



An exploratory study investigating the health and wellbeing impacts of housing created through permitted development in London

Dr Ben Clifford

Bartlett School of Planning,
University College London (UCL)

Dr Helen Pineo

Institute for Environmental Design and
Engineering, University College London (UCL)

With Professor Rob Aldridge and Dr Max Eyre
(UCL Institute of Health Informatics)

Supported by

Impact
on **Urban**
Health

Contents

| | |
|---|-----------|
| Executive summary | 3 |
| Introduction | 10 |
| Approach taken | 14 |
| Results and analysis | 21 |
| Survey data overview | 21 |
| Interview data overview | 45 |
| Emerging themes | 53 |
| Conclusions | 60 |
| Key findings on residents of PDR housing | 60 |
| Studying the health and wellbeing of PDR housing residents | 63 |
| Recommendations | 65 |
| Acknowledgements | 68 |
| References | 69 |
| Appendix 1: Survey instrument | 73 |
| Appendix 2: Interview schedule | 79 |
| Appendix 3: Income and housing quality analysis results | 80 |

Executive summary

There is extensive evidence linking various elements of housing quality with health. The factors influencing housing quality are complex and multifaceted, but certainly include the regulatory processes associated with urban planning. The planning system has been extensively reformed over recent years, particularly in England through the expansion of 'permitted development' (PD). This is a form of deregulation whereby certain categories of development no longer require the case-by-case scrutiny of planning permission granted by the local planning authority. Traditionally used for small and temporary development, since 2013 a range of extensions to permitted development rights (PDR) have allowed the conversion of office and other commercial buildings into residential use. Under PD, there is reduced scope and ability for the local planning authority to determine the principle of development or regulate the design (and so quality) of the scheme. Health and wellbeing impacts of this expansion of PD were not considered in the government's impact assessment when it was introduced.

Although a range of existing studies (e.g. Clifford et al 2018 and 2020) have identified design quality issues with housing units created through PD, this has been based on analysis of plans, site visits and expert interviews rather than engaging residents of such housing. As Marsh et al (2020) have highlighted, while existing studies identify potential ways that PD conversions might have more negative than positive health impacts, this warrants further research.

PD conversions are particularly prevalent in Greater London, with 18,872 new housing units created through this route from 2015-2020 alone. In this small-scale exploratory study, we have engaged residents in housing created through PD in the London Boroughs of Hillingdon, Hounslow, Lambeth and Southwark to better understand residents, their self-reported health, wellbeing and demographics, and characteristics of their housing and wider neighbourhood that are known to influence health and wellbeing. As this research was exploratory, we also aimed to test approaches to studying these issues, including an online survey, short interviews, visual inspection of properties (where invited) and collaboration with a charitable organisation working on housing insecurity.

Our study identified 3,206 housing units created under PD where the approval was granted between 2013 and 2019 in the four London boroughs being considered. A postcard inviting survey participation was sent to 2,404 of these housing units (selected at random). Researchers also knocked on doors at as many of the 271 buildings as they could access to encourage residents to complete the survey. 218 people completed a questionnaire survey online. Survey respondents could also volunteer to be interviewed in their home and provide more detail about their personal experience of living in housing converted from non-residential properties. 41 interviews were conducted in May-July 2022.

Survey questions had been developed on the basis of previous studies of housing and health and following a workshop with people with experience of housing precarity. Survey questions were formulated to allow benchmarking against key existing data including the UK census. Mental wellbeing was measured using the survey questions defined by the Warwick-Edinburgh Mental Wellbeing Scales (WEMWBS). A range of statistical analyses were conducted on the survey data. For the interview data, notes taken during the interviews were typed-up and manually coded with a summary of issues raised in relation to each theme.

The 218 survey respondents were 56% female and 68% aged 18-35 years. 59% were white, 16% of Indian ethnicity and the rest in smaller numbers from other ethnic backgrounds. 70% were employed and 14% self-employed. 50% had a bachelor's degree and 30% a Master's degree or equivalent. 38% of survey respondents owned their home (either outright or with a mortgage), 54% rented without housing benefit and 4.8% rented with housing benefit. This compares to census data for the boroughs showing 44% owning their home and 22% renting from a private landlord.

We do not have any demographic data for residents of PD housing to know how representative this survey sample is of the wider population living in this type of housing. Indeed, given the predominance of studio and one bed flats in PD conversions, a younger population might be expected, and a younger population may be more likely to be in the private rental sector. Nevertheless, comparison with census data suggests our survey respondents are younger, more likely to be educated to a higher level, and more likely to be employed than the general population in the study boroughs. In general, our survey respondent cohort appears to be of higher socioeconomic status than might have been expected from the typical population of these London boroughs. We believe this represents selection bias, i.e. residents of higher socioeconomic status who received the invitation to participate in our research appear to have been more likely to respond to that than those from lower socioeconomic groups rather than this being representative of the wider population living in PD housing.

In terms of general health, the proportion of survey respondents self-reporting bad or very bad general health (1.9% and 0.9% respectively) was lower than the general population self-reporting this on their census return (3.6% and 1.1% respectively), however the proportion reporting having their day-to-day activities limited by a health problem or disability was higher (14.9% in our survey compared to 7.5% in the census data).

In terms of mental wellbeing, the proportion of survey respondents with a WEMWBS score that indicated low wellbeing was higher than the UK average (23% of survey respondents compared to 15% UK average) and the proportion with a score that indicates high wellbeing was lower than the UK average (6.8% of survey respondents compared to 15% UK average).

In terms of housing problems, the six most commonly reported problems on the survey were a shortage of space (46% of respondents), street noise (40%), noise from neighbours (26%), pollution (from traffic or industry) (16%), vandalism or crime (16%) and a lack of fresh air in the dwelling (14%). In terms of thermal comfort, 92% reported being able to keep comfortably warm during cold winter weather (this question related to the ability to keep the home warm, rather than the cost of doing so) but only 63% were able to keep comfortably cool during hot summer weather (63%), suggesting potential issues with these PD homes overheating.

A high proportion of the cohort reported not having a single window they would open (14%) with only 68% reporting at least one window they could easily see outside through. 6.4% of the cohort reported not having any of the seven amenity types listed on the survey (park or green space, shop to buy food, public transport access, primary school, GP surgery, cafe or restaurant or leisure centre) within a ten-minute walk of their accommodation.

Conducting a regression analysis showed that having sufficient space in the housing was strongly associated with improved wellbeing as self-reported using the WEMWBS scores (after controlling for household income). Taking all of the results related to thermal comfort together, there is evidence to suggest that accommodation cooling options and ability to keep comfortable during hot weather were an important determinant of mental wellbeing in PDR housing. Having more types of amenities within a ten-minute walk of accommodation was associated with higher wellbeing scores. Respondents' perceptions of safety were also strongly associated with mental wellbeing. Respondents having a lack of fresh air as a problem in their housing were more likely to have a lower WEMWBS score. There was, however, no significant association found in our survey data between having a window you could easily see out of or reporting street or neighbour noise as a problem and mental wellbeing as measured by the WEMWBS score.

Some interviewees reported, positively, that it felt good living in their home because of its convenient location. However, more made negative comment about what it felt like to live in their home. There were comments about it feeling 'temporary', for example because of the nature of renting. A lack of space was mentioned by eleven interviewees with descriptions such as the flat felt "overwhelming" as it was so small. Asked about what they would improve about their flat with an unlimited budget, 27 interviewees mentioned increasing the size to have more space. Other mooted improvements include access to outdoor space, with one interviewee saying the lack of this meant they felt "trapped during lockdown" and another commenting "having some open space to yourself would massively improve my happiness". Better windows and natural light and better thermal comfort were also mentioned here several times as potential improvements people would like to see to their PD homes.

The issue of access to greenspace was mentioned when people were asked about things in their local area they think benefited their health and wellbeing: 34 out of the 41 interviewees mentioned a local park or open space they visit, one describing it as “low cost therapy” and another commenting having such a place nearby “saved my mental health during the pandemic”. The accessibility of local amenities was commonly commented on as well.

Asked about things in the local area they felt harmed their health and wellbeing, 16 interviewees raised concern about crime and anti-social behaviour. Traffic pollution was mentioned 14 times. Similarly, commenting about sounds and smells they might notice in their home, 20 interviewees mentioned street noise and 10 mentioned noise from neighbours.

Interviewees were explicitly asked about what they thought were the main impacts on their health and wellbeing from the design and condition of their home. Positively, some interviewees had dwellings with big windows and lots of nature life and felt this helped their mental health. Negatively, the most commonly cited issue which people explicitly felt harmed their health and wellbeing related to thermal comfort (primarily keeping cool in the summer – albeit the survey was conducted in late spring / early summer when the weather was warmer). There were also mentions of a lack of natural light into their dwellings or windows they could see out of making their home feel “depressing”. Noise, a lack of interior space, a lack of outdoor space, mould and damp issues and general property maintenance issues were all mentioned as challenges in some homes but mentioned less frequently than thermal comfort.

This project has helped to fill gaps in existing knowledge around the experience of living in PD housing in London, which is important given the relationship between housing and health. We speculate that the higher socio-economic groups represented in our study sample may be likely to live in better quality PD housing that may not be representative of the average level of quality in this housing type. Nevertheless, our cohort of PD housing residents were more likely to have self-reported low wellbeing and less likely to have self-reported high wellbeing than the UK averages.

Looking across all our data, we found the following housing design and locational features to be important:

- Having sufficient space in the accommodation
- Having a home where thermal comfort could be assured year-round (with particular issues keeping cool being associated with some PD housing)
- Having fresh air, ventilation, and windows allowing in sufficient natural light and through which there was a view of the outside world
- Not having excessive levels of noise from neighbours and from the street outside
- Having access to open or greenspace

- Living in walkable neighbourhoods with good access to local amenities
- Living in a home in which you felt safe (considering both the security of the housing and its location)

The findings from this study support a number of potential recommendations which have the potential to improve housing quality and so the health of residents of homes created under permitted development rights. These are primarily focussed on policy and regulatory actions central and local government can take, however the importance of the relationship between housing, health and wellbeing which is supported by our research findings also suggest that developers and those working alongside them, such as architects, should also have a consciousness of the way that good design can help support healthier homes.

Space standards – Central government have required since April 2021 that all new housing created under PD complies with the Nationally Described Space Standards (NDSS). The evidence from this study supports this policy change. There is, however, a question about how to manage existing PD housing developed between 2013 and 2021 which does not comply with the standards, sometimes by some considerable degree. Consideration might be given, for example through the local plan process, to identifying such housing and seeing if improved open space provision in the immediate vicinity can be provided to try and ameliorate the small spaces, or whether sizes are so small that housing enforcement powers should be used. Further, the NDSS do not, however, apply to all housing created through traditional planning permission as for this development permitting route, they need to be introduced into local plan policy and are subject to viability testing. Given the current proposals to have ‘national development management’ policies which apply across England, the government might consider incorporating the NDSS requirements into these national policies so they apply to all housing created anywhere in England.

Windows – Central government have required since June 2020 that all new housing created under PD allows adequate natural light to all habitable rooms. Although our qualitative evidence was stronger on issues of the importance of natural light and a window you can view out of than our quantitative analysis, previous studies have also shown the importance of adequate window arrangements for the wellbeing of residents. Further, we found a surprisingly high number of PD dwellings where there was not a window people could have a view outside through. We therefore support the importance of the June 2020 policy, but remain concerned that natural light may be achieved without having a window people actually have a view out of. The PD regulations could be strengthened around this issue to ensure adequate window arrangements. For housing units developed under an ordinary full planning permission, most local authorities would follow guidance such as BRE’s Right to Light principles and many have policies encouraging dual aspect windows. Integrated design approaches may help balance between natural light, noise and thermal comfort

considerations and this may be something to consider further in future, for example as part of the national development management policies and emerging design code work.

Location of housing – Access to amenities is important for people’s wellbeing.

This is not something that can adequately be considered through current PD regulations. This gap could be addressed through future amendments to the regulations governing housing created through permitted development, so that local authorities are better enabled to consider access to amenities as part of the prior approval process. Again, for housing units developed under an ordinary full planning permission, this should be considered as part of the proposed national development management policies. Further, local authorities might want to consider as part of their local plan making process, where existing large PD conversions are located and whether any supporting infrastructure can be enabled within those neighbourhoods to improve amenities including shops and public transport.

Outdoor space – Access to open / green space is important for people’s wellbeing and it is not something that can be considered through current PD regulations. This could be addressed through future amendments to the regulations governing housing created through permitted development, so that local authorities are better enabled to consider this as part of the prior approval process. Again, for housing units developed under an ordinary full planning permission, this may be something to consider as part of the proposed national development management policies. Further, local authorities might want to consider as part of their local plan making process, where existing large PD conversions are located and whether additional open or green space can be created within those neighbourhoods, (including play space for children).

Ventilation and thermal comfort – Issues of ventilation and thermal comfort in dwellings are covered by the Building Regulations in England. These were updated in summer 2022 with new Approved Document O dealing with overheating. This research supports the need for such requirements. Building Regulations apply to housing created under PD in the same way as housing created under a full planning permission. Previous research (Clifford et al, 2018) has, however, questioned the enforcement of Building Regulations requirements to PD housing. Given the risk of lower housing quality in the deregulated space of PD, local authorities should maximise their ability to monitor these conversions through the use of conditions on prior approvals to notify local authorities of the commencement and completion of works to implement schemes and ensure this information is shared between planning and Building Regulations teams as appropriate.

Housing enforcement – The regulations around PD have been tightened-up in 2020 and 2021, which should reduce (although not eliminate) the risk of poor quality housing being created in future. There is, however, a large stock of housing created under less strict PD regulations from 2013-2021. In some cases, this housing appears likely to be

harming the health and wellbeing of residents. The Housing Health and Safety Rating System, Decent Homes Standard and Homes (Fitness for Human Habitation) Act do give local authorities considerable powers around housing enforcement. Some of the issues which have been raised in our research data, such as insufficient space, insufficient natural light, problems with noise, problems with thermal comfort and problems with ventilation are all issues covered by the HHSRS, for example. Cromarty (2022) notes issues of ineffective local authority enforcement of housing standards. Given the impact on people's health and wellbeing, this is an important area for local authorities to proactively take action, supported by central government providing adequate resourcing. Visiting PD housing created from 2013-2021 may be a particular priority for housing enforcement teams.

Introduction

There is extensive evidence linking various measures of housing quality with health (Bird et al, 2018; WHO, 2018). The factors which determine the quality of housing are complex and multifaceted, but certainly include regulatory processes associated with urban planning. The planning system has been a focus of considerable policy attention in the UK over recent years, most particularly in England where there has been a trend towards regulatory reform associated with trying to promote a greater amount of housing development by the private sector.

A particularly pronounced example of this is permitted development (PD). PD is a form of deregulation in the UK whereby certain categories of development are exempted from the need for case-by-case planning permission being granted by the relevant local planning authority. Although permitted development rights (PDR) have existed since the birth of the statutory planning system in 1948, they were traditionally used to avoid bureaucratic processes for allowing small and temporary development, such as an extension to the rear of an existing house or erection of a garden shed. In England since 2013, however, they have been progressively expanded to include various changes of use of commercial buildings to residential and upward extensions to existing residential and commercial buildings to allow additional residential space to be built. A further expansion in 2021 allowed an even greater range of non-residential buildings to be converted to residential use under PDR: up to 80% of buildings which are not currently residential, including offices, shops, light industrial units, gyms, restaurants, day centres and clinics can now potentially be converted into housing under PD (Clifford et al, 2021).

Under PD, there is reduced regulatory scope and ability of the local planning authority to influence the design of the scheme, with the principle of development assumed to be acceptable and only a few pre-set technical issues able to be checked before a development can proceed. Policies from the local plan, which may include those related to residential design and amenity and promoting more healthy environments cannot be applied or considered as part of decision-making. Health and wellbeing impacts of this policy change were not considered in the initial impact assessment (DCLG, 2013). Between 2013 and 2020, housing units created through PD were not required to have any windows at all. An amendment was introduced in June 2020 that required 'adequate natural light to all habitable rooms', albeit this does not actually require a window that permits views outdoors. Between 2013 and 2021, local authorities had no ability to consider the space standards of PD housing (since April 2021, they have had to comply with the Nationally Described Space Standard (defined in DCLG, 2015)).

There have been a number of studies of the impact of this planning deregulation, most notably Clifford et al (2018) funded by the RICS and Clifford et al (2020) funded by MHCLG. These studies look at a range of case studies of building conversions to residential use allowed through PD and compare these to those allowed through traditional, full scrutiny planning permission. These studies both identified that PD conversions were less likely to have adequate internal space standards, less likely to have access to outdoor 'amenity' space, less likely to have adequate natural light into the dwelling and were more likely to be in locations unsuitable for residential use (such as in industrial estates). Indeed, Clifford et al (2020: 10) found that only 22.1% of units created through PD would meet suggested national space standards and just 3.5% of the units analysed benefitted from access to private amenity space and concluded that "permitted development conversions do seem to create worse quality residential environments than planning permission conversions in relation to a number of factors widely linked to the health, wellbeing and quality of life of future occupiers."

The Clifford et al (2020) study was based, however, on analysis of plans, site visits and expert interviews with local planners rather than directly engaging residents of housing created under PDR. As Marsh et al (2020) have highlighted, whilst a number of published studies identify potential ways that PDR conversions have more negative than positive health impacts, this warrants further research, particularly given the lack of data on the experience of residents of PDR conversions. This has not been the subject of previous academic study, albeit there are some useful accounts by investigative journalists highlighting the poor quality of life of residents of some conversions, many of whom are vulnerable temporary housing occupiers (for example, Glass, 2019; Wall, 2019; Mercer, 2020; Spratt, 2020). This is an important gap. Government statistics have only been collected since 2015-16 but these show that between April 2015 and March 2020 a total of 72,981 new dwellings have been created across England through PD (MHCLG, 2020). PD conversions are particularly prevalent in Greater London, where housing need is high, and 18,872 have been created in London 2015-20. Given the average household size of 2.3 persons, that suggests at least 43,405 Londoners living in PD conversions and at least 167,856 people across England.

There are multiple populations and mechanisms through which PDR housing can affect health. Pineo's (2020) conceptual framework for healthy urbanism describes how features of the urban environment, such as buildings, operate via three interconnected scales of health impact with spatial and temporal effects, which are: planetary health, ecosystem health and local health. For example, the energy efficiency of PDR housing may impact the thermal comfort of building occupants in the short-term. If energy efficiency is low in these properties, it would result in higher building-related emissions, increasing the global health risks created by the climate crisis, such as extreme weather and disrupted food supplies. Figure 1, below, shows a range of potential exposures and behavioural / health outcomes which might be associated with PDR housing.

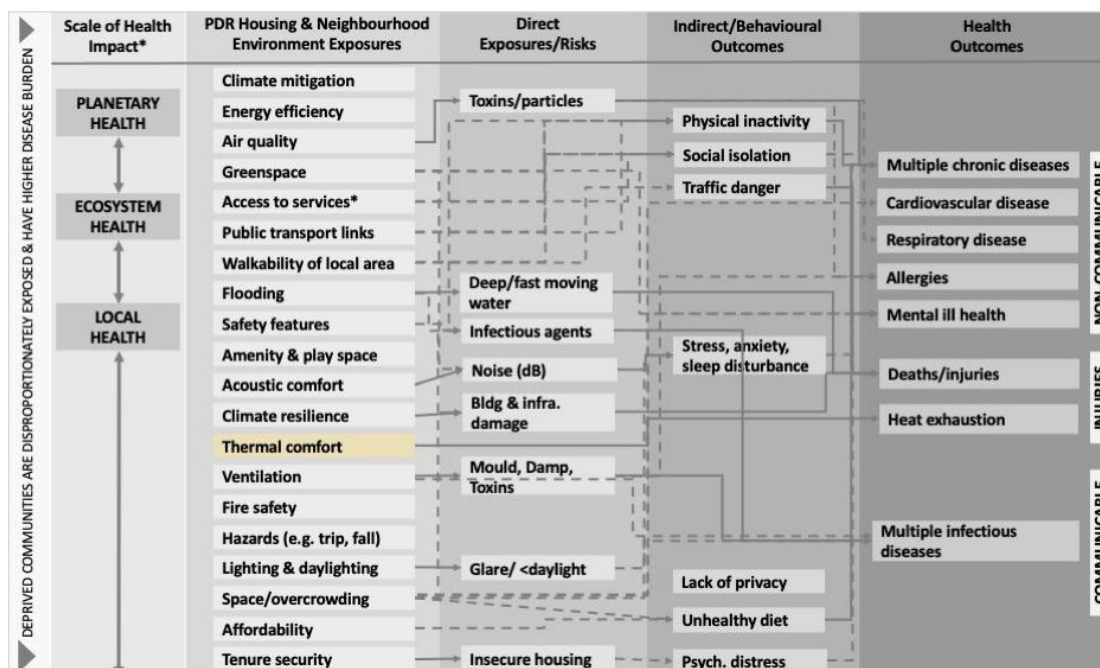


Figure 1: Exposures and behavioural/health outcomes from PDR housing identified in the literature (Marsh et al. 2020), aligned to the THRIVES Framework scales of health impact (Pineo, 2020).

