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Residential built environment and working from home: A New Zealand perspective during COVID-19

Bethany Mayer, Megan Boston

School of Engineering, University of Waikato, Hamilton 3216, New Zealand

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ABSTRACT

In response to the COVID-19 pandemic, 90 countries, including Aotearoa New Zealand, executed lockdowns. As non-essential businesses could not operate from their usual centralised locations, some responded by implementing working from home (WFH). This caused a temporary shift in how people interacted with the built environment and provided a unique opportunity to investigate the relationship between WFH and New Zealand’s built environment. A nationwide survey was conducted online using Google Forms to explore the experiences of New Zealanders while WFH during the 2020 nationwide lockdown. Questions focused on workplace and WFH conditions, and built environment features and characteristics before, during, and after the lockdown. The quality of residential housing and its impact on respondents’ ability to effectively WFH was of particular interest.

In total, 794 survey respondents experienced WFH. Respondents generally had a positive experience while WFH, with 82.6% of respondents that experienced WFH wanting to shift to part- or full-time WFH. While the context of the COVID-19 lockdown is unique, the results have potential applications for future policies that can increase the quality of the residential built environment to benefit the well-being of its users.

1. Introduction

Telecommuting, also referred to as teleworking or remote working, allows employees to utilise technology to complete work outside centralised workplaces. Alternative locations include public spaces (e.g., libraries or cafes), workers’ residences, co-working spaces, or hot-desking facilities (Bishop, 2021; Doyle, 2020; Shieh & Searle, 2013). Telecommuting became a popular topic in the 1970s due to advancements in technology and has since been extensively researched and scrutinised (Berthiaume, 2020). Despite some businesses being unable to operate remotely due to their services, an estimated 30–40% of jobs can be performed remotely (Brynjolfsson et al., 2020; Dingel & Neiman, 2020; Sostero, Milasi, Hurley, Fernandez-Macías, & Bisello, 2020). The form of telecommuting considered in this article is working from home (WFH).

WFH is often associated with sustainability, resilience, and societal benefits. Examples include providing job opportunities for those who may not be able to work in a centralised location due to distance, access to transportation, disabilities, familial commitments, or other reasons (Bailey & Kurland, 1999; Nilles, 1975); travelling outside of peak traffic times to reduce greenhouse gas emissions and time wasted (Giovanis, 2018; Lachapelle, Tanguay, & Neumark-Gaudet, 2018; Nilles, 1975); increased business continuity and resilience, as employees do not congregate in a central location that may be unusable due to maintenance or disasters (Donnelly & Proctor-Thomson, 2015); and increased or sustained productivity while working flexible hours best suited to employees’ schedules (Felstead & Reuschke, 2020; Richter, 2020).

One key factor that has an intrinsic relationship with WFH is the built environment, as WFH affects built environment design, and in turn, the built environment affects the WFH experience. Nilles (1975) illustrated this relationship by highlighting changes that would occur if large-scale WFH should occur. Suggestions include the number of centralised workplaces decreasing, allowing the buildings or land to be used for other societal needs; central business districts (CBD) requiring less high-density housing; and decreased demand for roading and public transport as employees no longer commute.

Despite its potential benefits, the uptake of WFH has been minimal, as perceived negative repercussions have prevented employers or employees from performing trials. Because of this, the effects of large-scale WFH are not clear (Bloom, Liang, Roberts, & Ying, 2015; Green, Tappin, & Bentley, 2020). Location is another significant factor that affects the uptake and
success of WFH. Each country and region has different major industries, unique legislation, cultural barriers, social issues, and stigmas (Dingel & Neiman, 2020; Sostero et al., 2020). These factors may prevent people from WFH when it is better suited to their circumstances (Lott & Abendroth, 2020). Therefore, while generalised aspects of WFH can be explored at an international level, specified locations and communities should be investigated in context to understand the potential for and effects of WFH.

Aotearoa New Zealand experienced large-scale WFH during the COVID-19 pandemic and resulting lockdowns. An estimated 40% of New Zealanders experienced WFH during the lockdown, a significant increase from the 16% of workers that had WFH arrangements before COVID-19 (Stats NZ, 2019). This occurred due to the stringent restrictions that required all non-essential businesses to close (Stats NZ, 2020). The lockdown resulted in the nation’s largest WFH ‘trial’ to date and provided a unique opportunity to investigate alternative working arrangements in New Zealand.

While some studies have considered WFH in New Zealand (Donnelly & Proctor-Thomson, 2015; Green et al., 2020; O’Kane, Walton, & Ruwhiu, 2020), no existing literature sources that explicitly examine WFH experiences concerning the WFH environment were found. This study aims to provide an initial insight into this area.

A survey was distributed to explore New Zealanders’ opinions, attitudes, and experiences regarding their WFH experience during the first nationwide lockdown. Questions were based on common themes found in international literature related to the built environment and WFH, including home and workplace environments, and transportation. The survey received 1076 responses, with 794 respondents having experienced WFH during COVID-19-related lockdowns. This paper summarises the survey’s key findings.

1.1. WFH in New Zealand during COVID-19

Interactions with built environment systems changed significantly during COVID-19. By early April 2020, four months after the first reports of the virus, 90 countries had implemented lockdown orders, affecting an estimated 3.9 billion people (Sandford, 2020). This was due to advice from the World Health Organization to limit movements and enact physical distancing measures, as there was a lack of pharmaceutical treatments available at the time (World Health Organization, 2020). In this context, lockdowns include implementing stay-at-home orders, and shutting down schools, public spaces, and non-essential workplaces, while essential workplaces (e.g., supermarkets and medical facilities) remain open with increased hygiene and safety practices in place (Hamzelou, 2020; Seetharaman, 2020). As non-essential businesses closed their centralised premises during lockdowns, many businesses resorted to WFH to continue functioning (Belzunegui-Eraso & Errá-Garcés, 2020; Carillo, Cacht-Rosset, Marsan, Saba, & Klarsfeld, 2020; Felstead & Reuschke, 2020).

New Zealand confirmed its first case of COVID-19 on the 28th of February 2020 (Cooke & Chunko, 2020). An Alert Level system was developed in response, as outlined in Fig. 1.

The first nationwide Alert Level 3 and 4 lockdowns occurred from the 25th of March through the 13th of May 2020. Based on the University of Oxford’s COVID-19 Government Response Tracker, which compares the various measures taken by international governments to mitigate the virus across 21 indicators, the nationwide Alert Level 4 lockdown was one of the most restrictive in the world. Restrictions implemented during this Alert Level received a Stringency Index (SI) of 96.30 on a scale of 0 to 100, with 100 indicating the most stringent measures (Hale, Petherick, Phillips, & Webster, 2020). Nationwide Alert Level 1 had minimal restrictions, receiving an SI of 22.22 (Hale et al., 2021). Other national and regional lockdowns occurred intermittently as community cases were detected (New Zealand Government, 2020), and, at the end of 2021, a new protection framework replaced the Alert Levels. The SI varied in these circumstances, as the Alert Levels and restrictions differed between regions (Hale et al., 2021).

