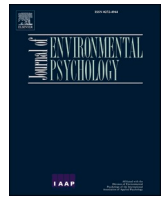




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'It feels smaller now': The impact of the COVID-19 lockdown on apartment residents and their living environment – A longitudinal study

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ABSTRACT

Introduction: The COVID-19 pandemic and associated lockdown restrictions prolonged residents' exposure to their home environment. The impact of lockdowns could be heightened for apartment residents as they typically have smaller, less versatile homes, and share communal and circulation spaces. This study examined changes in apartment residents' perceptions and experiences of their dwelling before and after the Australian COVID-19 national lockdown.

Methods: Participants consisted of 214 Australian adults who completed a survey on apartment living between 2017 and 2019 and a follow-up survey in 2020. Questions focused on residents' perceptions of their dwelling design, apartment living experiences, and personal life events/changes due to the pandemic. Differences between pre- and post-lockdown periods were assessed via paired sample t-tests. The lived experience of a subset of residents (n = 91) following lockdown was also assessed using qualitative content analysis of free-text responses to an open-ended survey item.

Results: Compared to the pre-pandemic period, after the lockdown residents reported less satisfaction with the amount/layout of their apartment space and private open space (e.g., balconies or courtyards). Increased noise annoyance from indoor and outdoor noise sources was also reported, however disputes with neighbours decreased. The qualitative content analysis highlighted a complex interplay of personal, social and environmental impacts of the pandemic on residents.

Conclusions: Findings suggest an increased 'dose' of the apartment facilitated by stay-at-home orders negatively influenced residents' apartment perceptions. Design strategies that maximise spacious, flexible dwelling layouts with health-promoting elements (e.g., enhanced natural light/ventilation and private open space) are recommended to promote healthy and restorative living environments for apartment residents.

1. Introduction

Rapid population growth and urbanisation have driven the rise of high-density housing in urban areas all over the world. Australia's housing profile – historically dominated by detached dwellings – is also evolving, with more Australians living in higher-density housing than ever before. Over 2.5 million people (10.3% of the population) are apartment dwellers, with apartment development accounting for 31% of the increase in private dwellings between 2016 and 2021 (Australian Bureau of Statistics, 2022a). Despite the public stigma high-density housing faces, with Australians having a longstanding preference for detached housing (Kelly et al., 2011), increased residential density is important from an urban planning perspective as it allows more

residents to be in closer proximity to shops, services and public transit, thereby promoting more sustainable and healthier communities (Giles-Corti et al., 2016).

The coronavirus (COVID-19) pandemic and associated lockdown measures profoundly altered daily life for much of the world's population. In 2020, an estimated 3.9 billion people – half the global population – experienced some form of lockdown restrictions (Sandford, 2020). Australia's national lockdown, beginning in March 2020, lasted for six weeks and was followed by a series of targeted lockdowns initiated by state governments to control outbreaks (Australian Bureau of Statistics, 2021). Notably, the city of Melbourne, Victoria experienced one of the longest and strictest lockdown periods in the world – a cumulative 262 days, or almost nine months, until restrictions eased in October 2021

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(Jose, 2021). The number and type of lockdown restrictions implemented throughout Australia varied, but usually involved 'stay-at-home' orders with travel only permitted for essential reasons, closure of 'non-essential' businesses and hospitality, a shift to work from home (WFH) arrangements, and other social distancing measures including mask mandates and density limits (Australian Bureau of Statistics, 2021).

Lockdown measures meant that everyday life had to occur almost exclusively within people's homes. Australian evidence indicates that connections to the neighbourhood realm were weakened, with once 'urban practices' (including work, learning/schooling, food provisioning, and extracurricular activities) concentrated within the boundaries of one's dwelling (Horne et al., 2020). This presented significant challenges, with many people confined to living environments that were ill-suited to prolonged exposure. Working and schooling from home necessitated material changes (e.g., rearrangement of dwelling layouts and furniture) and social changes (e.g., compromises reached between household members to minimise disturbance) (Horne et al., 2020). While such changes were common across all housing typologies, apartments are often less versatile due to a lack of available space, restrictive or poorly conceived layouts, and insufficient natural lighting (Abed, 2021; Bettaieb & Alsabban, 2020). These space and storage limitations can restrict the rearrangement or introduction of furniture to create appropriate workspaces (Oswald et al., 2022).