From existing literature, we can therefore speculate that PDR housing may be causing health and health equity issues given common design features and existing understanding of the relationships between these exposures and health outcomes. Although some additional safeguards were introduced in 2020 around natural light and 2021 around space standards, there are important questions about the implications of housing created under PDR between 2013 and 2020/21 when these safeguards were not in place, and the implications of potentially inadequate design features. Further, other issues such as immediate location and access to amenity space remain deregulated and unscrutinized. Importantly, planning officers still cannot take a holistic view on the quality of a scheme under PDR, with reduced ability to uphold housing quality standards compared to the traditional process of granting planning permission. As government have continued to expand PDR so that there is a greater possibility to create housing under this deregulated route and given the way that the Covid-19 pandemic put a particular & focus on issues of housing quality and links to existing inequalities, we sought to investigate further the health and wellbeing of residents of PDR.

Our study was a small-scale exploratory study, focussed on Greater London given the concentration of uptake of PDR there and seeking to consider the following questions in relation to four boroughs selected for the study:

- Who are the residents of PDR housing?
- What is the self-reported health and wellbeing of residents of PDR housing?
- What are the dwelling-related characteristics of PDR housing?
- How can we effectively study the health and wellbeing of residents of PDR housing?

In the next section, we explain the approach our research took. We then explore the results from our approach of a postal survey and series of short, structured interviews, before drawing conclusions.

Approach taken

The research was designed as a scoping piece of work to evaluate potential health and wellbeing impacts of housing created through PDR in England and potential research approaches to explore and understand these, through consideration of schemes in four London boroughs. Taking a resident centred approach, the research aimed to fill an important gap in existing work and provide an exploratory study of whether there are impacts of planning deregulation on health in order to help evaluate existing policy and so recommendations can be made for future governance of the built environment.

The decision to investigate the issue by looking at schemes in London boroughs was determined because of the high rate of PD conversions seen in London, the accessibility of buildings in London for researchers and also the geographical focus of the funders of the research. Within Greater London, it was then decided that the research would be approached by looking at PDR conversions in two neighbouring inner London boroughs and two neighbouring outer London boroughs: Lambeth and Southwark and Hillingdon and Hounslow. These boroughs were selected to offer a range of different built environment and socio-economic characteristics and all have sufficient housing units created through PDR between 2015-20 to offer a reasonable opportunity to explore the quality of housing created through this deregulated route and resident health and wellbeing (Table 1). It is worth highlighting that the boroughs of Barnet, Camden, Croydon and Richmond-upon-Thames were used in previous studies of PDR by Clifford et al so are not considered for inclusion here due to the risk of over burdening local planners with requests to assist with academic research.

The research began by identifying completed PD conversions to residential use in the four case study boroughs. No public document exists listing these. We began with the list of prior approval applications to convert commercial buildings to residential use under PDR which is publicly available from the Greater London Authority as the 'London Planning DataHub' (GLA, 2022). In order to convert a building to residential use under PDR, the developer must notify the local planning authority who then grant prior approval through a process which has a reduced scope compared to traditional planning permission but does give some grounds to refuse prior approval. From the dataset, we could therefore identify all prior approvals granted for our four boroughs from 1 May 2013 (when this type of PDR was introduced for office-to-residential conversion) to 30 March 2019 (we selected this as a cut-off as buildings consented after that date would be less likely to actually be converted and be occupied by residents yet).

This analysis of the public dataset found 904 prior approvals granted in the relevant period across the four boroughs. The next step was to further analyse this data to, firstly, remove duplicates whereby more than one prior approval was granted for the same building (as developers revise the scheme before implementing a conversion)

and secondly, to remove unimplemented schemes (as not every potential conversion that gains prior approval is actually then carried out, for a variety of reasons). The first part of the analysis was based on the address data contained in the Planning DataHub data set. The second part was conducted by comparing the addresses from the Planning DataHub with the addresses of residential properties in the government’s public available Energy Performance Certificate dataset (DLUHC, 2022) and Council Tax band information (HMRC, 2022) since if the same property was listed in these two data sets as in the prior approval list, it had clearly been converted as they only contain residential (not commercial) properties. This analysis identified 271 implemented conversion schemes, and within these 3,206 individual residential units with their full postal addresses recorded.

| Borough | Units |
|-----------------------------|---------------|
| Barking and Dagenham | 135 |
| Barnet | 1,151 |
| Bexley | 111 |
| Brent | 568 |
| Bromley | 642 |
| Camden | 581 |
| City of London | 1 |
| Croydon | 3,217 |
| Ealing | 636 |
| Enfield | 401 |
| Greenwich | 159 |
| Hackney | 170 |
| Hammersmith and Fulham | 538 |
| Haringey | 367 |
| Harrow | 1,356 |
| Havering | 280 |
| Hillingdon | 1,003 |
| Hounslow | 1,241 |
| Islington | 527 |
| Kensington and Chelsea | 16 |
| Kingston upon Thames | 484 |
| Lambeth | 809 |
| Lewisham | 395 |
| Merton | 527 |
| Newham | 228 |
| Redbridge | 442 |
| Richmond upon Thames | 647 |
| Southwark | 133 |
| Sutton | 801 |
| Tower Hamlets | 428 |
| Waltham Forest | 309 |
| Wandsworth | 502 |
| Westminster | 67 |
| Greater London total | 18,872 |

Table 1: Number of new housing units created through PD conversions 2015-20 in London (data from MHCLG, 2020b)

Alongside this, work began on developing a questionnaire survey and set of interview questions to be used in order to capture resident experience of living in these PDR conversions and their self-reported health and wellbeing. The development of this involved considering the previous research by Clifford et al on potential key influences from typical PDR housing quality and design issues, for example an understanding that there might be particular issues around space standards, windows and lighting, thermal comfort and immediate neighbourhood location. This was supplemented by holding a workshop arranged by the charity Groundswell, with six people with experience of homelessness and temporary housing present. From previous research, we know some of the lowest quality PDR housing has been used to home those in housing precarity and thought it was important to proactively engage those with experience of this. The workshop showed, for example, there was a real concern about security and feeling safe in the home. Further, potential survey questions were also discussed with two residents of PDR housing identified through Clifford et al's previous research, who were particularly concerned that there be consideration of mental health implications from inadequate housing.

Following this initial scoping work, the researchers then developed the survey instrument. Appendix 1 shows the final questions used. In developing these questions, we were keen that the survey be fairly short, able to be completed in about 10 minutes, as occupants may have little spare time and so a quicker survey might get a better response rate. We were keen also to ensure that the survey measured housing exposures where there was sufficient evidence from previous research to link health and/or wellbeing (e.g. Foye, 2016), and that questions be, as far as possible, either validated through use in previous surveys (e.g. Dunn, 2002 and Adamkiewicz et al, 2014) or be able to produce data that would be comparable to widely available data sets such as the UK census or the English Housing Survey. In terms of mental health and wellbeing, we decided to adopt a validated questionnaire, the Warwick-Edinburgh Mental Well-being Scale (WEMWBS) (Tennant, 2007).

The survey was administered online, hosted on a secure web portal called REDcap where sensitive data can be collected and stored on the UCL Data Safe Haven. Potential survey respondents were recruited by being sent a recruitment postcard addressed 'to the occupier' at the addresses of PDR housing in the four boroughs (figure 2). In our original research bid we had expressed a desire to have 125 survey responses, which we felt would provide a sufficient sample size for some basic statistical analysis. There was not much existing literature to indicate a likely response rate for a survey being administered in this manner, with some incentivisation (a £10 voucher was sent to each survey respondent who wanted it). Therefore, an initial tranche of 802 postcards was sent out. These addresses were selected at random from the 3,206 identified. The survey opened in April 2022 and by early May only 39 responses had been received. It was therefore decided to send out a further 1,602 in two batches in May, meaning in the end that 2,404 postcards had been sent out.

The survey closed at the end of June 2022, by which time we had received 218 responses. Although in theory many households would have more than one resident, assuming that the postcard would have been seen and potentially responded to by one person per household receiving it, this makes an overall response rate of 9.07% (218 survey responses from 2,404 postcards sent out).

The recruitment postcard had a link to a website where information was provided in the 14 most common languages other than English spoken in the UK (according to census data) and provision was made to provide translations of the survey into any of these languages on request, but no such requests were received. The recruitment postcard also gave an option to request, by telephone, a paper copy of the survey be sent to people without internet access. Three of the respondents had utilised this.

The survey then included an option to volunteer to be interviewed in person, for which a further £20 voucher was offered as an incentivisation. A total of 89 people volunteered to be interviewed, however not all of them then responded to emails seeking to arrange an interview. In the end 41 interviews were conducted between May and July 2022. The interviews took place at the individual's home address, with two researchers visiting. The researchers asked the questions from our interview guide in Appendix 2, which was developed to give the opportunity to expand – in their own words – on the key issues from the survey, focusing on residents' subjective experiences. Visiting in person also allowed the opportunity to ask if residents wanted to show any particular features of their home (that they really liked or disliked) and potentially have a photograph of that taken by the researcher. The interviews were not audio recorded but contemporaneous notes were taken by one of the researchers. The interviews generally lasted 20-25 minutes each.

During May and June 2022, the research assistants (three UCL MSc students and one peer researcher from Groundswell) also conducted some door knocking. This involved visiting the buildings identified as PDR conversions in the four boroughs and knocking on the doors (or pressing the door buzzers) to try and encourage the residents to complete the survey. No particular selection was made of buildings, instead researchers were given a list of all those in a particular geographical area. If a resident did answer, the researchers would explain the research and encourage them to complete the online survey. We do not have a record of how many people completed the survey because of this encouragement as opposed to just because they received a postcard, however there was an increase in response rate once this door knocking began in mid-May 2022.

We need your help
to understand the link
between your housing
and your health

and we'll give you
a **£10 voucher**
as a thank you for
completing our survey



THE BARTLETT
SCHOOL OF PLANNING

Dear resident

We know that there can be an important link between your housing and your health and wellbeing but we need more data to help us understand that. For that we need your help. As someone who lives in a home which has been created from converting a former commercial building, we would like to invite you to complete a short online survey. In exchange for completing a survey, we will send you a **£10 gift voucher redeemable in over 20,000 high street stores nationwide**. The study is being conducted by university researchers and your individual information will be treated with confidence.

To complete the survey or for more information you can scan the QR code below or visit bit.ly/PDRhousing and complete it online. If you do not have internet access, you can telephone us on **020 3108 9524** and leave your address details and we will post you a paper survey to complete.

For more information in other languages visit bit.ly/PDRlanguages

Please help complete our survey.

Dr Ben Clifford and Dr Helen Pineo
University College London



THE BARTLETT
SCHOOL OF PLANNING



Figure 2: Survey recruitment postcard sent out to PD housing residents

Once the survey closed, an analysis of the results was conducted. In relation to mental health and wellbeing, this was measured using survey questions defined by the Warwick-Edinburgh Mental Wellbeing Scales (WEMWBS) and scored following the WEMWBS protocol, with each participant receiving an integer score between 0 (worst health) and 70 (best health). A validation of WEMWBS in the UK general population found that a score below 42 was indicative of low wellbeing (equivalent to the bottom 15% of wellbeing in the UK population) (Tennant et al, 2007). Another unpublished report (Bianco, 2012) has also indicated high correlation with the Center for Epidemiologic Studies Depression Scale (CES-D) for a similar cut-off value of 41, finding that scores below this value were correlated with probable clinical depression (see also Warwick Medical School, no date).

Firstly, associations between monthly net per-capita household income after housing costs and housing quality indicators were explored using logistic regression. For this purpose, any housing quality indicator variables with more than two possible responses were recategorised into a binary outcome with the two most negative responses (e.g. 'strongly disagree' and 'disagree' that there is sufficient space to have visitors for socialising) coded as 1, and the other responses coded as 0 ('neutral', 'agree' and 'strongly agree').

Then, associations between housing quality and mental wellbeing were examined for two mental wellbeing outcomes: i) WEMWBS score and ii) the probability of having a score indicative of low wellbeing (<42). Both outcomes were considered to give a measure of i) the relative difference in mental wellbeing and ii) the risk of severe poor mental wellbeing. This analysis was informed by the assumed causal relationships described in Figure 3. WEMWBS score was modelled using linear regression and probability of low wellbeing was modelled using logistic regression. Coefficients and odds ratios were reported as both unadjusted and adjusted for net monthly per-capita household income after housing costs. An odds ratio is a measure of association between an exposure and an outcome. The OR represents the odds that an outcome will occur given a particular exposure, compared to the odds of the outcome occurring in the absence of that exposure (Szumilas, 2010).

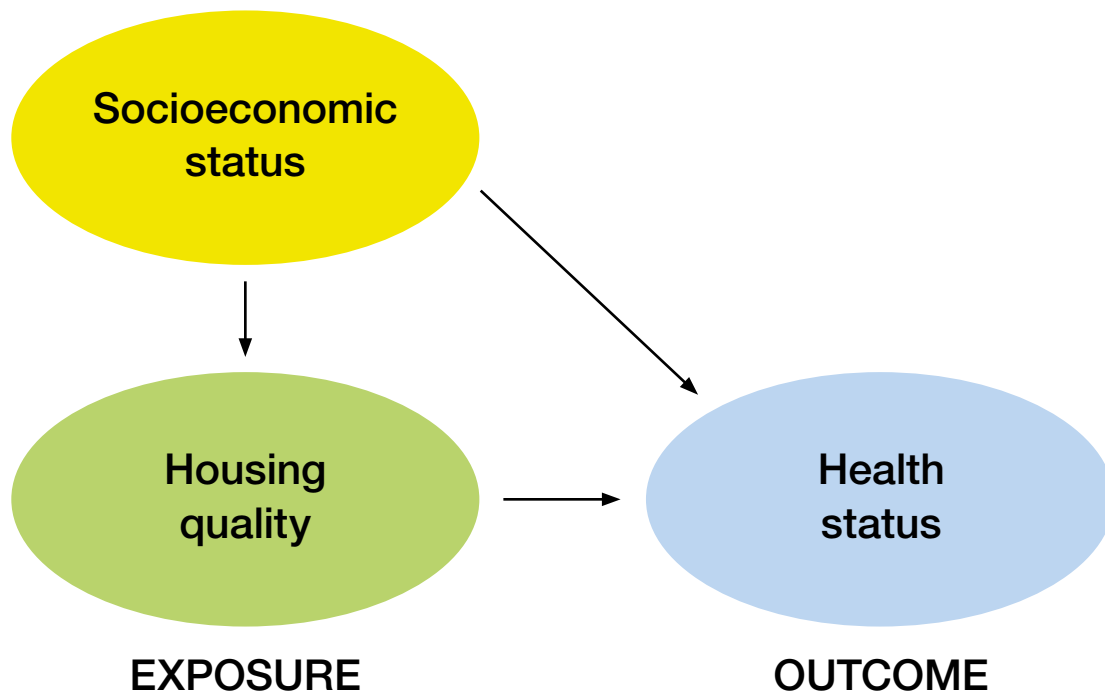


Figure 3: Directed acyclic graph (DAG) representation of causal relationships between housing quality (exposure of interest), health status (outcome) and socioeconomic status (ancestor of exposure and outcome)

Finally, two additional univariable analyses were conducted using logistic regression to identify associations between i) the probability that a respondent reported not being able to keep comfortably cool during hot weather and available accommodation cooling options, and ii) the probability that a respondent reported feeling unsafe at home when alone and reported difficulty in locking their entrance or windows.

For the interviews, the hand-written notes taken during the interviews were typed up, and then organised by the issue of theme to which they responded. A summary of the issues raised in relation to each theme was then produced. The aim of collecting the qualitative data is not to claim that they are ‘representative’ but rather to give richer detail on the everyday lived experience of residents in these dwellings. A workshop was also held with the two lead researchers, a representative of Groundswell and the four research assistants who conducted the door knocking and interviews to capture their feedback on how the research had gone in practice and what struck them as any key issues or topics from the interviews.

The research was governed through an approval via the Bartlett School for Environment, Energy and Resources Low Risk Ethics Approval procedures (devolved from the UCL Research Ethics Committee) and UCL Data Protection Office. All data have been securely stored throughout the research, with personal identifiers removed before analysis. The principles of informed consent were followed in all cases.

Results and analysis

Survey data overview

Descriptive analysis

In terms of demographic and socio-economic data, the survey respondents were 56% female and 44% male. The respondents were relatively young, with 68% of respondents aged between 18 and 35 years. The (recently released) 2021 census data for the four boroughs shows that an average 46% of the adult population of the four boroughs is aged 18-35 years (ONS, 2022a), so our survey respondent cohort appears to be younger than the local population in general. The two most common ethnicity groups in our survey respondent cohort were white (59%) and Indian (16%) (with the rest of the cohort being made up of smaller numbers of people from various other ethnic backgrounds). The 2011 census data for the four boroughs shows an average across them of 56% white and 9% Indian population (ONS, 2012).

37% of our respondents lived in a single person household. 52% of the respondents said two people usually lived in their household, and 11% said three or more people usually lived in their household. Across the four boroughs, according to 2011 census data, 29% of the population live in one person households, 31% in two person households and 40% in households where three or more people usually reside (ONS, 2022b).

Most respondents were employed (70%) or self-employed (14%), with 28% working from home part-time or full-time (indicating a significant amount of time spent in their accommodation). The 2011 census data for the four boroughs has an average across them of 53% of all usual residents aged 16-74 years as employed and 10% self-employed. Our survey respondent cohort had high educational attainment with 50% having a bachelor's degree and 30% with a master's degree. This compares with a 2011 census data average across the four boroughs of 38% having a level 4 qualification or higher (suggesting a bachelor's degree or equivalent is held).

Our survey captured more households in the higher income categories, with 18%, 28%, 21% and 22% of the cohort reporting a net monthly household income of £501-1000, £1001-2000, £2001-3000 and >£3000, respectively. Per-capita net monthly household income after housing costs had 24%, 35%, 26% and 15% of the cohort reporting a net monthly household income after housing costs of <£750, £750-1250, £1251-1750 and £1751-3500, respectively. Despite this, a significant proportion found it a strain to meet monthly housing costs, with 29% agreeing or strongly agreeing that this was a challenge.

In terms of self-reported health, a low proportion of the survey respondent cohort reported bad or very bad general health (1.9% and 0.9%, respectively), but despite this 14.9% reported having their day-to-day activities limited by a health problem or

disability. This compares to an average across the four boroughs, in the 2011 census data, of 3.6% reporting bad and 1.1% reporting very bad general health and 7.5% reporting having their day-to-day activities limited by a health problem or disability. In terms of mental wellbeing, the proportion of survey respondents with a WEMWBS score that indicates low wellbeing (23%) was higher than the UK average (15%) and the proportion with a score that indicates high wellbeing (6.8%) was lower than the UK average (15%).

In terms of housing situation, the majority of respondents were either renting their accommodation without housing benefit (54%) or owned it with a mortgage or loan (32%). A small proportion owned their accommodation outright (5.8%) or rented it with housing benefit (4.8%). Of those who rented, 44.6% were renting from a private landlord and 44.6% from a letting agent. For comparison, the 2011 census data shows across the four boroughs an average of 17.6% owning their accommodation outright, 26% owning with a mortgage or loan and 22% renting their accommodation from a private landlord.

Nearly all our respondents (95%) lived in a self-contained flat/maisonette/apartment, reflecting the typical character of PDR conversions. This compares to an average across the four boroughs, in the 2011 census data, of 55% of households being in a self-contained flat/maisonette/apartment. Although all respondents were in buildings not previously used for housing, only 67% were aware of this. The length of time that respondents had spent living in their current accommodation varied, with 33% living there for less than a year, 25% for 1-2 years, 16% for 2-3 years, 16% for 3-5 years, 8.7% for 5-10 years and 1% for more than 10 years. Any issues with housing quality are, of course, likely to impact a significant proportion of residents who have been enduring them for a year or longer.

In terms of housing problems, the six most commonly reported problems were:

- a shortage of space (46%)
- street noise (40%)
- noise from neighbours (26%)
- pollution (16%)
- vandalism or crime (16%)
- lack of fresh air (14%).

Only 14% of respondents reported having none of the accommodation problem survey responses.

In terms of thermal comfort, 92% reported being able to keep comfortably warm during cold winter weather but a lower proportion were able to keep comfortable during hot summer weather (63%). This may be related to flats in former office

buildings having single aspect windows and window arrangements not suitable for residential use with large former open plan offices divided into small housing units (e.g. windows that do not open, large windows now on smaller spaces).

A surprisingly high proportion of the cohort reported not having a single window that they could open (14%), with only 68% reporting at least one window that they could easily see outside through. Outdoor facing windows were more common in bedrooms (70% reported having one in all bedrooms), and the living area (75%), with a lower proportion reported in the kitchen (39%) and bathroom (8.7%). After windows, the most commonly reported means of keeping accommodation cool were blinds (67%), curtains (29%) and internal shutters (8.7%).