The experience of WFH during a disruptive event, such as a pandemic with stringent restrictions, differs from WFH during business as usual. Some challenges faced by employers and employees while WFH during lockdown included decreased social interactions due to lockdown orders, lack of preparation or training, disrupted supply chains for equipment, and WFH being mandatory rather than voluntary (Green et al., 2020; Richter, 2020). These may affect perceptions of WFH, meaning the COVID-19 context should be accounted for when analysing this study.

![Fig. 1. New Zealand’s COVID-19 Alert Level measures (adapted from New Zealand Government, 2021a).](image-url)
However, disruptive events also provide an opportunity to investigate a system's vulnerabilities and evaluate if current conventions and practices are suitable. Once these reviews occur, positive societal and legislative changes can be made (Barber, Cole, Foster, & Murtola, 2020; Belesova, Heymann, & Haines, 2020; Megahed & Ghoneim, 2020).

2. Materials and methods

Academic literature related to WFH was reviewed and used to narrow the scope of the study. As there was a lack of information about WFH and New Zealand's built environment, the authors determined that this would be the primary focus of the study, specifically how the built environment impacted people's experiences of WFH.

2.1. Survey design

A survey was created and distributed using Google Forms to gather this information. This platform was used due to ease of use and to achieve anonymity. Questions and survey logic structure allowed anyone aged 16 or older that lived in New Zealand during lockdown to participate. The survey consisted of single- and multiple-answer multiple-choice questions, and prompts with 10-point Likert scales for respondents to rank their experience. The Likert scale questions predominantly asked how strongly respondents agreed with statements, with 1 being 'strongly disagree' and 10 being 'strongly agree'. However, some of these questions asked respondents to compare their WFH experience to their pre-lockdown working experience (e.g., if they had lower or higher bills while WFH). For these comparative questions, a ranking of 1 indicated a decrease compared to their pre-lockdown state (e.g., lower bills), while 10 indicated an increase (e.g., higher bills).

The survey consisted of seven sections with a total of 67 questions. A summary of the sections is as follows:

- Part one (eight questions answered by all respondents): basic demographic information of the respondent, e.g., age, region, income bracket, education, etc.;
- Part two (14 questions answered by all respondents): information about respondents' workplaces before lockdown, e.g., their commute, workplace features and characteristics, available facilities, etc.;
- Part three (six questions answered by all respondents): information about respondents' residences before lockdown, e.g., housing type, whom they shared it with, etc.;
- Part four (26 questions answered only by respondents that experienced WFH during lockdown): information about respondents' housing and WFH experience during the lockdown, e.g., where in the house they worked, features and characteristics of this environment, WFH preference, etc.;
- Part five (five questions answered by all respondents): respondents' experience of working after lockdown, e.g., if they returned to their centralised workplace, how they felt, COVID-19 safety measures in place, etc.;
- Part six (two questions answered by all respondents): respondents' active transport habits after lockdown and barriers that prevent them from using active transport;
- Part seven (six questions answered by all respondents): respondents ranked how strongly they agreed with six statements about WFH.

Each section included questions unrelated to the built environment to investigate other general opinions about workplaces and WFH (e.g., if having flexible working hours or spending more time around household members made their WFH experience more enjoyable). Open-ended prompts were provided at the end of each section, allowing respondents to add further comments if they so desired.

The survey was peer-reviewed to ensure the content was coherent. Ethics approval was granted by the HECS Ethics Committee at the University of Waikato (application number HREC(HECS)2020#63).

2.2. Data collection

The flowchart in Fig. 2 summarises the process of data collection and analysis. Initially, the survey was distributed through the researchers' networks and social media, including Facebook and LinkedIn. It was emailed to all regional, district and city councils and tertiary education departments and institutions that provided email addresses on their websites. These organisations were targeted as it was presumed they would have some interest in research or the built environment.

A distribution method was originally utilised to directly contact five to ten businesses from each industry listed in the survey, shown in Table 1, via email. However, this generated few responses, as administrators or directors had to be willing to forward the survey to staff. It also limited potential responses from employees that did not have access to email or a staff portal, such as casual or subordinate employees. Therefore, this step only occurred for nine of the 21 industries, including the councils and educational providers.

Social media was the primary distribution method. Moderators of seven New Zealand based Reddit forums (including, but not limited to r/newzealand, r/Wellington, and r/theron) and 68 Facebook community groups (including, but not limited to Taunui Local Noticeboard, Palmerston North Community, and Dunedin News) allowed the survey to be published. On the first day of posting the survey to these pages, 271 responses were received (26.4 % of the total responses), thus highlighting its effectiveness. This method also diversified responses, as respondents working in all positions and industries could access the survey. Responses were collected from the 14th of January through the 29th of March 2021.

2.3. Data analysis

To understand the role of the built environment in shaping the WFH experience, respondents who experienced WFH were divided into three subgroups based on their indicated WFH preference: Group 1 would continue to WFH full-time if given the opportunity; Group 2 would prefer to WFH part-time and from their centralised workplace part-time; and Group 3 do not want to WFH and would prefer to return to their centralised workplace full-time.

Null hypothesis significance testing was used to find variables of statistical significance. The null hypothesis (H0) for all variables was there is no difference between groups’ responses, and the specified variable had no effect on the respondent's WFH preferences. The alternative hypothesis (H1) was there is a difference between the groups' responses, and the specified variable did affect the respondents' WFH preference. A significance level (p-value) of 0.05 was used, meaning if a variable had a p-value greater than 0.05, H1 was rejected.

Due to the nature of the data, the p-values were calculated using two analysis methods. Categorical variables were analysed using the two-way chi-square tests. These questions were mostly related to respondents' demographics, transportation habits, and workplace and lockdown WFH home environments. The Likert scales were analysed using Analysis of Variance (ANOVA).

The 10-point Likert scales were transformed to equivalent 5-point scales for each question to simplify analysis and interpretation. Respondents who selected 1 or 2 on the original 10-point Likert scale, indicating they strongly disagreed with the statement, were combined and grouped as 1 on the new 5-point scale. The transformation was done for the remaining results, with 3–4, 5–6, 7–8, and 9–10 on the original 10-point scale being transformed to 2, 3, 4, and 5 respectively on the new 5-point scale.
3. WFH and respondent demographics

The survey received 1076 responses. One respondent was removed due to providing the same non-sensical answer to all open-ended questions, leading to 1075 useable responses for the data analysis.

The results showed that 759 respondents experienced WFH, and 35 respondents studied from home during the lockdown. These 794 respondents will be grouped and referred to as those who experienced WFH, as they completed some form of work from their residence during the lockdown.

