



Health and wellbeing impacts of housing converted from non-residential buildings: A mixed-methods exploratory study in London, UK

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ABSTRACT

Housing quality is a determinant of health, wellbeing and inequities. Since 2013, changes to Permitted Development Rights (PDR) allow conversions of non-residential buildings into housing without planning permission in England. We explored the potential health and wellbeing impacts of such 'PDR housing' through an online survey and semi-structured interviews in four London boroughs. We found an association between low wellbeing and lack of residential space and accommodation cooling options, fewer local amenities and lower perceived safety. Participants highlighted problems with windows and outdoor space. Poor quality PDR conversions may pose health and wellbeing risks that could be avoided through regulation and enforcement.

1. Introduction

Factors related to housing quality, affordability and tenure security have been associated with physical and mental health outcomes. The interconnected challenges of lack of affordable housing and deregulation of built environment policies have created new health and housing concerns in several countries (Madeddu and Clifford, 2023). A form of deregulation in the UK known as Permitted Development Rights (PDR) was amended in 2013, allowing developers to convert many types of commercial and light industrial building into housing without planning permission in England. Potential negative health and wellbeing impacts of housing created through this mechanism (referred to here as 'PDR housing') relate to this accommodation having the following characteristics: location in non-residential neighbourhoods, poor quality design with lack of natural light, single-aspect windows, lack of privacy, small internal spaces, and lack of private outdoor and shared amenity space (Clifford, 2019; Clifford et al., 2020). This paper describes an exploratory study investigating the health and wellbeing impacts of PDR housing in four London boroughs.

The conversion of non-residential properties to housing creates several potential risks for health and wellbeing. Depending on the quality of the conversion, non-residential buildings, such as offices, may not support indoor environmental quality (i.e. thermal comfort, noise, air quality, lighting) when floors are portioned into flats. The location of such buildings may be disconnected from social infrastructure, such as in retail and office parks, reducing residents' ability to access education, employment or social activities. Under Permitted Development (PD), the local authority has reduced regulatory scope and ability to influence design, with the principle of development assumed to be acceptable and only a few pre-set technical issues open to scrutiny. Policies from the local plan, such as those related to residential design, amenity and 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 government's initial impact assessment (DCLG, 2013).

Occupants of PDR housing may be more vulnerable to poor quality housing than the general population as they may be likely to experience concurrent social and economic challenges. Lower quality PDR housing

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has been observed in local authorities with greater levels of deprivation and lower average house prices (Clifford et al., 2020) where residents may be characterised as vulnerable in terms of socioeconomic status and pre-existing health conditions (Marsh et al., 2020). Furthermore, Clifford et al. (2020) identified the potential for significant use of PDR housing for local authority temporary housing, representing a vulnerable population group in housing insecurity. Low-income and temporary housing occupants may lack resources (or permission) to adapt properties to increase indoor environmental quality, such as shades to avoid overheating. Where PDR housing is used for residents in temporary accommodation, poor housing quality may be particularly harmful when considering residents' existing or prior challenges with housing insecurity or homelessness, health, discrimination, violence, immigration and other factors.

The health and wellbeing impact of PDR housing in the UK is currently unknown, although existing research and journalism has established a likely problem. Clifford et al. (2020) established the quantity, location and quality of PDR housing. Journalists have highlighted the poor quality of life of residents of some non-residential conversions, many of whom are vulnerable temporary housing occupants (for example, Glass, 2019; Mercer, 2020; Spratt, 2020; Wall, 2019). The scale of this potential problem is also currently unknown. Government statistics on PDR housing are available from 2015-16 (although the policy change occurred in 2013). Between April 2015 and November 2022 a total of 93,301 new dwellings were created across England through PD (MHCLG, 2022). PD conversions are particularly prevalent in Greater London, where housing need is high, and 22,385 have been created in London 2015-22.

This paper reports our transdisciplinary approach and study findings regarding the health impact of PDR housing in four London boroughs (Hillingdon, Hounslow, Lambeth and Southwark). The following section describes the policy context for permitted development, existing research on this type of housing and how the conversion of non-residential buildings to housing could create negative health impacts. We then describe our methods and results, covering our research objectives to explore the demographics and experiences of PDR housing residents, their self-reported health and wellbeing and the association between housing characteristics and health/wellbeing outcomes. The discussion section relates our finding to wider literature on housing and health. We then conclude with a series of recommendations for future research and policy related to PDR housing and health.

2. PDR housing, health and wellbeing

Permitted Development Rights have existed since the start of the UK's statutory planning system in 1948, exempting certain categories of development from the need for case-by-case planning permission from the relevant local planning authority. PDR have traditionally been used to avoid bureaucratic processes for small and/or temporary development, such as a rear extension to an existing house. In England since 2013, PDR have been progressively expanded to increase the supply of housing in the context of a long-term housing shortage (Madeddu and Clifford, 2023). The initial PDR expansion allowed office buildings to be changed to residential use, and former offices are the majority of PDR housing. A further expansion in 2021 meant that up to 80 % of non-residential buildings in England, including offices, shops, light industrial units, gyms, restaurants, day centres and clinics could potentially be converted to housing under PDR (Clifford et al., 2021).

Building regulations apply to permitted development, however this does not guarantee that conversions have been adequately constructed, inspected or maintained. Madeddu and Clifford (2023, pp. 3-4) outline the regulations' omission of design issues such as lighting and space, however they do cover 'building structure, fire safety, site preparation, toxic materials, sound, ventilation, sanitation, drainage, heating, falling objects, power and fuel efficiency, access, overheating, electrical safety, security, ICT, infrastructure for electrical vehicles and workmanship.'

Building access for mobility-impaired residents is included (Approved Document M), however it does not apply to PDR conversions (ibid). Non-compliance with building regulations in England is a long-standing issue (Baiche et al., 2006), with the *Independent Review of Building Regulations and Fire Safety* highlighting 'system failure' and a 'culture of indifference' regarding compliance (Hackitt, 2018). Ferm et al. (2021, p. 2051) found that PDR conversions are smaller than conversions that have undergone full planning scrutiny and are 'more likely to suffer from lack of natural ventilation and have poor quality or unsafe internal finishing.' The health-related risks of non-compliance with building regulations in PDR housing could be substantial.