Respondents reported lower satisfaction with the amount of space in the accommodation available for socialising (13% disagreed and 5.8% strongly disagreed that there was sufficient space) and studying (17% disagreed and 4.9% strongly disagreed) than for household members being able to eat together comfortably (2.9% disagreed and 1.9% strongly disagreed).

A significant proportion (6.4%) of the cohort reported not having any of the seven amenity types within a ten-minute walk of their accommodation, with 24% reporting having four or fewer types. The least common amenities were leisure centre (47% reported living within a ten-minute walk), primary school (64%) and GP surgery (74%).

In terms of perceptions of safety when at home alone, a minority of respondents reported feeling a bit unsafe (8.3%), very unsafe (1.5%) or never being at home alone because of safety concerns (0.5%). The most common reasons given were 'fear of being burgled' (11%) and 'harassment by others' (6.0%). Perceptions of safety in the neighbourhood when walking alone outside during the daytime were similar to being home alone, with 6.9% and 1.0% of respondents reporting feeling a bit unsafe or very unsafe, respectively. After dark, respondents reported feeling less safe when walking alone in the neighbourhood, with 35% and 4.9% reporting feeling a bit unsafe or very unsafe, respectively.

Regression results

Associations between net monthly per-capita household income (after housing costs) and housing quality outcomes

Participants living in a household with a net monthly per-capita household income (after housing costs) of less than £750 had over four times the odds of living in accommodation without any windows that they could easily see outside through (OR 4.17, 95%CI 1.58, 12.1; $p = 0.005$), relative to those with a household income in the range £1751-3500.

Surprisingly, our analysis found that reporting problems with street or neighbour noise in accommodation was most common in the highest income band (£1751-3500), with those earning £1251-1750 less likely to report noise as a problem (OR 0.38, 95%CI 0.15, 0.94; $p=0.039$).

No other housing quality outcomes were associated with household income.

All estimates can be found in Tables A1-3 in Appendix 3.

Associations between housing quality indicators and WEMWBS health outcomes while controlling for net monthly per-capita household income after housing costs (Tables 3 & 4)

Accommodation space: Space was strongly associated with improved wellbeing, with respondents who strongly disagreed that there was sufficient space i) to have visitors for socialising or ii) for household members to eat together comfortably being much more likely to have WEMWBS scores that may be indicative of low wellbeing (Table 3) compared to those who strongly agreed, with estimated odds ratios of i) 8.40, (95%CI 1.83, 42.7; $p=0.007$) and ii) 24.2 (95%CI 2.53, 560; $p=0.012$) after controlling for income. Increasingly negative responses had an increasing risk of low wellbeing for both of these survey questions, for example the 'space for household members to eat together comfortably' variable had estimated odds ratios of 2.34 ('agree'), 3.43 ('neutral'), 7.62 ('disagree') and 22.9 ('strongly disagree') relative to 'strongly agree', after controlling for household income.

Similarly, a clear trend was identified in the linear regression (Table 4), with increasingly negative responses associated with lower WEMWBS scores for these two survey questions. Relative to respondents who strongly agreed that there was sufficient space for socialising, eating with their household comfortably or studying, those who strongly disagreed were associated with a WEMWBS score that was 12 (95%CI 6, 17; $p<0.001$), 13 (95%CI 4.9, 22; $p=0.002$) and 13 (95%CI 7.2, 19; $p<0.001$) points lower after controlling for household income, respectively.

Thermal comfort: When compared to respondents who only had 'windows that open, internal shutters, curtains or blinds', those with 'no cooling options' were associated with a WEMWBS score that was 16 (95%CI 6.2, 26; $p=0.002$) points lower on average, after controlling for household income. This was also associated with a higher relative risk of having a WEMWBS score indicative of low wellbeing (unadjusted OR 10.1, 95%CI 1.25, 207; $p=0.048$), although there were too few observations to estimate the association while controlling for household income. A clear trend was observed in Table 4, with respondents reporting better accommodation cooling options found to have a higher estimated relative WEMWBS score indicative of higher mental wellbeing. Those reporting 'external shutters, fans, fixed shading or awnings or canopies over windows or doors' and 'air conditioning' were estimated to have a WEMWBS score that was on

average 4.4 (95%CI 0.51, 8.2; p=0.0027) and 5.1 (95%CI -0.40, 11; p=0.069) points higher when controlling for household income.

Respondents who reported being unable to keep comfortable during hot summer weather had about twice the odds of having a WEMWBS score indicative of low wellbeing (OR 2.10 95%CI 1.04, 4.26; p=0.038) compared to those who were able to keep comfortable. Interestingly, there was no association between a respondent's self-reported ability to keep comfortably warm during cold winter weather and wellbeing as indicated by WEMWBS score (OR 1.25 95%CI 0.33, 3.89; p=0.7). Contradictorily, a respondent's self-reported ability to keep comfortable during hot summer weather or cold winter weather was not associated with a higher WEMWBS score in the linear regression (Table 4) or any accommodation cooling options (Table 5). This may be associated with the way the different questions about the ability to keep thermally comfortable were asked in the survey, with the potential for measurement error. However, taking all of these results together there is evidence to suggest that accommodation cooling options were an important determinant of mental wellbeing in PDR housing.

Availability of local amenities: Having more types of amenities within a ten-minute walk of accommodation was associated with higher wellbeing, with those reporting fewer than four types (out of 'park or greenspace', 'shop to buy food', 'public transport access', 'primary school', 'GP surgery', 'cafe or restaurant', 'leisure centre') found to have an increased risk of having a WEMWBS score indicative of low wellbeing (OR 2.64, 95%CI 1.03, 6.57; p=0.038), after controlling for household income. In the linear regression, each additional type of amenity that a respondent had was associated with a WEMWBS score increase of 1.4 (95%CI 0.71, 2.1; p<0.001) points after adjusting for household income (Table 4).

Perception of safety: Respondents' perceptions of safety were strongly associated with mental wellbeing for all three survey questions relating to 'safety when home alone', 'walking alone in the neighbourhood during daytime' and 'walking alone in the neighbourhood after dark' (Tables 3 and 4). Respondents reporting feeling 'a bit unsafe' when at home alone or walking in the neighbourhood during the daytime were more likely to have a WEMWBS score indicative of low mental wellbeing with estimated odds ratios of 5.46 (95%CI 1.72, 18.0; p=0.004) and 5.01 (95%CI 1.34, 18.7; p=0.015) after controlling for household income, respectively. Feeling 'very unsafe' when walking in the neighbourhood after dark was associated with a much higher risk of having a WEMWBS score indicative of low wellbeing (OR 13.8, 95%CI 1.63, 303; p=0.031) after controlling for household income. There was a clear trend in both the logistic regression and linear regression results, with individuals who felt less safe more likely to have a lower WEMWBS score indicative of low wellbeing than those who felt more safe. For example, relative to those who felt 'very safe' when walking alone in the neighbourhood during daytime, reporting feeling 'fairly safe', 'a bit unsafe' and 'very unsafe' were

associated with a WEMWBS score that was 4.6 (95%CI 2, 7.1; $p < 0.001$), 8.3 (95%CI 3.5, 13; $p < 0.001$) and 11 (95%CI 1.4, 22; $p = 0.082$) points lower when controlling for household income.

An important determinant of perception of safety when at home alone was the ability of a respondent to lock the entrance, with those reporting difficulty locking the entrance having over eight times the odds of reporting feeling 'very unsafe' or 'a bit unsafe' (OR 8.42, 95%CI 1.93, 34.9; $p = 0.003$) when compared to those who had no difficulties (Table 6). Difficulty locking windows was not associated with perceptions of safety when at home alone (OR 3.12, 95%CI 0.44, 14.7; $p = 0.2$).

Windows and accommodation problems: Respondents reporting a lack of fresh air as a problem in their accommodation were found to have a WEMWBS score that was on average 5.2 (95%CI 1.7, 8.6; $p = 0.004$) points lower than those who did not report this problem, after controlling for household income. Surprisingly, respondents who did not have a single window that they could easily see outside through were not found to have an increased risk of having a WEMWBS score indicative of low mental wellbeing or any relative difference in WEMWBS score. This was also the case for those reporting living in accommodation for which street or neighbour noise was a problem or for which condensation, leaks, damp or rot were present (although for damp and mould, this was a small number in the sample).

Table 2: Frequency table of all survey questions (n=218)

| Survey question | n (%); Median (IQR) |
|--|----------------------------|
| Demographic & socioeconomic status | |
| Age (years) | |
| 18-25 | 31 (14%) |
| 26-35 | 118 (54%) |
| 36-45 | 41 (19%) |
| 46-55 | 18 (8.3%) |
| 55-65 | 7 (3.2%) |
| >65 | 3 (1.4%) |
| Sex | |
| Female | 122 (56%) |
| Male | 93 (43%) |
| Unspecified | 2 (0.9%) |
| Missing | 1 |
| Number of people usually living in this household | |
| 1 | 79 (37%) |
| 2 | 111 (52%) |
| 3 | 16 (7.5%) |
| 4 | 5 (2.3%) |
| 5 | 1 (0.5%) |
| 10 | 1 (0.5%) |
| Missing | 5 |
| Ethnicity | |
| White | 123 (59%) |
| Irish Traveller | 0 (0%) |
| Indian | 34 (16%) |
| Black African | 7 (3.4%) |
| Black other | 3 (1.4%) |
| Chinese | 4 (1.9%) |
| Roma | 0 (0%) |
| Filipino | 4 (1.9%) |
| Other | 32 (15%) |
| Missing | 11 |
| Work status/employment | |
| Employee | 152 (70%) |
| Self-employed or freelance (last 7 days) | 30 (14%) |
| Temporarily away from work ill, on holiday or temporarily laid off | 13 (6.0%) |
| On parental leave | 3 (1.4%) |
| Doing any other kind of paid work | 4 (1.8%) |

| | |
|--|-----------|
| Working from home (part-time or full-time) | 60 (28%) |
| Retired | 6 (2.8%) |
| Studying | 21 (9.6%) |
| Looking after home or family | 12 (5.5%) |
| Long-term sick or disabled | 6 (2.8%) |
| Highest education level achieved | |
| Early childhood | 0 (0%) |
| Primary education | 2 (0.9%) |
| Secondary education | 23 (11%) |
| Vocational/technical | 13 (6.0%) |
| Bachelors degree | 108 (50%) |
| Masters degree | 65 (30%) |
| PhD | 7 (3.2%) |
| None/other | 0 (0%) |
| Net monthly household income (after housing costs) | |
| <300 | 9 (4.1%) |
| 300-500 | 13 (6.0%) |
| 501-1000 | 39 (18%) |
| 1001-2000 | 62 (28%) |
| 2001-3000 | 46 (21%) |
| >3000 | 49 (22%) |
| Missing | 39 |
| Net monthly per-capita household income (after housing costs) | |
| <750 | 51 (24%) |
| 750-1250 | 75 (35%) |
| 1251-1750 | 56 (26%) |
| 1751-3500 | 31 (15%) |
| Missing | 5 |
| Strain to meet monthly housing costs | |
| Strongly agree | 24 (12%) |
| Agree | 35 (17%) |
| Neutral | 60 (29%) |
| Disagree | 61 (30%) |
| Strongly disagree | 26 (13%) |
| Missing | 12 |
| General health | |
| How is your health in general? | |
| Very good | 79 (37%) |
| Good | 91 (42%) |
| Fair | 39 (18%) |

| | |
|---|-----------|
| Bad | 4 (1.9%) |
| Very bad | 2 (0.9%) |
| Missing | 3 |
| Day-to-day activities limited by health problem/disability | |
| No | 183 (86%) |
| Yes – limited a little | 27 (13%) |
| Yes – limited a lot | 4 (1.9%) |
| Missing | 4 |
| Health conditions | |
| Asthma | 18 (8.3%) |
| COPD | 1 (0.5%) |
| Other lung condition | 0 (0%) |
| Heart attack (or chronic sequelae) | 0 (0%) |
| Other heart condition | 4 (1.8%) |
| Hypertension | 11 (5.0%) |
| Stroke (or chronic sequelae) | 2 (0.9%) |
| Alzheimer’s disease or other cause of dementia | 0 (0%) |
| Neurological condition | 4 (1.8%) |
| Cancer | 1 (0.5%) |
| Osteoarthritis | 4 (1.8%) |
| Other type of arthritis | 3 (1.4%) |
| Low back pain/other chronic back defect | 16 (7.3%) |
| Neck pain or other chronic back defect | 6 (2.8%) |
| Diabetes | 4 (1.8%) |
| Allergy | 16 (7.3%) |
| Liver disease | 3 (1.4%) |
| Urinary incontinence | 1 (0.5%) |
| Kidney problems | 1 (0.5%) |
| Depression | 24 (11%) |
| Anxiety | 49 (22%) |
| PTSD | 7 (3.2%) |
| Other mental health condition | 7 (3.2%) |
| Deafness/hearing loss | 5 (2.3%) |
| Blindness/partial sight | 1 (0.5%) |
| Learning disability | 7 (3.2%) |
| Autism/autism spectrum condition | 2 (0.9%) |
| Mobility/dexterity difficulty that requires use of a wheelchair | 1 (0.5%) |
| Mobility/dexterity difficulty that limits basic physical activities | 1 (0.5%) |
| Other | 14 (6.4%) |
| No health condition | 99 (45%) |

| Smoker in household | |
|--|-----------|
| No | 193 (90%) |
| Yes | 18 (8.4%) |
| Prefer not to say | 4 (1.9%) |
| Missing | 3 |
| Mental wellbeing | |
| Wellbeing – feeling optimistic about the future | |
| None of the time | 3 (1.4%) |
| Rarely | 22 (11%) |
| Some of the time | 76 (37%) |
| Often | 85 (41%) |
| All of the time | 21 (10%) |
| Missing | 11 |
| Wellbeing – feeling useful | |
| None of the time | 2 (1.0%) |
| Rarely | 15 (7.3%) |
| Some of the time | 67 (33%) |
| Often | 95 (46%) |
| All of the time | 26 (13%) |
| Missing | 13 |
| Wellbeing – feeling relaxed | |
| None of the time | 6 (2.9%) |
| Rarely | 49 (24%) |
| Some of the time | 81 (39%) |
| Often | 56 (27%) |
| All of the time | 14 (6.8%) |
| Missing | 12 |
| Wellbeing – feeling interested in other people | |
| None of the time | 5 (2.5%) |
| Rarely | 19 (9.4%) |
| Some of the time | 69 (34%) |
| Often | 80 (39%) |
| All of the time | 30 (15%) |
| Missing | 15 |
| Wellbeing – energy to spare | |
| None of the time | 8 (3.9%) |
| Rarely | 52 (25%) |
| Some of the time | 86 (42%) |
| Often | 48 (23%) |
| All of the time | 13 (6.3%) |

| | |
|--|-----------|
| Missing | 11 |
| Wellbeing – dealing with problems well | |
| None of the time | 3 (1.5%) |
| Rarely | 30 (15%) |
| Some of the time | 75 (36%) |
| Often | 87 (42%) |
| All of the time | 11 (5.3%) |
| Missing | 12 |
| Wellbeing – thinking clearly | |
| None of the time | 3 (1.5%) |
| Rarely | 17 (8.3%) |
| Some of the time | 74 (36%) |
| Often | 97 (47%) |
| All of the time | 14 (6.8%) |
| Missing | 13 |
| Wellbeing – feeling good about myself | |
| None of the time | 5 (2.4%) |
| Rarely | 30 (14%) |
| Some of the time | 87 (42%) |
| Often | 68 (33%) |
| All of the time | 17 (8.2%) |
| Missing | 11 |
| Wellbeing – feeling close to other people | |
| None of the time | 4 (1.9%) |
| Rarely | 31 (15%) |
| Some of the time | 72 (35%) |
| Often | 74 (36%) |
| All of the time | 25 (12%) |
| Missing | 12 |
| Wellbeing – feeling confident | |
| None of the time | 5 (2.5%) |
| Rarely | 31 (15%) |
| Some of the time | 81 (40%) |
| Often | 70 (34%) |
| All of the time | 17 (8.3%) |
| Missing | 14 |
| Wellbeing – able to make up my own mind | |
| None of the time | 2 (1.0%) |
| Rarely | 17 (8.2%) |
| Some of the time | 54 (26%) |

| | |
|---|-------------|
| Often | 105 (51%) |
| All of the time | 29 (14%) |
| Missing | 11 |
| Wellbeing – feeling loved | |
| None of the time | 6 (2.9%) |
| Rarely | 18 (8.7%) |
| Some of the time | 42 (20%) |
| Often | 90 (43%) |
| All of the time | 51 (25%) |
| Missing | 11 |
| Wellbeing – interested in new things | |
| None of the time | 3 (1.5%) |
| Rarely | 17 (8.3%) |
| Some of the time | 69 (34%) |
| Often | 84 (41%) |
| All of the time | 32 (16%) |
| Missing | 13 |
| Wellbeing – feeling cheerful | |
| None of the time | 3 (1.5%) |
| Rarely | 28 (14%) |
| Some of the time | 73 (36%) |
| Often | 86 (42%) |
| All of the time | 14 (6.9%) |
| Missing | 14 |
| WEMWBS score (0-70) | 49 (42, 54) |
| Missing | 11 |
| WEMWBS score – benchmarked for wellbeing relative to UK general population | |
| Low wellbeing | 47 (23%) |
| Average wellbeing | 146 (71%) |
| High wellbeing | 14 (6.8%) |
| Missing | 11 |
| Housing – general information | |
| Accommodation ownership | |
| Owns outright | 12 (5.8%) |
| Owns with a mortgage/loan | 67 (32%) |
| Part-owns and part-rents (shared ownership) | 2 (1.0%) |
| Rents with housing benefit | 10 (4.8%) |
| Rents without housing benefit | 111 (54%) |
| Lives here rent-free | 5 (2.4%) |
| Missing | 11 |

| | |
|--|------------|
| Rentor (if rent) | |
| Housing association/charitable trust | 7 (5.4%) |
| Private landlord | 58 (44.6%) |
| Private renting with a letting agent | 58 (44.6%) |
| Employer of a household member | 3 (2.3%) |
| Relative/friend of a household member | 3 (2.3%) |
| Other | 1 (0.8%) |
| Missing | 24 |
| Time spent living in accommodation | |
| Less than 12 months | 69 (33%) |
| 12 months but less than 2 years | 51 (25%) |
| 2 years but less than 3 years | 33 (16%) |
| 3 years but less than 5 years | 34 (16%) |
| 5 years but less than 10 years | 18 (8.7%) |
| 10 years or more | 2 (1.0%) |
| Missing | 11 |
| Accommodation previously not used for housing | |
| No | 22 (11%) |
| Yes | 138 (67%) |
| Don't know | 46 (22%) |
| Missing | 12 |
| Accommodation type | |
| House/bungalow | 2 (1.0%) |
| Self-contained flat/maisonette/apartment | 195 (95%) |
| Room(s) (bedsit/flatlet) | 6 (2.9%) |
| Other | 3 (1.5%) |
| Missing | 12 |
| Number of rooms available for use only by this household (not including kitchen, bathroom, halls or landings) | |
| 1 | 88 (43%) |
| 2 | 82 (40%) |
| 3 | 30 (15%) |
| 4 | 5 (2.4%) |
| >10 | 1 (0.5%) |
| Missing | 12 |
| Number of available rooms that are bedrooms | |
| 1 | 147 (72%) |
| 2 | 51 (25%) |
| 3 | 4 (2.0%) |
| 4 | 1 (0.5%) |

| | |
|--|-----------|
| 11 | 1 (0.5%) |
| Missing | 14 |
| Housing – problems | |
| Accommodation problems | |
| Shortage of space | 101 (46%) |
| Noise from neighbours | 56 (26%) |
| Other street noise | 88 (40%) |
| Too dark, not enough light | 28 (13%) |
| Too much light, without adequate shading | 17 (7.8%) |
| Difficulty locking the entrance | 9 (4.1%) |
| Difficulty locking windows | 8 (3.7%) |
| Lack of adequate heating facilities | 13 (6.0%) |
| Condensation | 25 (11%) |
| Leaky roof | 11 (5.0%) |
| Damp walls, floors, foundation etc. | 15 (6.9%) |
| Rot in window frames or floors | 13 (6.0%) |
| Lack of fresh air | 30 (14%) |
| Pollution, grime or other environmental problems caused by traffic or industry | 35 (16%) |
| Vandalism or crime in the area | 35 (16%) |
| None of the above | 31 (14%) |
| Can keep comfortably warm during cold winter weather | |
| Yes | 187 (92%) |
| No | 17 (8%) |
| Missing | 14 |
| Can keep comfortable during hot summer weather | |
| Yes | 128 (63%) |
| No | 76 (37%) |
| Missing | 14 |
| Accommodation windows | |
| No window that you can open | 30 (14%) |
| Only one window that you can open | 17 (7.8%) |
| More than one window that you can open | 171 (78%) |
| At least one window facing outdoors | 116 (53%) |
| At least one window facing outdoors that you can open | 143 (66%) |
| At least one window that you can easily see outside through | 148 (68%) |
| A sun light that brings natural light | 41 (19%) |
| None of the above | 4 (1.8%) |
| Rooms with outdoor facing window | |
| All bedrooms | 153 (70%) |