Beyond disruptions to daily life, lockdown measures were successful in reducing coronavirus transmission and the associated disease burden and mortality risk – but nevertheless had other unintended health consequences. Numerous longitudinal studies examined the impact of lockdown measures on health behaviours (Barr-Anderson et al., 2021; Daly & Robinson, 2021; Mason et al., 2021; Quirk et al., 2022) and mental health (Dickerson et al., 2022; Griffiths et al., 2022; Liao et al., 2021; Quirk et al., 2022) compared with pre-pandemic timepoints; many of which demonstrated lockdowns had a harmful effect. Apartment dwellers may be uniquely vulnerable to poorer health and well-being outcomes during lockdowns because: (1) apartments typically have less indoor and private outdoor space than other dwelling types, inflexible layouts that make it difficult to repurpose space, and limited control over indoor conditions (e.g., air quality, sunlight, noise and visual privacy) (Peters & Halleran, 2020); and (2) apartment buildings house more people and contain communal or shared areas that may be difficult for residents to bypass, which potentially poses a greater risk for the spread of COVID-19 infection. Recent evidence shows that living in an apartment (compared to other housing types) during lockdowns was a risk factor for poorer mental health and depressive symptoms (Abir et al., 2021; Amerio et al., 2020) and lower health-related quality of life in children and adolescents (Bourion-Bédès et al., 2022), with a smaller dwelling space (Amerio et al., 2020; Mouratidis, 2022), and poor-quality private open space and outlook (Amerio et al., 2020; Molaei et al., 2022) being particularly strong risk factors. Indeed, Peters and Halleran (2020) emphasise the importance of 'restorative environmental design' principles, including adequate space, lighting, ventilation and nature access, to mitigate these risks in apartment housing.

However, outside of research exploring health outcomes, few studies to date have investigated the impact of lockdown restrictions specifically on apartment dwellers' perceptions and experiences of their home environment. Understanding if, and how, residents' perceptions changed over time is crucial to identifying how apartment housing performs in a pandemic context, given its unique limitations and potential stressors. Indeed, additional contextual factors – including the Australian public's resistance to apartment living – further underscore the importance of designing apartments that residents both *want* to live in longer term and are resilient to current and future pandemics (or other circumstances that cause residents to spend more time in their homes, such as illness or unemployment). This study addresses the lack of empirical research on the experiences of apartment residents during stay-at-home orders by: (1) describing the personal, apartment and

wider building changes or events encountered due to the pandemic; (2) identifying the extent to which residents' perceptions of their apartment design and experience of apartment living changed after lockdown measures; and (3) drawing on a subset of participants' open-ended responses to understand the lived experience of apartment residents during this period. While the study is largely descriptive, with the intent of understanding the experience of apartment residents during lockdown, our underlying hypothesis was that the pandemic would prove challenging for this population and undermine many of the positives of apartment living.

2. Methods

2.1. Study context

The HIGH LIFE study was designed to examine the impact of apartment design policy on residents' health and wellbeing. Apartment developments ($n = 115$) were randomly sampled in three Australian cities (Sydney, Melbourne and Perth). Inclusion criteria for developments included: (1) being three or more storeys; (2) with ≥ 40 apartments; (3) constructed between 2006 and 2016; and (4) accessible endorsed architectural or development plans. Households ($n = 10,560$) from all apartment buildings were contacted via post and invited to participate in the HIGH LIFE study. Residents completed a baseline survey on their apartment and building design, administered between 2017 and 2019 ($n = 1326$; response rate 13.2% after accounting for a 5% rental vacancy rate). In May 2020, residents who completed the baseline survey and consented to be contacted about future research ($n = 790$) were invited via email to complete a follow-up online survey following the national (six-week) COVID-19 lockdown restrictions if they still lived in an apartment ($n = 257$; response rate 32.5%). After excluding participants with incomplete data, the analytic sample for the current study comprised $n = 214$ participants who completed the follow-up survey, and a subset of $n = 187$ who completed the follow-up survey and lived in the *same* apartment as when they completed the baseline survey. A further subset ($n = 91$) provided an open-ended response detailing their experience of apartment living during the pandemic. The study has been described in full elsewhere (Foster et al., 2019). The HIGH LIFE study has ethics approval from the RMIT University Design and Social Context College Human Ethics Advisory Network (CHEAN B 21146-10/17) and the University of Western Australia Human Ethics Research Committee (RA/4/1/8735).

2.2. Study variables

2.2.1. COVID-19 variables

In the follow-up survey, residents were asked about what changes they had experienced following the COVID-19 pandemic. These included: whether they had contracted COVID-19 or been required to self-isolate; their risk perception (more, less, or the same) of contracting the virus due to living in an apartment complex; any changes implemented in the apartment complex to mitigate the risk of virus transmission; changes they had made to their apartment to accommodate spending more time at home; and any personal changes and/or negative life events experienced due to the pandemic.

Residents' lived experience during the COVID-19 pandemic was explored via open-ended responses to the following (final) survey question: "Do you have any additional comments about the topics raised in the survey? Whether positive or negative, we would love to hear about your thoughts about apartment living since the COVID-19 pandemic".

2.2.2. Apartment living perceptions and/or experience variables

Both the baseline and follow-up surveys included items on residents' perceptions and/or experiences relating to apartment living. Housing satisfaction was measured via a single survey item: "how satisfied are

you with your housing situation?" Response options were provided on a 6-point Likert scale (1 = not at all satisfied; 6 = fully satisfied) (Eurostat, 2003). Residents' noise annoyance was measured using items adapted from the World Health Organisation (WHO) (Niemann & Maschke, 2004) assessing the frequency of noise from different sources. Items (rated 1 = never; 2 = less than once a month; 3 = monthly; 4 = weekly; 5 = most days; and 6 = every day) were combined into scales capturing the frequency of noise sources internal to the apartment building (i.e., from neighbours, children, pets or mechanical sources, including elevators or appliances) (Cronbach's $\alpha = 0.75$); and external to the building (i.e., from traffic, public transit, construction or pedestrians) (Cronbach's $\alpha = 0.76$). Problems with other residents were also assessed, with items relating to noise, smells, parking, pets, visitors, damage to private property, damage to building property, aggressive or threatening behaviour, and breaking building by-laws. An additional option for not adhering to social distancing was included in the follow-up survey. Problems were assessed via a yes/no response, with the total number of yes responses summed. Residents also reported the total number of hours spent at home between 8am and 8pm on weekdays and weekend days.