Prior research on PDR housing has identified numerous potential health risks, although we could not find previous studies that examined the relationship between specific PDR housing-related exposures and health and/or wellbeing outcomes. A recent systematic review (Marsh et al., 2020) identified that only one study involved a small survey of residents (n=38 participants) and the focus was not explicitly about health (Clifford et al., 2018). Other research on this topic has been conducted using expert opinion, desk-based reviews and case studies focussed on design issues, thus identifying a gap in understanding of residents' health and wellbeing-related experiences. Clifford et al. (2018) and (2020) compared case studies of PD building conversions to residential use with those allowed through traditional, full scrutiny planning permission. They found that PD conversions were less likely to have adequate internal space standards, access to outdoor amenity space and adequate natural light in the dwelling. PD units were more likely to be in locations unsuitable for residential use (such as in industrial estates). 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 (Clifford et al., 2020). Between 2013 and 2021, local authorities had no ability to consider the space standards of PD housing. Since April 2021, PD conversions must comply with the Nationally Described Space Standard (NDSS) defined in DCLG (2015). PDR housing created between 2013 and 2020 were not required to have windows. An amendment was introduced in June 2020 that required 'adequate natural light to all habitable rooms', although this does not require a window that permits views outdoors.

Marsh et al.'s (2020) systematic review of the relationship between PDR housing and health identified multiple scales of potential health impacts based on studies of such conversions. At the *building level* studies identified small internal spaces, lack of private and shared amenity space (e.g. balcony or garden) and poor building design (including issues with noise, lighting, ventilation and windows). At the *neighbourhood level* studies found loss of developer contributions toward social infrastructure and affordable housing, locations preventing access to schools, healthcare, public transport and supermarkets, negative impact on local area (e.g. through reducing employment opportunities) and lack of community consultation. Studies of PDR housing included in their review catalogued 29 negative health impacts, compared to 8 positive impacts (e.g. increasing housing and low-cost housing) with particular concerns raised about health equity. There is a lack of data on who is living in PDR housing and what experiences they encounter, thus reducing understanding of the health risks of this accommodation.

Multiple governments have explored or adopted strategies to increase housing supply through the conversion of non-residential buildings in Europe, North America and Asia (Canelas et al., 2022; Hughes, 2022; Kim and Lee, 2020; Madeddu and Clifford, 2023; Sali, 2022). Conversions may also revitalise urban centres that have been suffering under-occupancy following the COVID-19 pandemic, such as in US cities (Glaeser, 2022). In principle, reusing existing buildings to meet housing need is a sustainable construction strategy to avoid new carbon emissions embodied in new development. These environmental considerations are important for health, although they operate over longer time scales and larger spatial scales than the local health impacts of PDR housing. Pineo's (2020) conceptual framework for healthy urbanism outlines how urban features, such as buildings, influence three

time. Compared with purpose-built housing in particular, PDR units are likely to have differences in occupants, design, materials, building management systems (and sometimes location) that may result in different health and wellbeing risks. Fig. 1 represents a conceptual framework for the health and wellbeing impacts of PDR housing using existing literature (Marsh et al., 2020; Pineo, 2020) and it is adapted from a prior review of evidence linking the urban environment to health (Pineo et al., 2018). Depicting the THRIVES Framework's three scales of health impact (planetary, ecosystem and local) in Fig. 1 demonstrates that exposures related to PDR may affect health and wellbeing across diverse spatial areas and time periods. Drawing from Krieger's eco-social theory, we also note that individuals may experience the same environment in different ways, resulting in diverse health and wellbeing impacts. The conceptual framework in Fig. 1 informed our exploratory study design (see Methods).

3. Methods

We adopted a transdisciplinary approach to our study (see Pineo et al., 2021), meaning that we collaborated across academic disciplines (planning, urban health, epidemiology and public health) and with a charitable organisation working with people experiencing housing insecurity and homelessness, Groundswell. We developed our research questions, methods and analysis in partnership with these groups, including conducting fieldwork with a Groundswell researcher. Below we describe our methods for developing the survey and interview guide, followed by our research procedures. We adopted a convergent (also called concurrent) mixed-methods study design in which qualitative and quantitative data can be gathered simultaneously (one does not inform the analysis of the other) and are integrated for the purposes of triangulation (Clark et al., 2021). The research was governed through the Bartlett School for Environment, Energy and Resources Low Risk Ethics Approval and the UCL Data Protection Office procedures. We followed principles of informed consent and Groundswell's policy for Safeguarding Vulnerable Adults. The supplementary material (Section 1) contains further information on our methods including survey development, sampling and recruitment, protocol for data collection and our assumptions about the causal relationships that we used to inform our statistical analysis. We also include additional analyses in the supplementary material.

3.1. Developing the survey and interview guide

Our survey aimed to establish the characteristics of people living in PDR housing and the housing-related factors of greatest risk to their health and wellbeing. Our objectives for the survey were to explore who was living in PDR housing in the London boroughs of Lambeth, Southwark, Hillingdon and Hounslow; to gather data on their housing condition and self-reported health and wellbeing; and to explore the effectiveness of a postal survey to gather this data (to inform future research). We aimed for a relatively short survey with questions informed by lived experience. In addition, we prioritized survey questions that were comparable with routinely collected data, previously validated, and, where relevant, we used questions which measured housing exposures with sufficient evidence of a link to health and/or wellbeing.

Topic areas and sample survey questions were developed using research about housing and health, as visually shown in Fig. 1 (Adamkiewicz et al., 2014; Aldridge et al., 2021; Barnes et al., 2011; Bentley et al., 2016; Braubach et al., 2011; Chen et al., 2021; Clapham et al., 2018; Dunn, 2002; Foye, 2016; Gibson et al., 2011; Ige et al., 2018; Jacobs et al., 2010; Marsh et al., 2020; Thomson et al., 2013, 2009; Tomaszewski and Perales, 2014; WHO, 2018). We then held a focus group with participants who represent the potential population of some housing created through PDR (as indicated in the literature). Participants were volunteers working with Groundswell who had experience of

homelessness, insecure housing and temporary accommodation. The two-hour focus group took place in December 2021 and there were six participants (informed and consented). Following this event, we added new survey and interview questions covering: internal space, security, ability to meet monthly housing costs, and the home being representative of the occupant's identity.

The interview guide was developed to give the opportunity to expand on the survey, focusing on residents' subjective experiences. Visiting the home allowed participants to show the researchers any features of their home to be photographed.

3.2. Sampling and recruitment

Our geographical focus on London was determined by its high rate of PDR conversions, the accessibility of buildings to researchers and the geographical remit of the research funder (Impact on Urban Health primarily works in Southwark and Lambeth). Within Greater London, we explored PDR conversions in two neighbouring inner (Lambeth and Southwark) and outer (Hillingdon and Hounslow) boroughs. These boroughs offer a range of different built environment and socio-economic characteristics and sufficient housing units created through PDR between 2015-20 (supplementary material, Table S1).

