were still decreasing from their pandemic-era peaks in 2023. Therefore, additional data collection is necessary to determine their post-pandemic steady state.

Our subgroup analyses of changes and persistence in shopping behaviors (Appendix A.5) suggest that females, high-income groups, older age groups, and lower-education groups exhibited a lower frequency of grocery shopping in physical stores after the pandemic compared to the pre-pandemic period, highlighting differences among subgroups. With online grocery shopping, males, low-income groups, older age groups, and lower-education groups showed higher frequencies compared to pre-pandemic levels. For online shopping behaviors excluding groceries, the subgroups demonstrated similar trends of change.

4.4 Information Technology

The COVID-19 pandemic has also accelerated the spread and acceptance of emerging technologies. Behavioral shifts associated with internet usage were particularly prominent. The proportion of people who browse the internet with high frequency (defined as at least five days per week) and use social media platforms such as WhatsApp, WeChat, Facebook, Twitter, and Instagram have increased markedly from the pre-pandemic baseline (Table 4. C).

Additionally, the prevalence of video calling and online conferencing technologies for both work-related and personal interactions has experienced a substantial increase. The proportion of individuals using such technologies at least once per week has risen from 38.86% in the latter half of 2019 to 50.83% in the post-pandemic era. Nevertheless, mirroring trends seen in remote work, the use of video calling and online conferencing has noticeably declined after a peak at T3.

Another salient trend was the sustained growth in high-frequency digital payment usage through all five time periods, including platforms such as Octopus, credit cards, Alipay, and WeChat Pay. This trajectory demonstrated not only the ongoing entrenchment of e-payments in consumers' daily transactions but also its potential expansion in the future. However, we need further data to corroborate changes in this behavior in the post-pandemic period. Notably, the above behavioral changes were similar across different subgroups (Appendix A.6).

5. DISCUSSION

This investigation offers a comprehensive examination of the changes in everyday behaviors of Hong Kong residents across the COVID-19 pandemic. Epitomizing the response of a prototypical high-density urban environment, these shifts contrast with changes reported from other places. The findings elucidate how the city's intrinsic characteristics have shaped the local response to a global crisis, offering nuanced insights into the interplay between urban form and pandemic-induced behavioral change.

Our results indicated that the elevated prevalence of telecommuting during the pandemic did not persist in Hong Kong. Our analysis suggested that the utilization of telecommuting in the post-pandemic era has not only continued to decline but has also dropped below the levels observed in the latter part of 2019. This discrepancy may be attributed to the extraordinary circumstances prevailing in late 2019 amidst the social unrest in Hong Kong, instigated by the "Anti-Extradition Law Amendment Bill Movement" (Shek, 2020; Zhou et al., 2022). As a result, telecommuting may have temporarily spiked due to the disturbances, which would bias the differences between post-pandemic and pre-pandemic rates towards underestimation.

Despite this possibility of bias, the decline in telecommuting among Hong Kong residents from the pandemic-era peak has been substantial, in contrast to strong stickiness observed in the US (Salon et al., 2021; Salon et al., 2022). This may demonstrate differences between Hong Kong as an ultra-high-density metropolis and

the US. In the US, the persistence of the telecommuting is largely due to a more accommodating home work environment and considerable commuting time savings (Lister & Harnish, 2011). Conversely, according to the Hong Kong 2021 Population Census (HKSAR Government, 2023b), Hong Kong's significantly lower per capita living space, 172 square feet compared to the US's 1058 square feet (American Enterprise Institute, 2016), suggests that for many, WFH may lead to a cramped and less conducive work setting. More importantly, employer resistance to telecommuting, based on the belief that on-site work and direct communication are more efficient (Berger, 2023), may also play a role. Our results also suggested that the decrease in WFH practices after the pandemic has been mainly due to employers no longer offering the option rather than employees choosing not to work from home when given the opportunity, which is in line with Lee & De Vos' (2023) finding that employer support had a significant effect on the WFH frequency of Hong Kong employees.

Our research revealed that the use of online meetings among Hong Kong residents has demonstrated stronger persistence in comparison to telecommuting. Online meetings have emerged as a practical alternative to face-to-face gatherings, providing convenience without disrupting conventional office-based work structures. The logistical and physical overhead of setting up and attending online meetings is significantly lower than that of in-person meetings. This ease of use may facilitate enduring prevalence of online meetings regardless of working arrangements (Hameed

et al., 2021), whether on-site or from home, and is expected remain prevalent well into the post-pandemic future.

Our study revealed that throughout the COVID-19 pandemic, travel mode habits in Hong Kong were resilient. Despite some initial shifts towards WFH and a slight reduction in public transport utilization during the early and mid-pandemic waves, the dominant role of public transportation as the main commuting method remained largely unaffected. Analyses excluding the impact of WFH showed insignificant decline in public transport use, with transient upticks in walking and private vehicle use. Hong Kong has a highly developed and efficient public transport network, including the Mass Transit Railway (MTR), buses, trams, and ferries, and a long-standing culture of using public transport. The extensive railway network covers the area where over 70% of the population lives and 80% of job opportunities are located, facilitating daily commutes (HKSAR Government, 2023c). The convenience and reliability of these services make them an attractive option for commuters (Cervero & Murakami, 2009). Additionally, unlike other jurisdictions, Hong Kong never imposed broad-based lockdowns and restrictions on personal movement and activities, hence modifications to travel mode habits were never strictly necessary for residents.

The minor changes in private car usage in Hong Kong contrasts with the surge in the US over the same period of time (Salon et al., 2021). Private car usage also increased in urban areas of Europe during the COVID-19 pandemic, due to lockdowns, concerns over contagion in crowded spaces, and a reduction in road congestion (Eisenmann et al., 2021; Vega-Gonzalo et al., 2023). However, the notoriously

expensive cost of car ownership and use in Hong Kong (Cullinane, 2003) and other high-density regions (Chng et al., 2019), could exceed the perceived benefits. In addition, the stability of car usage could be also attributed to the Hong Kong Government's imposition of a 15% rise in the private vehicle registration tax and a 30% increment in annual license fees effective from February 24, 2021 (HKSAR Government, 2021), intended to alleviate congestion potentially exacerbated by increased private vehicle usage during the pandemic. This policy may have curtailed the growth in private car usage that might otherwise have occurred. Interestingly, we instead observed an increase in the frequency of driving or riding in a private vehicle with at least one other person in the car in the post-pandemic period.

Our analysis of dining consumption behaviors revealed a significant decrease in restaurant dine-in activities during the pandemic, accompanied by a shift towards alternative dining options. There has been a considerable uptick in food-delivery orders and an even more substantial rise in the use of pick-up services. Yet, the significant changes in dining behavior from T4 to T5 indicate that dining practices were still adjusting in 2023. The results indicated that the prevalence of delivery orders returned to pre-pandemic levels, challenging the assumption that food delivery services would remain popular post pandemic (Li et al., 2022). The compact urban layout of Hong Kong facilitates short distances from work or home to restaurants (Boakye-Dankwa et al., 2019), making food pick-up a convenient option that is not overly time-consuming compared to food delivery. Moreover, the food delivery services are more expensive than pick-up (SCMP, 2024), which potentially reduces

their appeal. The sustained preference for in-store pick-up could have helped restaurants maintain direct engagement with customers and stay in business through the pandemic.