Three scales assessed residents' perceptions of their apartment (described in full elsewhere) (Kleeman et al., 2022). Briefly, residents reported their agreement with a series of statements based on a five-point Likert scale (1 = strongly disagree; 5 = strongly agree). Example items included: 'My apartment feels roomy', 'I can find space to myself in my apartment when I want it', and 'I can easily move furniture

around or change how I use the rooms in my apartment' (see Supplementary Table S1 for the full list). Items were coded (or recoded) to have positive phrasing. Scales were created for: (1) the size, layout and functionality of the internal dwelling space (Cronbach's $\alpha = 0.86$); (2) the experience of sharing space (or crowding) if living with others (Cronbach's $\alpha = 0.80$); and (3) the amount of private open space available (i.e., in balcony or courtyard) (Cronbach's $\alpha = 0.85$) (Kleeman et al., 2022).

2.2.3. Sociodemographic variables

Respondents' sociodemographic characteristics included: sex, age (in years), country of origin (Australia; other), living with a partner, living with children, educational attainment (secondary or less; trade/apprenticeship/certificate; bachelor or higher), household income (\$0-\$60,000; \$60,001-\$100,000; \$100,001-\$150,000; >\$150,000), tenure type (public housing; private rental; own outright or with mortgage), city, length of residence (in years), and area socioeconomic status (SES) based on the Australian Bureau of Statistics Index of Relative Socioeconomic Disadvantage (IRSD) 2011 state decile rankings at the SA1 level, stratified into three groups: deciles 1-4 (higher relative disadvantage); deciles 5-7 (mid-range disadvantage); and deciles 8-10 (lower relative disadvantage).

2.3. Data analysis

Differences in sociodemographic characteristics between residents

Table 1

Demographic characteristics of HIGH LIFE study participants at baseline (2017-2019) by whether they completed the follow up survey or completed the follow up survey and lived in the same apartment at both timepoints.

Sociodemographic characteristics	Completed baseline survey only % (n)	Completed both surveys % (n)	p	Completed both surveys & lived in same apartment both times % (n)	p
% (n)	81.9 (966)	18.1 (214)		16.2 (187)	
Sex					
Male	38.4 (371)	39.3 (84)	0.818	40.6 (76)	0.566
Female	61.6 (595)	60.7 (130)		59.4 (111)	
Age ^a	41.7 (15.7)	44.4 (16.0)	0.024	45.4 (16.3)	0.004
Country of origin					
Australia	55.8 (539)	68.7 (147)	<.001	70.1 (131)	<.001
Other	44.2 (427)	31.3 (67)		29.9 (56)	
Partner					
Yes	52.3 (505)	46.7 (100)	0.142	48.7 (91)	0.365
No	47.7 (461)	53.3 (114)		51.3 (96)	
Children living at home					
Yes	11.6 (112)	11.2 (24)	0.875	11.2 (21)	0.887
No	88.4 (854)	88.8 (190)		88.8 (166)	
Education					
Secondary or less	15.2 (147)	10.3 (22)		11.2 (21)	
Trade/certificate	20.4 (197)	14.0 (30)	0.007	14.4 (27)	0.031
Bachelor or higher	64.4 (622)	75.7 (162)		74.3 (139)	
Household income					
\$0 - \$60,000	23.8 (230)	21.0 (45)		19.3 (36)	
\$60,001 - \$100,000	25.1 (242)	25.2 (54)		26.2 (49)	
\$100,001 - \$150,000	22.7 (219)	24.3 (52)	0.931	23.5 (44)	0.733
>\$150,000	24.5 (237)	25.2 (54)		26.2 (49)	
Not reported	3.9 (38)	4.2 (9)		4.8 (9)	
Tenure					
Public housing	3.6 (35)	1.4 (3)		1.6 (3)	
Private rental	50.1 (484)	37.4 (80)	<.001	30.5 (57)	<.001
Own outright or mortgage	46.3 (447)	61.2 (131)		67.9 (127)	
Length of residence (years) ^a	2.3 (2.2)	2.3 (1.8)	0.737	2.4 (1.8)	0.742
City					
Perth	45.2 (437)	42.5 (91)		43.3 (81)	
Melbourne	33.7 (326)	34.1 (73)	0.688	31.6 (59)	0.454
Sydney	21.0 (203)	23.4 (50)		25.1 (47)	
Area SES					
IRSD 1-4	24.9 (241)	20.1 (43)		18.2 (34)	
IRSD 5-7	35.2 (340)	31.3 (67)	0.057	30.5 (57)	0.011
IRSD 8-10	39.9 (385)	48.6 (104)		51.3 (96)	

P values comparing differences from Pearson Chi-Square (categorical variables) and independent sample t-test (continuous variables).