| | |
|--|-----------|
| Kitchen | 86 (39%) |
| Living area | 163 (75%) |
| Bathroom | 19 (8.7%) |
| Hallway and/or foyer | 10 (4.6%) |
| Other | 12 (5.5%) |
| Accommodation cooling | |
| Windows that you can open | 190 (87%) |
| Fixed ceiling fans | 16 (7.3%) |
| Internal shutters | 19 (8.7%) |
| External shutters | 3 (1.4%) |
| Curtains | 64 (29%) |
| Blinds | 147 (67%) |
| Awnings or canopies over windows or doors that you can unroll | 3 (1.4%) |
| Fixed shading for windows or doors | 8 (3.7%) |
| Air conditioner | 10 (4.6%) |
| No cooling options | 15 (6.9%) |
| Space to have visitors for socialising | |
| Strongly agree | 46 (22%) |
| Agree | 87 (42%) |
| Neutral | 35 (17%) |
| Disagree | 26 (13%) |
| Strongly disagree | 12 (5.8%) |
| Missing | 12 |
| Space for household members to eat together comfortably | |
| Strongly agree | 69 (33%) |
| Agree | 98 (48%) |
| Neutral | 29 (14%) |
| Disagree | 6 (2.9%) |
| Strongly disagree | 4 (1.9%) |
| Missing | 12 |
| Space for household members to study | |
| Strongly agree | 41 (20%) |
| Agree | 74 (36%) |
| Neutral | 46 (22%) |
| Disagree | 35 (17%) |
| Strongly disagree | 10 (4.9%) |
| Missing | 12 |
| Home reflects personal identity | |
| Strongly agree | 31 (15%) |
| Agree | 69 (34%) |

| | |
|--|-----------|
| Neutral | 65 (32%) |
| Disagree | 27 (13%) |
| Strongly disagree | 13 (6.3%) |
| Missing | 13 |
| Local amenities within a 10-minute walk | |
| Park or greenspace | 189 (87%) |
| Shop to buy food | 189 (87%) |
| Public transport access | 193 (89%) |
| Primary school | 139 (64%) |
| GP surgery | 162 (74%) |
| Cafe or restaurant | 181 (83%) |
| Leisure centre | 103 (47%) |
| Local amenities – number of types selected | |
| 0 | 14 (6.4%) |
| 1 | 10 (4.6%) |
| 2 | 2 (0.9%) |
| 3 | 10 (4.6%) |
| 4 | 17 (7.8%) |
| 5 | 25 (11%) |
| 6 | 61 (28%) |
| 7 | 79 (36%) |
| Perception of safety when at home on own | |
| Very safe | 104 (50%) |
| Fairly safe | 80 (39%) |
| A bit unsafe | 17 (8.3%) |
| Very unsafe | 3 (1.5%) |
| Never at home alone because I feel unsafe | 1 (0.5%) |
| Never at home alone, other reasons | 0 (0%) |
| Don't know | 1 (0.5%) |
| Missing | 12 |
| Reason for feeling unsafe when home on own | |
| Fear of being burgled | 25 (11%) |
| Harassment by other people | 13 (6.0%) |
| Fear of a fire breaking out | 7 (3.2%) |
| Rat and mice infestation | 8 (3.7%) |
| Fear of having a fall at home | 6 (2.8%) |
| Other reasons | 8 (3.7%) |
| Not applicable | 123 (56%) |
| Perception of safety in neighbourhood when walking alone outside during daytime | |
| Very safe | 71 (35%) |

| | |
|--|-----------|
| Fairly safe | 114 (56%) |
| A bit unsafe | 14 (6.9%) |
| Very unsafe | 2 (1.0%) |
| Never at home alone because I feel unsafe | 1 (0.5%) |
| Never at home alone, other reasons | 0 (0%) |
| Don't know | 2 (1.0%) |
| Missing | 14 |
| Perception of safety in neighbourhood when walking alone outside after dark | |
| Very safe | 23 (11%) |
| Fairly safe | 87 (42%) |
| A bit unsafe | 72 (35%) |
| Very unsafe | 10 (4.9%) |
| Never at home alone because I feel unsafe | 9 (4.4%) |
| Never at home alone, other reasons | 2 (1.0%) |
| Don't know | 3 (1.5%) |
| Missing | 12 |

Table 3: Univariable logistic regression analysis of risk factors for mental wellbeing showing associations between risk of being classified as having low wellbeing (as indicated by WEMWBS score) and housing quality. Odds ratios are shown i) unadjusted and ii) adjusted for net monthly per-capita household income after housing costs (OR = Odds Ratio, CI = Confidence Interval)

| Variable | Unadjusted | | | Adjusted | | |
|--|------------|------------|---------|----------|------------|---------|
| | OR | 95% CI | p-value | OR | 95% CI | p-value |
| Can keep comfortable during hot summer weather | | | | | | |
| Yes | — | — | | — | — | |
| No | 1.86 | 0.95, 3.65 | 0.070 | 2.10 | 1.04, 4.26 | 0.038 |
| Can keep comfortably warm during cold winter weather | | | | | | |
| Yes | — | — | | — | — | |
| No | 1.10 | 0.30, 3.29 | 0.9 | 1.25 | 0.33, 3.89 | 0.7 |
| Space to have visitors for socialising | | | | | | |
| Strongly agree | — | — | | — | — | |
| Agree | 1.62 | 0.62, 4.79 | 0.3 | 1.72 | 0.64, 5.20 | 0.3 |
| Neutral | 1.98 | 0.62, 6.62 | 0.3 | 2.35 | 0.71, 8.19 | 0.2 |
| Disagree | 3.53 | 1.10, 12.1 | 0.036 | 3.24 | 0.99, 11.2 | 0.054 |
| Strongly disagree | 6.67 | 1.63, 29.1 | 0.009 | 8.40 | 1.83, 42.7 | 0.007 |
| Space for household members to eat together comfortably | | | | | | |
| Strongly agree | — | — | | — | — | |
| Agree | 2.34 | 1.01, 5.91 | 0.056 | 2.65 | 1.11, 6.90 | 0.034 |
| Neutral | 3.43 | 1.17, 10.3 | 0.025 | 3.55 | 1.18, 11.0 | 0.024 |
| Disagree [†] | 7.62 | 1.24, 48.0 | 0.024 | 6.51 | 1.01, 42.7 | 0.042 |
| Strongly disagree | 22.9 | 2.59, 495 | 0.010 | 24.2 | 2.53, 560 | 0.012 |
| Space for household members to study | | | | | | |
| Strongly agree | — | — | | — | — | |
| Agree | 1.88 | 0.71, 5.58 | 0.2 | 2.10 | 0.77, 6.43 | 0.2 |
| Neutral | 1.83 | 0.63, 5.83 | 0.3 | 1.91 | 0.64, 6.16 | 0.3 |

| | | | | | | |
|--|------|---------------|-------|------|---------------|-------|
| Disagree | 0.75 | 0.18, 2.88 | 0.7 | 0.73 | 0.17, 2.84 | 0.7 |
| Strongly disagree | 13.6 | 2.96, 79.0 | 0.001 | 13.8 | 2.88, 83.2 | 0.002 |
| Self-reported general shortage of space | | | | | | |
| No | — | — | | — | — | |
| Yes | 1.97 | 1.02, 3.89 | 0.046 | 1.91 | 0.97, 3.83 | 0.065 |
| Local amenities – number of types selected | | | | | | |
| 4+ | — | — | | — | — | |
| <4 | 2.61 | 1.06, 6.24 | 0.032 | 2.64 | 1.03, 6.57 | 0.038 |
| Local amenities – number of types selected (increase per additional one amenity type) | 0.83 | 0.70, 1.00 | 0.043 | 0.84 | 0.70, 1.01 | 0.066 |
| Perception of safety when at home on own | | | | | | |
| Very safe | — | — | | — | — | |
| Fairly safe | 1.12 | 0.53, 2.34 | 0.8 | 1.09 | 0.50, 2.34 | 0.8 |
| A bit unsafe | 5.03 | 1.72, 15.1 | 0.003 | 5.46 | 1.72, 18.0 | 0.004 |
| Very unsafe | 2.24 | 0.10, 24.5 | 0.5 | 1.99 | 0.09, 22.5 | 0.6 |
| Perception of safety in neighbourhood when walking alone outside during daytime | | | | | | |
| Very safe | — | — | | — | — | |
| Fairly safe | 1.99 | 0.92, 4.58 | 0.090 | 2.18 | 0.97, 5.29 | 0.069 |
| A bit unsafe | 4.58 | 1.28, 16.2 | 0.017 | 5.01 | 1.34, 18.7 | 0.015 |
| Very unsafe | 6.10 | 0.23, 163 | 0.2 | 5.20 | 0.19, 145 | 0.3 |
| Perception of safety in neighbourhood when walking alone outside after dark | | | | | | |
| Very safe | — | — | | — | — | |
| Fairly safe | 2.74 | 0.71, 18.1 | 0.2 | 5.31 | 0.98, 98.8 | 0.12 |
| A bit unsafe | 3.00 | 0.76, 20.0 | 0.2 | 5.85 | 1.07, 109 | 0.10 |
| Very unsafe | 7.00 | 1.10, 60.5 | 0.048 | 13.8 | 1.63, 303 | 0.031 |

| | | | | | | |
|--|------|------------|-------|------|------------|-------|
| Accommodation cooling | | | | | | |
| Only windows that open/internal shutters/curtains/blinds | — | — | | — | — | |
| External shutters/fans/awning/fixed shading | 0.93 | 0.29, 2.51 | 0.9 | 0.87 | 0.24, 2.56 | 0.8 |
| No cooling options ¹ | 10.1 | 1.25, 207 | 0.048 | - | - | - |
| Accommodation windows – At least one window that you can easily see outside through | | | | | | |
| Yes | — | — | | — | — | |
| No | 1.59 | 0.79, 3.16 | 0.2 | 1.35 | 0.63, 2.83 | 0.4 |
| Accommodation problems – noise (street or neighbour) | | | | | | |
| No | — | — | | — | — | |
| Yes | 0.91 | 0.47, 1.75 | 0.8 | 1.00 | 0.51, 1.97 | 0.9 |
| Accommodation problems – condensation/leaky roof/damp/rot | | | | | | |
| No | — | — | | — | — | |
| Yes | 1.32 | 0.60, 2.77 | 0.5 | 1.29 | 0.58, 2.76 | 0.5 |
| Accommodation problems – lack of fresh air | | | | | | |
| No | — | — | | — | — | |
| Yes | 2.27 | 0.97, 5.13 | 0.053 | 2.21 | 0.91, 5.18 | 0.071 |

¹Too few observations to estimate adjusted ORs

Table 4: Univariable linear regression analysis of risk factors for mental wellbeing showing associations between WEMWBS score and housing quality. Effect sizes can be interpreted as the relative increase in WEMWBS score (range 0-70) for a given change in explanatory variable category, and are shown as i) unadjusted and ii) adjusted for net monthly per-capita household income after housing costs (CI = Confidence Interval)

| Variable | Unadjusted | | | Adjusted | | |
|--|------------|-------------|---------|----------|-------------|---------|
| | Beta | 95% CI | p-value | Beta | 95% CI | p-value |
| Can keep comfortable during hot summer weather | | | | | | |
| Yes | — | — | | — | — | |
| No | -1.9 | -4.4, 0.57 | 0.13 | -2.3 | -4.8, 0.18 | 0.069 |
| Can keep comfortably warm during cold winter weather | | | | | | |
| Yes | — | — | | — | — | |
| No | -1.9 | -6.2, 2.5 | 0.4 | -2.4 | -6.7, 1.9 | 0.3 |
| Space to have visitors for socialising | | | | | | |
| Strongly agree | — | — | | — | — | |
| Agree | -3.4 | -6.4, -0.36 | 0.029 | -3.5 | -6.6, -0.53 | 0.021 |
| Neutral | -4.4 | -8.1, -0.70 | 0.020 | -4.9 | -8.6, -1.1 | 0.011 |
| Disagree | -4.7 | -8.8, -0.68 | 0.022 | -4.4 | -8.5, -0.40 | 0.032 |
| Strongly disagree | -10 | -16, -4.8 | <0.001 | -12 | -17, -6.0 | <0.001 |
| Space for household members to eat together comfortably | | | | | | |
| Strongly agree | — | — | | — | — | |
| Agree | -3.1 | -5.7, -0.46 | 0.021 | -3.6 | -6.3, -1.0 | 0.008 |
| Neutral | -3.8 | -7.5, -0.16 | 0.041 | -3.7 | -7.4, -0.02 | 0.049 |
| Disagree | -7.1 | -14, -0.07 | 0.048 | -6.7 | -14, 0.37 | 0.063 |
| Strongly disagree | -13 | -22, -4.9 | 0.002 | -13 | -22, -4.9 | 0.002 |
| Space for household members to study | | | | | | |
| Strongly agree | — | — | | — | — | |
| Agree | -3.5 | -6.7, -0.30 | 0.032 | -3.6 | -6.8, -0.38 | 0.028 |
| Neutral | -3.6 | -7.2, -0.14 | 0.042 | -3.6 | -7.1, -0.07 | 0.045 |

| | | | | | | |
|--|------|----------------|--------|------|---------------|--------|
| Disagree | -1.6 | -5.3, 2.2 | 0.4 | -1.6 | -5.3, 2.2 | 0.4 |
| Strongly disagree | -13 | -19, -7.3 | <0.001 | -13 | -19, -7.2 | <0.001 |
| Self-reported general shortage of space | | | | | | |
| No | — | — | | — | — | |
| Yes | -2.0 | -4.4, 0.44 | 0.11 | -1.8 | -4.3, 0.63 | 0.14 |
| Local amenities – number of types selected | | | | | | |
| 4+ | — | — | | — | — | |
| <4 | -7.3 | -11, -3.6 | <0.001 | -7.1 | -11, -3.4 | <0.001 |
| Local amenities – number of types selected (increase per additional one amenity type) | 1.4 | 0.75, 2.1 | <0.001 | 1.4 | 0.71, 2.1 | <0.001 |
| Perception of safety when at home on own | | | | | | |
| Very safe | — | — | | — | — | |
| Fairly safe | -1.9 | -4.4, 0.53 | 0.12 | -1.9 | -4.4, 0.63 | 0.14 |
| A bit unsafe | -8.2 | -12, -3.8 | <0.001 | -8.1 | -13, -3.5 | <0.001 |
| Very unsafe | -2.5 | -11, 5.9 | 0.6 | -4.6 | -14, 5.1 | 0.4 |
| Perception of safety in neighbourhood when walking alone outside during daytime | | | | | | |
| Very safe | — | — | | — | — | |
| Fairly safe | -4.2 | -6.7, -1.7 | 0.001 | -4.6 | -7.1, -2.0 | <0.001 |
| A bit unsafe | -8.1 | -13, -3.3 | 0.001 | -8.3 | -13, -3.5 | <0.001 |
| Very unsafe | -10 | -20, -0.72 | 0.035 | -11 | -22, 1.4 | 0.082 |
| Perception of safety in neighbourhood when walking alone outside after dark | | | | | | |
| Very safe | — | — | | — | — | |
| Fairly safe | -4.5 | -8.4, -0.70 | 0.021 | -5.3 | -9.2, -1.4 | 0.008 |
| A bit unsafe | -5.8 | -9.7, -1.9 | 0.004 | -6.7 | -11, -2.7 | 0.001 |
| Very unsafe | -7.3 | -12, -2.2 | 0.005 | -8.8 | -15, -2.6 | 0.005 |

| | | | | | | |
|--|-------|------------|--------|------|------------|-------|
| Accommodation cooling | | | | | | |
| Only windows that open/internal shutters/curtains/blinds | — | — | | — | — | |
| Air conditioning | 5.6 | 0.09, 11 | 0.046 | 5.1 | -0.40, 11 | 0.069 |
| External shutters/fans/awning/fixed shading | 3.9 | 0.15, 7.7 | 0.042 | 4.4 | 0.51, 8.2 | 0.027 |
| No cooling options | -14 | -22, -5.3 | <0.002 | -16 | -26, -6.2 | 0.002 |
| Accommodation windows – At least one window that you can easily see outside through | | | | | | |
| Yes | — | — | | — | — | |
| No | -0.60 | -3.3, 2.1 | 0.7 | 0.28 | -2.6, 3.2 | 0.8 |
| Accommodation problems – noise (street or neighbour) | | | | | | |
| No | — | — | | — | — | |
| Yes | -1.4 | -3.9, 1.0 | 0.3 | -1.9 | -4.4, 0.61 | 0.14 |
| Accommodation problems – condensation/leaky roof/damp/rot | | | | | | |
| No | — | — | | — | — | |
| Yes | -1.3 | -4.3, 1.7 | 0.4 | -1.3 | -4.3, 16 | 0.4 |
| Accommodation problems – lack of fresh air | | | | | | |
| No | — | — | | — | — | |
| Yes | -5.2 | -8.6, -1.7 | 0.003 | -5.2 | -8.6, -1.7 | 0.004 |

1Too few observations to estimate adjusted ORs.

Table 5: Univariable logistic regression analysis of thermal comfort showing associations between the probability that a respondent reported not being able to keep comfortably cool during hot weather and available accommodation cooling options (OR = Odds Ratio, CI = Confidence Interval)

| Variable | OR | 95% CI | p-value |
|--|-----------|---------------|----------------|
| Accommodation cooling options | | | |
| External shutters/fans/awning/fixed shading | — | — | |
| Air conditioning | 0.24 | 0.01, 1.67 | 0.2 |
| Only windows that open/internal shutters/curtains/blinds | 1.41 | 0.56, 3.85 | 0.5 |
| No cooling options | 1.07 | 0.05, 13.2 | >0.9 |

Table 6: Univariable logistic regression analysis of safety showing associations between the probability that a respondent reported feeling unsafe at home when alone and reported difficulty in locking their i) entrance or ii) windows (OR = Odds Ratio, CI = Confidence Interval)

| Variable | OR | 95% CI | p-value |
|--|-----------|---------------|----------------|
| Difficulty locking the entrance | | | |
| No | — | — | |
| Yes | 8.42 | 1.93, 34.9 | 0.003 |
| Difficulty locking windows | | | |
| No | — | — | |
| Yes | 3.12 | 0.44, 14.7 | 0.2 |

Interview data overview

Interviewees were asked about **a typical day in their home** and the activities this included. Cooking and daily life activities predominated in the answers given. 23 of the 41 interviewees talked about working from home at least a couple of times per week, reflecting pandemic-related working patterns. Two participants did not like this and felt a lack of separation between their home and work as a result. Another two interviewees made a point of saying they could not work from home due to their being insufficient space in their flats, and another said they could not work from home as the flat was prone to overheating and so not being a comfortable environment in which to work. There were few mentions of activities like socialising and having friends or family visit.

Interviewees were then asked **what it felt like to live in their home**. There were a mix of positive and negative experiences shared here. The most common positive, mentioned by eight different interviewees, was that they liked living where they did because of its good location, for example with amenities nearby, with nice parks and cafes or in an area that people liked. Some people said their home felt calm and safe, or cosy, or, in the words of one interviewee “like a sanctuary... I feel serenity when I close the door”. Four interviewees said that there was sufficient space. Good neighbours were mentioned by two interviewees. Three valued the natural light into their dwelling. There was mention of the ease of cleaning their home, comments on maintenance and that, in one case, the appliances worked well. Two interviewees said it was good to live where they did because it was quiet and peaceful. There was also discussion of the way that the property felt like a long-term investment, that there was a sense of pride in owning their own place and that it was good to have their own space. In summing up what it felt like to live where they did, three people said it “felt like home”.

There were, however, more negative than positive responses to this question. Fourteen interviewees made comments along the lines that it felt temporary living where they did, with some linking this to insecure tenure and the nature of renting, one linking this to a feeling their home did not reflect their identity and another suggesting it was functional without a sense of community. The design feature mentioned most frequently here was in relation to a lack of space, with eleven interviewees discussing this, for example someone saying that it felt “cramped”, that there was no space for hobbies like yoga, that there was insufficient space to have friends or guests over, that there was so little space it was hard to work from home, that the lack of space meant there needed to be a folding table and bed, and that the flat felt “overwhelming as so small”. One interviewee specifically linked this to a lack of storage space.

Quite powerfully, four residents spoke about feeling “trapped” in their housing, one linking this to being isolated during Covid, one to the warm weather, one to being unable to “escape” as they could not sell their flat (having bought ‘off plan’ [before it was completed] but now being unable to sell it on [presumably due to lack of interest]) and one because

it is located in a basement and they feel “locked away” there. Another resident concluded that they felt that living where they did they “are not getting [their] money’s worth”. Thermal comfort was discussed by three different interviewees, saying that it felt uncomfortably warm to live in their home, one describing how they had to use two fans constantly to try and keep cool and another linking this to making it hard to sleep.