Shopping consumption patterns have similarly evolved; despite the persistence of in-store shopping, there was a clear movement towards increased online shopping among Hong Kong consumers. During the pandemic, people avoided going out for health reasons and online shopping became an attractive alternative (Bhatti et al., 2020; Grashuis et al., 2020; Roggeveen & Sethuraman, 2020). As people become more familiar with online shopping, people are more aware of its advantages, including wide product variety (Lim & Cham, 2015), competitive prices, and improved online payment and logistics (L. Zhou et al., 2007). Although levels of online shopping in the post-pandemic period were significantly higher than pre-pandemic levels, there has also been a significant drop from the peaks, suggesting the possibility of unsustainable growth in online shopping, similar to the trend in Japan (Inoue & Todo, 2023). Because post-pandemic shopping behaviors were still adjusting in 2023, continued monitoring is necessary to determine whether these behavioral shifts represent a lasting change.

Our study also indicated an acceleration in the adoption of digital technologies during the COVID-19 pandemic, with a marked increase in frequent internet and social media usage. This may just coincide with the continually increasing popularity of the internet and social media observed in Hong Kong and globally (Al-Qaysi et al., 2020; Lam & Nie, 2020; Dwivedi et al., 2023), thus we need further research to explore the

underlying mechanism. Studies elsewhere have reported that the COVID-19 pandemic motivated social media adoption by small-and-medium enterprises (Hu et al., 2023), healthcare providers (Anderson et al., 2022), and educators (Al-Qaysi et al., 2023), among other sectors. However, because lockdown policies and other responses varied considerably globally, additional research is necessary to determine whether COVID-19 was a driving factor for increased internet and social media usage in Hong Kong. Additionally, there has been a rise in the weekly employment of video calling and online conferencing technologies, which, after peaking during the pandemic, have shown signs of a subsequent decline. This partial reversion towards pre-pandemic usage of video conferencing has rarely been empirically observed elsewhere, so more research is necessary to determine whether this trend is unique to Hong Kong.

Concurrently, there has been a sustained uptick in the utilization of digital payment platforms, with significant growth observed through the pandemic and into the normalization period, which is in line with trends elsewhere in the world (Al-Qudah et al., 2024; Tut, 2023). It suggests a deeper entrenchment of electronic payment methods in consumer habits, though additional data is required to fully ascertain the persistence of these trends post-pandemic.

Our study conducts subgroup analyses, covering key influencing factors such as gender, income, educational attainment, and gender differences, to enhance the robustness of the results. Changes in transportation patterns, working from home, and internet usage behaviors remained relatively similar across different population

groups. However, changes in other behaviors exhibit variations among subgroups. This heterogeneity among groups highlights the need for further research. The subgroup analyses control for only one variable at a time in a discontinuous manner, thus they cannot account for potential interactions between variables. Other potential external factors are left to be explored in future research.

Other major phenomena occurred concurrently with the emergence of COVID-19, thus our study cannot disaggregate their effects from those that are related to the pandemic. For example, environmental and climate-related factors may have influenced behavioral patterns throughout the study period. The pandemic coincided with continually increasing environmental and sustainability awareness, though heightened awareness did not necessarily result in greater action or engagement (Delina et al., 2023). Additionally, seasonal differences across the time periods of focus likely affect respondent reporting of behaviors independently of pandemic conditions, particularly in transportation and outdoor activities. Familial and household dynamics, such as childcare responsibilities and multigenerational living arrangements common in Hong Kong, likely shape telecommuting persistence in ways that are relatively unique to Hong Kong (Yeung and Hao, 2024). Stress also emerges as a mediator during catastrophic events, with green and open spaces playing a vital role in promoting wellbeing and active lifestyles, potentially increasing walking and cycling during periods of stress and uncertainty (Barquilla et al., 2023). Finally, evolving media coverage and information environments throughout the pandemic may shape risk perceptions and behavioral responses independently of

actual infection rates (Du et al., 2023). These factors underscore the complex interplay of influences beyond the pandemic that contribute to the observed behavioral patterns.

The exigencies imposed by the pandemic have necessitated a recalibration of normative behaviors and routines, precipitating notable behavioral adaptations among the populace. While certain behavioral modifications may represent ephemeral responses to transient conditions, others have the potential to crystallize as enduring norms in the socio-behavioral landscape of the post-pandemic period, providing a foundation for policymakers and businesses to develop strategies that address these changes in the post-pandemic era.

The findings of this investigation carry significant implications for post-pandemic urban development and resilience in Hong Kong. Key principles associated with Social-Ecological-Technological Systems (SETS) resilience—adaptability, transformability, and flexibility (Sharifi, 2023)—should guide these urban development strategies. For instance, the observed behavioral shifts, particularly the decline in telecommuting and the sustained use of online meetings, necessitate a reevaluation of urban space design and functionality. As telecommuting has not retained its previous momentum, there exists an opportunity to reconsider office space utilization. Creating multifunctional spaces that accommodate both work and leisure is particularly relevant in Hong Kong's compact urban layout, facilitating such adaptations.

Additionally, the findings underscore the importance of fostering resilience within

urban infrastructure and services. The stability of Hong Kong's public transportation system highlights its crucial role in maintaining urban functionality during pandemics, as emphasized by Escorcia Hernández et al. (2023). Continued investment in the accessibility and efficiency of this system is essential, especially as urban density poses ongoing mobility challenges. Moreover, the integration of smart city technologies is paramount for enhancing urban resilience and addressing pandemic-related challenges, as noted by Amirzadeh et al. (2023). The acceleration of digital technology adoption, including online meetings and digital payment platforms, suggests that urban development should increasingly embrace smart city principles, facilitating seamless technology integration into daily life.

6. CONCLUSION

This study analyzed how daily behaviors in Hong Kong shifted during the COVID-19 pandemic , focusing on the persistence of changes in telecommuting, transportation, dining, shopping, and internet usage across five distinct periods. Whereas changes in behaviors like online meetings and digital payments have persisted, others, such as telecommuting and food delivery, have largely reverted to pre-pandemic levels. These findings underscore the unique impact of Hong Kong's high-density urban environment, shaped by factors like efficient public transportation and compact living spaces.

The results have important implications for policymakers and urban planners. The decline in telecommuting highlights the need to rethink office space utilization and

possibly create flexible workspaces, especially in compact cities like Hong Kong. Continued investment in public transit and the integration of smart city technologies are also essential for enhancing urban resilience during future crises. From a research perspective, this study contributes to understanding pandemic-induced behavioral changes in high-density urban contexts and emphasizes the importance of regional factors. Future research should focus on tracking long-term behavioral shifts, comparing urban contexts, exploring employer policies on telecommuting, and addressing digital divides to ensure equitable adaptation.

Limitations of this study include the reliance on self-reported data, the absence of causal analysis, and the focus on Hong Kong, which may reduce the generalizability of our conclusions. Our findings should be interpreted as evidence of associations rather than causal effects. While the results capture changes in behaviors during and after the pandemic, the t-tests do not establish a causal link between these changes and the pandemic itself. Other analytical approaches suited for causal inference require variability in exposure to the COVID-19 pandemic within Hong Kong. Since all of Hong Kong was subject to the same COVID-19 restrictions and generally similar infection risk, such variability does not exist within our research context. Future studies should use real-time data, comparative methods, and account for external factors like climate and media influences. In conclusion, this study highlights the interplay between urban design, technology, and behavioral adaptation in responding to global health crises, providing a foundation for future research on resilient urban development in the post-pandemic era.