We identified address data for the completed PD conversions to residential use in the four selected boroughs. As these data are not published, we began with the list of 'prior approval' applications to convert commercial buildings to residential use under PDR using the Planning London Datahub, published by the Greater London Authority (GLA, 2022). Developers must notify the local planning authority of their intention to convert a building's use under PDR. The authority then grants (or refuses) 'prior approval' through a process that is more limited than full planning permission. We identified all prior approvals granted in the four boroughs from 1 May 2013 (when PDR was introduced for office-to-residential conversion) to 30 March 2019 (a cut-off date two years prior to our study to increase likelihood that the building had been converted, and before a regulatory change in 2021 which better regulated the internal sizes of PDR homes took effect). We removed duplicate buildings and unimplemented schemes using address data in the Planning London Datahub. The dataset included 904 prior approvals, which was reduced to 271 implemented conversion schemes, and within these we identified 3,206 individual residential units with full postal addresses. We identified individual addresses and confirmed that these properties were residential (not commercial) by comparing building addresses from the Planning London Datahub with the addresses of residential properties in the government's Energy Performance Certificate dataset (DLUHC, 2022) and Council Tax band information (HMRC, 2022).

The survey was administered online via University College London's REDcap web-based application, through which data were stored directly in the UCL Data Safe Haven (a technical solution for storing, handling and analysing data with high security standards and procedures). Potential survey respondents were recruited through invitation postcards addressed 'to the occupier' (from our previously described dataset containing 3,206 units). Participants were offered a £10 incentivisation voucher. The postcard contained a weblink for information in the 14 most common languages other than English spoken in the UK (according to census data) with provision for translation of the survey (no such requests were received). The postcard gave a phone number whereby recipients could request a paper copy of the survey and three respondents used this option. We mailed 802 postcards (see Table 1) from a randomly selected sample of addresses in April 2022 and by early May, 39 responses had been received. We then mailed a further 1,604 postcards in two batches in May (addresses randomly sampled), resulting in a total of 2,406 postcard invitations. Simultaneously, research assistants knocked on doors in converted buildings and handed out approximately 100 postcards. At the point of survey closure in the end of June 2022, we had received 218 responses (approximate response rate of 9 %).

Table 1
Number of PDR units we identified and postcard invitations sent in each of the four sample London Boroughs.

London borough	Number of PDR units	Number of survey invitations
Hillingdon	1,150	861
Hounslow	909	681
Lambeth	660	495
Southwark	487	369
Total	3,206	2,406

Recruitment for interviews was done by inviting survey participants upon completion of the survey, with a further £20 incentivisation voucher. A total of 89 people volunteered to be interviewed and between May and July 2022. There was some loss of participants at the stage of arranging interviews and a total of 41 interviews were conducted.

3.3. Conducting fieldwork

Research assistants from UCL and Groundswell met prior to conducting the fieldwork to discuss the protocol and receive training related to safety, safeguarding, and data collection and storage procedures. The Groundswell collaborators provided tips on building rapport and showing empathy for participants experiencing poor quality housing.

During May and June 2022, the research assistants (three UCL MSc students and one peer researcher from Groundswell) conducted door knocking for survey recruitment and attended participants' homes for interviews. Researchers were given a list of PDR housing addresses near to the addresses of interview participants. Interviews took place at the participant's home, with two researchers present. Interviews lasted 20-25 minutes each and they were not audio-recorded but contemporaneous notes were taken. Following the fieldwork, the research team met to discuss potential procedural improvements and meaningful issues raised during the interviews.

3.4. Analysis

Survey data were analysed using descriptive statistics. Mental wellbeing 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 (Tennant et al., 2007). These cut-off scores were also found to be the same in an analysis of data from the Health Survey for England 2010 and 2011 (Stranges et al., 2014), showing consistency over time. Another unpublished report (Bianco, 2012) 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, 2021).

We examined associations between housing quality and mental wellbeing were examined for two mental wellbeing outcomes: i) WEMWBS full numeric score and ii) the probability of having a low wellbeing WEMWBS score that may be indicative of probable clinical depression (<41). 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. WEMWBS score was modelled using linear regression and probability of low wellbeing was modelled using logistic regression. Regression coefficients and odds ratios (for outcomes i) and ii), respectively) were estimated for the association between each outcome and housing quality indicator, controlling for net monthly per-capita household income after housing costs, a confounder identified in our causal framework. Unadjusted estimates are provided in supplementary material, Section 3. Assumed causal relationships are shown in

a directed acyclic graph (DAG) in supplementary material, Section 1.3.

Informed by initial descriptive analyses, 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.

Finally, we examined 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'). These results are included in supplementary material Section 3.5.

Interview data and photographs were analysed using a qualitative content analysis performed by a research assistant, HP and BC (Bengtsson, 2016). As interviews were not audio-recorded, the digitised hand-written notes were analysed in Nvivo qualitative data analysis software from a manifest (not latent) perspective with deductive and inductive coding. Discussions between the researchers during the analysis process highlighted topics that were important in the quantitative and qualitative datasets (as part of our mixed-methods approach), prompting further analysis.

4. Results

4.1. Demographics

A total of 218 survey responses were received. Respondents were primarily young (68 % aged 18 and 35 years), White (59 %) and a slight majority were female (56 %) (Table 2). Residents were primarily employed (70 %) or self-employed (14 %) (Table 2). 28 % of respondents were working from home part-time or full-time, indicating they spent a significant amount of time in their accommodation. Educational attainment was high with 83.2 % having a higher education degree (e.g. Bachelor's, Master's, PhD), compared to a range of 37.5 % - 57.3 % in the study boroughs (supplementary material, Table S3). The majority of respondents had a per-capita net monthly household income after housing costs of less than £750-1250 and 29 % found it a strain to meet monthly housing costs (Table 2).

Most residents lived in households of one (37 %) or two (52 %) people, and had been living in their home for less than two years (58 %). More than half of respondents were renting their accommodation without housing benefit (54 %) and 38 % owned their home, either with or without a mortgage or loan. Accommodations were mostly self-contained flats and maisonettes (95 %), comprising one (72 %) or two (25 %) bedroom(s).

Most respondents (79 %) had 'good' or 'very good' self-reported health (Table 2), similar to the proportion reported across each of the four London boroughs (85.2 % - 86.5 %) (supplementary material, Table S3). 14.9 % reported having their day-to-day activities limited by a health problem or disability. The most common health conditions were anxiety (22 %), depression (11 %), asthma (8.3 %), allergy (7.3 %) and low back pain/other chronic back defect (7.3 %). 71 % of participants had a WEMWBS score that indicates average wellbeing. The proportion of 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 %) (Fig. 2) (Tennant et al., 2007). When benchmarked with CES-D, 19 % had a score that may be associated with probable clinical depression and 16 % had a score that may be associated with possible/mild clinical depression. Additional demographic data are reported in the supplementary material, Section 2.1.