^a Mean and standard deviation (SD) for continuous variables.

who only completed the baseline survey and those who completed both the baseline and follow-up surveys (n = 214) or completed both surveys and lived in the same apartment at both timepoints (n = 187) were compared using Pearson’s chi-squared test (χ^2) (categorical variables) and independent samples t-test (continuous variables) (Table 1). Descriptive statistics were calculated for the proportion of residents who had experienced COVID-19-related events or changes (%), (n) (Table 2, n = 214). Differences in apartment living perceptions and/or experiences pre- and post-lockdown were compared for those who lived in the same apartment at both timepoints (n = 187) using paired sample t-tests (Table 3).

To explore the lived experience of a subset of residents (n = 91) during the COVID-19 pandemic, responses to the open-ended item were reviewed and coded using qualitative content analysis. This method seeks to identify a constructs or concepts within the data to aid interpretation (Kleinheksel et al., 2020). Qualitative content analysis can be either manifest (i.e., describing what is occurring at surface level and staying ‘close to the text’) or latent (i.e., interpreting the underlying meaning of the text) (Bengtsson, 2016). Our study utilised a latent analysis, taking an inductive approach to analysing responses and developing codes and themes. The data was summarised at three levels: (1) ‘organising themes’ or broad categories encapsulating the data; (2) ‘sub-themes’ that exist underneath the umbrella of an organising theme, sharing the same central concept, but focusing on a more notable or specific element; and (3) ‘codes’ which operate at a more descriptive level, being less abstract or inclusive than a sub-theme. Frequent discussion between the authors informed the refinement of the final coding framework. Microsoft Excel was used for data management and framework development. The coding framework is presented in Supplementary Table S2.

3. Results

Table 1 describes the characteristics of participants, as recorded at baseline, comparing those who completed the baseline survey against those who (1) completed both the baseline and follow-up surveys; and (2) completed both surveys and lived in the same apartment at both survey timepoints.

There were differences between the samples, suggesting some

Table 2
Apartment residents’ COVID-19-related experiences.

	% (n)
	100 (214)
Received COVID diagnosis	0 (0)
Required to self-isolate for 14 days	
Yes (at home)	10.7 (23)
Yes (in hotel/other dwelling)	0.5 (1)
No	88.8 (190)
Perceived risk of apartment residents contracting COVID-19	
More risk	52.3 (112)
About the same risk	40.7 (87)
Less risk	7.0 (15)
Changes implemented in apartment building/complex due to COVID-19	
Closure of communal areas or facilities (e.g., gym, pool, sauna)	50.0 (107)
Restricted access to communal areas or facilities	37.4 (80)
Restrictions on who could enter the complex	31.3 (67)
Changes to building security (e.g., fob entry instead of keypad)	1.9 (4)
Increased cleaning of communal areas and surfaces	63.1 (135)
Provision of hand sanitiser in communal areas	30.4 (65)
Notices to encourage social distancing	71.0 (152)
Changes to building communications	21.5 (46)
Changes made to apartment use/layout due to COVID-19	27.6 (59)
Personal changes and/or negative life events experienced due to COVID-19	
I worked from home instead of the office	49.5 (106)
I had increased responsibilities at work	15.4 (33)
I became unemployed	5.1 (11)
Increased financial difficulties	11.7 (25)

Analysis applies to all residents who completed both surveys (n = 214).

Table 3
Apartment residents’ perceptions and/or experiences of their living environment.

Apartment variables	Baseline survey m (SD) ^a	Follow-up COVID-19 survey m (SD)	95% CI	p
% (n)	100 (187)	100 (187)		
Housing satisfaction scale ^b	4.8 (0.9)	4.7 (1.2)	−0.06, 0.26	0.216
Dwelling design perception scales ^c				
Space (layout/function)	3.7 (0.7)	3.6 (0.8)	0.07, 0.24	<.001
Space (crowding) ^d	4.0 (0.7)	3.7 (0.8)	0.13, 0.42	<.001
Balcony/courtyard space	3.9 (1.0)	3.6 (1.1)	0.21, 0.39	<.001
Noise annoyance scale ^e				
Indoor sources	2.0 (1.0)	2.3 (1.2)	−0.49, −0.19	<.001
Outdoor sources	2.5 (1.2)	2.7 (1.3)	−0.33, −0.20	0.027
Hours spent at home (8am–8pm)				
Weekday	4.2 (3.0)	9.3 (3.4)	−5.67, −4.51	<.001
Weekend day	7.1 (2.4)	9.8 (2.0)	−3.09, −2.33	<.001
Problems with residents (count)	2.0 (2.2)	1.4 (1.7)	0.33, 0.93	<.001

P values comparing differences from paired sample t-test.

Analysis applies to residents who completed both surveys and lived in the same apartment at both timepoints (n = 187).

^a Mean and standard deviation (SD) for continuous variables.

^b Responses based on six-point scale (1 = not at all satisfied; 6 = fully satisfied).

^c Responses based on five-point scale (1 = strongly disagree; 5 = strongly agree) reflecting participants’ agreement with a series of statements/items on each design aspect. All statements/items within each scale have been coded (or recoded) to have consistent positive phrasing (i.e., higher score = more positive perception).