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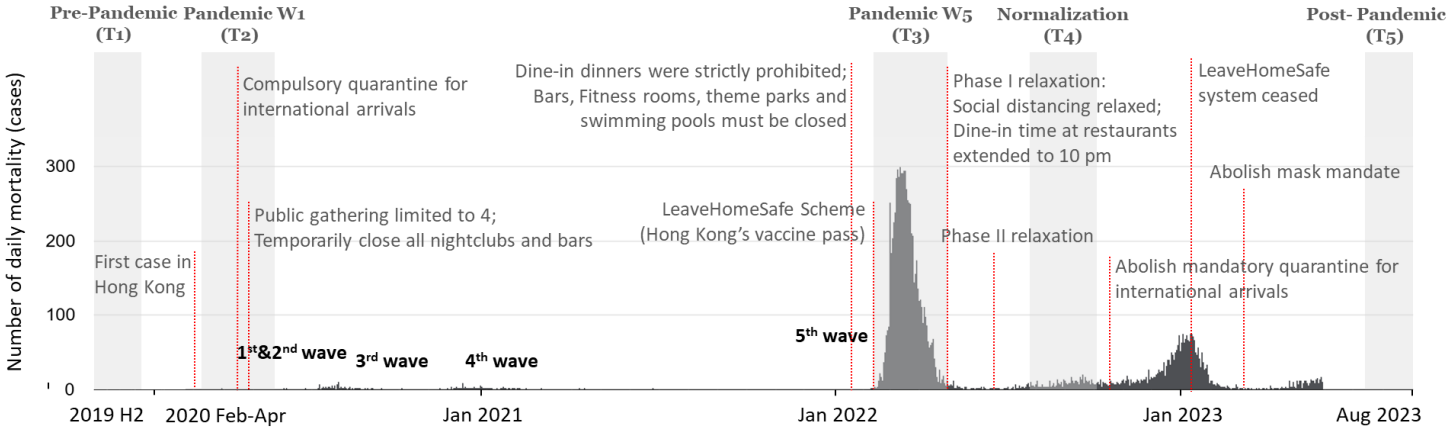
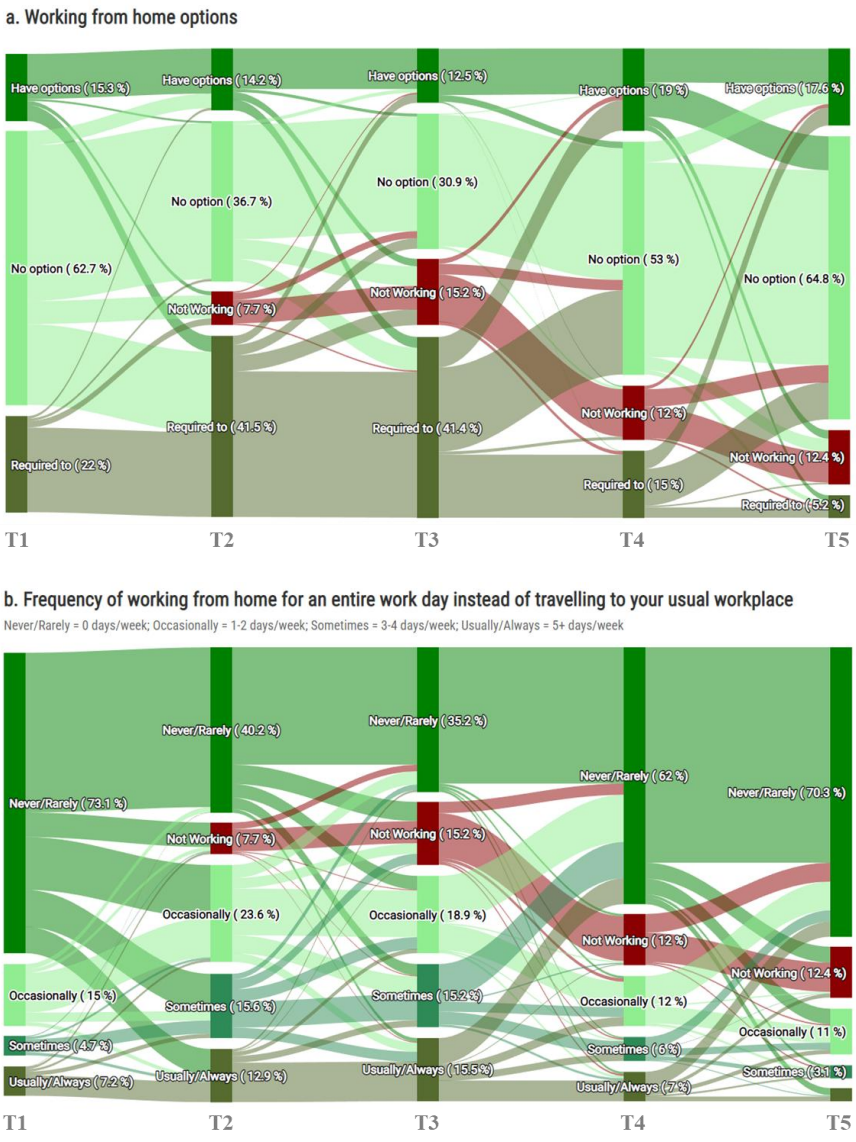
FIGURES

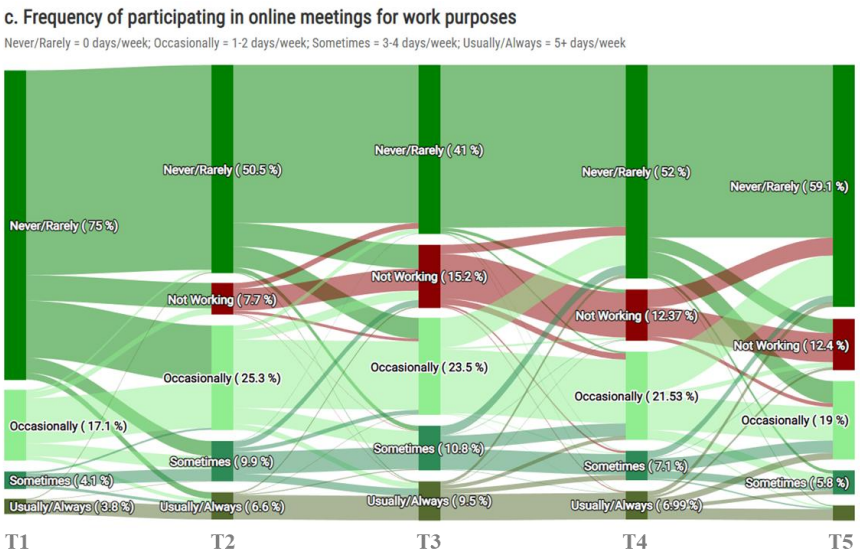
Figure 1. Pandemic timeline in Hong Kong and study periods



Data source: The University of Hong Kong, School of Public Health, 2025

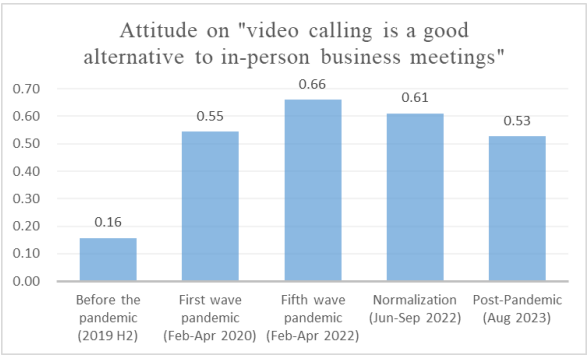
Figure 2. Telecommuting and online meeting behavioral changes