Table 2

Frequency table of study population (n=218) demographics. ¹Categories have been used from the UK Census and multiple options could be selected by participants within this survey question.

Survey question	n (%)
Age (years)	
18-25	31 (14%)
26-35	118 (54%)
36-45	41 (19%)
46+	28 (13%)
Sex	
Female	122 (56%)
Male	93 (43%)
Unspecified	2 (0.9%)
Missing	1
Ethnicity	
White	123 (59%)
Indian	34 (16%)
Black African	7 (3.4%)
Black other	3 (1.4%)
Chinese	4 (1.9%)
Filipino	4 (1.9%)
Other	32 (15%)
Missing	11
Work status/employment ¹	
Employee	152 (70%)
Self-employed or freelance (last 7 days)	30 (14%)
Studying	21 (9.6%)
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
Accommodation ownership	
Owns with or without a mortgage/loan	79 (38%)
Part-owns and part-rents (shared ownership)	2 (0.9%)
Rents with housing benefit	10 (4.8%)
Rents without housing benefit	111 (54%)
Lives here rent-free	5 (2.4%)
Missing	11
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
Smoker in household	
No	193 (90%)
Yes	18 (8.4%)
Prefer not to say	4 (1.9%)
Missing	3

4.2. Feelings about PDR housing

Reviewing interview participants' (n=41) responses provides context to the remaining quantitative data presented below. When asked specifically what it "feels like" to live in their home, participants responses could be grouped into positive, negative and neutral categories, but individual responses were often a contradictory mix of perspectives. For instance, three participants described their homes being "cosy", but also listed problems, such as the home being too small. Another respondent felt both "safe" and "locked away". Homes were described as "temporary" (by 13 participants), for reasons such as being too small, unsuitable for longer-term life plans or being an investment property. People seemed to appraise the house for what it offered at their life

Wellbeing in PDR participants vs. UK average

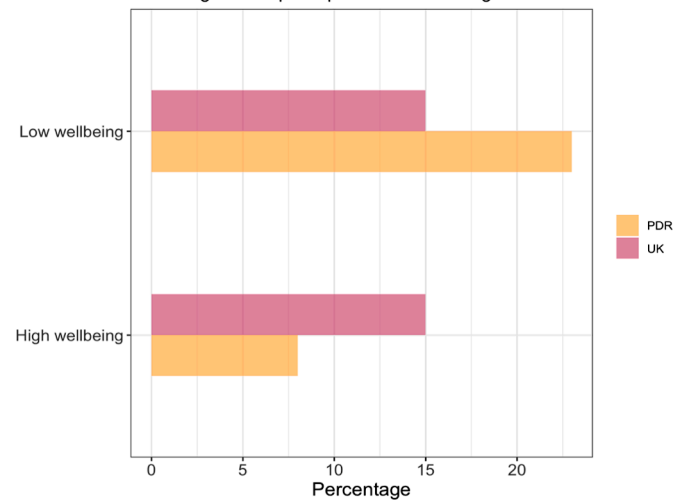


Fig. 2. Comparison of wellbeing scores indicating low and high levels between the study participants in PDR housing and the UK average (Tennant et al., 2007).

stage, meaning that temporary was not always problematic. One participant said, "It feels both temporary and homely", while another described it as feeling "temporary, but good for the moment".

Positive feelings about the home were expressed by 22 participants. They described feeling safe and happy to have their own home, such as one participant who said, "It feels wonderful, I am grateful for owning a flat in this lovely area of London". People described aspects of the home that they liked, such as privacy, lighting and attractive design. A more neutral response was visible through descriptions of the property as "functional", "practical" or "easy to clean". Negative responses were related to small space of the home, lack of outside space, poor lighting, overheating and other factors. Space and window related issues came up frequently. Other negative impressions included feeling "overwhelmed" with the lack of space, "trapped" due to the flat being in a basement, and "uncomfortable" due to lack of repairs to maintenance issues. Interview responses and photographs are integrated into the sections below to provide additional explanation to quantitative survey analyses.

4.3. Housing characteristics and wellbeing

The six most common problems that residents reported experiencing via the survey were a shortage of space (46%), street noise (40%), noise from neighbours (26%), pollution (16%), vandalism or crime (16%) and a lack of fresh air (14%) (Fig. 3). Only 14% of respondents reported having none of the listed accommodation problems.

4.3.1. Shortage of space

The largest complaint of survey participants was having a lack of space. Space was strongly associated with wellbeing. Respondents who strongly disagreed that there was sufficient space i) to have visitors for socialising or ii) for household members to eat together comfortably were more likely to have WEMWBS scores that may be indicative of probable clinical depression compared to those who strongly agreed, after controlling for net monthly income (Table 3). Similarly, a clear trend was identified in the linear regression, with increasingly negative responses associated with lower WEMWBS scores for these two survey questions (Table 3).

Adding more space was the most frequent response (n=20/41) to what interview participants would change in the home if they had unlimited budget and it was often raised in the context of factors that harm health and wellbeing. There were specific needs for larger kitchens (e.g. "the kettle is on a stool"), additional bedrooms and more storage (Fig. 4).

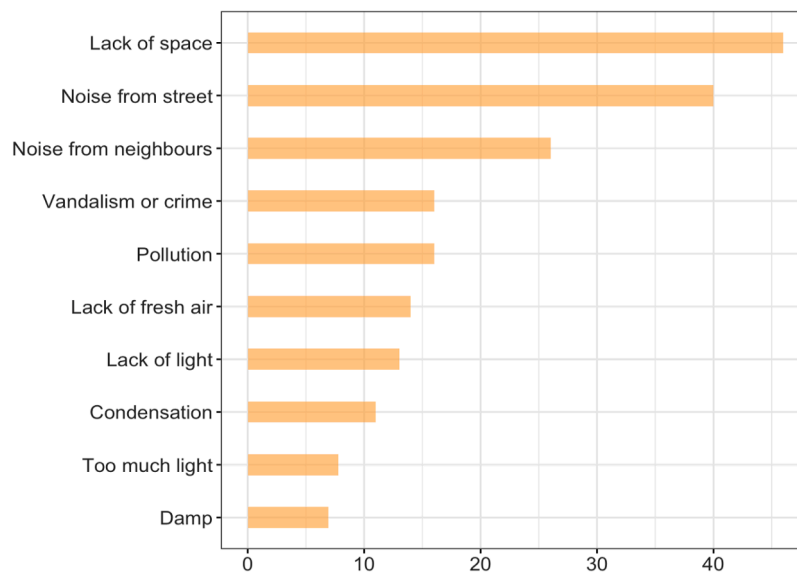


Fig. 3. Top ten housing-related problems experienced by survey respondents.