Of these 794 respondents, 157 (19.77 %) said they would prefer to continue WFH full-time (Group 1); 499 (62.84 %) would prefer to WFH part-time and part-time from their centralised workplace (Group 2); 138 (17.38 %) would prefer not to WFH and return to their centralised workplace full-time (Group 3). These results align with another New Zealand-based WFH survey performed by O’Kane et al. (2020) during the nationwide lockdown. This survey found that 22 % of respondents want to WFH daily, 67 % want to WFH occasionally, and 11 % did not want to WFH.

Table 2 summarises the demographics of respondents that experienced WFH.
Demographic information of respondents that experienced WFH.

| Demographic Information | Group 1: WFH full-time (%) | Group 2: WFH part-time (%) | Group 3: Centralised workplace full-time (%) | p-value |
|-------------------------|-----------------------------|-----------------------------|---------------------------------------------|--------|
| Gender                  | (n = 157)                   | (n = 499)                   | (n = 138)                                   |        |
| Female                  | 70.7                        | 71.7                        | 68.8                                        | 0.878  |
| Male                    | 28.0                        | 26.9                        | 30.4                                        |        |
| Other                   | 1.2                         | 1.4                         | 0.7                                         |        |
| Region                  |                             |                             |                                             | 0.998  |
| Auckland                | 24.2                        | 21.4                        | 21.7                                        |        |
| Waikato                 | 26.8                        | 25.5                        | 29.7                                        |        |
| Wellington              | 20.4                        | 15.2                        | 8.7                                         |        |
| Canterbury              | 5.7                         | 11.0                        | 10.1                                        |        |
| Otago                   | 7.6                         | 8.2                         | 7.2                                         |        |
| Other                   | 15.3                        | 18.7                        | 22.6                                        |        |
| Age                     |                             |                             |                                             | 0.767  |
| Under 18                | 0.0                         | 0.2                         | 0.0                                         |        |
| 18–24                   | 6.4                         | 6.4                         | 9.4                                         |        |
| 25–34                   | 17.2                        | 24.4                        | 24.6                                        |        |
| 35–44                   | 31.2                        | 25.5                        | 25.4                                        |        |
| 45–54                   | 23.6                        | 25.1                        | 22.5                                        |        |
| 55+                     | 19.7                        | 15.0                        | 15.2                                        |        |
| 65–74                   | 1.9                         | 3.2                         | 2.9                                         |        |
| 74+                     | 0.0                         | 0.2                         | 0.0                                         |        |
| Income                  |                             |                             |                                             | 0.035  |
| Less than $10,000       | 4.5                         | 3.0                         | 10.1                                        |        |
| $10,001 - $30,000       | 12.1                        | 6.2                         | 8.0                                         |        |
| $30,001 - $50,000       | 10.2                        | 8.8                         | 10.9                                        |        |
| $50,001 - $70,000       | 20.4                        | 25.9                        | 26.1                                        |        |
| $70,001 - $90,000       | 21.0                        | 21.8                        | 15.9                                        |        |
| $90,001 - $110,000      | 12.7                        | 13.9                        | 15.2                                        |        |
| $110,001 - $130,000     | 10.8                        | 12.6                        | 7.2                                         |        |
| More than $130,000      | 8.3                         | 7.8                         | 6.5                                         |        |
| Industry                |                             |                             |                                             | 0.004  |
| Business, finance,      | 8.3                         | 9.4                         | 8.0                                         |        |
| and insurance           |                             |                             |                                             |        |
| Education and training  | 14.6                        | 19.2                        | 34.1                                        |        |
| Engineering             | 4.5                         | 6.0                         | 6.5                                         |        |
| Health or social        | 9.6                         | 6.4                         | 4.3                                         |        |
| services                |                             |                             |                                             |        |
| Information technology  | 19.7                        | 11.8                        | 7.2                                         |        |
| and media               |                             |                             |                                             |        |
| Public administration   | 10.8                        | 18.6                        | 13.0                                        |        |
| and services            | 3.2                         | 5.0                         | 5.1                                         |        |
| Science                 | 5.1                         | 2.8                         | 9.4                                         |        |
| Student                 | 24.2                        | 20.6                        | 12.3                                        |        |
| Other                   |                             |                             |                                             |        |
| Ethnicity               |                             |                             |                                             | 0.252  |
| Māori                   | 11.5                        | 10.4                        | 5.1                                         |        |
| Pacific Islander        | 0.6                         | 1.8                         | 0.0                                         |        |
| New Zealand             | 73.9                        | 74.1                        | 76.1                                        |        |
| European                |                             |                             |                                             |        |
| Other European          | 14.0                        | 12.6                        | 8.0                                         |        |
| Asian                   | 3.8                         | 4.2                         | 5.1                                         |        |
| Other                   | 6.9                         | 8.6                         | 13.8                                        |        |
| Highest qualification   |                             |                             |                                             | 0.063  |
| NCEA Level 1 or 2      | 4.5                         | 3.0                         | 2.2                                         |        |
| NCEA Level 3 or equivalent | 3.8                      | 7.4                         | 8.7                                         |        |
| Diploma or certificate  | 32.5                        | 21.4                        | 18.1                                        |        |
| from a tertiary         |                             |                             |                                             |        |
| education institution   |                             |                             |                                             |        |
| Bachelor’s degree       | 25.5                        | 28.5                        | 33.3                                        |        |
| Bachelor’s with         | 7.0                         | 10.2                        | 9.4                                         |        |
| Honours                 | 15.9                        | 16.4                        | 17.4                                        |        |
| Master’s degree         | 4.5                         | 9.8                         | 8.0                                         |        |
| Doctoral degree         | 3.8                         | 1.8                         | 2.9                                         |        |

Notes: 
* Income is in New Zealand dollars (NZD).

Several demographic groups were overrepresented in the sample of those that experienced WFH. These included females (71.0 % of respondents vs. 50.6 % of the population), New Zealand and other Europeans (86.5 % of respondents vs. 70.2 % of the population), those with bachelor’s degrees or higher (57.3 % of respondents vs. 24.8 % of the population), and those living in Waikato (26.4 % of respondents vs. 9.7 % of the population) (Stats NZ, 2018). This discrepancy was expected, as literature sources state that those who have ‘remote-friendly’ jobs are often female, middle-aged, in high-skilled positions with tertiary level qualifications, and live in urban areas with high economic development (Brynjolfsson et al., 2020; Dey, Frazis, Loewenstein, & Sun, 2020; Felstead & Reuschke, 2020; Holgersen, Jia, & Svenkerud, 2021; Pouliakas, 2020; Raišienė, Rapuano, Varkulevičiūtė, & Stachová, 2020). As the demographics of this survey align with other studies, the data collected provides valuable initial insights about WFH in New Zealand for those that can WFH.

When comparing the groups, two demographics were statistically significant, as the p-values were less than 0.05. These were industry (p = 0.004) and income (p = 0.035).