^d Sample size n = 91 (i.e., participants living with other people).

^e Responses based on a 6-point scale (1 = never; 6 = every day).

attrition by individual-level socio-economic status. Participants who completed the follow-up survey (regardless of whether they lived in the same apartment at both timepoints) were more likely to be older, Australian born, well-educated, homeowners and live in more advantaged neighbourhoods.

At the time the follow-up survey was conducted, no residents had contracted COVID-19. However, Table 2 shows that over half of the residents perceived themselves to be at a greater risk of contracting COVID-19 due to living in an apartment complex. Residents reported that certain changes to the use and upkeep of communal spaces were implemented by building management following the COVID-19 pandemic, most commonly signs/notices stipulating social distancing requirements, increased cleaning frequency, and complete closure of certain facilities (e.g., gyms, pools). Some residents (28%) also made changes to the personal living spaces within their apartments. Finally, residents reported whether they had experienced changes and/or negative life events following the COVID-19 pandemic, most commonly reporting a shift to working from home (50%), increased responsibilities at work (15%) or financial difficulties (12%).

Residents’ perceptions and/or experiences of apartment living pre- and post-lockdown were compared in Table 3, with multiple changes evident between the two timepoints. Compared with the pre-pandemic period, residents surveyed in the lockdown period reported more negative perceptions of the amount of space or layout of their apartment (p < 0.001), worse crowding issues if sharing space with others (p < 0.001), and a poorer perception of the amount of private open space (balcony or courtyard) available to them (p < 0.001). Residents spent

significantly longer periods of time at home on both weekdays (5.1 hour average increase; $p < 0.001$) and weekend days (2.7 hour average increase; $p < 0.001$) following the stay-at-home orders. Further, they experienced greater annoyance with indoor noise sources (e.g., noise from neighbours or pets) ($p < 0.001$) and outdoor noise sources (e.g., traffic or construction noise) ($p = 0.027$). Notably, the average number of negative issues or disputes with neighbours decreased following the COVID-19 lockdown period ($p < 0.001$).

A total of 91 residents provided an open-text response to the final survey item on their experiences in lockdown. Four organising themes relating to the COVID-19 pandemic emerged from the responses, each of which contained their own set of sub-themes and codes. The four organising themes included: (1) personal impacts; (2) social impacts; (3) environmental (apartment) impacts; and (4) environmental (neighbourhood) impacts.

3.1. Personal impacts

Personal impacts converged around financial, lifestyle and emotional responses to the pandemic. Some residents spoke of financial difficulties stemming from a sudden unemployment or a lack of certainty about managing in the future.

“With the Covid situation, like many people I am feeling very uncertain about the future for both my work and finances.”

However, in some cases residents reported little change to their lifestyle and routines or even had a positive emotional response to the lockdown measures. Some expressed their comfort with working from home, while others gained a newfound appreciation for their circumstances relative to how unfavourable they *could* be.

“Living in this apartment through this pandemic has really raised my awareness of how fortunate my partner and I are ...”

3.1.1. Social impacts

Social responses tended to reflect either greater isolation or greater connection with others. The isolating impact of lockdown was evident for several residents, with many reporting reduced contact with family members and friends, along with a general wariness of neighbours in the wake of social distancing requirements. Loneliness was common.

“It’s so ... lonely here. My life was very busy before and now with everything stripped away, time seems to go slower ... I need my office, my work mates, my friends, my family, my hobbies back ...”

Conversely, some residents described feeling more connected with their apartment community – largely aided by shifts to virtual communication. Several residents recounted instances of neighbours supporting one another through difficult periods. Others were grateful for the general presence of others in their vicinity.

“I have noticed ... a lot more care between neighbours all looking out for each other. We started a WhatsApp group in our block which has been really helpful. People have reached out on it for all kinds of things, so in many ways it has brought us closer as a community.”

“Have actually appreciated hearing and seeing others around – I felt more connected despite the circumstances of isolation.”

3.1.2. Environmental (apartment) impacts

The lockdown period impacted many residents’ feelings about their apartment and building design. Having to spend much more time at home, several residents noticed more noise from their neighbours and pets.

“... as the weeks dragged on I began to like my place less and less. The noise from neighbours became much more noticeable.”

Operational changes to the building/s were noted by many. While residents were generally pleased with steps taken by building management to install stricter cleaning/sanitation regimes and social distancing protocols, some felt that only so much could be done given the physical design of their communal/circulation spaces and their proximity to neighbours.

“The design of this building does not meet social distancing rules. This is especially prevalent in the hallways, stairwells and lifts.”

However, communal spaces were important to residents. Those who still had accessible spaces expressed how fortunate they felt to be able to use them, while those who did not lamented their loss.

“I felt lucky having access to roof top indoor and outdoor amenities (that stayed open) where I could take a break or take my laptop and work from – good for mental health.”

“... [it] impacts significantly on apartment dwellers who might not have an appropriate outdoor space. Personally, closing the apartment gym was a great loss for my daily schedule/structure and wellbeing.”

Many residents commented on the value of their private open spaces (e.g., balconies, terraces), particularly if they were large or of good quality. A heightened appreciation for a pleasant view and access to sunlight was evident. Some residents missed having gardens or yards that come with other housing types.