A resident described not having a washing machine and another said that they had a tumble dryer in their bedroom, both due to lack of space. People lacked space to work from home and space for visitors. Some participants noted that the layout or conversion of their home was awkward and did not provide the most efficient use of space, e.g. “dead space” (Fig. 4).

4.3.2. Thermal comfort

Thermal comfort was problematic in summer weather for 37% of survey respondents, while 92% reported being able to keep comfortably warm during cold winter weather. Residents cooled their homes using windows that can open (87%), blinds (67%), curtains (29%) and internal shutters (8.7%). When compared to respondents who had at least one of: external shutters, fans, fixed shading or awnings or canopies over windows or doors, those with no cooling options were associated with a WEMWBS score that was on average 21 (95%CI 11, 32; $p < 0.001$) points lower and a significantly higher risk of having a WEMWBS score that may be indicative of probable clinical depression (OR 24.1, 95%CI 1.29, 845; $p = 0.042$), after controlling for household income (Table 3). The asymmetric confidence interval and resulting high upper value for this estimate of association with probable clinical depression is a result of having high effect sizes and significant uncertainty in estimates on the log-odds scale on which they are modelled, with these magnitudes further increased when exponentiated to the odds scale on which they are reported.

Interview participants said that their home being too warm in hot weather harmed their health (11/41). One participant said, “it is unbearable in summer” and another said the “flats are like greenhouses”. Some residents connected overheating and noise, noting that windows could not be open due to outdoor noise. In other cases, windows did not open at all (Fig. 5). Residents were also aware of lack of cross-ventilation through single aspect windows. Descriptions of overheating were more common than feeling too cold in the winter, however being too cold was listed by nine people as harming health and wellbeing. One participant said, “heating is a big issue for us” as the flat loses energy quickly, the bills are very high “an extortion, a shock to us”. Residents described poor insulation and heating systems, some of which they linked to the property conversion (e.g. heating being linked with other flats and controlled centrally).

4.3.3. Windows

Windows were a commonly reported problem. 14% of the survey

cohort reported not having a single window that they could open. 68% had at least one window that they could easily see outside through. Outdoor facing windows were more common in bedrooms (70% reported having a window in all bedrooms), and the living area (75%), with a lower proportion reported in the kitchen (39%) and bathroom (8.7%). Problems with windows were raised by 21/41 interview participants, with 13 people explicitly linking these to health and wellbeing harms. One participant said: “It is a very depressing flat as it has no windows and is designed with no consideration for disabled people”. Interview participants described poor daylighting, no views to the outdoors (Fig. 6), glaring lights from outside, single aspect causing ventilation problems and lack of double glazing (linked to noise problems). One participant said, “It is so noisy, and we have no view other than brick wall so we cannot even keep a houseplant alive”. In contrast, 12/41 participants referenced windows in their home as being beneficial for health and wellbeing, referencing good natural light and views.

A related issue to windows was the presence of damp, mould or foul smells in the homes of interview participants. Lack of “fresh air” was raised as a reason for lingering cooking smells and foul odours, which included sewage and tobacco/cannabis smoke. Survey 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. Some interview participants explicitly linked poor ventilation to lack of windows. Some participants had bought dehumidifiers.

4.3.4. Safety and security

Safety and security concerns were raised within PDR buildings and the wider neighbourhood. A minority of survey respondents reported feeling a bit unsafe (8.3%) or very unsafe (1.5%) at home alone when alone (Table 3). The most common reasons given were ‘fear of being burgled’ (11%) and ‘harassment by others’ (6.0%). 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 (Table 3). Feeling ‘very unsafe’ when walking in the neighbourhood after dark was associated with an increased risk of having a WEMWBS score that may be indicative of probable clinical depression (OR 10.7, 95%CI 1.45, 222; $p = 0.043$) after controlling for household income. An important determinant of perceived safety when at home alone was the ability to lock the home’s entrance, with those

Table 3

Frequency of survey responses on selected exposures; Depression columns: univariable logistic regression analysis for associations between risk of probable clinical depression (for which a WEMWBS score <41 was set equal to 1 and otherwise equal to 0) and housing quality (odds ratios are shown as adjusted for net monthly household income [OR = Odds Ratio]); Wellbeing columns: univariable linear regression analysis for 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 adjusted for net monthly household income, for example, beta estimates equal to 2 and -2 can be interpreted as an increase and decrease in the average WEMWBS score relative to the baseline category, respectively); CI = Confidence Interval; ¹Too few observations to estimate adjusted ORs. ²See supplementary material Table S6.

Survey questions	Frequency n (%)	Depression			Wellbeing		
		OR	95% CI	p-value	Beta	95% CI	p-value
Space to have visitors for socialising							
Strongly agree	46 (22%)	—	—	—	—	—	—
Agree	87 (42%)	2.23	0.60, 10.8	0.3	-4.1	-7.2, -0.93	0.011
Neutral	35 (17%)	2.98	0.63, 16.4	0.2	-4.7	-8.6, -0.80	0.018
Disagree	26 (13%)	4.45	1.00, 24.1	0.059	-3.7	-7.9, 0.53	0.086
Strongly disagree	12 (5.8%)	9.57	1.28, 76.2	0.026	-8.6	-15, -2.3	0.008
Missing	12	—	—	—	—	—	—
Space for household members to eat together comfortably							
Strongly agree	69 (33%)	—	—	—	—	—	—
Agree	98 (48%)	2.27	0.78, 7.68	0.2	-2.9	-5.6, -0.14	0.040
Neutral	29 (14%)	4.18	1.08, 17.1	0.039	-3.2	-7.1, 0.73	0.11
Disagree ¹	6 (2.9%)	—	—	—	-6.8	-16, 2.8	0.2
Strongly disagree	4 (1.9%)	26.8	1.78, 770	0.022	-11	-20, -1.0	0.031
Missing	12	—	—	—	—	—	—
Accommodation cooling							
External shutters/fans/awning/fixed shading	30	—	—	—	—	—	—
Air conditioning ¹	10	—	—	0.9	0.03	-6.3, 6.3	0.9
Only windows that open/internal shutters/curtains/blinds	420	2.08	0.52, 14.09	0.4	-4.5	-8.4, -0.73	0.020
No cooling options	15	24.1	1.29, 845	0.042	-21	-32, -11	<0.001
Perception of safety when at home on own							
Very safe	104 (50%)	—	—	—	—	—	—
Fairly safe	80 (39%)	1.11	0.42, 2.87	0.8	-2.1	-4.7, 0.53	0.12
A bit unsafe	17 (8.3%)	3.57	0.74, 16.6	0.10	-6.8	-12, -1.4	0.013
Very unsafe ¹	3 (1.5%)	-	-	-	-	-	-
Other ²	2 (1.0%)	—	—	—	—	—	—
Missing	12	—	—	—	—	—	—
Perceived safety in neighbourhood, walking alone, daytime							
Very safe	71 (35%)	—	—	—	—	—	—
Fairly safe	114 (56%)	1.66	0.57, 5.59	0.4	-3.5	-6.2, -0.76	0.013
A bit unsafe	14 (6.9%)	4.48	0.89, 22.0	0.06	-7.5	-12, -2.4	0.004
Very unsafe	2 (1.0%)	2.73	0.11, 36.7	0.5	-9.7	-19, -0.22	0.045
Don't know	2 (1.0%)	—	—	—	—	—	—
Missing	15	—	—	—	—	—	—
Perceived safety in neighbourhood, walking alone, after dark							
Very safe	23 (12%)	—	—	—	—	—	—
Fairly safe	87 (45%)	2.51	0.41, 48.6	0.4	-4.2	-8.0, 0.41	0.030
A bit unsafe	72 (37%)	2.91	0.47, 56.3	0.3	-6.2	-10, -2.4	0.002
Very unsafe	10 (5.1%)	10.7	1.45, 222	0.043	-9.0	-14, -4.0	<0.001
Don't know	3 (1.0%)	—	—	—	—	—	—
Missing	23	—	—	—	—	—	—