### 3.1. Industry

Sostero et al. (2020) investigated how suitable various occupations were for teleworking. They identified three areas to consider when determining how remote-friendly or ‘teleworkable’ a job is: the tasks performed (either physical, information-processing, or social interactions); how the work is performed; and the tools used to complete required tasks. They also found there is a high correlation between teleworkability and computer use.

The most common industry for those that wanted to WFH full-time was information technology and media. This industry is very teleworkable, as few physical tasks and social interactions are required, and many roles in this field require high computer use (Sostero et al., 2020). Many respondents in this group indicated that they could take office equipment home before lockdown or were subsidised for purchasing new equipment, thus allowing them to continue working.

The most common industry for Group 2 that wanted to WFH part-time and Group 3 that would prefer not to WFH was education and training, with 19.2 % and 34.1 % of respondents respectively employed in this field. There is some discrepancy between the roles filled by Groups 2 and 3, as illustrated in their pre-lockdown work environment: 23.2 % of Group 3 worked in a classroom environment, compared to only 5.6 % of Group 2.

Many jobs within the education and training sector can be performed remotely to a high standard; however, there are some associated challenges due to the social nature of some roles. For example, many non-verbal cues and other information may be lost when communicating or teaching remotely (Sostero et al., 2020). Educators and students must have access to appropriate equipment; and, in the case of younger students, must have adequate support from caregivers. Lessons require adaptation so content and feedback can be suitably communicated (Ferri, Grifoni, & Guzzo, 2020).

The challenges associated with remote teaching may have influenced the preferences of these groups to return to or work part-time from their centralised workplace after lockdown. Comments left by some respondents supported this. One respondent’s comments mirrored the challenges discussed previously: “online teaching was not an equitable experience. Some teachers found it very stressful, students didn’t get the individual support they needed, not all students had access to learning”. Another respondent found that increased flexibility for themselves and students was a struggle, as they would “spend much more time preparing for teaching and assessing”. A third respondent commented on the difficulties of working with neurodiverse students, saying WFH...
"created enormous barriers for my students at all levels, and I ended up working harder and longer hours than I ever have in order to address urgent and extreme student needs".

As summarised by a respondent, "some parts of my job cannot be satisfactorily carried out except in person". This much be accounted for when evaluating the appropriateness of WFH.

### 3.2. Income

As shown in Table 2, respondents in Group 2 that wanted to WFH part-time tended to have higher incomes, with 57.73 % earning more than $70,001 per year, compared to 55.03 % of Group 1 that wanted to WFH full-time and 49.60 % of Group 3 that would prefer not to WFH earning above this threshold.

The higher incomes of Groups 1 and 2 may affect their WFH preference, as they may be able to afford larger or better-quality houses, thus resulting in more favourable WFH environments. These respondents may have been able to afford appropriate equipment for WFH, such as computers, monitors, web cameras, and ergonomic furniture. This is supported by the equipment respondents had access to: 89.8 % and 83.2 % of respondents in Groups 1 and 2 respectively had access to desks, compared to 67.4 % of respondents in Group 3; 87.3 % and 74.5 % of respondents in Groups 1 and 2 respectively had access to comfortable chairs, compared to 64.5 % in Group 3.

### 4. WFH and transportation

The type of transportation used (p = 0.000), distance (p = 0.001), and time travelled (p = 0.015) to respondents’ workplaces were statistically significant, as the p-values were less than 0.05. Table 3 summarises the results.

#### 4.1. Travel time and distance

Respondents that wanted to WFH part-time or full-time required similar amounts of time to travel to their workplace, with 46.5 % of respondents in Group 1 and 46.2 % of respondents in Group 2 respectively requiring more than 20 min. Respondents in Group 3 that wanted to return to their centralised workplace full-time required less travelling time, with only 34.0 % requiring more than 20 min.

Respondents in Groups 1 and 2 also travelled further than those in Group 3. The percentage of respondents that travelled further than 10 km was 37 % in Group 1, 43.6 % in Group 2, and only 23.9 % in Group 3.

The statistical significance of these variables indicates that travel time and distance influence respondents’ WFH preference. This is supported by how strongly respondents agreed to the statement, ‘Having no commute made WFH more enjoyable’, illustrated in Fig. 3. Groups 1 and 2 tended to strongly agree that having no commute made their WFH experience more enjoyable, while Group 3 was more neutral towards this statement.

Respondents in Groups 1 and 2 commented on frustrations related to commuting once they returned to their workplace after lockdown. One said, “We spent more time and money to commute for zero benefit”, while another respondent commented that the WFH experience “made my commute to and from work something I dread now”. Two respondents felt more tired when they returned to their 45-min and 1.5-h one-way daily commutes. One respondent summarised the frustrations associated with commuting, stating, “it’s a shame it took a pandemic to make people realise how unnecessary a lot of travel is”.

Respondents commented that they used their commuting time for other activities when WFH, such as balancing familial commitments or fitness, with one respondent using their 20-min commute time for morning and afternoon walks.

#### 4.2. Dependency on private vehicles

Regarding transportation type, most respondents used private vehicles to commute: 61.8 %, 72.1 %, and 63.0 % for respectively Groups 1, 2, and 3, or approximately 68.5 % of all respondents that experienced WFH. 11.9 % of all respondents use public transport. Similar proportions of Groups 1 and 3 used active transportation (walking, cycling, or E-scooter) to commute to their workplace (respectively 25.5 % and 25.4 %), compared to 16 % of respondents from Group 2.

Environmental Health Indicators (2020) estimated that 79.9 % of all commuting time in New Zealand was spent as a driver or passenger of a private vehicle in 2015–2018. While survey results are less than this, New Zealand’s dependency on private cars is apparent.

New Zealand has the highest ratio of motor vehicles per person compared to other members of the Organization for Economic Co-Operation and Development (OECD, 2015). Public transport accounts for approximately 4 % of travelling (less than the number of WFH respondents that use public transport, as shown in Table 3). This dependency is due to inadequate availability of bus networks nationwide, other than in Auckland and Wellington, which also have rail (Ministry of Transport, 2015). Active transport is also limited. Most New Zealanders live in low-density areas that are poorly connected and far from key destinations, such as schools and shops (Badland et al., 2012; Witten et al., 2012). Active transportation networks, such as cycle lanes, are poorly designed, as they are often constructed in areas with high volumes of traffic, high-speed traffic, and dangerous crossings (Mandic et al., 2017).

These factors lead to excessive congestion, especially during peak traffic hours of 7 am – 9 am and 3 pm – 6 pm when people typically travel to work or school. The average one-way commute in Auckland, the nation’s most populated city, is 23 min one-way at a speed of 31 km/h, which is 19 km/h slower than the average urban speed limit (Stats NZ, 2021). This congestion costs the Auckland region an estimated NZ$1.25 billion per annum compared to free-flow traffic models when accounting for increased costs from saving time, scheduling, vehicle operation, crashes, and the environment (Wallis & Lupton, 2013).