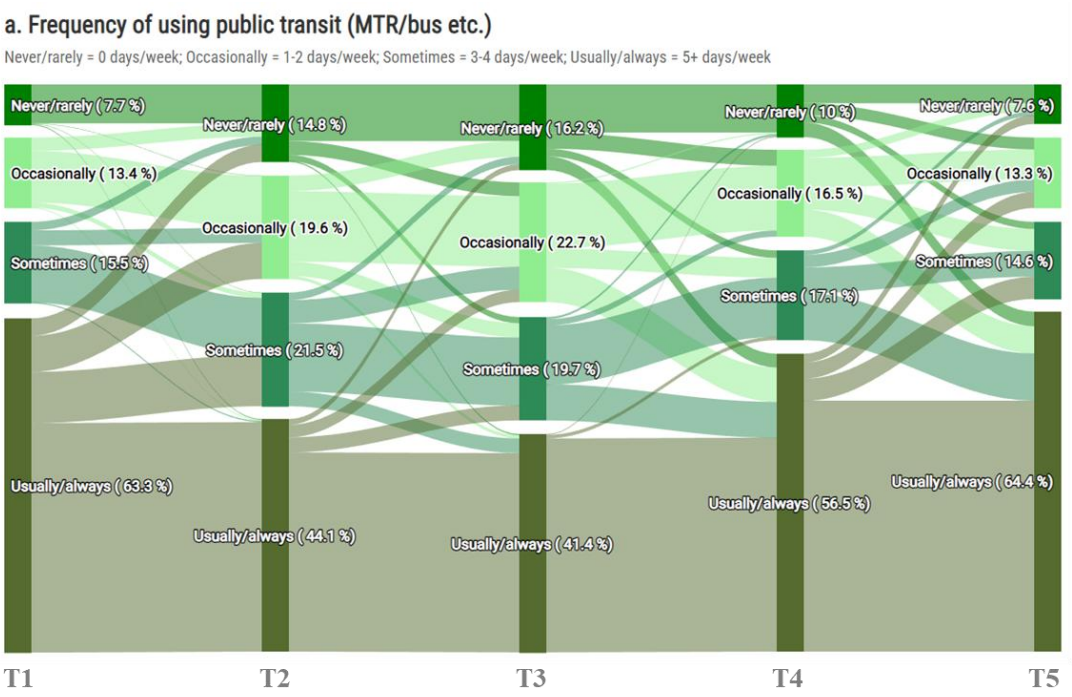
**Note that only data from respondents who answered the follow-up questionnaire and had a full five-period data set were used for the Sankey Diagram*

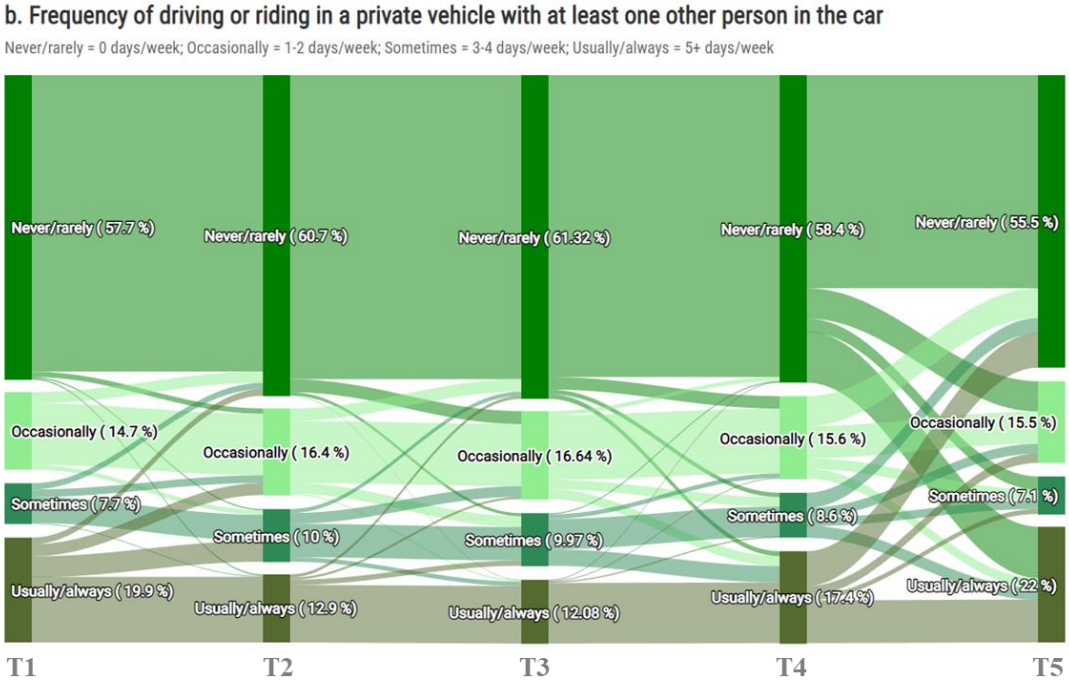
Figure 3. Attitude on the statement: "video calling is a good alternative to in-person business meetings"



Noted: -2 =strongly disagree; -1=somewhat agree; 0=neutral attitude; 1=somewhat agree; 2=strongly agree

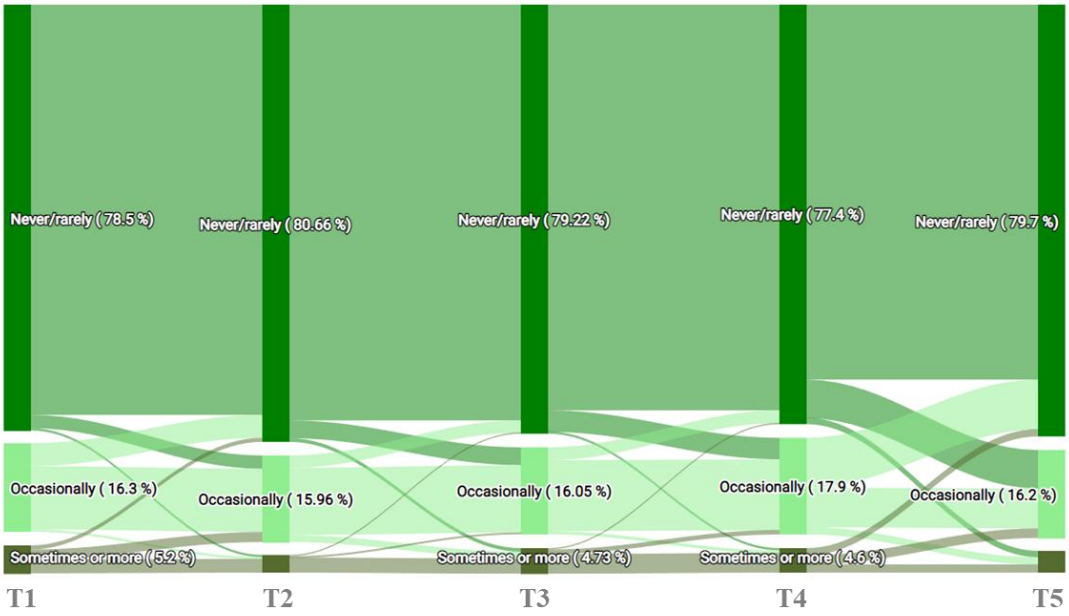
Figure 4. Daily travel behavioral changes