“I see the importance of having your own small bit of outdoor space just to get some fresh air and sun.”

“My main issue during this time is the lack of outdoor space in my apartment ... A backyard is appealing at the moment.”

A lack of space was a common issue for residents. Many found their apartments too small, impacting their ability to work or exercise comfortably – particularly if they lived with others. Some attempted to adapt their space (e.g., rearrange furniture to utilise space more efficiently), but others felt that apartment living was no longer suitable and spoke of plans to relocate.

“Almost 24/7 in a 1 [bedroom] apartment can get really hard, even for an introvert!”

“I don’t have a comfortable place to sit and do work ... I am in the same room all day. I try to break it up with walks but it’s just not enough. It feels smaller now ... maybe when this is all over, I might get a bigger place.”

3.1.3. Environmental (neighbourhood) impacts

Residents reflected on the benefits of their apartment building’s location and their appreciation for being close to shops, cafes, restaurants, and parks. However, the lockdown period largely prevented residents from accessing and enjoying these amenities. One resident noted that this destabilised the ‘necessary balance’ for apartment living.

“I’d say all the advantages of inner city apartment living have been removed since this crisis. Access to bars, restaurants, socialising have all been removed ... [this] for me, was what created a necessary balance to apartment living ...”

4. Discussion

While necessary to curb the spread of a highly transmissible virus, the COVID-19 lockdown restrictions also significantly disrupted day-to-day life. Stay-at-home orders not only impacted people’s normal routines but increased their exposure to their home environment – of which the type and quality can vary. This study explored the impact of COVID-19 lockdown restrictions on apartment dwellers in three Australian

cities. We found that our cohort of apartment residents generally had poorer perceptions of their apartment design after the first national lockdown compared to the pre-pandemic period. This related to the amount of apartment space or the functionality of its layout, worse crowding issues if sharing the apartment with others, and a lack of balcony or courtyard space. Residents also experienced significantly more noise annoyance from indoor and outdoor noise sources, although the number of complaints or disputes with neighbours decreased following the lockdown period. The qualitative content analysis of a subset of residents largely supported these findings, underscoring a complex interplay of personal, social and environmental impacts or challenges for residents.

4.1. Personal and social impacts

The follow-up survey was administered after the first national lockdown, at a time when Australia held a 'zero COVID' policy, with the closure of international borders and establishment of quarantine hotels to control the virus making infections relatively rare. No participants had contracted COVID-19 at the time they were surveyed, however the majority perceived themselves to be at a greater risk because they lived in an apartment complex. This remains a significant concern, with calls for appropriately sized apartments and layouts that support physical distancing (Peters & Halleran, 2020), and appropriate precautions to mitigate disease transmission risk in communal spaces (Eykelbosh, 2020). Our sample of residents reported that increased cleaning and distancing signage were common additions in their building and were generally pleased with the results; but noted that maintaining distance from others in confined spaces, such as elevators or corridors, remained challenging. Such problems are difficult to eliminate via design solutions (outside of adequate ventilation/space provision) given that apartment living fundamentally requires residents to access the same circulation spaces. Building management, however, can play a crucial role in maintaining regular cleaning and infection control standards, as well as initiating and monitoring capacity limits for confined areas.

Working from home (WFH) and increased responsibilities at work were the most common personal changes reported following the pandemic. Opinions were mixed – some preferred WFH, while others struggled with isolation or concentration. Recent evidence has linked increased psychological wellbeing with WFH (Pelly et al., 2022) or having a comfortable soundscape in WFH scenarios (Torresin et al., 2021). Residents' increased noise annoyance in our study – with indoor noise, particularly from neighbours, being slightly more problematic – aligns with a study of Canadian apartment dwellers. Andargie et al. (2021) highlighted that noise from neighbouring apartments impacted residents' ability to WFH more than noise from outdoor sources. Given that WFH is now common practice in many workplaces, adequate sound insulation should be a key construction and design consideration for apartment buildings. Andargie et al. (2021) point out that environmental noise guidelines are generally developed on the assumption that building occupants will be working from their offices rather than homes and should be updated to reflect changing work practices. The Building Code of Australia has requirements for airborne and impact sound insulation for high density residential buildings (Australian Building Codes Board, 2021), and while older buildings may suffer from inadequate insulation due to their development under outdated and lax compliance requirements, the newer developments sampled in our study may also have insufficient provisions or inadequate implementation of requirements – as evidenced by residents' increased noise annoyance.

However, while noise annoyance increased with more time at home, there was no corresponding increase in neighbour disputes or issues. That problems with other residents in fact *decreased* during the lockdown period may suggest that residents felt compelled to 'pull together' in a time of crisis. Indeed, open-ended responses reflected occasional wariness of neighbours due to the risk of virus transmission, but overall suggested that support between neighbours intensified during the

lockdown period, with residents staying connected virtually, sharing resources, and reaching out for assistance when needed. Increased neighbour support may have also been a function of proximity, with residents' regular social networks being more inaccessible due to stay-at-home orders. Our research indicates that this reduced level of contact with family and friends contributed to residents' sense of isolation and loneliness, which has concerning implications for the long-term mental health and wellbeing effects of lockdown restrictions. While social distancing requirements and the closure of public spaces was warranted to control the spread of disease, indoor public spaces (e.g., bars, shopping malls and sports centres) pose more risk than outdoor areas (Leclerc et al., 2020). As such, keeping high quality public outdoor space open and accessible seems crucial to counteracting loneliness and isolation via (comparatively safer) distanced socialisation opportunities (Shultz & Trounce, 2020). Indeed, the Victorian state government's decision to close public playgrounds during a COVID-19 outbreak was met with widespread criticism that the harms outweighed the benefits (Lloyd & Hermant, 2021).