Survey comments support these findings. Many respondents viewed

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**Table 3**

| WFH preference | Group 1: WFH part-time (% | Group 2: WFH part-time (%) | Group 3: Centralised workplace full-time (%) | p-value |
|----------------|-------------------------|---------------------------|------------------------------------------|---------|
|                | (n = 157)               | (n = 499)                 | (n = 138)                                |         |
| Travel time to workplace |                            |                           |                                          | 0.015   |
| Less than 10 min. | 35.7                   | 24.8                      | 31.9                                    |         |
| 10–20 min.     | 17.8                   | 28.9                      | 34.1                                    |         |
| 20–30 min.     | 17.8                   | 18.4                      | 14.5                                    |         |
| 30–40 min.     | 10.2                   | 12.2                      | 9.4                                     |         |
| More than 40 min. | 18.5                 | 15.6                      | 10.1                                    |         |
| Travel distance to workplace |                    |                           |                                          | 0.001   |
| Less than 5 km  | 40.1                   | 28.3                      | 42.0                                    |         |
| 5 km - 10 km   | 22.9                   | 28.1                      | 34.1                                    |         |
| 10 km - 20 km  | 13.4                   | 21.8                      | 13.0                                    |         |
| 20 km - 30 km  | 11.5                   | 10.2                      | 5.1                                     |         |
| More than 30 km | 12.1                   | 11.6                      | 5.8                                     |         |
| Transportation type |                        |                           |                                          | 0.000   |
| Personal vehicle | 61.8                 | 72.1                      | 63.0                                    |         |
| Walking        | 21.7                   | 9.0                       | 16.7                                    |         |
| Public transport | 12.7                | 11.8                      | 11.6                                    |         |
| Cycling        | 2.5                    | 6.8                       | 8.7                                     |         |
| E-Scooter      | 1.3                    | 0.2                       | 0.0                                     |         |

Key: min = minutes; km = kilometres.
WFH as a means to “reduce our car-based CO₂ emissions”. They noticed substantial environmental improvements during lockdown (“When there were no cars, the birdsong and air quality were mind-blowingly amazing…I wish I could re-experience that peace and cleanliness”). While WFH decreases dependency on cars and increases the use of alternative forms of transport (Lachapelle et al., 2018), WFH may not be appropriate for workers in all industries, as previously discussed. Considerations of alternative policies should also be made. Respondents advocated for “incentives to get people out of cars”, including improved public and active transport networks. “Better buses” and “more

Table 4
Comparison of built environment variables during lockdown by WFH preference.

| WFH preference                  | Group 1: WFH full-time (%) | Group 2: WFH part-time (%) | Group 3: Centralised workplace full-time (%) | p-value |
|---------------------------------|-----------------------------|-----------------------------|---------------------------------------------|---------|
| Related to the built environment? | (n = 157)                   | (n = 499)                   | (n = 138)                                   |         |
| Housing type                    | Yes                         |                             |                                             | 0.757   |
| House that I own                | 60.5                        | 61.7                        | 51.4                                        |         |
| House owned by family           | 10.8                        | 11.8                        | 15.9                                        |         |
| Rented house                    | 20.4                        | 21.2                        | 26.8                                        |         |
| An apartment I own              | 1.9                         | 0.6                         | 1.4                                         |         |
| Rented apartment                | 5.1                         | 3.4                         | 2.9                                         |         |
| Other                           | 1.2                         | 1.2                         | 1.4                                         |         |
| WFH location                    | Yes                         |                             |                                             | 0.000   |
| Office space that existed before lockdown was announced | 38.2 | 26.9 | 12.3 |
| Office space converted after lockdown was announced | 13.4 | 19.6 | 11.6 |
| Bedroom                         | 15.3                        | 14.2                        | 30.4                                        |         |
| Lounge area                     | 19.7                        | 18.6                        | 21.7                                        |         |
| Dining room                     | 9.6                         | 16.8                        | 22.5                                        |         |
| Other                           | 3.8                         | 3.8                         | 1.4                                         |         |
| WFH environment characteristics  | Yes                         |                             |                                             | 0.000   |
| Comfortable temperature         | 89.2                        | 83.4                        | 76.1                                        |         |
| Extremely hot or cold           | 5.7                         | 11.0                        | 13.0                                        |         |
| Enough space to complete work comfortably | 78.3 | 70.3 | 58.0 |
| In close proximity to others    | 3.8                         | 6.8                         | 5.8                                         |         |
| Windows with a nice view        | 68.2                        | 65.5                        | 53.6                                        |         |
| Damp, excessive condensation or mouldy | 3.2 | 3.8 | 5.1 |
| Structural issues               | 1.9                         | 2.0                         | 0.7                                         |         |
| Well-maintained, neat, clean    | 75.2                        | 63.9                        | 55.1                                        |         |
| Dirty, messy, disorganized      | 7.0                         | 10.6                        | 14.5                                        |         |
| Loud, noisy                     | 8.3                         | 11.8                        | 20.3                                        |         |
| Quiet                           | 56.1                        | 43.9                        | 33.3                                        |         |
| Other                           | 0.6                         | 4.0                         | 2.2                                         |         |
| WFH environment features        | Yes                         |                             |                                             | 0.581   |
| Natural lighting                | 96.2                        | 94.8                        | 92.0                                        |         |
| Good ventilation and airflow    | 91.7                        | 89.4                        | 86.2                                        |         |
| Double glazed windows           | 28.7                        | 31.9                        | 34.1                                        |         |
| Central heating or heat pumps   | 49.7                        | 50.9                        | 54.3                                        |         |
| Air conditioning                | 32.5                        | 28.3                        | 25.4                                        |         |
| Insulation                      | 75.2                        | 73.9                        | 68.1                                        |         |
| None of these features          | 1.3                         | 2.0                         | 4.3                                         |         |
| Other                           | 3.2                         | 3.6                         | 2.2                                         |         |
| Knowledge of techniques to improve housing performance | Yes | | | 0.891 |
| Yes, uses techniques regularly  | 81.5                        | 78.6                        | 79.0                                        |         |
| Yes, but does not use them      | 10.2                        | 12.8                        | 13.0                                        |         |
| No knowledge                    | 7.6                         | 8.4                         | 8.0                                         |         |

a Percentages are greater than 100 % as respondents could select multiple answers.
passenger trains” were the most common solutions suggested; however, two respondents highlighted that “public transport keeps getting more expensive and...it is more worth it to actually drive and park than take the bus (sic)”. A balance between increased public transport options and price should be considered when developing these policies.