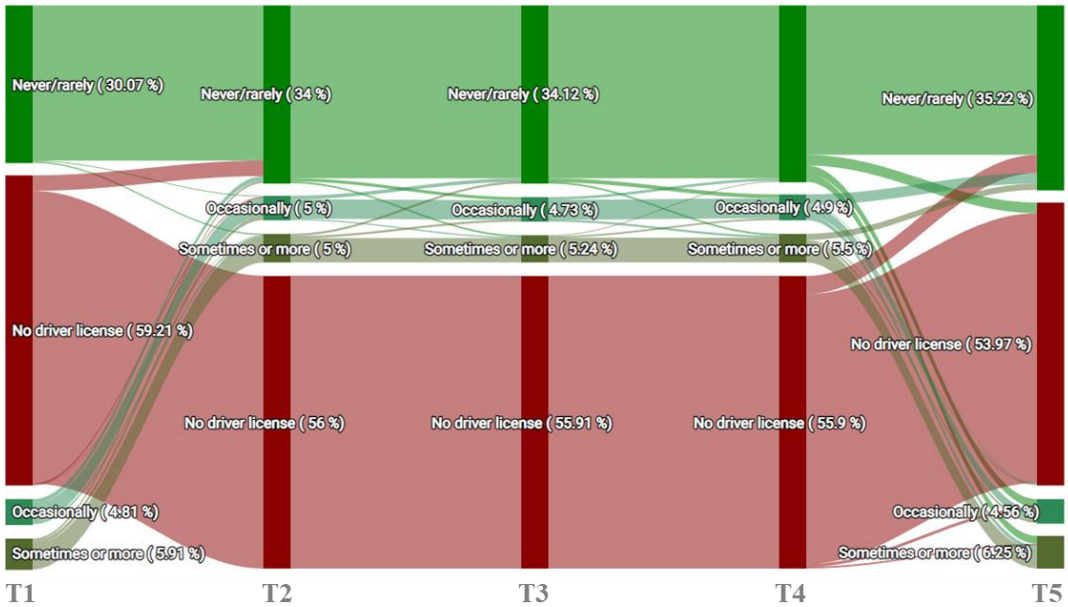
c. Frequency of using ride-hailing services or taking a taxi

Never/rarely = 0 days/week; Occasionally = 1-2 days/week; Sometimes or more = 3+ days/week



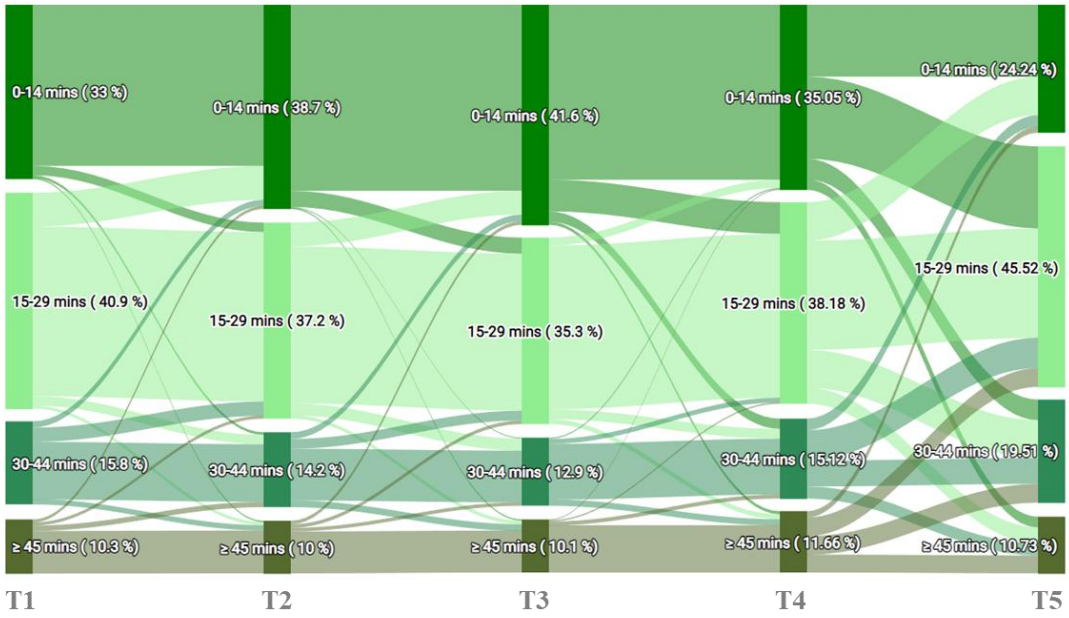
d. Frequency of driving alone (with no passengers in the car)

Never/Rarely = 0 days/week; Occasionally = 1-2 days/week; Sometimes or more = 3+ days/week



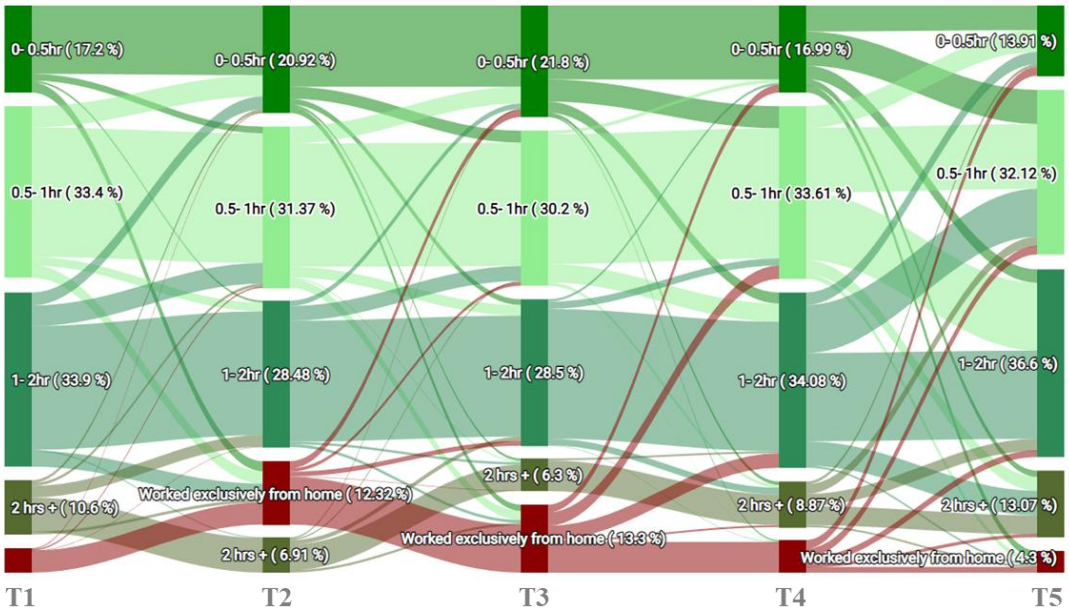
e. Transportation Walking Time

how much time did respondents spend walking each day for transportation purposes (not just for exercise)