4.2. Apartment space and design governance

Our content analysis of open-ended survey responses demonstrated that a subset of residents perceived themselves to be fortunate and comfortable in their home environment (comparative to how difficult they speculated circumstances might be for others). Nevertheless, a stronger overall trend emerged in our study – that is, a decline in residents' perceptions of space in both their immediate dwelling and private open space after lockdown. There is strong evidence that spacious, flexible and functional dwelling layouts are important to residents in urban areas (Chen et al., 2013; Dekker et al., 2011; Fang, 2006; Huang & Du, 2015; Mohit et al., 2010) and in apartments specifically (Buys & Miller, 2012; Easthope & Judd, 2010; Hofer, 2008; Mridha, 2015). Indeed, a recent literature review of domestic space design in the post-COVID era further underscores that large, flexible and multifunctional living spaces are more important than ever, as they allow for greater social distancing when needed and offer more privacy for different household members' work or relaxation purposes (Hanna, 2023). Our recent work with the HIGH LIFE baseline sample identified that perceptions of apartment space (i.e., size, layout and functionality) was a strong predictor of housing satisfaction (Kleeman et al., 2022). In the current study, residents' housing satisfaction fell between time-points, but differences were non-significant. Our follow-up survey was conducted after the first national lockdown (lasting approximately six weeks); however, results may have been different had the survey been administered later in 2020 and 2021 after the extended Melbourne and Sydney lockdowns.

Nevertheless, it is concerning that residents spent considerably longer periods of time in apartments that they had come to perceive more negatively. Design governance is the key instrument available to government to shape the design of apartments in the interests of the public (Carmona, 2016). Each Australian state represented in this study has legislated an apartment design policy, with the intention of improving the design of apartments, and the wellbeing of residents (Foster et al., 2020). These policies include minimum design requirements addressing indoor space and private open space policy requirements (relating to minimum apartment/room sizes and dimensions; and balcony or courtyard size, dimensions and orientation) (NSW Department of Planning and Environment, 2015; State of Victoria Department of Environment Land Water and Planning, 2021; Western Australian Planning Commission, 2019). However, the existence of these provisions does not necessarily equate to their on-ground implementation. Indeed, a recent study found that in Sydney, where buildings were developed under a comprehensive design policy (i.e., State Environmental Planning policy 65 and its accompanying design guide), buildings implemented just 54% and 69% of indoor space and private open space requirements respectively (Foster, Hooper, Duckworth &

Bolleter, 2022). Notably, increased implementation of objectively measured design policy requirements for indoor space, private open space and communal space has been associated with more positive perceptions of these attributes by apartment residents (Foster et al., 2022). Design policy and review processes that improve the implementation of space provisions in apartments are essential, especially in the context of lockdown periods and extended ‘doses’ of the home environment.

As residents were advised to leave their home only for essential reasons in the lockdown period, extended exposure to the outdoors and nature was limited – except via residents’ private open spaces. These spaces can provide opportunities for biophilic design (e.g., gardening activities or connection with nature via natural outlooks, which in turn is linked with restorative experiences and improved mental health and wellbeing (Kaplan, 2001). Private open spaces have been shown to positively influence apartment residents’ perceptions of liveability (Kennedy & Buys, 2015; Kennedy et al., 2015). More recent studies have shown that apartment residents with balconies utilised them more frequently in lockdown periods and that they contributed to improved mental wellbeing (Gur, 2022; Molaei et al., 2022; Zarrabi et al., 2020). In our study, the qualitative content analysis demonstrated that good quality balconies – larger, with an attractive outlook and access to sunlight and natural elements – were highly valued by residents after lockdown, while other residents with poorer quality balconies wished for gardens or yards inherent to larger dwelling types. However, housing affordability may inhibit some residents’ ability to relocate to other housing types. Indeed, affordability was the key reason influencing HIGH LIFE study residents’ selection of their apartment (Kleeman et al., 2022), underscoring how crucial it is that apartment balconies provide sufficient amenity for those who have no alternative housing options. Balconies must be large enough to accommodate a range of functions and activities; be oriented to receive adequate sunlight and achieve pleasant outlooks; and be accessible from living spaces for ease of use (Molaei et al., 2022; Peters & Halleran, 2020; Peters & Masoudinejad, 2022), with such design considerations also evident to varying degrees in current apartment design policy requirements in Australia (NSW Department of Planning and Environment, 2015; State of Victoria Department of Environment Land Water and Planning, 2021; Western Australian Planning Commission, 2019).