Alternative transportation was also discussed, including bikes, e-bikes, and car-sharing. Along with poor cycle lanes and walkways, respondents highlighted other barriers that prevent them from using active transport. Barriers included a lack of appropriate shower and changing facilities at their workplaces, travelling to various locations for work, and having too much equipment to take to work. Changes to business policy could overcome these barriers. Examples include having work vehicles permanently at the workplace for employee use; improving facilities to include showers, changing rooms, and secure lockers; and utilising technology, such as cloud storage and tablets, to minimise paper and equipment requiring transportation. Businesses can also integrate policies to minimise the need for travelling. Respondents highlighted that using videoconferencing, such as Zoom, was an effective way to reduce travel, including flying to other cities for meetings. This would minimise costs, the time required, and unnecessary emissions.

An alternative to changing transportation networks is improving housing policies. A proposed sustainable long-term solution to transportation issues is densification. For example, it has been found that individuals living in high-density areas tend to walk more for transport (Witten et al., 2012). Densification has already occurred in some regions in New Zealand, such as the Auckland CBD. This has increased walkability and connectedness, thus reducing the need for private vehicles (Carroll, Witten, & Kearns, 2011).

Two respondents highlighted a “big difference between urban and rural in regards to... public transport, active transport network”. One respondent had to cycle along “largely 100 km zones” when travelling between towns, which “doesn’t feel safe”. These rural areas must also be considered when developing transportation policies.

5. WFH and the workplace built environment

Table 4 summarises responses to questions regarding the workplace built environment and the WFH workplace. Statistically significant variables were WFH location and environment characteristics ($p = 0.000$ for both variables).

5.1. Impacts of the workplace built environment on health

Respondents in Group 3 that wanted to return to their centralised workplace full-time were less likely to agree with the statement, ‘I had a more comfortable experience WFH than I did at my workplace before lockdown’, as illustrated in Fig. 4.

The built environment impacts the physical and mental health of its occupants (Amerio et al., 2020; Azzazy, Ghaffarianhoseini, Ghaffarianhoseini, Naismith, & Doborjeh, 2021; Bower et al., 2021; Choi, Kim, & Chun, 2015; Evans & McCoy, 1998). Extended time in a small, poorly built, unhealthy environment results in unnecessary discomfort and increases the chances of contracting preventable mental and physical illnesses (Howden-Chapman & Pierse, 2020). The lack of personal control over environmental conditions in a centralised workspace, such as lighting, temperature, noise, and privacy, may also cause discomfort and distractions (Samani, 2015). Contrarily, quality working environments promote employee well-being and increase productivity and engagement (Chandrasekar, 2011).

Workplaces should be suitable for their use-case and employees’ needs. They should promote productivity, prioritise employee comfort and well-being, provide access to required resources and spaces, integrate appropriate health and safety practices, and consider the integration of the features outlined in Table 4 (Ajala, 2012; Harris, 2015; Nielsen et al., 2017; Sorensen et al., 2018). When considering WFH, the remote working environment should be suitable for the employee to complete their work and not be detrimental to their mental or physical health, productivity, or the business organization. If the remote working environment is detrimental, upgrades or changes should be made, or returning to a centralised workplace may be more appropriate.

5.2. Dedicated working space

The number of respondents who worked in an office space that existed before the lockdown was announced differs between groups. Of the respondents in Group 1 who wanted to WFH full-time, 38.2% had access to an existing office, compared to 26.9% in Group 2 who preferred to WFH part-time and 12.3% in Group 3 who did not want to WFH. Alternative locations, including bedrooms, lounges, and dining areas, were used by 76% of respondents in Group 3, compared to 48.4% in Group 1 and 53.4% in Group 2. These environments were not optimised for working, as respondents commented there was a lack of ergonomic furniture, minimal privacy, and poorly integrated multifunctional areas. 64.5% of respondents from Group 3 said that having a dedicated workspace would make WFH more positive or desirable. This aligns with other studies investigating WFH workspaces during COVID-19, which found having a dedicated workspace increased productivity and worker well-being (Amerio et al., 2020; Xiao, Becerik-Gerber, Lucas, & Roll, 2021).

Fig. 5 shows the space respondents had while WFH relative to their pre-lockdown workplace. Group 3 tended to strongly agree that they had less space.

Sharing a workspace with others tends to generate noise, which affects stress levels (Choi et al., 2015), and unwanted social interactions while trying to complete work-related tasks (Samani, 2015). The area available for working is also a significant indicator of workplace satisfaction, as this affects the amount of sound and visual privacy available to individuals (Green et al., 2020; Kim & De Dear, 2013). This is supported by respondents’ comments, including “having a separate space in

![Fig. 4. How strongly respondents agreed with the statement, ‘I had a more comfortable experience working from home than I did at my workplace before lockdown’.](image-url)
which to work is key to successfully WFH” and “I WFH so I need my peace and quiet”.

5.3. WFH workplace environmental characteristics

Respondents in Group 3 who wanted to return to their centralised workplace full-time tended to work in environments with less desirable characteristics compared to the other groups. Respondents in Group 3 were less likely to be working in quiet environments (56.1 % compared to 78.3 % for Group 1), had enough space were less likely to be working in quiet environments (33.3 % compared to 68.2 % from Group 1), and were well-maintained, neat, and clean (55.1 % compared to 75.2 % for Group 1).

Environmental characteristics related to sensory stimulation can lead to stress. Choi et al. (2015) performed a study during which participants were exposed to predetermined conditions within a climate chamber to investigate if the environment affected participants’ stress levels. Conditions adjusted were temperature, noise, and odour irritants. Participants were most stressed when exposed to traffic sounds, odours, and high temperatures. Stress levels were lowest when participants were exposed to nature sounds, no odours, and a ‘neutral’ temperature of 25°C. Table 4 reflects that respondents in Group 3 were more likely to be exposed to these stressful environments compared to other groups.

5.4. Availability of appropriate housing for WFH

Based on the requirements for appropriate WFH spaces discussed, the availability of housing with appropriate spaces and environments to work in affects the future of WFH in New Zealand.

New Zealand has severe housing deprivation, which has worsened since the early 2000s (Amore, 2016). This is reflected in the increased demand for public housing: as of June 2021, there were 24,474 households on the waitlist for public housing, an increase of 32.1 % from June 2020 (Ministry of Social Development, 2021).

House prices have disproportionately inflated relative to the income of most of the population, with approximately 25 % of households spending over 40 % on housing costs, either in the form of a mortgage or rent (Barber et al., 2020; Grimes, 2017; Murphy, 2016). Funds that could be spent on repairs are generally required for other necessities, such as rent or food (Chisholm & O’Sullivan, 2017; EHNZ, 2018; Grimes, 2017; Howden-Chapman et al., 2012; White, Jones, Cowan, & Chun, 2017).

The housing shortage and high property costs have led to people settling in poor quality housing (Amore, 2016), which is detrimental to occupants’ mental and physical health. Common housing issues include cold temperatures, structural issues, mould, excessive condensation, dampness, and household crowding. It has also been found that issues may be caused by lack of compliance with the New Zealand Building Code (Nwadike & Wilkinson, 2020), poor practice (Buchanan, Deam, Frangiaco, Gibson, & Morris, 2006), misinterpretation of codes (Murphy, 2014), and lack of enforcement and regulation (Nwadike & Wilkinson, 2021).