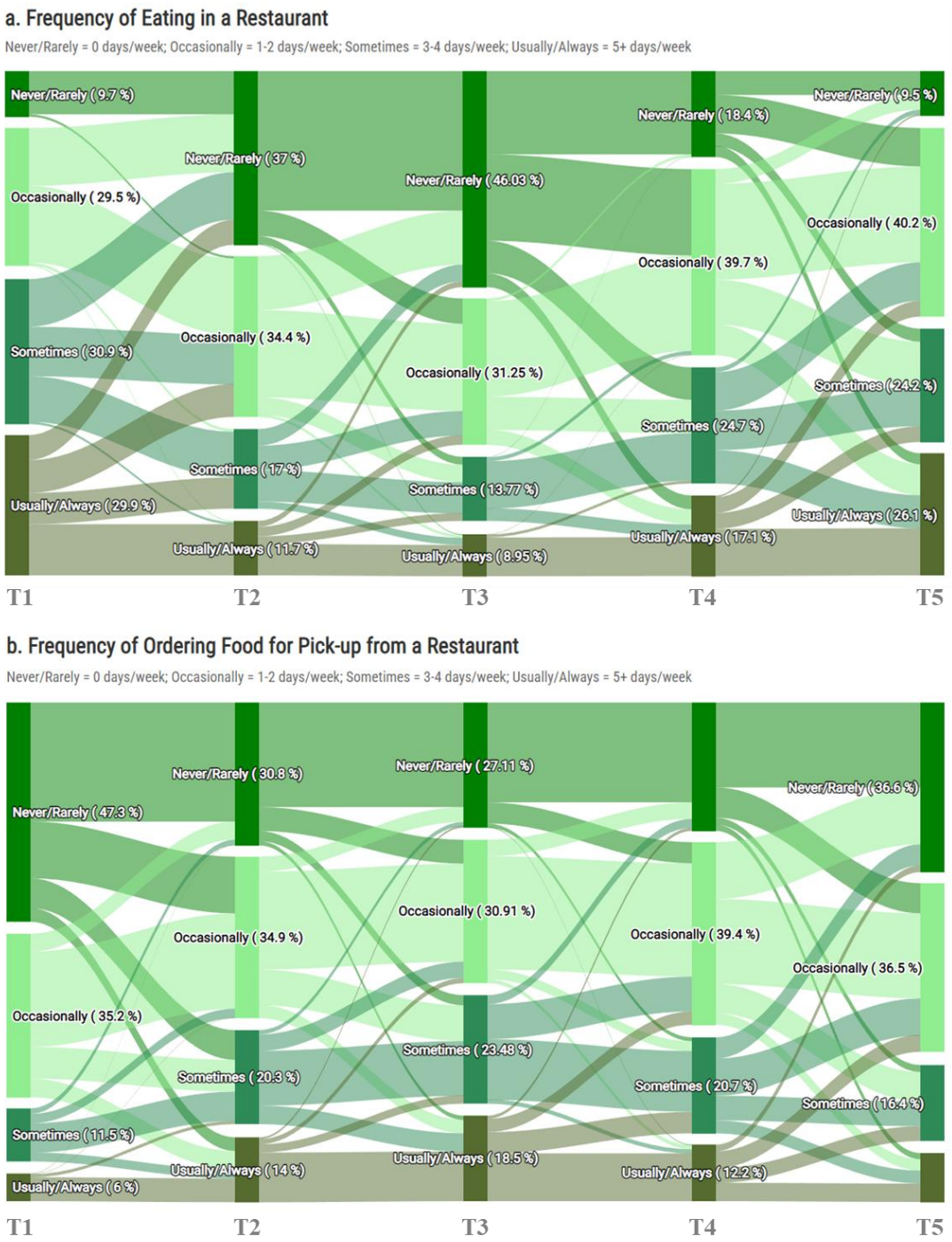
f. Daily Transportation Time

The total time spend on travel each day (including commuting and travel for other daily activities)



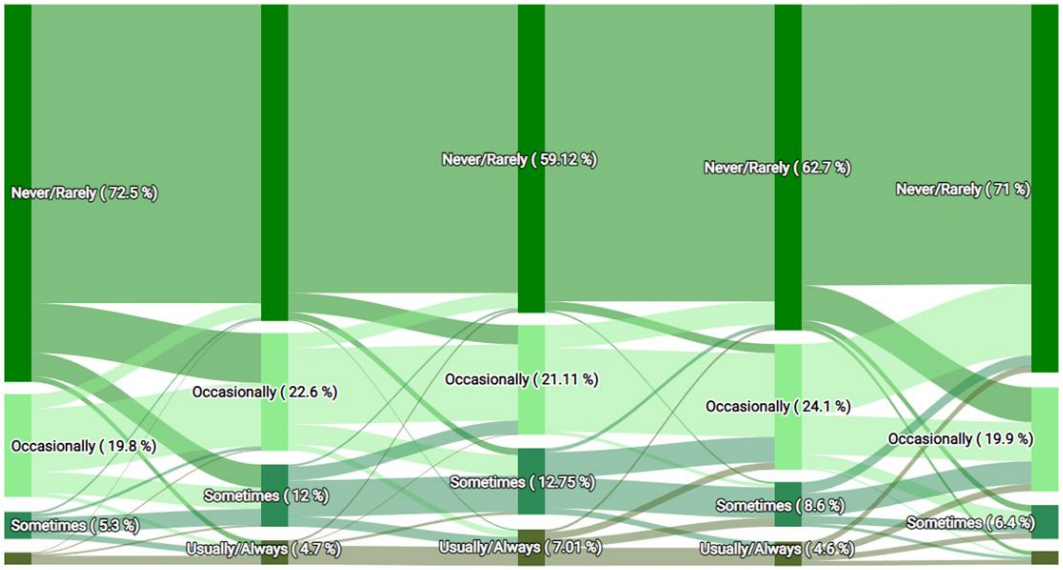
**Note that only data from respondents who answered the follow-up questionnaire and had a full five-period data set were used for the Sankey Diagram*

Figure 5. Catering and Shopping Behavioral Changes



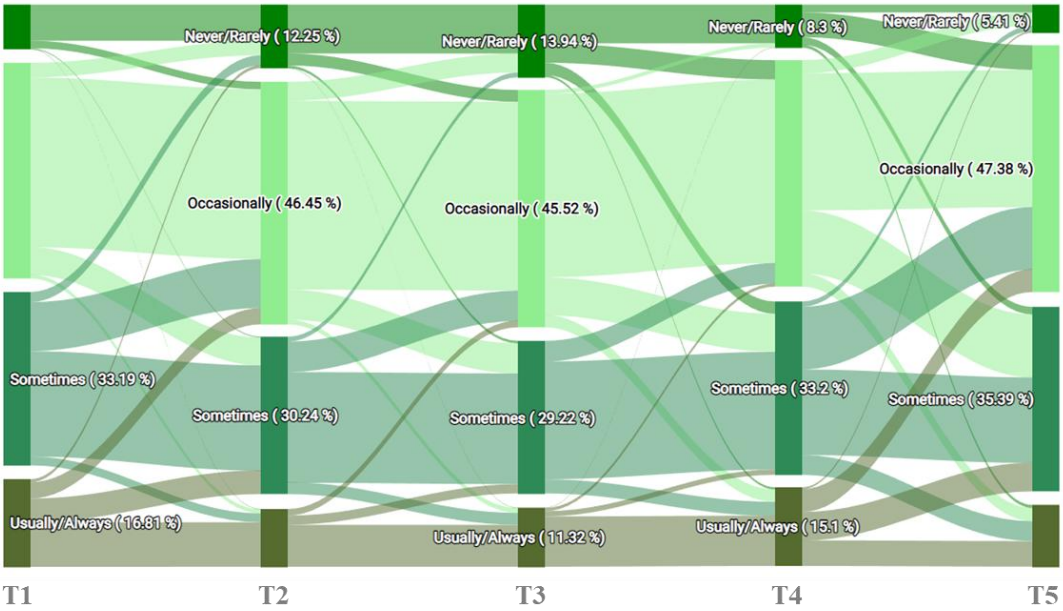
c. Frequency of Ordering Food for Delivery from a Restaurant

Never/Rarely = 0 days/week; Occasionally = 1-2 days/week; Sometimes = 3-4 days/week; Usually/Always = 5+ days/week