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 (supplementary material, Table S12). Safety and security issues were raised as harmful to health and wellbeing by roughly half of interview participants (22/41), with 11 people raising theft in particular. Fear of crime, vandalism, graffiti, loitering, racism, gender-based violence and knowledge of prior assaults were discussed.

4.3.5. Other built environment and health issues

The most beneficial factors that positively affected health and wellbeing according to interview participants was the availability of nearby amenities, including shops and cafes, local parks and nature, recreation facilities, and transport links and/or walkable neighbourhoods. A small proportion (6.4%) of the survey 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. Having more types of amenities within a ten-minute walk was associated with higher wellbeing, with each additional type of amenity increasing WEMWBS score by 1.5 (95%CI 0.70, 2.4; $p<0.001$) points after adjusting for household income (supplementary material, Table S9).

Lack of outdoor space, especially private space such as a balcony,

was frequently raised as an issue by interview participants (16/41). One participant described how "a little outside space, is a must" and they specifically raised this in relation to converted buildings:

"New flats, I've seen they are making the effort to have a little outdoor space. (...) In the high street you don't have a garden like any block of flats with communal gardens. These commercial blocks don't have, so a little space for you to sit out in the evenings is a must. If you are converting, you should consider this space, because there isn't, if I didn't have the park, it would be worse, many people don't have that access, and you would feel trapped if there was no outdoor space".

Other problematic factors identified in the study included internal and external issues. 49% of survey participants reported having a home that reflected their personal identity, with 19.3% disagreeing with this statement. In the interviews, negative factors were raised, including: nearby heavy traffic (14/41), pollution (12/41) and management and maintenance (11/41). Eleven participants said that noise disturbed their sleep. Sources of noise included traffic, planes/trains, neighbours and some building systems (e.g. a boiler). Inability to change their home due to being tenants was raised by three participants as the reason they could not modify the property for sound insulation, hanging blinds and ventilation.

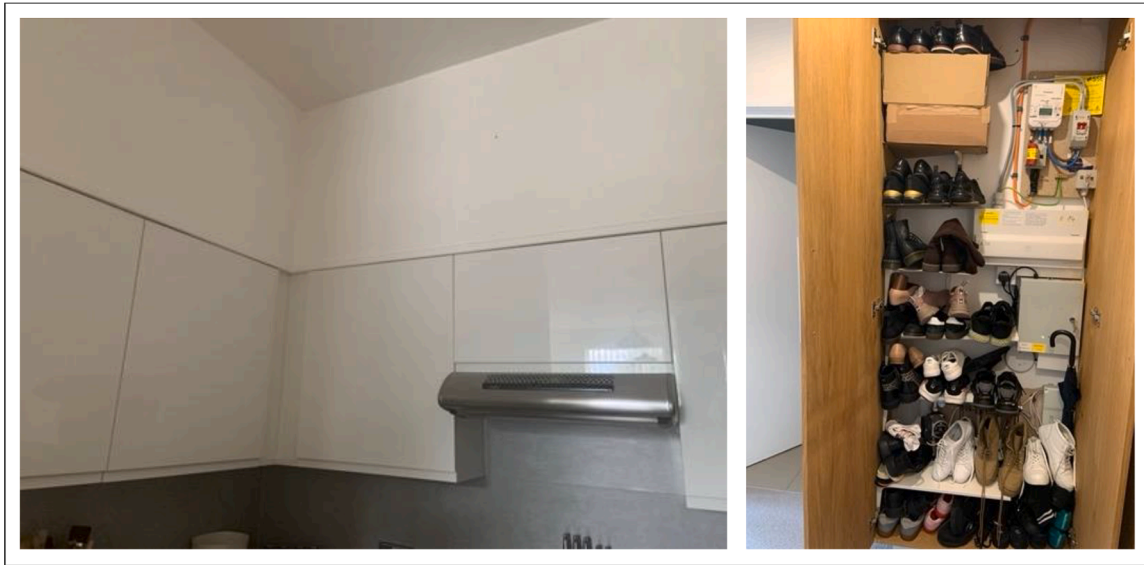


Fig. 4. LEFT: Participant felt that hollow space above cupboards could have been used for storage. RIGHT: Lack of storage resulted in make-shift use of utility spaces.



Fig. 5. LEFT: Resident experiences overheating as only the window on the far right opens. RIGHT: Resident could not install barrier to light on the large window and it did not open upon occupation of the flat.