In relation to this specific question, only two respondents explicitly referenced a lack of natural light when describing what it felt like to live in their home but one of these was quite evocative in their description that “it is a very depressing flat as it has no windows”. This resident then went on to explain that it was “designed with no consideration for disabled people” (which included this interviewee) and that they had chosen it in a rush but disliked living with “no views, no balcony, no outdoor space. The lift is often broken, so there is 60 steps or more to go up which is very difficult with a pram. It is challenging to work from home since there is no space enough to separate activities or to put up a desk and there is only space in the kitchen. It is difficult to dry washed clothes, which has to be done at night. It feels a temporary place”.

Finally, there was some discussion that it felt lonely to live in their homes; this was mentioned by three different interviewees but only one expanded that this was because it was not close to friends or family by way of explanation. This might be linked to social situation and location more than the actual design of the dwelling, but is demonstrative of the manner in which people’s consideration of what it feels like to live in their home is a complex web of experience influenced by their personal and social situation as well as the physical characteristics of the housing.

Interviewees were asked which **sounds and smells** they noticed most in their home. Seven responded they didn’t notice any noises specifically at all and that their flat had good sound insulation. Three commented just that they heard noises they liked, in one case church bells and in two cases birds, ducks and geese from the nearby river / canal. Five specifically commented that their flat had noticeably poor sound insulation, with one remarking “the walls are so thin, everyone hears everything”.

The most commonly mentioned noise issue was street noise, such as people outside, traffic noise, rubbish trucks, trains, planes and so on, which were mentioned by 20 of the interviewees. One of those said they actually liked this sort of noise and it gave a sense of urban life and living in a city, while another said they had got used to it, but the other 18 seemed to perceive this noise negatively. Indeed, one said it was so bad it was impossible to work from home, another said it was so bad they had trouble sleeping and had paid for secondary glazing themselves to reduce the noise, another said they had to take medication to be able to sleep, and another said it was so bad they could not sleep if the windows were open but that then leads to problems keeping cool in the summer.

This was followed by hearing noise from neighbours, such as people banging about, loud footsteps above, music and parties, which was mentioned by ten interviewees. Two said that this was so bad they had had to buy ear plugs to be able to sleep. There was then mention of construction noises from nearby work sites (twice), pipework causing a loud rattling noise (once) and one interviewee mentioned the noise from the building's boiler room (immediately adjacent to their flat) being so loud that it disturbed them and they'd had to buy earplugs to be able to sleep.

In terms of smells, the single most common response was that there were no noticeable smells in the home at all (ten interviewees said this). Five people specifically said that they thought their flat was well ventilated. However, there were then another eight who specifically mentioned that cooking smells would linger in their property, this often being linked by them to a comment that their flat was poorly ventilated. One explained how they had little space to dry clothes and that food smells would linger, so that the clothes could then pick-up these smells. Five interviewees mentioned cooking and food smells from neighbours being a problem, while another four mentioned food smells from outside their building being a problem, e.g. from nearby take-aways.

There was then mention of smells of cigarette or cannabis smoke from neighbours four times (one person said this didn't bother them but the others specified that it did bother them) and one specific mention of rubbish smells because the building's lift was apparently broken so instead of taking rubbish down to the bin area, neighbour's apparently often left it in the corridor overnight then took it down when leaving the building the next day, but this allowed a smell to build-up. Finally, there were four mentions of bad smells from drains including one linking this to the neighbour's toilet, one saying the bathroom had no windows so smelled very bad and one interviewee stating very clearly "the sink smells like shit".

We asked our interviewees if they had an unlimited budget to **change anything about their home**, what would that be? Four people responded that they liked their flat just like it was and wouldn't change anything. The other thirty-seven did all want to change something. The most common thing people wanted to change was to have more space, which was mentioned in one way or another 27 times. This included, most commonly, having more storage space (mentioned 11 times), having an extra bedroom (mentioned six times) and have a larger kitchen (mentioned five times, including one person saying they did not currently have sufficient room for a washing machine and another saying there was so little work surface space that the kettle had to be balanced on a stool). Some of these interviewees then offered further explanation about their desire for extra space in their dwellings, for example three people said they wanted enough space to actually be able to socialise with friends or have guests stay, two said they just wanted enough room to be able to separate our activities within their home and three mentioned specifically wanting enough room to be able to work from home comfortably.

The next most commonly cited issue was in relation to access to outdoor space. Eleven people would like a balcony or terrace access (which assumedly means they do not currently have one), with one commenting how they felt “trapped during lockdown” because their flat did not have access to private outdoor space while another said “having some open space to yourself would massively improve my happiness”. Green space, even if this was communal, was mentioned another four times, with one respondent explicitly stating this would be something which would help them feel “healthier and happier”.

Issues related to windows and natural light were the next most commonly discussed issue. For six respondents this was wanting bigger or better windows which would allow more natural light in, or which they could have a view out of. One interviewee mentioned their bedroom currently did not have a window at all (there was one in the living room of the flat but not the bedroom) and they would like one. Another three interviewees, however, had difficulty controlling light into the dwelling and would like better blinds to reduce this (it might be related to large former office type windows, which in some conversions can essentially constitute an entire wall).

Thermal comfort was mentioned by seven interviewees. Four of these said their flat overheated in summer so they would improve it by adding air conditioning; three others said their flat was not warm enough (one remarking “in winter it is very, very cold”) and so they would improve it by having better insulation or central heating.

There was then a range of other possible improvements discussed. This included three people discussing ways to reduce noise from the outside disturbing them (one suggested noise insulation, two suggested double glazing). Three people wanted to replace their shower room with a proper bathroom. One person would like a gas hob but could only have electricity into their flat. Two said their flat had awkwardly shaped rooms that ideally they would change to increase the utility of the space (but both recognised in practical terms this might be impossible). Finally, six people said they would just like to change the general décor of their dwelling but could not because they were renting rather than owning the property.

Interviewees were asked what **places in the local area they felt benefitted their health and wellbeing**. The standout response here, mentioned by 34 of the 41 interviewees, was a local park or green space. One interviewee commented that the “parks and green spaces in the local area are low cost therapy” and that it improved how they felt mentally so they spent as much time as possible there, whilst another commented about a local open space that having it “within 10 minutes’ walk is wonderful, it is lovely and safe, and it saved my mental health during the pandemic.”

The accessibility of local commercial amenities such as shops, supermarkets, cafes, bars and pubs was mentioned 28 times. A couple of people explicitly mentioned that

they felt they lived in a '15 minute neighbourhood' and spoke positively of the concept. The link between pubs and health was explained by one interviewee as allowing them to socialise. Another commented that "even at 10 at night, if you go out there are so many nice wine bars, and people are sitting out enjoying their meals, you don't feel isolated". One interviewee explicitly mentioned having a cinema nearby helped their sense of wellbeing. Having a library nearby was mentioned three times.

The nearby location of a gym or swimming pool was raised by 16 interviewees, with a perhaps fairly obvious link to potential health and wellbeing benefits (albeit two said they thought that having a gym nearby could benefit their health, but they never actually used it). An active lifestyle was supported by a feeling that their neighbourhood was walkable or easy to ride a bike in (mentioned five times). There were eleven mentions of having good public transport in the neighbourhood as something people perceive benefitted their health and wellbeing. Two interviewees lived in neighbourhoods without much road traffic and therefore air pollution.

Social connections were often a fairly commonly cited factor here. Six interviewees discussed living in a neighbourhood they felt had a good sense of community, or had good interpersonal relationships with their neighbours. There were two mentions here of living in a multicultural neighbourhood, which these respondents felt supported their sense of belonging and wellbeing. Five people raised the fact that their friends, family or partner lived nearby to them and viewed that as a feature of the place they lived supporting their health and wellbeing. Four interviewees mentioned having low crime rates in their area positively.

Less frequently cited, one interviewee raised the fact they lived near a beauty salon and massage parlour. One interviewee was aware of the mental health services in the area they lived and felt this was a good service compared to some others in London, so helped. One interviewee thought that having the availability of good broadband was a positive because it stopped them feeling isolated.

Conversely, we also asked about what **places in the local area they felt harmed their health and wellbeing**. The most commonly cited factors related to anti-social behaviour and perceptions of crime and security in the neighbourhood, which were raised by 16 interviewees. For many this was just a feeling, such as not feeling safe after dark for an unspecified reason, or concerns about the behaviour of street drinkers in the neighbourhood, but for a few this related directly to things that had happened in the neighbourhood (one had been threatened themselves by someone, another had witnessed a stabbing).

Traffic pollution was mentioned by 14 interviewees as a feature of their neighbourhood they felt harmful to their health and wellbeing, two specifically linking this with their asthma, albeit one commenting that it was "the same all over London". Four other

interviewees rode a bike but were concerned that the poor cycling infrastructure in their neighbourhood and the associated risk from other road traffic could harm their health and wellbeing. Similarly, two were concerned about the safety of crossing the road locally to where they lived (and one of these interviewees repeatedly called the local road traffic “overwhelming”).

Noise in the neighbourhood was mentioned six times as harming health and wellbeing, with this being linked by some to nearby construction sites and others to more general street noise including the noise of road traffic.

Accessibility and walkability of the neighbourhood were also mentioned a few times: three interviewees highlighted that their neighbourhood lacked amenities, for example one discussed there were no shops a reasonable walking distance from their flat. Two other interviewees highlighted the poor public transport links making them feel isolated and/or caused stress around any journey to/from their flat (e.g. to work).

More specifically, one interviewee discussed how they had ADHD and found living in what was a very busy neighbourhood stress inducing and found it “overstimulating” every time they went outside. Another interviewee said that the fact they lived so close to so many pubs and bars had a negative impact on their health and wellbeing because they felt the ease of access meant they ended up drinking too much.

It’s also worth highlighting that three interviewees said that they felt nothing at all in their neighbourhood harmed their health or wellbeing.

Finally, we asked interviewees what they felt the main **impacts on their health and wellbeing from the design and condition of their home** were. Some interviewees highlighted positive features here, often linked to a holistic view of health and wellbeing. Thermal comfort was an issue highlighted by ten interviewees. Six linked this to their property having good insulation, four to it having good central heating.

Nine interviewees felt that the fact their flat had big windows and lots of natural light was positive and supported their health and wellbeing. Two of these explicitly discussed the fact they had a good view out through their windows (one a view of trees and greenery), and one – discussing how they had recently been bereaved – said that when their mood was low, the bright natural light into their living room really helped improve their state of mind. They commented that “my mental wellbeing has a direct correlation to the space I live in... This flat is a gem, it allows me to feel well. The sun comes through the windows.” Another interviewee highlighted a skylight which allowed bright natural light to come into their hallway as a feature they really valued, making the property feel much lighter and airier.

The location of their flat was commented upon positively by five interviewees, with links to the fact their flat was located in a walkable neighbourhood, or accessible to green or open space, as something that they felt improved their health and wellbeing. Four interviewees felt that their flat was spacious and having plenty of space in their home supported their health and wellbeing. There were two interviewees who commented here on the good sound insulation of their property, whilst two others commented on the good ventilation. One interviewee discussed how their flat had better air quality than where they had previously lived and they felt this helped because they had lung cancer. Another commented on how they felt safe, living in a building with a concierge, and this helped their sense of health and wellbeing.

There were, however, then quite a few interviewees who mentioned features of their dwelling which they felt negatively impacted upon their health and wellbeing albeit these were quite a disparate collection of features. Most commonly cited was issued related to thermal comfort, highlighted ten times. For six interviewees this was because it was difficult to keep their flat cool in the summer, one describing this as “unbearable”, another that the flat was “like a greenhouse”. For four interviewees it was about trouble keeping the flat warm in winter, with poorly insulated properties which were hard to keep warm. One person explicitly linked this to their physical health, saying the cold affected their health condition (Lupus and Raynaud’s syndrome) whilst others linked this to the wider wellbeing as the difficulty keeping flats warm meant bills were “an extortion, a shock” or “leaving no disposable income” in winter.

There were issues related to windows and natural light into the dwelling, which seven interviewees highlighted, one commenting explicitly this “felt depressing” and another that “we cannot even keep a houseplant alive here”. For another interviewee it was not a lack of natural light into their dwelling but the fact they did not have a window which had a view out, which they felt negatively impacted their wellbeing. Interestingly, only other interviewee said that the windows were too large, letting in so much light it was hard to keep the flat cool and hard to sleep at times.

Issues to do with noise were mentioned five times in response to this question (having also been discussed previously), with these interviewees explaining how poor noise insulation or a noisy location meant they felt that noise coming into their flat was harming their health and wellbeing. This was linked by one interviewee to causing them sleeplessness and anxiety, whilst another said noise felt “overwhelming” and another said it was hard to sleep and they had to wear headphones in order to block out noise and try to sleep.

A lack of space inside the flat was raised five times, with interviewees discussing how this meant it was impossible to have visitors over, with someone saying that the general lack of space within their dwelling meant it “feels claustrophobic”. Another interviewee commented that they felt embarrassed to tell people where they lived and never had

visitors to their flat due to the lack of space, which then made them “more reclusive isolated and trapped.”

A lack of outdoor space was also mentioned five times. One of these interviewees commented that “it is easy to feel down due the lack of outdoor space” whilst another remarked that “everyone in flats need their outside space.”

Four interviewees raised issues of mould, damp and condensation in their flats which they felt harmed their health and wellbeing. Two of these discussed having to buy dehumidifiers for their properties, whilst another explained how a damp smell from their apartment lingered on their clothing. There were then three interviewees who mentioned a lack of ventilation into their flats and that there was not much fresh air, albeit one of these said that this was “standard for London though”.

General property maintenance issues were mentioned by three interviewees, such as broken lifts and boilers, which they said caused them stress and anxiety. Similarly, three discussed concerned about not feeling secure in their homes because of building issues like broken locks. And there were another three mentions of leaks specifically, with one interviewee explaining that the pipes were oddly placed due to it being a former office building then divided into flats, and this apparently made it harder to repair the leaks.

One interviewee explained how their flat had had cockroach and ant infestations, which they felt was harmful to their health and wellbeing. Three then raised the fact they had high bills, which were going up under the cost of living crisis, and felt this was linked to the design of their flats (e.g. hard to keep warm meaning high energy costs) and they also felt harmed their health and wellbeing.

Finally, asked at the end of the interview if there was **anything else they wanted to raise**, there were a couple of mentions of building maintenance issues in general. Three different interviewees seemed to have issues with utilities directly related to the conversion of former commercial buildings to residential, such as complexities around the gas and electricity supply or telecoms. One interviewee also had problems with deliveries because the residential addresses for the property had not been properly set-up instead of the former address as an office building and did not always work properly in mapping systems held by delivery companies.

One interviewee had brought the flat off plan, unaware it was a conversion and thinking it was a new build and felt the value had dropped considerably. Another discussed how the flat had a strange design with doors hard to open. This did not impact their health and wellbeing but was more an everyday annoyance for them.

Relating more directly back to health and wellbeing, one interviewee reflected that the small space standards but also constant maintenance and other issues all combined

made the flat an unpleasant place to live and they felt this was largely responsible for their depression. Another said that the quality of housing had, in their view, a direct impact on the “human spirit” of residents and was vitally important.

Interestingly, for one of our interviews two partners were both present during the discussion. In this, there was a clear difference in their experience and view on their home. One partner was out at work almost every day, working long hours and felt there were no major issues with the flat, but the other, who was at home almost every day, felt it was problematically small and poorly design and impacted her wellbeing.

Emerging themes

In this section we bring together the most important results from the survey descriptive and regression analysis together with the interview data to consider how much of a determinant of health each variable may be, how prevalent it was within the cohort and thus what are the key themes and issues emerging from this exploratory research.

Household income, housing quality indicators and noise

Surprisingly, net monthly per-capita household income (after housing costs) was associated with only two housing quality indicators. Those in the lowest household income band (24% of the cohort) were much more likely to live in accommodation without any windows that they could easily see outside through. Conversely, respondents in the highest income band were more likely to report street or neighbour noise as a problem than other income groups. The former may reflect a link between household income and housing quality, an association which has been well established in previous studies (for example Evans and Kantrowitz, 2002; Lelkes and Zólyomi, 2010). The latter may perhaps be explained by an increased sensitivity to noise by those living in higher-income housing situations. This may reflect an increased likelihood to work from home and so spend longer in the dwelling; in their in-depth interviews with 50 London residents about their experience of housing during the Covid-19 pandemic, Alonso and Jacoby (2022) found that noise was the most common housing problem reported and had been exacerbated by the increased time their interviewees were spending at home during the Covid-19 era.

In our own interviews, noise was fairly widely reported as an issue in the interview data, and might reflect a broader issue that there is the potential for there to be some housing quality issues associated with PD housing impacting even higher income residents (e.g. even otherwise higher quality conversions might still have poor noise insulation). Certainly noise might be something less immediately obvious when viewing properties but which becomes clearer in its impacts through the everyday experience of living there, meaning that people with greater agency over their housing choice might still end up living somewhere with these sorts of issues. Environmental noise is a significant public health issue (Mitchell et al, 2022) and the UK government’s Housing

Health and Safety Rating System (HHSRS) lists noise as a potential hazard in the home, considering freedom from noise disturbance as one of the 'psychological requirements' of decent housing (ODPM, 2006). In our study, although there was an association found between household income and perceptions of noise as a problem, we did not find evidence that those reporting living in accommodation for which street or neighbour noise was a problem had an increased risk of having a WEMWBS score indicative of low mental wellbeing. This is in contrast to some other research, for example Jensen et al (2018) and Bower et al (2021).

Accommodation space

Having sufficient space for socialising, eating together as a household and studying was strongly associated with mental wellbeing. Those respondents who did not have sufficient space were much more likely to have a WEMWBS score that was indicative of being in the bottom 15% of mental wellbeing in the UK. When compared to other housing quality indicators, having sufficient space was found to have the greatest estimated effect size on respondent mental wellbeing, suggesting that it may be a particularly important determinant of mental wellbeing. Our results suggest that space in accommodation may have had a significant impact on the wellbeing of this cohort, with 19% and 22% of respondents 'disagreeing' or 'strongly disagreeing' that there was sufficient space to have visitors for socialising or being able to eat as a household together, respectively. In interviews, the design feature most commonly mentioned when discussing what it was like to live in their home was a lack of space, and 27 interviewee said the thing that they would most like to improve about their home was to increase the space available (the most commonly discussed potential improvement).

At the most extreme, insufficient accommodation space may lead to overcrowding. This has been linked to increased risk of infectious disease (and so harm to physical health), increased risk of stress and mental health problems and lower educational attainment and behavioural difficulties with children (Reynolds, 2005; WHO, 2018, Marsh et al, 2019). The Covid-19 pandemic has provided further evidence recently of the link between household overcrowding and increased risk of infectious disease (Aldridge et al, 2021; Soltan et al, 2021). In situations where the housing is not per se overcrowded but merely small, the evidence supporting a link between internal space standards and mental health and wellbeing has previously been considered less well developed, with difficulties establishing causative links albeit there does appear to be associative links (HATC, 2006). Nevertheless, given the way availability of space in the home impacts everything from how and where you prepare and consume food, how you socialise, privacy and separation of activities, children's ability to play and the adaptability of the home to new needs, there are a range of reasons to consider the importance of sufficient space within the dwelling (Appolloni and D'Alessandro, 2021). Further, under lockdown, with more time spent at home, there is some suggestion that lack of space may have had mental health and wellbeing impacts (Kearns, 2022; Netwon et al, 2022). The HHSRS lists crowding and insufficient space as potential

hazards in relation to the 'psychological requirements' of a decent home (ODPM, 2006). Our finding here therefore adds to evidence suggesting the importance of sufficient housing space and mental wellbeing.

Thermal comfort

While only a relatively small proportion of respondents reported having no cooling options (6.9%), this group had much lower average mental wellbeing than those who had windows that open, internal shutters, curtains or blinds. Respondents with windows that open, internal shutters, curtains or blinds constituted the majority of the cohort (78%) and were found to have a lower wellbeing than those with external shutters, fans, fixed shading or awnings or canopies over windows or doors. Interestingly, respondents who were unable to keep comfortable during hot summer weather were found to be more likely to be classified as having low mental wellbeing than those who could, but this difference was not seen for respondents who reported not being able to keep comfortable during cold winter weather. This is particularly important given that 37% of respondents reported not being able to keep comfortable during hot summer weather, indicating that a significant proportion of the cohort would have been affected in this way.