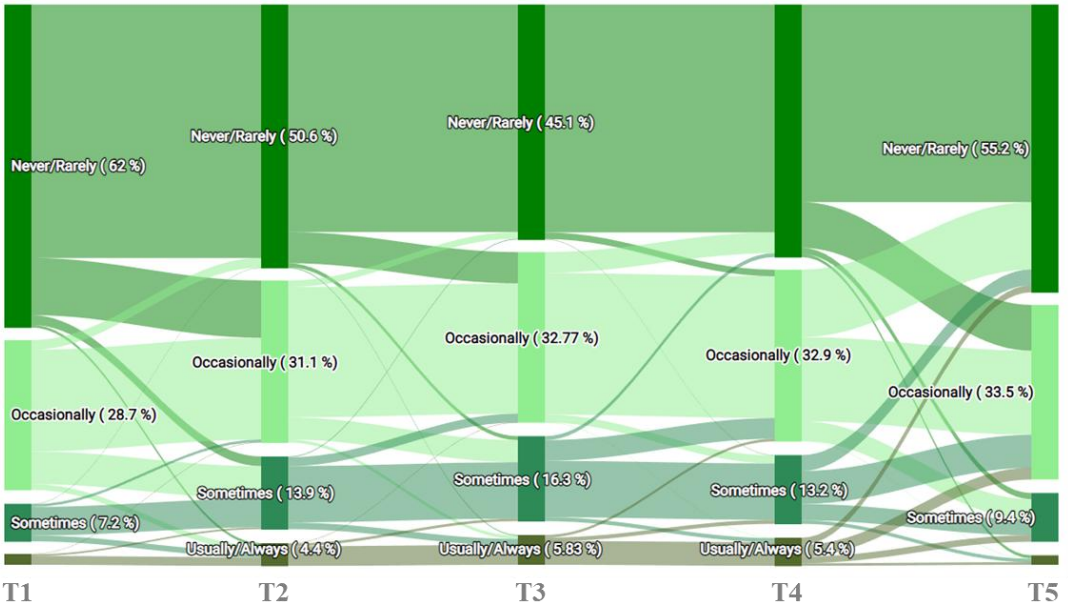
d. Frequency of Shopping for Groceries in a Store (e.g. supermarket)

Never/Rarely = 0 days/week; Occasionally = 1-2 days/week; Sometimes = 3-4 days/week; Usually/Always = 5+ days/week



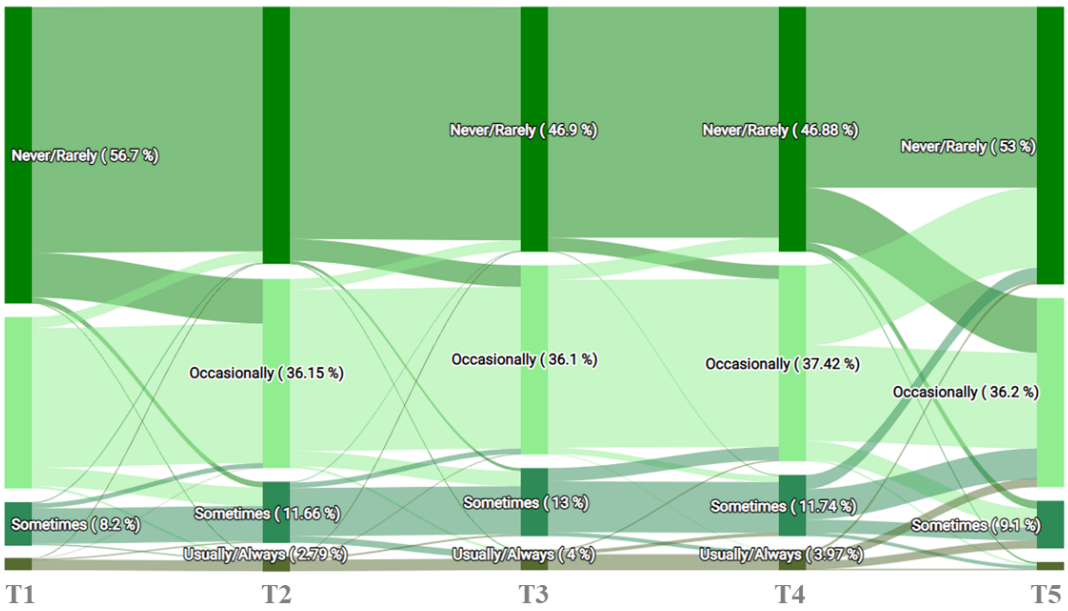
e. Frequency of Shopping Groceries Online for Delivery

Never/Rarely = 0 days/week; Occasionally = 1-2 days/week; Sometimes = 3-4 days/week; Usually/Always = 5+ days/week



f. Frequency of Shopping other items (not groceries) online for delivery

Never/Rarely = 0 days/week; Occasionally = 1-2 days/week; Sometimes = 3-4 days/week; Usually/Always = 5+ days/week



**Note that only data from respondents who answered the follow-up questionnaire and had a full five-period data set were used for the Sankey Diagram*

TABLES

Table 1. Summary Statistics of Survey Sample Socio-Demographics

Demographic Variable Proportion (%)	Initial Survey (2022 Jun-Sep)	Follow-up Survey (2023 Aug)	Proportion (%) in 2021 Census
Gender:			
Female	53.11	53.04	54.38
Male	46.89	46.96	45.62
Birthplace:			
Hong Kong	75.27	78.10	61.7
Mainland China	22.61	20.00	29.9
Others	2.12	1.90	8.4
Education:			
Primary School or below	2.68	1.83	24.5
Lower Secondary	8.84	5.93	16.9
Higher Secondary (Including Secondary 5 & Sixth Form)	28.94	24.69	25.2
College/ Community College/ Post-Secondary (Non-degree)	14.85	14.36	10.5
Bachelor's degree*	30.62	36.56	22.9*
Master's degree or above	14.06	16.63	N/A
Age:			
19-29	18.30	18.10	13.17
30-39	27.03	31.50	16.08
40-49	22.05	20.29	17.48
50-59	17.60	17.22	19.58
60+	16.80	12.89	33.68
Individual Income:**			
Less than $10,000	6.50	5.30	12.54
$10,000-19,999	26.28	25.60	37.98
$20,000-29,999	24.60	25.40	20.85
$30,000-39,999	15.91	17.80	10.14
$40,000-59,999	13.55	13.70	9.16

$60,000+	13.15	12.20	9.33
Number of observations:	3039	1365	NA

**Bachelor's degree: 22.9% represents the proportion of the population with a bachelor's degree or higher in the 2021 Hong Kong Census*

***Note that only employed respondents are considered, and the number varies in different phases*

Table 2. Changes and Persistence in Telecommuting and Online Meeting Behaviors Across Periods

	Pre-Pandemic (T1)	Pandemic W1 (T2)	Pandemic W5 (T3)	Normalization (T4)	Post-Pandemic (T5)	Difference I (T5-T1)	Difference II (T5-T4)
A. The prevalence of telecommuting and online meeting behaviors among all Hong Kong residents (percentage)							
Working from home or having the option to Work from home	38.83%	57.36%	61.60%	40.36%	25.84%	-12.99%*** -10.19%***	-14.52%*** -11.78%***
Working from home at least one day a week	27.90%	53.50%	56.50%	28.86%	19.25%	-8.64%*** -6.02%**	-9.61%*** -8.78%***
Working from home at least three days a week	12.75%	29.90%	37.09%	14.83%	6.79%	-5.96%*** -4.40%***	-8.04%*** -7.51%***
Online Meeting at least one day a week	27.32%	44.76%	49.66%	39.04%	30.80%	3.48%* 7.41%***	-8.24%*** -7.86%***
Online Meeting at least three days a week	10.17%	19.32%	25.10%	17.13%	10.54%	0.36% 3.24%**	-6.59%*** -4.50%***
B. The prevalence of telecommuting and online meeting behaviors of Hong Kong residents who have the option to WFH (percentage)							
Working from home at least one day a week	57.89%	85.33%	84.40%	60.35%	63.53%	5.64% 10.87%	3.18% 2.99%
Working from home at least three days a week	25.40%	47.46%	55.71%	29.42%	20.78%	-4.62% 2.17%	-8.64%** -13.77%***
Online Meeting at least one day a week	50.11%	65.90%	69.03%	63.72%	60.78%	10.67%** 11.59%*	-2.94% -8.98%*