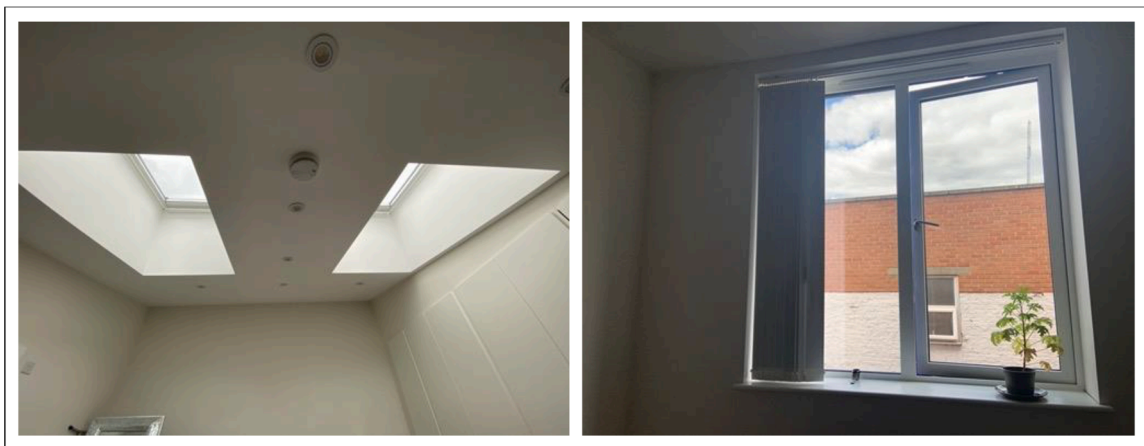


Fig. 6. LEFT: Skylight windows are the only windows in the resident's bedroom. RIGHT: The only window in the resident's flat, situated on the living/kitchen space.

We found no statistical associations (at the conventional 5% level) between either mental wellbeing outcome (WEMWBS score or WEMWBS score that may be indicative of probable clinical depression) and: i) not having at least one window that respondents could easily see outside through, ii) reporting street or neighbour noise as a problem, iii) living in accommodation with condensation, leaks, damp or rot, or iv) reporting lack of fresh air as a problem (supplementary material, Table S9).

5. Discussion

This exploratory study contributes new understanding of PDR housing and its residents in four London boroughs, including the relationship between this form of housing and health and wellbeing. We identified an association between wellbeing and residential space, accommodation cooling options, local amenities and perceived safety. Our qualitative data provide additional insights about residents' experiences and the multi-dimensional role of windows on health and wellbeing, as they are linked to lighting, views outside, cooling and ventilation. The associations that we have identified should not be interpreted as evidence of a causal relationship between exposures in PDR housing and health and wellbeing impacts. In this section, we discuss study limitations, consider our findings in relation to existing research and theory and provide recommendations for policy.

We used a transdisciplinary approach to design and conduct mixed-methods research about the health impacts of PDR housing. The combination of survey and interview data provides greater understanding about the potential relationships between PDR housing and health than the existing evidence (to our knowledge, only one study (Clifford et al., 2018) explored residents' perspectives, but their survey was not health/wellbeing-specific). Our convergent mixed-methods study design allowed us to integrate quantitative and qualitative data to better understand which characteristics of PDR housing may pose a problem for health and wellbeing and why. Our transdisciplinary approach improved the likelihood that our survey and interview collected data that would be of value to residents and local government planning officers.

Based on educational attainment, we believe that our survey respondent cohort was of higher socioeconomic status than the general population of these London boroughs. We attribute this to selection bias, whereby residents of higher socioeconomic status who received the invitation to participate in our research appear to have been more likely to respond than those from lower socioeconomic groups. When conducting fieldwork, researchers reported difficulty recruiting participants in properties that were visibly of poor quality. Whilst our study sample size was likely the largest to date of PDR housing residents, we were likely underpowered to detect associations with factors that were not very strongly associated with health outcomes. Nevertheless, it is noteworthy that our comparatively higher socioeconomic participants had concerning housing quality issues (particularly related to windows) and low wellbeing compared with the UK average. This exploratory study offers new data on an under-researched topic of international relevance. However, other study designs are needed to establish the true extent of health and wellbeing impacts of PDR housing. This exploratory study has informed our ongoing national study on this topic which uses electronic health records and a comparison group of non-PDR housing alongside social research, environmental monitoring and modelling and health economic modelling (see summary on the National Institute for Health and Care Research website: <https://fundingawards.nihr.ac.uk/award/NIHR150963>).

5.1. Sufficient space

Having sufficient space for socialising, eating together as a household and studying was strongly associated with higher mental wellbeing (WEMWBS score). The health and wellbeing impacts of having sufficient

space within a residence are related to infectious disease transmission, stress, privacy (e.g. for quiet activities such as studying), social connection and pride of one's home. The COVID-19 pandemic recently underscored the importance of household space with an increased risk of transmission in homes experiencing overcrowding (Aldridge et al., 2021) and the changing uses of homes during and after the pandemic, with concomitant space requirements (Kearns, 2022; Newton et al., 2022). Increasing usable spaces within a home (such as through an extension or warmth intervention) can reduce overcrowding and this has been shown to reduce stress, illness and mess, while simultaneously increasing use of the kitchen leading to better diet, studying and leisure opportunities and family functioning (Thomson and Thomas, 2015). Our findings add to evidence suggesting the importance of sufficient housing space and mental wellbeing.

5.2. Accommodation cooling options

Overheating in homes is an increasingly important policy issue in the UK due to climate change (Mavrogianni et al., 2021). Our study found that residents of PDR housing may be particularly vulnerable to overheating due to lack of cooling options or inability to change their home (e.g. due to rental agreements). In addition to wellbeing impacts, excess heat or cold within buildings can cause respiratory and cardiovascular diseases, including emergency hospitalisations and death (WHO, 2018). In schools and workplaces, excess heat or cold has been linked to reduced productivity and ability to concentrate (Allen and Macomber, 2020), which has become relevant in residential settings with post-COVID working patterns. Housing improvements for 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 (Rodgers et al., 2018). In combination with other study results, our data suggest that PDR housing may be particularly at risk of overheating due to factors linking building design and indoor heat exposure, such as being single aspect (Clifford et al. (2019) found that 85.3% of surveyed PDR homes were single aspect), no shading, restricted window opening, large glazing areas and community heating systems, among other factors (Mavrogianni et al., 2021).

5.3. Windows, lighting and air pollution

Numerous issues were raised regarding windows, including their absence or low number, sound insulation properties, operability for ventilation, daylighting, glare and views outside. Although we did not find an association between windows and wellbeing using our survey data, lack of fresh air was associated with worse mental wellbeing. The lack of association between windows and wellbeing in our study could be related to a deficiency in our survey question on windows. We believe that the wording in this newly developed question could have been confusing and we will adapt and test this further in our current national study of the health impacts of PDR housing. Existing evidence demonstrates the importance of windows for daylight, which links to mental health, safety, visual performance and physiological functions, including sleep (Nagare et al., 2021; Osibona et al., 2021). Views outside, particularly to nature, are considered to be important for wellbeing (Stigsdotter et al., 2011), and poor-quality views were linked with depressive symptoms of residents during COVID-19 (Amerio et al., 2020).