Respondents from Group 3 were more likely to have lower incomes compared to other groups, meaning they may be more likely to experience housing issues, which may have affected their WFH experience. Housing inequalities may prevent some employees from WFH when it would be better suited to their circumstances. It may also result in other inequities: individuals unable to WFH may feel that they have to work in a poor environment or struggle to find work if more companies require all employees to WFH (Nanda, Thanos, Valtonen, Xu, & Zandieh, 2021).

Although the types of housing occupied during lockdown were not statistically significant, many respondents commented on housing-related issues related. One respondent from Group 1 referred to available apartments as “shoebox slums”, and another said rentals are “in a sorry state of neglect” and mitigations should be made to bring “all the terrible housing stock up to 21st century standards”. In summary, there was agreement that housing is an issue that must be addressed.

6. WFH built environment policies and liable parties

The survey asked all survey respondents to rate how strongly they agreed with the role of various parties in ensuring houses are suitable for WFH. These parties were the government, landlords, employers, and house occupants. At least 64 % of respondents from each group agreed (i.e., rated 4 or 5 on the 5-point Likert scale) that landlords should ensure their tenants had access to healthy houses where they could comfortably work or study. Consensus differed on the responsibilities of the government and employers. Over 61 % of respondents from Group 1 and Group 2 agreed that the government should ensure access to a healthy house where one can work or study, compared to 51.82 % of Group 3. Regarding employers, 46.45 % of Group 1, 40.16 % of Group 2, and 36.96 % of Group 3 agreed that employers should subsidise WFH employees to upgrade their houses to be healthy and comfortable.

Twenty-six respondents (2.42 % of the 1075 survey respondents) added further commentary. They agreed that healthy housing should not be reserved for only those that WFH and each party had some responsibility for creating and maintaining healthy housing. They agreed that governments are responsible for passing laws and standards for healthy housing, landlords are responsible for ensuring their housing abides by these standards, employers are responsible for mitigating costs directly related to WFH, and tenants are responsible for ensuring healthy environments are maintained.

6.1. Role of the government

One respondent stated that the government is responsible for “ensuring a healthy built home, but it’s not up to the government to ensure how the home is used”, thus summarizing the opinions of those who commented on the government’s role.

Respondents provided suggestions on what the government could do.
to ensure healthy housing availability. These included sanctioning “stronger standards for landlords”, “capital gains tax”, ensuring tenants are “aware of their rights”, updating “building codes”, “legislating” and subsiding “comfortable, rentals, and introducing “long-term rental models”.

A bipartisan-supported amendment to the Resource Management Act (RMA) was announced in October 2021 as an attempt to increase the housing supply. The amendment will allow the construction of buildings up to three storeys without a resource consent, as was previously required, in New Zealand’s most populous cities: Auckland, Hamilton, Tauranga, Wellington, and Christchurch (New Zealand Government, 2021b). This is expected to decrease house prices and increase home-ownership rates, resulting in positive social and environmental impacts (Greenway-McGrevy, 2022). It is recommended that the government ensures that the new housing is constructed to a high standard, accounting for the suggestions and discussions from survey respondents.

If large-scale WFH occurs, it is expected the government will decrease expenditure related to infrastructure development and upgrades, reading, and climate-related mitigations (Kwon & Jeon, 2017; Listler & Harnish, 2011; Nilles, 1975). These saved costs could be distributed elsewhere to incentivise or support employees that WFH or increase housing supply and ensure healthy homes are constructed.

6.2. Role of the landlord

Fifteen respondents from all Groups agreed that it is a landlord’s responsibility to always provide a healthy home, “not just because of WFH”. One respondent commented that “if a home is healthy and comfortable to live in, then it is probably healthy and comfortable for WFH, apart from additional space required”. Many respondents agreed space or room usage was not the landlord’s responsibility.

Private rentals tend to be in poorer condition than council or state-owned rentals or privately owned properties, thus disproportionately affecting lower-income and vulnerable households and causing them to live in poorer conditions (Howden-Chapman et al., 2012; Rangiwhetu, Pierse, Viggers, & Howden-Chapman, 2018). Several facets contribute to this issue, including unequal power dynamics between landlords and tenants; low monitoring of housing conditions; the Tenancy Tribunal operating as a self-reporting system; and tenants being unaware of their rights (Chisholm, Howden-Chapman, & Fougere, 2017).

To mitigate issues with rentals, researchers have proposed that houses require a regular warrant of fitness (WOF) (Adé & Rehm, 2020; Bennett, Howden-Chapman, Chisholm, Keall, & Baker, 2016; Chisholm et al., 2017; Rangiwhetu et al., 2018). Just as with a vehicle, the WOF would ensure that houses adhere to predetermined characteristics and have necessary features to enhance residents’ well-being and safety. The WOF system would also provide a better overview of the state of housing in New Zealand. Bennett et al. (2016) proposed 63 criteria for the WOF and performed a trial of this process in five cities: Auckland, Christchurch, Dunedin, Wellington, and Tauranga. Of the 144 privately owned rental properties assessed, only eight had a 100 % pass rate. The most common criteria that failed were unsafe water temperatures, lack of security stays for windows higher than 2 m above the ground, lack of smoke alarms, and handrails and balustrades not meeting Building Code regulations. Pass rates of other criteria varied between 70 and 100 %, smoke alarms, and handrails and balustrades not meeting Building Code regulations. Pass rates of other criteria varied between 70 and 100 %.

One respondent that lived in medium-density housing liked their space or room usage was not the landlord’s responsibility. Another respondent commented that there is “no use setting standards if people don’t know how to keep or maintain (healthy housing)”. A variety of techniques can maximise housing performance, thus minimising costs and preventable illnesses. These include using curtains for temperature control, regularly opening windows for ventilation and moisture management, purchasing energy-efficient appliances, and regular cleaning to increase hygiene (Chenari, Dias Carrilho, & Gameiro Da Silva, 2016; Hong, Taylor-Lange, D’Oca, Yan, & Corgnati, 2016; Zhang, Bai, Mills, & Pezzey, 2018). Education and information about these techniques should be easily accessible. Employers may provide such information if instigating WFH. Social and cultural values should be accounted for when developing curricula (Gowan, Mardon, & Jones, 2020; Gianfrate et al., 2017; Nguyen, Lobo, & Greenland, 2017).