4.3. Neighbourhood context

Residents’ more negative perceptions of their indoor/private open space in the lockdown period are also important to consider in the larger context of apartment living. While the reduced living space inherent to apartments may be a drawback for residents, there can be a trade-off in that apartments tend to be located in denser, more walkable, and well-connected neighbourhoods with ample services and recreational destinations (Giles-Corti, Ryan, & Foster, 2012). These aspects of neighbourhood liveability are vital from an urban planning perspective, allowing residents to ‘live locally’ (Giles-Corti et al., 2016). In our sample, residents appreciated their neighbourhood amenity, but the closure of many of these facilities and businesses in the lockdown period upset the “necessary balance” (as one resident put it) for apartment living. Indeed, recent census data shows that Melbourne and Sydney had record population losses following the onset of the pandemic, with inner-city areas experiencing the most dramatic declines (Australian Bureau of Statistics, 2022b). People relocated to regional areas under what was deemed a ‘tree-change’ lifestyle effect (i.e., a desire for more space and exposure to nature) in lieu of urban areas with limited appeal following lockdown restrictions (Wilson & Grossman, 2021). Indeed, emerging evidence indicates that exposure to highly urban city centres devoid of natural elements may be a risk factor for stress and anxiety responses in lockdown contexts, further emphasising the importance of incorporating high quality green space in urban areas (Olszewska-Guzzo et al., 2021). Given that the closure of neighbourhood amenities

is necessary to preventing mass gatherings and virus transmission ‘super-spreader’ events in future pandemics, the impetus to deliver well designed apartments that are spacious, flexible, and liveable for residents is paramount. Despite the existence of Australian apartment design policies with health-promoting design objectives – relating to indoor space, private open space, daylight, natural ventilation and acoustic/visual privacy – it is evident that such principles have not been fully implemented as intended in our sample of apartments (Foster, Hooper, Duckworth, & Bolleter, 2022). There may be some reluctance on the part of developers to deliver on these design principles if they add to the cost of development. The challenge therefore lies in incentivising the development community to look beyond commercial interests and invest in the long-term performance and design quality of apartment buildings to protect the quality of life of apartment residents (Mould, 2011).

4.4. Strengths and limitations

This study has several strengths. Its longitudinal cohort design allowed for us to compare residents’ perceptions of their apartment before and after the lockdown. This adds to the robustness of the study findings, as we did not have to rely on respondents’ retrospective reports of pre-pandemic periods, which may be subject to recall bias (Paulhus & Vazire, 2007). Indeed, our work builds on that of Zarrabi et al. (2020) who previously explored ‘healthy home preferences’ among apartment residents in Tehran, but only utilised cross-sectional data collected in 2020. Our study also capitalises on Australian apartment dwellers, sampled from three cities and from neighbourhoods of varying area-level disadvantage in an effort to capture a varied and representative apartment resident population. However, our study also has limitations. The use of a single open-ended survey item allowed for a wide breadth of responses to be analysed via the qualitative content analysis, but more targeted questions (e.g., specifically asking residents about what they felt their home environment lacked in lockdown) may have also been useful. Our baseline data was collected 1–3 years before the onset of the pandemic, so it is possible that other factors (not attributable to the pandemic or lockdowns) impacted resident changes in the intervening years. Given that the buildings sampled were constructed somewhat recently (between 2006 and 2016), our findings may not be generalisable to residents living in older apartment buildings. Further, the sample size for the follow-up COVID-19 survey was small, with some noted socio-economic differences between those who did and did not complete both surveys (e.g., those who completed both surveys were older, Australian-born, and owned their apartment) suggesting that this sample may be somewhat more affluent. Our focus on apartment residents also precluded the assessment of residents in other housing types, hence we cannot claim that apartment residents experienced more changes or negative impacts due to lockdowns than other residents. Indeed, while this study makes a notable contribution for its focus on residents’ apartment living experiences, future longitudinal research could explore how apartment residents’ health behaviours or health outcomes were impacted in the wake of the COVID-19 pandemic.

5. Conclusion

There is a dearth of research on the impact of COVID-19 lockdown restrictions on apartment dwellers. This study addressed this research gap by examining how lockdown affected Australian apartment residents’ experiences and perceptions of their home environment. After the lockdown period, residents had more negative perceptions of the amount/layout of their apartment space and private open space and reported greater noise annoyance. However, neighbour disputes decreased after lockdown, which is surprising given residents were spending considerably more time in close proximity with their neighbours. Qualitative content analysis of open-ended survey responses showed that residents experienced a range of personal, social and

environmental (apartment and neighbourhood-level) challenges stemming from the pandemic and lockdown restrictions. Given the likelihood of future pandemics, it is essential that apartment design policies and approval processes prioritise spacious, flexible dwelling layouts, adequate sound insulation to support WFH practices, and health-promoting elements (e.g., enhanced natural light/ventilation and private open space amenity to better enable outdoor activities and exposure to nature). Engaging the development community to deliver on these strategies is key, though remains a challenge.

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CRediT authorship contribution statement

Alexandra Kleeman: Conceptualization, Data curation, Methodology, Software, Formal analysis, Writing – original draft, Writing – review & editing. **Sarah Foster:** Conceptualization, Data curation, Methodology, Writing – review & editing.

Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jenvp.2023.102056>.

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