In the interviews, the most commonly cited feature of the design or condition of the home that people felt impacted their health and wellbeing negatively was about thermal comfort. This was more often about the difficulty of keeping their flat cool in the summer than about keeping warm in winter. In general, thermal comfort in housing has been widely linked to health (Ormandy and Ezratty, 2012). Both excess cold and excess heat are considered hazards under the HHSRS, listed in relation to the 'physiological requirements' for a decent home (ODPM, 2006). There has also been some speculation that PD housing specifically might be liable to overheat in warm weather (Carrington, 2021). There is evidence in our research that this is the case, with overheating issues being apparently fairly widespread in PD housing. Further, there is an association between that and low mental wellbeing found in our data. Although our study does not lend itself to understanding any potential physical health implications, existing studies link thermal comfort issues and physical health (WHO, 2018). Housing improvements that help thermal comfort, such as improving insulation and replacing single-glazed with double-glazed windows have also been found to reduce hospital admission and primary health-care utilisation (Rogers et al, 2018).

Availability of amenities

Having more types of amenities within a ten-minute walk was associated with higher mental wellbeing. This was clearly a problem in the cohort, with 6.4% reporting not having a single amenity type within a ten-minute walk and 24% reporting having four or fewer. The amenities included in our survey were a park or greenspace, a shop to buy food, public transport access, a primary school, a GP surgery, a cafe or restaurant and a leisure centre. We comment further on outdoor space below. In interviews, the general

accessibility of local commercial amenities such as shops and cafes was mentioned frequently, being the second most common neighbourhood feature which people felt helped their health and wellbeing, followed by the accessibility of a gym or swimming pool. Asked about any design features of their home that supported their health and wellbeing, there was also reference to the location of the flat in a number of interviews.

Access to amenities supports health and wellbeing through increased mobility, social participation and physical activity (Bird et al, 2018). The so-called compact or 15 minute city idea is related to this neighbourhood accessibility of amenities within a walkable distance, and has been linked to both sustainability and health debates as a now popular manifestation of healthy urbanism (Pineo, 2022).

Perception of safety

Our results suggest that safety both in the home and outside in the neighbourhood was an important determinant of mental wellbeing. Respondents who felt very unsafe in their home or neighbourhood were much more likely to experience low mental wellbeing than those who felt very safe. This was particularly true for those who reported feeling very unsafe when walking around alone after dark which was associated with much worse mental wellbeing. A clear driver of feeling unsafe at home was having difficulties locking the accommodation entrance. While only a minority of the cohort reported feeling very unsafe or a bit unsafe at home alone (9.8%) or when walking in the neighbourhood alone during the daytime (7.9%), this was much more common when walking in the neighbourhood alone after dark (39.9%). This suggests that while security may affect mental wellbeing generally, perception of security in the neighbourhood after dark may be a particularly important determinant of mental wellbeing.

In our interviews, perception of safety was only mentioned three times in relation to the design of the home (all related to issues like broken locks), but issues related to anti-social behaviour and perceptions of crime were the most commonly cited factor in relation to things in their neighbourhood which people felt harmed their health and wellbeing (mentioned by 16 interviewees). This suggests the issue here may be more about the location of the flat rather than its design. Interestingly, Geen et al (2002) found in their survey residents who generally felt safe in their homes but unsafe out on their neighbouring streets at night, and found that such fear of crime could erode quality of life and be associated with health status. Fear of crime in the neighbourhood may relate to a notion of insecurity on housing, an important psychosocial factor which may link housing to psychological wellbeing (Evans et al, 2003). That said, Stafford et al (2007) do speculate that whilst there is commonly found to be an association between fear of crime and measures of physical and mental health, the direction of causality and linking pathways remain unclear: fear of crime could lead to poorer health, but equally poorer health might increase a sense of vulnerability and so fear of crime.

Lack of fresh air and other accommodation problems

Having a lack of fresh air in accommodation was associated with worse mental wellbeing, with 14% of respondents reporting it as a problem. Interestingly, although other accommodation problems such as relating to dampness were reported, they were not associated with mental wellbeing. In interviews, eight people explicitly reported their flat as being poorly ventilated so that they noticed cooking smells lingering. Asked about design features of their home which might directly influence their health and wellbeing, four interviewees mentioned mould, damp and condensation specifically whilst another three commented on a perceived lack of ventilation and fresh air. This was at the scale of the dwelling, whilst it is also worth highlighting that in interviews, the second most commonly cited neighbourhood feature which people felt harmed their health and wellbeing was road traffic pollution.

Poor indoor air quality has a number of adverse health effects (WHO, 2018), being a long-standing and widely recognised health determinant which can have multi-systemic health effects on people at all stages of life (Apte and Salvi, 2016; Capasso and D'Alessandro, 2021). There are health risks when housing has poor ventilation, which is particularly important given how much time most people spend in their homes (Wargocki, 2016). Poor ventilation is linked with poor indoor air quality and issues like mould and damp. Indoor air quality itself represents a mix of both indoor contaminants (e.g. from combustion sources and heating and cooling systems, emissions from building materials and furnishings, household cleaning products, the behaviour of building occupants and so on) and outdoor pollutants which infiltrate the dwelling (particularly road traffic and industrial activities) (Jones, 1999; Cincinelli and Martellini, 2017). Road traffic pollution itself can contribute to mortality and morbidity, with studies finding associations with childhood asthma and incidence of dementia, for example (Künzli et al, 2000; McConnell et al, 2010; Calderón-Garcidueñas and Villarreal-Ríos, 2017). Our study does not involve statistical analysis in relation to physical health problems, but it is interesting to note that air quality has been raised as an issue in both our survey and interviews with residents of PD housing, and that we have found that lack of fresh air in the accommodation was associated with lower mental wellbeing scores, suggesting links not just to physical health from these issues but also mental health.

Window arrangements

The picture in relation to windows is complex. A surprisingly high proportion of the cohort reported not having a single window that they could open (14%), with only 68% reporting at least one window that they could easily see outside through. In our interview data, when asked what it felt like to live in their home, only two people made a connection between a negative feeling about their home and a lack of daylight. When asked about what improvements they might make to their home, though, six interviewees wanted bigger or better windows to allow more natural light in and/or through which they could have a view out. Eight interviewees raised window arrangements negatively (such as a lack of natural light or view) when asked about

the impacts their home had on their health and wellbeing, explicitly linking this to the home feeling “depressing”. And conversely, nine interviewees felt the fact their flat had big windows and lots of natural light was a positive feature which supported their health and wellbeing. In our survey data, however, we could not find an association between reporting these window problems and an increased risk of having a WEMWBS score indicative of low mental wellbeing.

It is not our aim in this report to evaluate existing studies, but to contextualise our own findings, there is a range of existing studies which have relevant findings here. One function of windows is to provide daylight into dwellings. Some previous studies find a link between natural light into dwellings and health. There is discussion in some literature about the role of daylight as an environmental cue for the body and circadian alignment and therefore linked to multiple dimensions of health including sleep and mental health (Nagare et al, 2021) and evidence exists for daylight’s effects on physical and mental health (Beute de Kort, 2014). Looking specifically at mental health, Swanson et al (2016) found significant positive association between self-reported wellbeing and annual indoor sunlight opportunity in the home, while Bower et al (2021) report that people satisfied with the amount of natural light in their dwelling had significantly lower odds of depression. At the same time, however, Aries et al (2015) argue that there is only limited statistically significant evidence for the link between daylight and its potential health consequences and both Münch, et al (2020) and Wirz-Justice et al (2021) call for more evidence-based data around daylight and healthy living. Bird et al (2018) do include daylight exposure in their factors promoting healthy housing, but note the evidence here is lower quality than in relation to other factors of housing quality.

As well as allowing natural light into the dwelling, windows can serve other functions as well. This can include offering a view out of the dwelling. Window views have been argued to lead to better mental health for urban dwellers, particularly if there’s a view out to natural features such as trees or other greenery (Elsadek et al, 2020). Amerio et al (2020) found an increased risk of moderate-severe and severe depressive symptoms for those living in small apartments with poor views. The HHSRS discusses the need for sufficient natural light and a window with a view under the ‘psychological requirements’ of a decent home (ODPM, 2006). Windows can also be a means of ventilation into dwellings, and in our survey data analysis we did find having a lack of fresh air in accommodation was associated with worse mental wellbeing. This is again slightly complicated because of course the effectiveness of windows as providing natural ventilation also then links to the outdoor air quality. Window arrangements can also be linked to thermal comfort, and again we have found some association in relation to thermal comfort control ability and mental wellbeing in our survey analysis. It therefore appears that the health and wellbeing impacts of window arrangements in PD housing require further study.

Access to outdoor space

One final theme from our study is access to outdoor space. In the survey, we did ask about access to green space as part of the wider question about access to local amenities, and those with better access appeared to have better mental wellbeing according to our analysis. Similarly, in interviews the single issue with the greatest level of consensus across all of our interviews was what feature in their neighbourhood people felt supported their health and wellbeing: 34 out of 41 interviewees commented on the importance to them of a local park or green space, with many making explicit connections between visiting these places and their mental health. This reflects a great deal of existing literature which argues for the connection between access to nature and human health and wellbeing (including through neighbourhood parks), such as Grinde and Patil (2009) and, conversely, there is evidence that lack of green space access is associated with an increased risk of depression (Rautio et al, 2018). There is often also an association between access to outdoor space and health inequalities (Mitchell and Popham, 2008).

We did not ask in our survey, however, about access to private green or outdoor space, e.g. a roof terrace, balcony or garden provided at their dwelling. In interviews, the second most commonly discussed improvement that people would like to make to their home was to provide a balcony or terrace access, which people felt would improve their happiness. Similarly, when discussing their view on the relationship between their housing and their health and wellbeing, a lack of outdoor space was also mentioned several times, with explicit reference again made to this making people feel less well mentally. Gibson et al (2011) note that many studies noting the positive impacts of outdoor space do not distinguish between communal and private outdoor space, but found particular benefit from improved access to private gardens. Making a distinction between private outdoor space access and neighbourhood green space and considering both might therefore also be a useful area for further study, but there is some evidence in our data for its importance as part of housing quality to promote health and wellbeing.

Conclusions

A large number of studies considering the relationship between housing and health already exist. As many of the physical health effects of poor housing have been reduced in high income countries, there has been an increasing interest in mental health and psychosocial relationships with housing design (Clark and Kearns, 2012). The relationship and pathways can, of course, be complex. This includes issues related to the fact that exposure to poor environmental conditions is not randomly distributed but often associated with lower socioeconomic status where there may be multiple environmental risk exposures (Evans, 2003). Housing quality also needs to be considered holistically, including economic, political and ecological dimensions in addition to architectural and technical design dimensions (Lawrence, 1995). There are studies which show housing improvements appear to be associated with health improvements, including both physical health (Thomson et al, 2009; Rodgers et al, 2018) and mental health (Pevalin et al, 2017). And there is ample evidence of the continued existence of poor housing in general: recent data from the English Housing Survey estimates that 23% of private rental sector homes would not meet the Decent Homes Standard (Cromarty, 2022). This existing data is not specific to PD homes. Previous studies have shown a high rate of housing quality issues associated with PD housing and this has been the basis for speculation that there may be health and wellbeing implications for the residents of such housing (Marsh et al, 2020) but have called for further study. This project has helped to fill gaps in existing knowledge around the experience of living in PD housing in London, which is important given the relationship between housing and health.

Key findings on residents of PDR housing

Our first aim in this exploratory study was to better understand who the residents of PD housing are. Through our questionnaire survey, we got a snapshot of 218 residents of housing developments allowed under permitted development across the London Boroughs of Hillingdon, Hounslow, Lambeth and Southwark. In summary, our survey respondent cohort were 56% female and 68% aged 18-35 years old. 59% identified as white and 16% as of Indian ethnicity. 70% were employed and 14% were self-employed. 54% were privately renting their accommodation, 5.8% owned their home outright and 32% owned with a mortgage or loan. 58% had lived in their accommodation for less than 2 years. 37% of our respondents lived in a single person household and 52% said two people usually lived in their household.

An important question for us is how representative our sample is of the wider population living in PD housing across those four boroughs (or indeed across London and across England more generally). There is no existing public dataset on residents of PD housing, and indeed a key contribution of this study is to provide some insight into

this issue. Given the predominance of studio and one bed flats in PD schemes, it is perhaps not unsurprising to see a population that is skewed towards younger and smaller households. Nevertheless, the demographic data suggests that our survey respondent cohort were noticeably from higher socio-economic groups compared to the local population in the four boroughs. A distinguishing feature of PD housing is that not all of it is poor quality: previous research (Clifford et al 2018 and 2020) has found some high-quality conversions as well as some considered very poor in terms of design and location. As the only way to distinguish housing quality is to do a detailed examination of each scheme individually (for example looking at floorplans), this research did not distinguish between conversions of different quality and included all the PD housing stock identified in the four case study boroughs. It therefore appears probable that our respondent cohort is skewed towards wealthier, better educated residents who might be more likely to live in the better quality conversions.

Despite this, reported housing quality issues were fairly widespread amongst our cohort, with only 14% of respondents having reported none of the accommodation problems our survey asked about. Most common was a shortage of space, reported by 46% of respondents, followed by street noise (40% of respondents). Only 63% of respondents said they were able to keep comfortable in their home during hot summer weather. 14% of our cohort reported not having a single window that they could open and only 68% reported having at least one window in their home that they could easily see the outside world through. Apart from windows, experience of the other housing design issues was not associated with income. This may be suggestive of a lack of housing choice and availability leading many people to make compromises on quality when they are able to exert agency over housing choice, or may reflect that some of these design issues (other than window arrangements) would be less apparent on a cursory view of a property and may only become fully apparent through the lived experience of actually inhabiting the dwelling. Our findings here support existing research which found housing design quality issues commonly associated with PD housing and provide some further detail on these issues.

Our second aim was to better understand the self-reported health and wellbeing of residents of PD housing. In terms of self-reported health, a low proportion of the survey respondent cohort reported bad or very bad general health (1.9% and 0.9% respectively) but 14.9% reported having their day-to-day activities limited by a health problem or disability. This compares to 3.6% reporting bad and 1.1% reporting very bad general health, and 7.55 reporting having their day-to-day activities limited by a health problem or disability across the four boroughs (Hillingdon, Hounslow, Lambeth and Southwark). From this data, it is difficult to say much about the relationship between PD housing and physical health, but this is perhaps not unexpected given the comparatively short time most survey respondents have been living in their housing and also given the potential skew of our cohort towards higher socio-economic groups.

There are, however, interesting findings in relation to mental health and wellbeing. The proportion of our survey respondents with a WEMWBS score indicating low wellbeing – 23% – was higher than the UK average (15%) and conversely the proportion with a score indicating high wellbeing – 6.8% – was lower than the UK average (15%).

These findings then accord with the results of our regression analysis, looking for associations between housing quality outcomes and wellbeing as measured by WEMWBS scores whilst controlling for household income (as an indicator of socio-economic status). Through the regression analysis, we found:

- Accommodation space in the home was strongly associated with improved wellbeing, with respondents who strongly disagreed that there was sufficient space to have visitors for socialising 8.4 times more likely to have a WEMWBS score that may be indicative of low wellbeing and respondents who strongly disagreed that there was sufficient space for the household to eat together comfortably being 24.2 times more likely to have a WEMWBS score that may be indicative of low wellbeing (in both cases whilst controlling for income)
- Thermal comfort was also associated with wellbeing. Respondents who were unable to keep comfortable during hot summer weather had 2.1 times the odds of having a WEMWBS score indicative of low wellbeing and at the extreme, those with ‘no cooling options’ available in their home at all were 10.1 times more likely to have a WEMWBS score indicative of low wellbeing (albeit there were insufficient observations to control for income here)
- Fresh air and ventilation was another important issue. Respondents reporting a lack of fresh air as a problem in their accommodation had lower WEMWBS scores (5.2 points lower on average)
- The neighbourhood location was also important. Residents having more types of amenity within a ten-minute walk of their home was associated with higher wellbeing, with those who had fewer than four of these (such as park, food shop, public transport access, primary school, GP surgery, cafe, leisure centre) being 2.64 times as likely to have a WEMWBS score indicative of low wellbeing (having controlled for income). Those who reporting feeling a ‘bit unsafe’ when walking in the neighbourhood during the daytime were 5.01 times more likely to have a WEMWBS score indicative of low wellbeing, and this rose to 13.8 times more likely if they felt ‘very unsafe’ when walking in the neighbourhood after dark

Further evidence comes from the qualitative findings from our interviews with residents of PD housing. Looking at what interviewees commonly reported as problems with their homes that they thought might negatively impact their health and wellbeing, and conversely any positive features of their homes which positively impact their health and wellbeing, we found the following housing design and locational features to be important:

- Having sufficient space in the accommodation
- Having a home where thermal comfort could be assured year-round (with particular issues keeping cool being associated with some PD housing)
- Having fresh air, ventilation, and windows allowing in sufficient natural light and through which there was a view of the outside world
- Not having excessive levels of noise from neighbours and from the street outside
- Having access to open or greenspace
- Living in walkable neighbourhoods with good access to local amenities
- Living in a home in which you felt safe (considering both the security of the housing and its location)

From our study, there is some evidence to suggest an association between housing quality and mental health, and this can have a negative impact even on those in higher socio-economic groups who usually enjoy, on average, better general health and wellbeing. In other words, there is some association here between design quality issues commonly associated with PD housing and the wellbeing of the residents of that housing.

One important issue here is the potential cumulative impacts of multiple housing quality issues: Boch et al (2020) conclude that each additional poor housing characteristic found in their study was associated with poorer health status. Another issue is the relationship between individual dwelling characteristics and those of the wider neighbourhood setting: Jones-Rounds et al (2014) found that neighbourhood quality can either amplify or attenuate housing quality impacts on wellbeing with better neighbourhood quality buffering against the negative effects of poor housing on psychological wellbeing and the opposite also true. Similarly, Clark and Kearns (2012) found that wider neighbourhood quality could moderate the psychosocial benefits of housing quality improvements. PD housing with multiple poor design features, and PD housing with poor design features located in unsuitable neighbourhoods are thus likely to be the housing at most risk of having a detrimental impact on the health and wellbeing of residents.

Studying the health and wellbeing of PDR housing residents

As an exploratory study, our third research question was “how can we effectively study the health and wellbeing of residents of PDR housing?” There are elements of the research approach taken in this study which appear to have worked effectively. Firstly, a desktop approach to identifying PD housing. Previous studies (Clifford et al, 2018 and Clifford et al, 2020) relied on obtaining lists of prior approvals (potential PD conversions allowed by the relevant local planning authorities) then undertaking site visits to see which schemes had actually been implemented, which is quite resource intensive. In this case, prior approval lists were compared to open data sources on residential addresses (such as Energy Performance Certificates for residential properties) which appeared to work effectively to identify the PD dwellings in the four boroughs.

Secondly, the survey instrument itself seemed to have worked effectively, and produced valuable data on the main topics for understanding potential health and wellbeing impacts from living in PD housing. The workshop with Groundswell was useful in understanding key topics and issues to include, as was being able to benchmark questions against things like census data through using the same categories on relevant questions. Almost all respondents completed the survey in full. The response rate (9%) was healthy for a postal survey, recruited via non-personalised postcards sent “to the occupier”. The door knocking by research assistants appears to have helped boost the response rate, given the survey response rate increased once this exercise commenced. The voucher incentivisation may also have helped.

Thirdly, the interview response rate was also better than expected in our original research proposal. Again, the voucher incentivisation is likely to have supported this. The interview questions appear to have been appropriate, promoting thoughtful responses from people which effectively complemented the survey data.

There are, however, some lessons for further research in this area. Firstly, the representativeness of the survey cohort. As already noted, as we do not have any existing data on the population of PD housing, we do not know how representative the sample obtained through our recruitment approach is, but there are reasons to believe it may be skewed towards higher socio-economic groups. Given the probable link between income and housing quality, this may mean we do not have many people living in the lower quality PD housing in our sample. One potential solution to this might be to include postcodes in the survey and monitor where responses are coming from as they are submitted, then direct research assistants to proactive door knocking in those buildings under-represented in the responses being received (although this is resource intensive).

It was also noteworthy that although the recruitment postcard (which was in English) included a link to a website with the 14 most common languages other than English spoken in the UK with instructions on how to request a translated version of the survey, not a single person requested this. Having this information in other languages included on the actual recruitment postcard might have been a better approach to recruiting people from minority communities, which in turn might also have helped potential representativeness of the responding cohort.

Secondly, in terms of the survey instrument, this might have usefully included a question on access to private amenity / outdoor space provision. There might usefully have been a question on whether the windows in the home all faced one direction only (single aspect) or more than one direction. The questions relating to tenure might have more explicitly included an option for being in temporary housing. In multi-person households, the survey would have just been completed by one individual. It would not be valid to ask about the health and mental wellbeing of other residents in the same

way as asking people to comment on their personal circumstances, however there may be a way to ask about others living in the household directly in order at least to offer the opportunity to capture useful data on this, which could be particularly useful as a way to capture some sense of potential health implications for any children living in these properties.

Finally, in terms of the interviews, audio-recorded and fully transcribed data would have better captured the richness of the discussions and allowed more detailed coding of the interview data. We contacted those volunteering on the survey to be interviewed by email and then arranged interviews with all those responding to those emails and available when our researchers were free. In a larger study, a selection strategy might be necessary to manage who is interviewed from a potentially bigger pool of volunteers.