7. The future of WFH in Aotearoa New Zealand

7.1. Hybrid WFH

Most survey respondents that experienced WFH (62.84 %) would prefer to WFH part-time and work from their centralised workplace part-time, indicating that a hybrid WFH model should be developed. Hybrid WFH can address many challenges related to WFH, such as collaboration, home-work balance, and social isolation (Green et al., 2020); however, it presents complications when considering the built environment. Large-scale full-time WFH or returning full-time to centralised workplaces results in only one type of environment requiring management and potential improvements. Hybrid WFH requires consideration for home and centralised workplace environments. Would employees split into teams, with some WFH while the others are at the office? Would all employees WFH on given days then come into the workplace on others, leaving it empty for part of the week? Could the
workplace be shared or leased to another business during WFH days? What facilities and equipment are required at both employees’ homes and the workplace, and what costs would this ensue? Solutions must address these larger organizational issues. Hybrid WFH models will likely initially require development on a company-by-company basis, ensuring that employees’ needs and positive company outcomes are achieved.

7.2. WFH under business as usual

As with WFH during other disruptive events (Donnelly & Proctor-Thomson, 2015; Green, Tappin, & Bentley, 2017), WFH during the COVID-19 induced lockdown differs from WFH under business as usual (BAU). Respondents from all groups highlighted challenges related specifically to WFH during COVID-19.

Survey respondents reported that stress-related to COVID-19 and lockdown impacted their WFH experience. One respondent commented, “the stress of lockdown and wondering how others were doing had a significant impact on my ability to concentrate on work”. Another respondent commented, “it’s important to note that working from home during lockdown wasn’t the same mentally as working from home at other times. My team liked to say, ‘we aren’t working from home, we are at home, during a crisis, trying to work’. I spent a lot of time on my staff’s well-being which meant I was less ‘productive’”.

Comments related to struggling to find a balance between childcare or homeschooling and working were common. A respondent from Group 1 said, “much of the ability to WFH is influenced by childcare”, supported by a respondent from Group 2 that commented, “the main thing I struggled with WFH during lockdown was trying to meet the expectation of being productive while having two kids under five at home”. Under BAU, schools and childcare facilities would be open, meaning childcare arrangements for parents or guardians would be similar to when they work at their centralised workplace.

Survey respondents from all groups were concerned about the social isolation that occurred while WFH during the lockdown. Respondents in Group 3 that wanted to return to their centralised workplace full-time tended to be more negative about working in isolation than other groups. They perceived that WFH would “feed more into the loneliness epidemic”, “be an anti-social movement”, and result in “real social costs if everyone spent their lives locked up at home”. Contrarily, respondents in Groups 1 and 2 that wanted to WFH to some degree commented that they “enjoyed not having the drama of a workplace”, “realised how toxic the work environment was before lockdown”, and commonly referred to their workplace as “loud” with “social distractions”. These differences in opinion highlight that respondents rely on different groups for social interactions. This is supported by 63.7 % of respondents in Group 1 and 42.9 % of respondents in Group 2 strongly agreeing with the statement ‘I enjoyed having more time around other household members while WFH during lockdown’, compared to only 21.0 % in Group 3. Under BAU, other social opportunities would be available for those that WFH, including in-person interactions with family, friends, groups, and communities. WFH also presents an opportunity for flexible work schedules, meaning schedules could be adjusted to suit these social interactions if company policy allows.

7.3. Future research on WFH

As no studies have investigated the relationship between WFH and the built environment in New Zealand, this research has filled a gap in literature and is a valuable starting point to build on. Future studies and analyses can continue developing this research.

To make valuable changes that ensure New Zealanders have appropriate WFH environments, more information is required about various subgroups, such as employees in specific industries, ethnic groups, or groups that live in different housing types. This could be extracted from this survey’s data, or the subgroup of interest can be targeted further through surveys or focus groups. The perspective of the employer on the built environment and WFH policies should also be considered.

Several respondents commented on the necessity of a reliable internet connection to be able to WFH. Some struggled with poor internet, especially in rural areas. This was not explicitly explored in this survey and should be accounted for in further works related to WFH.

If WFH is unfeasible for businesses (e.g., due to the services they offer), findings from this study about healthy work environments should still be considered and integrated into the workplace environment to ensure it promotes employee well-being.

Some survey questions were not analysed or discussed in this article due to the focus being on the built environment and its relation to the WFH experience. These will be explored in future works, along with results from respondents who did not WFH.

8. Conclusion

In an age of technological advances, WFH has become feasible for a significant proportion of industries, allowing employees to work from their homes while offering economic, environmental, and time-related benefits. The COVID-19 lockdown provided the backdrop for a WFH trial for many people who may not have experienced it otherwise. Our survey results show that a significant proportion of New Zealanders who experienced WFH during this time want to WFH part- or full-time in the future. These findings align with another WFH study performed in New Zealand during COVID-19 (O’Kane et al., 2020).

However, when considering the future of WFH, it is imperative to examine the relationship between the built environment and WFH. The built environment affects the success of WFH, while large-scale WFH will affect built environment interactions and demand for various built environment systems.

Transportation and distance to the workplace are factors in people’s desire to continue WFH. Those with short commute times and distances were happy to continue working at a centralised workplace. However, those that commute farther and longer enjoyed the added time and flexibility provided by permanent or hybrid WFH environments. If communities and workplaces elect to revert to centralised office environments, effort and resources should be put into place to shorten commutes and encourage alternative transportation methods.

Comfortable environments are essential for worker comfort regardless of location. Effective WFH often included dedicated working spaces that were spacious, quiet, and well maintained. Successful WFH also required access to appropriate equipment. Positive work environments promote employee productivity and sustain their well-being, thus benefiting the employee and their employer long-term. For continued WFH to be successful, the quality of residential housing needs to be fit for purpose. Housing should have adequate space for creating a constructive WFH environment for long term success.

Various parties are responsible for the state of housing and the WFH environment. These responsibilities should be split between the government, homeowners/landlords, home occupiers, and employers. The government is encouraged to enact housing standards that ensure all homes are healthy and rentals are held to a high standard over their lifetime. Landlords should ensure their rentals are built to and maintain the regulated standards. Home occupiers are responsible for daily maintenance to ensure the house continues to perform as intended. Employers can support employees that WFH by ensuring they have access to equipment and subsidising costs directly related to the business.

In industries where WFH may not be appropriate, business policies can be adapted to encourage other forms of transportation, including providing changing facilities and utilising videoconferencing for meetings.

Further research about WFH and the built environment is required to ensure appropriate policies are put in place. A hybrid WFH model considering the built environment should be developed, as most respondents wanted to WFH part-time. WFH should also be considered
outside of the COVID-19 pandemic, as many lockdown-induced stressors may not be relevant to WFH under business as usual. Various subgroups, especially minorities and vulnerable populations, should be considered individually.

CRediT authorship contribution statement

**Bethany Mayer:** Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Visualization.

**Megan Boston:** Conceptualization, Methodology, Validation, Writing – review & editing, Supervision, Project administration.

Declaration of competing interest

None.

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Data availability statement

The data presented in this study is available on request from the corresponding author. The data is not publicly available due to meeting the conditions of the ethics approval process to protect potential privacy issues of survey participants.

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