Online Meeting at least three days a week	19.22%	29.67%	36.49%	32.33%	28.63%	9.41%** 11.59%**	-3.70% -2.99%

*Noted: 1). In the two rightmost columns, the upper result in each row is from the independent sample t-test and the lower result is from the paired sample t-test; 2). * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; 3). only respondents of employment status in each period were asked questions on their telecommuting and online meeting practices, and the dataset therefore exhibits variability in response rates.*

Table 3. Changes and Persistence in Daily Transportation Modes Across Periods

	Pre-Pandemic (T1)	**Pandemic W1 (T2)**	**Pandemic W5 (T3)**	**Normalization (T4)**	**Post-Pandemic (T5)**	**Difference I (T5-T1)**	**Difference II (T5-T4)**
A. Prevalence of various commuting mode among Hong Kong workers (percentage)							
Public transport	74.66%	66.19%	63.80%	72.70%	75.22%	0.56% -2.79%*	2.53% -0.21%
Working from home	2.85%	11.31%	13.71%	4.92%	2.66%	-0.19% 0.59%	-2.26%** -2.00%**
Walking	10.15%	9.83%	9.45%	9.99%	11.32%	1.17% 0.94%	1.33% 2.12%**
Private vehicle	8.25%	8.64%	8.80%	8.56%	7.17%	-1.08% -0.54%	-1.40% -0.15%
Taxi/Ride-hailing	2.71%	2.54%	2.79%	2.65%	2.62%	-0.09% 0.87%*	-0.03% 0.68%
Biking	0.55%	0.63%	0.46%	0.50%	0.45%	-0.10% -0.20%	-0.05% -0.21%

Others	0.83%	0.83%	1.00%	0.94%	0.58%	-0.26%	-0.37%
						0.06%	-0.23%
B. Prevalence of various commuting modes among Hong Kong workers, excluding the proportion of work from home (percentage)							
Public transport	76.76%	74.62%	74.06%	76.47%	77.13%	0.37%	0.66%
						-2.16%	-1.82%
Walking	10.45%	11.08%	11.00%	10.47%	11.62%	1.16%	1.14%
						0.67%	1.70%*
Private vehicle	8.53%	9.76%	10.05%	8.97%	7.34%	-1.19%	-1.63%
						0.57%	-0.25%
Taxi/Ride-hailing	2.80%	2.90%	3.28%	2.84%	2.86%	0.06%	0.02%
						1.14%*	0.86%*
Biking	0.56%	0.68%	0.53%	0.54%	0.46%	-0.10%	-0.08%
						-0.21%	-0.22%
Others	0.89%	0.92%	1.09%	0.98%	0.59%	-0.30%	-0.38%
						-0.01%	-0.26%
C. Prevalence of various non-work travel modes among Hong Kong residents (percentage)							
Public transport	74.74%	70.00%	69.38%	72.56%	73.80%	-0.93%	1.24%
						-3.58%**	1.21%
Walking	9.76%	11.35%	11.51%	9.88%	11.47%	1.71%*	1.59%*
						1.10%	0.37%
Private vehicle	10.29%	12.27%	12.62%	11.11%	9.62%	-0.68%	-1.50%
						1.38%	0.61%
Taxi/Ride-hailing	3.72%	4.13%	4.12%	4.09%	4.09%	0.37%	0.00%
						1.11%*	0.62%
Biking	0.60%	0.79%	0.80%	0.96%	0.47%	-0.12%	-0.49%

						0.05%	-0.21%
Others	0.90%	1.45%	1.57%	1.39%	0.56%	-0.34%	-0.84%*
						-0.06%	-0.18%

*Noted: 1). In the two rightmost columns, the upper result in each row is from the independent sample t-test and the lower result is from the paired sample t-test; 2). * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; 3). only respondents of employment status in each period were asked questions on their telecommuting and online meeting practices, and the dataset therefore exhibits variability in response rates.*

Table 4. Changes and Persistence in Catering, Shopping and Internet Usage Behaviors Across Periods

	Pre-Pandemic (T1)	Pandemic W1 (T2)	Pandemic W5 (T3)	Normalization (T4)	Post-Pandemic (T5)	Difference I (T5-T1)	Difference II (T5-T4)
A. Catering-related consumption behaviors (in proportion)							
Dine-in at least one day a week	88.27%	63.37%	56.09%	80.37%	90.62%	2.35%*	10.25%***
						0.30%	8.96%***
Dine-in at least 3 days a week	58.93%	28.43%	23.06%	41.83%	50.38%	-8.55%***	8.55%***
						-11.07%***	8.43%***
Pick-up at least one day a week	53.49%	67.79%	70.88%	70.32%	63.36%	9.87%***	-6.96%***
						11.72%***	-7.55%***
Pick-up at least 3 days a week	19.37%	34.62%	40.65%	32.84%	27.48%	8.11%***	-5.36%**
						12.16%***	-3.52%*
Food delivery at least one day a week	30.27%	40.74%	43.15%	40.12%	28.68%	-1.59%	-11.44%***
						3.15%*	-6.08%***
Food delivery at least 3 days a week	9.03%	17.23%	19.93%	14.43%	9.16%	0.13%	-5.27%**
						4.10%***	-1.47%
B. Retail consumption behaviors (in proportion)							
Shop for grocery in a store at least one day a week	91.07%	88.01%	85.97%	91.40%	94.68%	3.61%***	3.28%***
						2.93%***	2.56%***
Shop for grocery in a store at least 3 days a week	49.77%	40.58%	39.95%	47.89%	48.87%	-0.90%	0.98%
						-1.90%	0.15%
	37.22%	48.35%	52.08%	50.03%	46.10%	8.88%***	-3.93%*

Order groceries online for delivery at least one day a week						8.13%***	-5.57%***
Order groceries online for delivery at least 3 days a week	9.68%	17.56%	21.01%	18.12%	13.64%	3.96%***	-4.48%***
						4.62%***	-4.98%***
Order other items (not including groceries) online for delivery least one day a week	41.93%	49.01%	50.96%	51.75%	48.29%	6.36%***	-3.46%*
						4.91%**	-5.05%***
Order other items (not including groceries) online for delivery at least 3 days a week	10.14%	14.39%	16.93%	15.94%	13.20%	3.06%**	-2.74%*
						2.78%*	-2.71%*
C. Summary statistics on Internet usage behaviors (in proportion)							
Browse the internet on a computer at least five days a week	58.16%	61.90%	63.83%	62.70%	66.47%	8.31%***	3.77%*
						4.52%**	0.23%
Use of video calling/ online conferencing technology at least one day a week	39.26%	62.02%	65.48%	59.39%	52.30%	13.04%***	-7.09%***
						16.34%***	-4.69%**
Use digital payment (e.g. octopus/credit cards/Alipay) at least five days a week	49.40%	51.46%	55.64%	61.27%	NA	NA	NA
						NA	NA
Use social media (e.g, WhatsApp, Wechat, Facebook, Twitter, Instagram) at least five days a week	80.37%	82.23%	83.49%	83.52%	86.54%	6.17%***	3.02%*
						4.30%***	1.51%

Noted: 1). In the two rightmost columns, the upper result in each row is from the independent sample t-test and the lower result is from the paired sample t-test; 2).
** $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*

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