Recommendations

The findings from this study support a number of potential recommendations which have the potential to improve housing quality and so the health of residents of homes created under permitted development rights. These are primarily focussed on policy and regulatory actions central and local government can take, however the importance of the relationship between housing, health and wellbeing which is supported by our research findings also suggest that developers and those working alongside them, such as architects, should also have a consciousness of the way that good design can help support healthier homes.

Space standards – Central government have required since April 2021 that all new housing created under PD complies with the Nationally Described Space Standards (NDSS). The evidence from this study supports this policy change. There is, however, a question about how to manage existing PD housing developed between 2013 and 2021 which does not comply with the standards, sometimes by some considerable degree. Consideration might be given, for example through the local plan process, to identifying such housing and seeing if improved open space provision in the immediate vicinity can be provided to try and ameliorate the small spaces, or whether sizes are so small that housing enforcement powers should be used. Further, the NDSS do not, however, apply to all housing created through traditional planning permission as for this development permitting route, they need to be introduced into local plan policy and are subject to viability testing. Given the current proposals to have ‘national development management’ policies which apply across England, the government might consider incorporating the NDSS requirements into these national policies so they apply to all housing created anywhere in England.

Windows – Central government have required since June 2020 that all new housing created under PD allows adequate natural light to all habitable rooms. Although our qualitative evidence was stronger on issues of the importance of natural light and a

window you can view out of than our quantitative analysis, previous studies have also shown the importance of adequate window arrangements for the wellbeing of residents. Further, we found a surprisingly high number of PD dwellings where there was not a window people could have a view outside through. We therefore support the importance of the June 2020 policy, but remain concerned that natural light may be achieved without having a window people actually have a view out of. The PD regulations could be strengthened around this issue to ensure adequate window arrangements. For housing units developed under an ordinary full planning permission, most local authorities would follow guidance such as BRE's Right to Light principles and many have policies encouraging dual aspect windows. Integrated design approaches may help balance between natural light, noise and thermal comfort considerations and this may be something to consider further in future, for example as part of the national development management policies and emerging design code work.

Location of housing – Access to amenities is important for people's wellbeing. This is not something that can adequately be considered through current PD regulations. This gap could be addressed through future amendments to the regulations governing housing created through permitted development, so that local authorities are better enabled to consider access to amenities as part of the prior approval process. Again, for housing units developed under an ordinary full planning permission, this should be considered as part of the proposed national development management policies. Further, local authorities might want to consider as part of their local plan making process, where existing large PD conversions are located and whether any supporting infrastructure can be enabled within those neighbourhoods to improve amenities including shops and public transport.

Outdoor space – Access to open / green space is important for people's wellbeing and it is not something that can be considered through current PD regulations. This could be addressed through future amendments to the regulations governing housing created through permitted development, so that local authorities are better enabled to consider this as part of the prior approval process. Again, for housing units developed under an ordinary full planning permission, this may be something to consider as part of the proposed national development management policies. Further, local authorities might want to consider as part of their local plan making process, where existing large PD conversions are located and whether additional open or green space can be created within those neighbourhoods, (including play space for children).

Ventilation and thermal comfort – Issues of ventilation and thermal comfort in dwellings are covered by the Building Regulations in England (Approved Document F deals with ventilation, for example). These were updated in summer 2022 with new Approved Document O dealing with overheating (see <https://www.gov.uk/government/collections/approved-documents>). This research supports the need for such requirements. Building Regulations apply to housing created under PD in the same way

as housing created under a full planning permission. Previous research (Clifford et al, 2018) has, however, questioned the enforcement of Building Regulations requirements to PD housing. Given the risk of lower housing quality in the deregulated space of PD, local authorities should maximise their ability to monitor these conversions through the use of conditions on prior approvals to notify local authorities of the commencement and completion of works to implement schemes and ensure this information is shared between planning and Building Regulations teams as appropriate.

Housing enforcement – The regulations around PD have been tightened-up in 2020 and 2021, which should reduce (although not eliminate) the risk of poor quality housing being created in future. There is, however, a large stock of housing created under less strict PD regulations from 2013-2021. In some cases, this housing appears likely to be harming the health and wellbeing of residents. The Housing Health and Safety Rating System, Decent Homes Standard and Homes (Fitness for Human Habitation) Act do give local authorities considerable powers around housing enforcement. Some of the issues which have been raised in our research data, such as insufficient space, insufficient natural light, problems with noise, problems with thermal comfort and problems with ventilation are all issues covered by the HHSRS, for example. Cromarty (2022) notes issues of ineffective local authority enforcement of housing standards. Given the impact on people’s health and wellbeing, this is an important area for local authorities to proactively take action, supported by central government providing adequate resourcing. Visiting PD housing created from 2013-2021 may be a particular priority for housing enforcement teams.

Acknowledgements

We wish to acknowledge Impact on Urban Health as funders of this study and particularly Nikita Sinclair and Michael Parsons there for their helpful support and feedback as the project progressed. The project was given ethical approval by UCL, reference 20220303_IEDE_STA_ETH. We are grateful for the critical advice at project inception from Michael Chang, Tom Campbell and Jin Lim. We acknowledge the support of Suzy Solley and Stephan Morrison from Groundswell and the participants in the workshop they arranged to help shape the survey and interview questions, ensuring a better understanding from those in housing precarity. Our MSc students Jimmy Chan, Meagan Colaiacovo and Sam Fitzpatrick undertook the majority of interviews with diligence. Finally, we are very grateful to the survey respondents and interviewees for their time and engagement in the research. All interpretation of the data and advice is the responsibility of the researchers alone.

References

- Aldridge, R. W., Pineo, H., Fragaszy, E., Eyre, M., Kovar, J., Nguyen, V., ... & Hayward, A. (2021). Household overcrowding and risk of SARS-CoV-2: analysis of the Virus Watch prospective community cohort study in England and Wales. *medRxiv*.
- Alonso, L. and Jacoby, S. (2022) The impact of housing design and quality on wellbeing: lived experiences of the home during COVID-19 in London, *Cities & Health*, DOI: 10.1080/23748834.2022.2103391
- Amerio, A., Brambilla, A., Morganti, A., Aguglia, A., Bianchi, D., Santi, F., ... & Capolongo, S. (2020). COVID-19 lockdown: housing built environment's effects on mental health. *International journal of environmental research and public health*, 17(16), 5973.
- Appolloni, L., & D'Alessandro, D. (2021). housing spaces in nine european countries: A comparison of dimensional requirements. *International Journal of Environmental Research and Public Health*, 18(8), 4278.
- Apte, K., & Salvi, S. (2016). Household air pollution and its effects on health. *F1000Research*, 5.
- Aries, M. B., Aarts, M. P., & van Hoof, J. (2015). Daylight and health: A review of the evidence and consequences for the built environment. *Lighting Research & Technology*, 47(1), 6-27.
- Beute, F., & de Kort, Y. A. (2014). Salutogenic effects of the environment: Review of health protective effects of nature and daylight. *Applied psychology: Health and well-being*, 6(1), 67-95.
- Bianco, D. (2012). Performance of the Warwick-Edinburgh Mental Well-Being Scale (WEMWBS) as a screening tool for depression in UK and Italy, https://warwick.ac.uk/fac/sci/med/research/platform/wemwbs/using/howto/donatella_bianco-thesis.pdf (accessed 16.12.22)
- Bird, E., Ige, J. O., Pilkington, P., Pinto, A., Petrokofsky, C. and Burgess-Allen, J. (2018). Built and natural environment planning principles for promoting health: an umbrella review. *BMC public health*, 18 (1), 930
- Boch, S. J., Taylor, D. M., Danielson, M. L., Chisolm, D. J., & Kelleher, K. J. (2020). 'Home is where the health is': Housing quality and adult health outcomes in the survey of income and program participation. *Preventive medicine*, 132, 105990.
- Bower, M, Buckle, C, Rugel, E, Donohoe-Bales, A, McGrath, L, Gournay, K, Barrett, E, Phibbs, P and Teesson, M (2021) 'Trapped', 'anxious' and 'traumatised': COVID-19 intensified the impact of housing inequality on Australians' mental health, *International Journal of Housing Policy*, DOI: 10.1080/19491247.2021.1940686
- Calderón-Garcidueñas, L., & Villarreal-Ríos, R. (2017). Living close to heavy traffic roads, air pollution, and dementia. *The Lancet*, 389(10070), 675-677.
- Capasso, L., & D'Alessandro, D. (2021). Housing and health: Here we go again. *International Journal of Environmental Research and Public Health*, 18(22), 12060.
- Carrington, D. (2021). Converted offices pose 'deadly risk' in heatwaves, experts warn, <https://www.theguardian.com/society/2021/aug/01/converted-offices-pose-deadly-risk-in-heatwaves-experts-warn> (accessed 19.12.22)
- Cincinelli, A., & Martellini, T. (2017). Indoor air quality and health. *International Journal of Environmental Research and Public Health*, 14(11), 1286.
- Clark, J., & Kearns, A. (2012). Housing improvements, perceived housing quality and psychosocial benefits from the home. *Housing Studies*, 27(7), 915-939.
- Clifford, B., Ferm, J., Livingstone, N. and Canelas, P. (2018). *Assessing the impacts of extending Permitted Development Rights to office-to-residential change of use in England*. Report to the RICS Research Trust. RICS, London
- Clifford, B., Dennett, A. and Chi, B. (2021). *Mapping Class E: Understanding the expansion of permitted development*, https://www.tcpa.org.uk/wp-content/uploads/2021/11/mappingclassereport-uclv3_ss.pdf (accessed 04.05.23)

Clifford, B., Canelas, P., Ferm, J., Livingstone, N., Lord, A. and Dunning, R. (2020). *Research into the quality standard of homes delivered through change of use permitted development rights*. Ministry of Housing, Communities and Local Government, London

Cromarty, H. (2022). Housing conditions in the private rented sector (England) at <https://researchbriefings.files.parliament.uk/documents/CBP-7328/CBP-7328.pdf>

DCLG (2006). *Housing Health and Safety Rating System: Guidance for Landlords and Property Related Professionals*. Department for Communities and Local Government, London.

DCLG (2013) Relaxation of planning rules for change of use from offices to residential: Impact assessment. At: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/207922/Relaxation_of_planning_rules_for_change_of_use_from_offices_to_residential_-_impact_assessment.pdf (accessed 22.12.20).

DLUHC (2022). Energy Performance of Buildings Data: England and Wales. At: <https://epc.opendatacommunities.org/>

Elsadek, M., Liu, B., & Xie, J. (2020). Window view and relaxation: Viewing green space from a high-rise estate improves urban dwellers' wellbeing. *Urban Forestry & Urban Greening*, 55, 126846.

Evans, G. W. (2003). The built environment and mental health. *Journal of urban health*, 80(4), 536-555.

Evans, G. W. and Kantrowitz, E. (2002). Socioeconomic status and health: the potential role of environmental risk exposure. *Annual review of public health*, 23(1), 303-331.

Evans, G. W., Wells, N. M., & Moch, A. (2003). Housing and mental health: a review of the evidence and a methodological and conceptual critique. *Journal of social issues*, 59(3), 475-500.

Gibson, M, Thomson, H, Kearns, A and Petticrew, M (2011) Understanding the Psychosocial Impacts of Housing Type: Qualitative Evidence from a Housing and Regeneration Intervention, *Housing Studies*, 26:04, 555-573

GLA (2022). The Planning London DataHub. At: <https://www.london.gov.uk/programmes-strategies/planning/digital-planning/planning-london-datahub#acc-i-62155> (accessed 04.11.22)

Glass, K. (2019). "Human warehouses": the families forced to spend Christmas in repurposed office blocks', <https://www.thetimes.co.uk/article/human-warehouses-the-families-forced-to-spend-christmas-in-repurposed-office-blocks-d817h8d2x> (accessed 19.09.20)

Green, G., Gilbertson, J. M., & Grimsley, M. F. (2002). Fear of crime and health in residential tower blocks: a case study in Liverpool, UK. *The European Journal of Public Health*, 12(1), 10-15.

Grinde, B. and Patil, G. G. (2009). Biophilia: does visual contact with nature impact on health and well-being?. *International journal of environmental research and public health*, 6(9), 2332-2343.

HATC (2006). Housing Space Standards at https://www.london.gov.uk/sites/default/files/hatc_housing_space_standards_report_for_gla_2006.pdf

HMRC (2022). Check and challenge your Council Tax band. At: https://www.tax.service.gov.uk/check-council-tax-band/search?_ga=2.129551948.1329069103.1666974254-873882044.1660560799

Jensen, H. A. R., Rasmussen, B., & Ekholm, O. (2019). Neighbour noise annoyance is associated with various mental and physical health symptoms: Results from a nationwide study among individuals living in multi-storey housing. *BMC Public Health*, 19(1), 1508

Jones, A. P. (1999). Indoor air quality and health. *Atmospheric environment*, 33(28), 4535-4564.

Jones-Rounds, M. L., Evans, G. W., & Braubach, M. (2014). The interactive effects of housing and neighbourhood quality on psychological well-being. *J Epidemiol Community Health*, 68(2), 171-175.

Kearns, A. (2022) Housing space and occupancy standards: developing evidence for policy from a health and wellbeing perspective in the UK context, *Building Research & Information*, 50:7, 722-737

Künzli, N., Kaiser, R., Medina, S., Studnicka, M., Chanel, O., Filliger, P., ... & Sommer, H. (2000). Public-health impact of outdoor and traffic-related air pollution: a European assessment. *The Lancet*, 356(9232), 795-801.

Lawrence, R. J. (1995). Housing quality: an agenda for research. *Urban Studies*, 32(10), 1655-1664.

Lelkes, O. and Zólyomi, E. (2010). Housing Quality Deficiencies and the Link to Income in the EU. *Policy Brief*, 3, 2010.

Marsh, R., Salika, T., Crozier, S., Robinson, S., Cooper, C., Godfrey, K., ... & SWS Study Group. (2019). The association between crowding within households and behavioural problems in children: Longitudinal data from the Southampton Women's Survey. *Paediatric and perinatal epidemiology*, 33(3), 195-203.

Marsh, R., Chang, M. and Wood, J. (2020). The relationship between housing created through Permitted Development Rights and health: a systematic review, *Cities & Health*, DOI: 10.1080/23748834.2020.1833281

Mayor of London (2020). The London Plan: Publication London Plan December 2020, https://www.london.gov.uk/sites/default/files/the_publication_london_plan_2020_-_clean_version_0.pdf (accessed 22.12.20)

McConnell, R., Islam, T., Shankardass, K., Jerrett, M., Lurmann, F., Gilliland, F., ... & Berhane, K. (2010). Childhood incident asthma and traffic-related air pollution at home and school. *Environmental health perspectives*, 118(7), 1021-1026.

MHCLG (2020a). Open consultation: Supporting housing delivery and public service infrastructure, <https://www.gov.uk/government/consultations/supporting-housing-delivery-and-public-service-infrastructure/supporting-housing-delivery-and-public-service-infrastructure> (accessed 22.12.20)

MHCLG (2020b). Live tables on housing supply: net additional dwellings, <https://www.gov.uk/government/statistical-data-sets/live-tables-on-net-supply-of-housing> (accessed 22.12.20)

Mercer, S. (2020). 'Harlow homes: How PDR destroys local communities and builds Britain's worst housing', <https://www.thedeveloper.live/film/harlow-homes-how-pdr-destroys-local-communities-and-builds-britains-worst-housing> (accessed 19.09.20)

Mitchell, A., Erfanian, M., Soelistyo, C., Oberman, T., Kang, J., Aldridge, R., ... & Aletta, F. (2022). Effects of Soundscape Complexity on Urban Noise Annoyance Ratings: A Large-Scale Online Listening Experiment. *International Journal of Environmental Research and Public Health*, 19(22), 14872.

Mitchell, R. and Popham, F. (2008). Effect of exposure to natural environment on health inequalities: an observational population study. *The Lancet*, 372 (9650): 1655-1660

Münch, M., Wirz-Justice, A., Brown, S. A., Kantermann, T., Martiny, K., Stefani, O., ... & Skene, D. J. (2020). The role of daylight for humans: gaps in current knowledge. *Clocks & sleep*, 2(1), 61-85.

Nagare, R., Woo, M., MacNaughton, P., Plitnick, B., Tinianov, B., & Figueiro, M. (2021). Access to daylight at home improves circadian alignment, sleep, and mental health in healthy adults: a crossover study. *International journal of environmental research and public health*, 18(19), 9980.

Newton, D., Lucock, M., Armitage, R., Monchuk, L., & Brown, P. (2022). Understanding the mental health impacts of poor quality private-rented housing during the UK's first COVID-19 lockdown. *Health & Place*, 78, 102898.

ODPM (2006). Housing Health and Safety Rating System Operating Guidance at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/15810/142631.pdf

ONS (2012). 2011 Census: Key Statistics for Local Authorities in England and Wales, <https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/2011censuskeystatisticsforlocalauthoritiesinenglandandwales> (accessed 12.12.22)

ONS (2022a). First results from Census 2021 in England and Wales, <https://www.ons.gov.uk/releases/initialfindingsfromthe2021censusinenglandandwales> (accessed 12.12.22)

ONS (2022b). Household and resident characteristics, England and Wales: Census 2021 at <https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/bulletins/householdandresidentcharacteristicsenglandandwales/census2021> (accessed 22.12.22)

Ormandy, D. and Ezratty, V. (2012). Health and thermal comfort: From WHO guidance to housing strategies. *Energy Policy*, 49, 116-121.

Pevalin, D. J., Reeves, A., Baker, E., & Bentley, R. (2017). The impact of persistent poor housing conditions on mental health: A longitudinal population-based study. *Preventive medicine*, 105, 304-310.

Pineo, H. (2022). *Healthy Urbanism: Designing and Planning Equitable, Sustainable and Inclusive Places*. Palgrave Macmillan.

Pineo, H., Glonti, K., Rutter, H., Zimmermann, N., Wilkinson, P. and Davies, M. (2018). Urban Health Indicator Tools of the Physical Environment: a Systematic Review, *Journal of Urban Health*, 95, 613–646

Rautio, N., Filatova, S., Lehtiniemi, H., & Miettunen, J. (2018). Living environment and its relationship to depressive mood: A systematic review. *The International Journal of Social Psychiatry*, 64(1), 92–103

Reynolds, L. (2005). Full house? How Overcrowded Housing Affects Families at https://assets.ctfassets.net/6sxxmndnnpn0s/6dU8FFbZ6RnSk6DbnDOMHb/61e30884aff47a789891b2dce54fcbc7/Full_house_overcrowding_effects.pdf

Rodgers SE, Bailey R, Johnson R, Poortinga W, Smith R, Berridge D, *et al.* (2018). Health impact, and economic value, of meeting housing quality standards: a retrospective longitudinal data linkage study. *Public Health Research*, 6(8)

Spratt, V. (2020). 'I was temporarily housed in a former office block with my children. Two years later, we're still here', <https://inews.co.uk/opinion/temporary-housing-permitted-development-rights-former-office-block-427205> (accessed 19.09.20)

Soltan M, Crowley L, Melville C, *et al.* (2021) To what extent are social determinants of health, including household overcrowding, air pollution and housing quality deprivation, modulators of presentation, ITU admission and outcomes among patients with SARS-COV-2 infection in an urban catchment area in Birmingham, United Kingdom? *Thorax* 2021;76: A237-A238

Stafford, M., Chandola, T., & Marmot, M. (2007). Association between fear of crime and mental health and physical functioning. *American journal of public health*, 97(11), 2076-2081.

Swanson, V., Sharpe, T., Porteous, C., Hunter, C., & Shearer, D. (2016). Indoor annual sunlight opportunity in domestic dwellings may predict well-being in urban residents in Scotland. *Ecopsychology*, 8(2), 121-130.

Szumilas, M. (2010). Explaining odds ratios. *Journal of the Canadian academy of child and adolescent psychiatry*, 19(3), 227-229.

Tennant, R., Hiller, L., Fishwick, R., Platt, S., Joseph, S., Weich, S., ... & Stewart-Brown, S. (2007). The Warwick-Edinburgh mental well-being scale (WEMWBS): development and UK validation, *Health and Quality of Life Outcomes*, 5(1), 63.

Thomson, H., Thomas, S., Sellstrom, E. and Petticrew, M. (2009). The health impacts of housing improvement: a systematic review of intervention studies from 1887 to 2007. *American journal of public health*, 99(S3), S681-S692.

Wall, T. (2019). 'It feels almost like prison': the developers building homes with no natural light', <https://www.theguardian.com/cities/2019/dec/19/it-feels-almost-like-prison-the-developers-building-homes-with-no-natural-light> (accessed 19.09.20)

Wargocki, P. (2013) The Effects of Ventilation in Homes on Health, *International Journal of Ventilation*, 12:2, 101-118

Warwick Medical School (no date). Collect, score, analyse and interpret WEMWBS, <https://warwick.ac.uk/fac/sci/med/research/platform/wemwbs/using/howto> (accessed 16.12.22)

WHO (2018). WHO Housing and health guidelines at <https://www.who.int/publications/item/9789241550376>

Appendix 1: Survey instrument

| Question | Your answer |
|---|--|
| 1. What is your year of birth? | |
| 2. What was your sex assigned at birth? | Female <input type="checkbox"/> Male <input type="checkbox"/> Prefer not to say <input type="checkbox"/> |
| 3. How many people usually live in this household? | |
| 4. What is your ethnic group? (Choose one option that best describes your ethnic group or background) | White <input type="checkbox"/> Irish Traveller <input type="checkbox"/> Indian <input type="checkbox"/> Black African <input type="checkbox"/> Black Other <input type="checkbox"/> Chinese <input type="checkbox"/> Roma <input type="checkbox"/> Filipino <input type="checkbox"/> Mixed ethnic group, write in _____ Any other ethnic group, write in _____ |
| 5. In the last seven days, were you doing any of the following? (Tick all that apply. Include casual or temporary work, even if only for one hour.) | <input type="checkbox"/> Working as an employee <input type="checkbox"/> Self-employed or freelance <input type="checkbox"/> Temporarily away from work ill, on holiday or temporarily laid off <input type="checkbox"/> On maternity or paternity leave <input type="checkbox"/> Doing any other kind of paid work <input type="checkbox"/> Working from home (part-time or full-time) <input type="checkbox"/> Retired (whether receiving a pension or not) <input type="checkbox"/> Studying <input type="checkbox"/> Looking after home or family <input type="checkbox"/> Long-term sick or disabled <input type="checkbox"/> Other, write in _____ |
| 6. What is the highest level of education you have completed? (Choose one option.) | <input type="checkbox"/> Early childhood education (<4 year old) <input type="checkbox"/> Primary education (4-11 year old) <input type="checkbox"/> Secondary education (11-18 year old) <input type="checkbox"/> Vocational or technical programs <input type="checkbox"/> Bachelors degree <input type="checkbox"/> Masters degree <input type="checkbox"/> Doctoral equivalent (PhD) |
| 7. On average, how much money does your household have to live on per week? (Choose one option.) | <input type="checkbox"/> More than £547 <input type="checkbox"/> Between £547 to £329 <input type="checkbox"/> Less than £329 <input type="checkbox"/> Don't know |

| | |
|---|---|
| <p>8. How is your health in general? (Choose one option.)</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Very good <input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Bad <input type="checkbox"/> Very bad |
| <p>9. Are your day-to-day activities limited because of a health problem or disability which has lasted, or is expected to last, at least 12 months? (Choose one option. Include problems related to old age.)</p> | <ul style="list-style-type: none"> <input type="checkbox"/> No <input type="checkbox"/> Yes, limited a little <input type="checkbox"/> Yes, limited a lot |
| <p>10. Do you have any of the following conditions which have lasted, or are expected to last, at least 12 months? (Tick all that apply.)</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Asthma <input type="checkbox"/> Chronic obstructive pulmonary disease (COPD) <input type="checkbox"/> Other lung condition <input type="checkbox"/> Heart attack or chronic consequences of heart attack <input type="checkbox"/> Other heart condition <input type="checkbox"/> High blood pressure (hypertension) <input type="checkbox"/> Stroke (cerebral bleed, cerebral thrombosis) or chronic consequences of stroke <input type="checkbox"/> Alzheimer's disease or other cause of dementia <input type="checkbox"/> A neurological condition, such as epilepsy <input type="checkbox"/> Cancer (diagnosis or treatment in the last 5 years) <input type="checkbox"/> Osteoarthritis <input type="checkbox"/> Other type of arthritis <input type="checkbox"/> Low back pain or other chronic back defect <input type="checkbox"/> Neck pain or other chronic neck defect <input type="checkbox"/> Diabetes <input type="checkbox"/> Allergy, such as rhinitis, hay fever, eye inflammation, dermatitis, food allergy or other allergy (allergic asthma excluded) <input type="checkbox"/> Liver disease <input type="checkbox"/> Urinary incontinence, problems in controlling the bladder <input type="checkbox"/> Kidney problems <input type="checkbox"/> Depression <input type="checkbox"/> Anxiety <input type="checkbox"/> Post Traumatic Stress Disorder (PTSD) <input type="checkbox"/> Other mental health condition <input type="checkbox"/> Deafness or hearing loss <input type="checkbox"/> Blindness or Partial sight <input type="checkbox"/> A learning disability <input type="checkbox"/> Autism or autism spectrum condition <input type="checkbox"/> A mobility or dexterity difficulty that requires the use of a wheelchair <input type="checkbox"/> A mobility or dexterity difficulty that limits basic physical activities (for example walking or dressing) <input type="checkbox"/> Other <input type="checkbox"/> No condition |
| <p>11. Do you or anyone else in your household smoke in the home? (Choose one option.)</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Prefer not to say |
| <p>12. Below are some statements about feelings and thoughts. Please tick the box that best describes your experience of each over the last 2 weeks</p> | |

| | None of the time | Rarely | Some of the time | Often | All of the time |
|---|---|--------|------------------|-------|-----------------|
| I've been feeling optimistic about the future | | | | | |
| I've been feeling useful | | | | | |
| I've been feeling relaxed | | | | | |
| I've been feeling interested in other people | | | | | |
| I've had energy to spare | | | | | |
| I've been dealing with problems well | | | | | |
| I've been thinking clearly | | | | | |
| I've been feeling good about myself | | | | | |
| I've been feeling close to other people | | | | | |
| I've been feeling confident | | | | | |
| I've been able to make up my own mind about things | | | | | |
| I've been feeling loved | | | | | |
| I've been interested in new things | | | | | |
| I've been feeling cheerful | | | | | |
| 13. Does your household own or rent this accommodation? (Choose one option.) | <input type="checkbox"/> Owns outright <input type="checkbox"/> Owns with a mortgage or loan <input type="checkbox"/> Part-owns and part-rents (shared ownership) <input type="checkbox"/> Rents with housing benefit <input type="checkbox"/> Rents without housing benefit <input type="checkbox"/> Lives here rent-free | | | | |
| 14. If you rent, who do you rent from? (Choose one option.) | <input type="checkbox"/> Housing association or charitable trust <input type="checkbox"/> Private landlord <input type="checkbox"/> Private renting with a letting agent <input type="checkbox"/> Employer of a household member <input type="checkbox"/> Relative or friend of a household member <input type="checkbox"/> Other <input type="checkbox"/> Not applicable | | | | |
| 15. How long have you lived in this accommodation? (Choose one option.) | <input type="checkbox"/> Less than 12 months <input type="checkbox"/> 12 months but less than 2 years <input type="checkbox"/> 2 years but less than 3 years <input type="checkbox"/> 3 years but less than 5 years <input type="checkbox"/> 5 years but less than 10 years <input type="checkbox"/> 10 years or more | | | | |
| 16. Is this accommodation in a building that was previously not used for housing? (Choose one option.) | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know | | | | |

| | | | |
|---|--|--------------------------|--------------------------|
| <p>17. Is the household's accommodation: (Choose one option.)</p> | <input type="checkbox"/> A house or bungalow <input type="checkbox"/> A self-contained flat, maisonette or apartment <input type="checkbox"/> A room or rooms (e.g. bedsit or flatlet) <input type="checkbox"/> Other | | |
| <p>18. How many rooms are available for use only by this household? (Do NOT count the kitchen, bathroom, halls or landings.)</p> | | | |
| <p>19. How many of these rooms are bedrooms? (Include all rooms built or converted for use as bedrooms, even if they are not currently used for that purpose.)</p> | | | |
| <p>20. Does your accommodation have any of the following problems? (Tick all that apply. If you experience these problems sometimes, choose 'Yes').</p> | | YES | NO |
| | Shortage of space | <input type="checkbox"/> | <input type="checkbox"/> |
| | Noise from neighbours | <input type="checkbox"/> | <input type="checkbox"/> |
| | Other street noise (traffic, businesses, factories etc) | <input type="checkbox"/> | <input type="checkbox"/> |
| | Too dark, not enough light | <input type="checkbox"/> | <input type="checkbox"/> |
| | Too much light, without adequate shading | <input type="checkbox"/> | <input type="checkbox"/> |
| | Lack of adequate heating facilities | <input type="checkbox"/> | <input type="checkbox"/> |
| | Condensation | <input type="checkbox"/> | <input type="checkbox"/> |
| | Leaky roof | <input type="checkbox"/> | <input type="checkbox"/> |
| | Damp walls, floors, foundation etc. | <input type="checkbox"/> | <input type="checkbox"/> |
| | Rot in window frames or floors | <input type="checkbox"/> | <input type="checkbox"/> |
| | Lack of fresh air | <input type="checkbox"/> | <input type="checkbox"/> |
| | Pollution, grime or other environmental | <input type="checkbox"/> | <input type="checkbox"/> |
| | Problems caused by traffic or industry | <input type="checkbox"/> | <input type="checkbox"/> |
| | Vandalism or crime in the area | <input type="checkbox"/> | <input type="checkbox"/> |
| <p>21. Do you experience any of the following at this address?</p> | | YES | NO |
| | Difficulty locking the entrance to my home | <input type="checkbox"/> | <input type="checkbox"/> |
| | Difficulty locking windows | <input type="checkbox"/> | <input type="checkbox"/> |
| <p>22. During the cold winter weather, can you normally keep comfortably warm in your accommodation? (Choose one option.)</p> | <input type="checkbox"/> Yes <input type="checkbox"/> No | | |

| | |
|--|---|
| <p>23. During the hot summer weather, can you normally keep comfortable in your accommodation? (Choose one option.)</p> | <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> |
| <p>24. Do you have any of these in your accommodation? (Tick all that apply.)</p> | <p><input type="checkbox"/> One window that you can open <input type="checkbox"/> More than one window that you can open <input type="checkbox"/> At least one window facing outdoors <input type="checkbox"/> At least one window facing outdoors that you can open <input type="checkbox"/> At least one window that you can easily see outside through <input type="checkbox"/> A sun light (or sun pipe) that brings natural light, but is not a window <input type="checkbox"/> None of the above</p> |
| <p>25. Which rooms in your accommodation have a window that faces outdoors? (Tick all that apply.)</p> | <p><input type="checkbox"/> All bedrooms <input type="checkbox"/> Kitchen <input type="checkbox"/> Living area <input type="checkbox"/> Bathroom <input type="checkbox"/> Hallway and/or foyer <input type="checkbox"/> Other, write in_____</p> |
| <p>26. Do you have any of these in your home? (Tick all that apply.)</p> | <p><input type="checkbox"/> Windows that you can open <input type="checkbox"/> Fixed ceiling fans <input type="checkbox"/> Internal shutters <input type="checkbox"/> External shutters <input type="checkbox"/> Curtains <input type="checkbox"/> Blinds <input type="checkbox"/> Awnings or canopies over windows or doors that you can unroll <input type="checkbox"/> Fixed shading for the windows or doors <input type="checkbox"/> Air conditioner <input type="checkbox"/> None of these</p> |
| <p>27. There is space to have visitors in my home for socialising. (Tick one)</p> | <p><input type="checkbox"/> Strongly Agree <input type="checkbox"/> Agree <input type="checkbox"/> Neutral <input type="checkbox"/> Disagree <input type="checkbox"/> Strongly Disagree</p> |
| <p>28. There is space for me (and my household members, if applicable) to eat together comfortably. (Tick one)</p> | <p><input type="checkbox"/> Strongly Agree <input type="checkbox"/> Agree <input type="checkbox"/> Neutral <input type="checkbox"/> Disagree <input type="checkbox"/> Strongly Disagree</p> |
| <p>29. There is comfortable space for my children/myself to study. (Tick one)</p> | <p><input type="checkbox"/> Strongly Agree <input type="checkbox"/> Agree <input type="checkbox"/> Neutral <input type="checkbox"/> Disagree <input type="checkbox"/> Strongly Disagree</p> |

| | | | |
|--|---|--------------------------|--------------------------|
| <p>30. I feel like my home reflects my identity. (Tick one)</p> | <input type="checkbox"/> Strongly Agree <input type="checkbox"/> Agree <input type="checkbox"/> Neutral <input type="checkbox"/> Disagree <input type="checkbox"/> Strongly Disagree | | |
| <p>31. It is a strain to meet my monthly housing costs. (Tick one)</p> | <input type="checkbox"/> Strongly Agree <input type="checkbox"/> Agree <input type="checkbox"/> Neutral <input type="checkbox"/> Disagree <input type="checkbox"/> Strongly Disagree | | |
| <p>32. Does the area around your accommodation have the following amenities within a 10-minute walk?</p> | | YES | NO |
| | Park or greenspace | <input type="checkbox"/> | <input type="checkbox"/> |
| | Shop to buy food | <input type="checkbox"/> | <input type="checkbox"/> |
| | Public transport access (bus stop, train station etc.) | <input type="checkbox"/> | <input type="checkbox"/> |
| | Primary school | <input type="checkbox"/> | <input type="checkbox"/> |
| | GP surgery | <input type="checkbox"/> | <input type="checkbox"/> |
| | Café or restaurant | <input type="checkbox"/> | <input type="checkbox"/> |
| | Leisure centre | <input type="checkbox"/> | <input type="checkbox"/> |
| <p>33. How safe do you feel generally when you are at home on your own? (Choose one option.)</p> | <input type="checkbox"/> Very safe <input type="checkbox"/> Fairly safe <input type="checkbox"/> A bit unsafe <input type="checkbox"/> Very unsafe <input type="checkbox"/> Never at home alone because I feel unsafe <input type="checkbox"/> Never at home alone, other reasons <input type="checkbox"/> Don't Know | | |
| <p>34. If you said that you felt unsafe at home on your own, why did you say that? (Tick all that apply.)</p> | <input type="checkbox"/> Fear of being burgled <input type="checkbox"/> Harassment by other people <input type="checkbox"/> Fear of a fire breaking out <input type="checkbox"/> Rat and mice infestation <input type="checkbox"/> Fear of having a fall at home <input type="checkbox"/> Other reasons <input type="checkbox"/> Not applicable | | |
| <p>35. How safe do you feel generally in this neighbourhood when you are walking outside on your own during the daytime? (Choose one option.)</p> | <input type="checkbox"/> Very safe <input type="checkbox"/> Fairly safe <input type="checkbox"/> A bit unsafe <input type="checkbox"/> Very unsafe <input type="checkbox"/> Never walk outside alone because I feel unsafe <input type="checkbox"/> Never walk outside alone, other reasons <input type="checkbox"/> Don't Know | | |
| <p>36. And how safe do you feel walking outside in this neighbourhood alone after dark? (Choose one option.)</p> | <input type="checkbox"/> Very safe <input type="checkbox"/> Fairly safe <input type="checkbox"/> A bit unsafe <input type="checkbox"/> Very unsafe <input type="checkbox"/> Never go out alone/after dark because I feel unsafe <input type="checkbox"/> Never go out alone/after dark, other reasons <input type="checkbox"/> Don't Know | | |

Appendix 2: Interview schedule

Background points

- Information and consent sheet (signed).
- Check if participants have any questions before starting.
- We want to learn from you about your experiences – you're the expert.

Interview questions

1. Thank you for completing our online survey. Are there any questions that you would like to discuss and tell us more about (show list of topics on a card)?
2. Could you describe your typical day, focusing on the activities that you do in your home?
3. What does it feel like to live in your home?
4. What are the sounds and smells that you notice most in this home?
5. If you had an unlimited budget (and ability) to improve this home, what would you change? Why?
6. Thinking about this home, what do you think are the main impacts on your health and wellbeing from the design or condition of your home?
7. In your local area, what are the places that you feel benefit your health and wellbeing? (*Prompts: parks, schools, nearby train stops...*)
8. In your local area, what are the places that you feel harm your health and wellbeing? (*Prompts: busy roads, lack of supermarket...*)

Appendix 3: Income and housing quality analysis results

Table A1: Univariable logistic regression analysis for associations between net monthly per-capita household income (after housing costs) and binary housing quality outcomes (OR = Odds Ratio, CI = Confidence Interval).

| Characteristic | Cannot keep comfortable during hot summer weather | | | Cannot keep comfortably warm during cold winter weather | | | Space to have visitors for socialising | | | Space for household members to eat together comfortably | | | Space for household members to study | | |
|---|---|------------|---------|---|------------|---------|--|------------|---------|---|------------|---------|--------------------------------------|------------|---------|
| | OR | 95% CI | p-value | OR | 95% CI | p-value | OR | 95% CI | p-value | OR | 95% CI | p-value | OR | 95% CI | p-value |
| Net monthly household per-capita income (after housing costs) | | | | | | | | | | | | | | | |
| 1751-3500 | — | — | | — | — | | — | — | | — | — | | — | — | |
| <750 | 1.40 | 0.54, 3.74 | 0.5 | 0.73 | 0.15, 3.94 | 0.7 | 3.13 | 1.00, 12.0 | 0.066 | 4.00 | 0.64, 77.7 | 0.2 | 3.12 | 1.00, 12.0 | 0.066 |
| 750-1250 | 1.24 | 0.51, 3.16 | 0.6 | 1.00 | 0.26, 4.85 | >0.9 | 0.57 | 0.15, 2.38 | 0.4 | 0.39 | 0.02, 10.2 | 0.5 | 1.79 | 0.58, 6.72 | 0.3 |
| 1251-1750 | 0.65 | 0.24, 1.76 | 0.4 | 0.31 | 0.04, 2.01 | 0.2 | 1.64 | 0.50, 6.41 | 0.4 | 1.10 | 0.10, 24.2 | >0.9 | 1.28 | 0.37, 5.11 | 0.7 |

Table A2: Univariable logistic regression analysis for associations between net monthly per-capita household income (after housing costs) and binary housing quality outcomes (OR = Odds Ratio, CI = Confidence Interval).

| Characteristic | Local amenities – number of types selected | | | Perception of safety in neighbourhood when walking alone outside after dark | | | Perception of safety in neighbourhood when walking alone outside during daytime | | | Perception of safety when at home on own | | |
|---|--|------------|---------|---|------------|---------|---|------------|---------|--|------------|---------|
| | OR | 95% CI | p-value | OR | 95% CI | p-value | OR | 95% CI | p-value | OR | 95% CI | p-value |
| Net monthly household per-capita income (after housing costs) | | | | | | | | | | | | |
| 1751-3500 | — | — | | — | — | | — | — | | — | — | |
| <750 | 2.08 | 0.65, 8.05 | 0.2 | 1.49 | 0.58, 3.96 | 0.4 | 0.70 | 0.17, 3.08 | 0.6 | 4.12 | 1.00, 28.1 | 0.080 |
| 750-1250 | 1.16 | 0.36, 4.48 | 0.8 | 1.42 | 0.59, 3.51 | 0.4 | 0.25 | 0.05, 1.21 | 0.083 | 0.79 | 0.15, 5.97 | 0.8 |
| 1251-1750 | 0.96 | 0.27, 3.95 | >0.9 | 1.35 | 0.54, 3.48 | 0.5 | 0.60 | 0.15, 2.62 | 0.5 | 0.81 | 0.13, 6.43 | 0.8 |

Table A3: Univariable logistic regression analysis for associations between net monthly per-capita household income (after housing costs) and binary housing quality outcomes (OR = Odds Ratio, CI = Confidence Interval).

| Characteristic | No accommodation cooling options | | | Accommodation windows – No windows that you can easily see outside through | | | Accommodation problems – noise (street or neighbour) | | | Accommodation problems – condensation/leaky roof/damp/rot | | | Self-reported general shortage of space | | |
|---|----------------------------------|------------|---------|--|------------|---------|--|------------|---------|---|------------|---------|---|------------|---------|
| | OR | 95% CI | p-value | OR | 95% CI | p-value | OR | 95% CI | p-value | OR | 95% CI | p-value | OR | 95% CI | p-value |
| Net monthly household per-capita income (after housing costs) | | | | | | | | | | | | | | | |
| 1751-3500 | – | – | | – | – | | – | – | | – | – | | – | – | |
| <750 | 1.23 | 0.23, 9.30 | 0.8 | 4.17 | 1.58, 12.1 | 0.005 | 0.57 | 0.22, 1.42 | 0.2 | 2.31 | 0.73, 8.90 | 0.2 | 1.65 | 0.67, 4.16 | 0.3 |
| 750-1250 | 0.82 | 0.15, 6.12 | 0.8 | 0.79 | 0.29, 2.29 | 0.6 | 0.46 | 0.19, 1.07 | 0.075 | 2.13 | 0.71, 7.92 | 0.2 | 1.63 | 0.70, 3.89 | 0.3 |
| 1251-1750 | 0.82 | 0.13, 6.50 | 0.8 | 1.62 | 0.61, 4.70 | 0.3 | 0.38 | 0.15, 0.94 | 0.039 | 1.47 | 0.44, 5.76 | 0.5 | 1.10 | 0.45, 2.75 | 0.8 |