In British homes, windows are a common means of ventilation for air circulation and cooling, and both of these issues were raised in our data as problematic. Interview data described damp, mould, lingering smells and poor ventilation. Outdoor traffic pollution, which enters buildings, was also raised in the survey data as the third most commonly cited factor that people felt harmed their health and wellbeing. Poor ventilation is linked with poor indoor air quality and issues like mould and damp. People living in deprived neighbourhoods in London have greater

exposure to outdoor air pollution and inadequate housing increases the risk of indoor air pollution exposure (Ferguson et al., 2021). The health impacts of air pollution include respiratory and cardiovascular diseases, adverse birth outcomes, neurodevelopment deficits, diabetes (WHO, 2013), dementia (Peters et al., 2015) absenteeism, reduced productivity and sick building syndrome (Kelly and Fussell, 2019), and there is emerging evidence for obesity (Lam et al., 2021) and mental health conditions, including depression and anxiety (Braithwaite et al., 2019). In the context of PDR housing in deprived neighbourhoods being of lower quality and having poor ventilation (Clifford et al., 2018; Ferm et al., 2021), it is likely that such PDR housing has greater exposures to air pollution from external and internal factors and our study added further evidence to this risk.

5.4. Perceived safety

Our results suggest that perceived safety at home and in the neighbourhood were determinants of mental wellbeing. For neighbourhood safety, effect sizes were larger for those who felt very unsafe relative to those who felt very safe, and were comparable in magnitude to those for accommodation space, with an average difference in WEMWBS score ranging between 8.6 and 11 when controlling for household income. A clear driver of feeling unsafe at home was difficulty locking the accommodation entrance. Interview participants also referenced factors related to the concept of defensible spaces, which separate private and public areas to increase perceived safety (Carmona, 2021). Perceptions of safety affect health-related behaviours, for instance by reducing outings that would improve physical activity and social connection, and are thus important factors for healthy urban development (Pineo, 2020, 2022). Social and structural factors affect perceived safety (ibid) and both issues were raised by our study participants. Social factors included fear of racism and crime, while structural elements included litter and poorly maintained spaces. Location of PDR housing, design quality, maintenance and residents' individual characteristics appeared to affect perceived safety in our study. Our findings align with previous research linking the built environment, perceived safety, and quality of life and wellbeing (Evans, 2003; Weich et al., 2002; Won et al., 2016).

5.5. Amenities and outdoor space

Having more types of amenities within a ten-minute walk was associated with higher mental wellbeing in our study. Availability of amenities was a problem for a small portion of our cohort, adding to prior evidence from Clifford et al. (2020) who found that 7.9% of analysed PDR conversions were in commercial areas, such as business or industrial parks, compared with only 1% of schemes that went through full planning scrutiny. Access to amenities supports health and wellbeing through increased mobility, social participation and physical activity (Bird et al., 2018).

The survey and interview data showed the importance of access to outdoor space in terms of nearby parks, private outdoor space (e.g. a garden or balcony) and shared amenity space (e.g. a rooftop garden). This reflects a great deal of existing literature demonstrating the connection between access to nature and human health and wellbeing (Rautio et al., 2018; Rojas-Rueda et al., 2019; van den Bosch and Ode Sang, 2017). Although most of our study participants did have access to nearby greenspace, lack of amenity space in the PDR building was a problem and interview participants made the link between such space and their mental health. Our survey did not ask about access to private or shared outdoor space, e.g. a roof terrace, balcony or garden provided at their dwelling. Further research is needed to understand the proportion of PDR housing residents with access to different types of outdoor spaces and how this may affect their health and wellbeing.

5.6. Residents' health in PDR housing

The population of PDR housing residents may have a higher portion of vulnerable residents than the general population (due to its 'natural' affordability or its use as temporary accommodation by local government) and PDR housing in deprived neighbourhoods is of poorer quality (Clifford et al., 2018; Ferm et al., 2021; Marsh et al., 2020), raising important implications for health and wellbeing. Pineo (2022) highlights the value of an ecosocial theory (Krieger, 1994, 2001) interrogation of built environment health impacts. For instance, she points out that air pollution exposures are spatially patterned within cities according to socioeconomic and race/ethnicity factors and that air pollution affects people differently, with unborn babies, children, elderly people and those with existing conditions being disproportionately affected. Biological, social and built environment factors are interrelated in the potential health effects of air pollution in PDR housing residents. Building on Krieger's constructs of embodiment, pathways of embodiment and cumulative interplay, it is evident that the environmental factors identified in our study of PDR housing (e.g. lack of ventilation and exposure to traffic pollution) may be more problematic for residents of PDR housing who experience other socioeconomic disadvantages. These groups would have greater vulnerability to environmental exposures (e.g. air pollution or overheating) and less power and agency to change their circumstances (and exposures) than other socioeconomically advantaged residents. Some residents in our study described such issues, for example, noting that they would change the blinds or cooling options, but it was not allowed through their rental agreement.

Drawing on ecosocial theory and Shaw's (2004) conceptual model of housing and health, it may be possible that the experiences and wellbeing of study participants who viewed the property as "temporary" and fitting their stage in life, would be different to those who did not have agency in adjusting the property or moving as a result of financial or other circumstances. In other words, living in less-than-ideal living conditions could be tolerated for discrete periods with minimal health and wellbeing impacts for people who feel they can move. Conversely, poor quality PDR housing may have an outsized health and wellbeing impact on people who experience other challenges, such as unaffordable housing, insecure tenure or cumulative housing problems (Singh et al., 2019).

6. Conclusion

This research has established previously unstudied factors regarding the population of PDR housing, the environmental characteristics of such housing and their potential health and wellbeing effects. This exploratory study is the largest investigation of the perceptions of PDR housing residents to date and the only to examine their health and wellbeing. Given our study's potential selection bias (we do not claim to have a representative sample), additional research is required to more fully understand the health and wellbeing impacts of housing deregulation in England and other settings. Given the variation in building regulations and planning policies that affect housing internationally, we do not anticipate that our findings from London would be relevant in all non-residential conversions. Comparative research would be helpful to establish the likely challenges that may transfer internationally. Our national study on this topic aims to include a more socio-economically diverse set of participants from a broader range of geographical locations across England to gain a better understanding of the nature of PDR housing, its occupants and the health and wellbeing impacts of this type of housing. PDR housing occupants in our exploratory study experienced problems with shortage of space, overheating, windows, perceived safety, lack of outdoor space and neighbourhood environmental burdens such as noise and pollution. In combination with existing research, we add new evidence that a deregulated approach to building conversion has led to housing quality problems that are likely to affect residents' health and wellbeing, more so for residents who are socioeconomically

disadvantaged.

Immediate policy recommendations can be made on the basis of this exploratory study, existing knowledge of PDR housing and studies of housing and health, as follows:

Space standards: Although space standards are now in place for PDR housing (Pitcher, 2020), many units created between 2013 and 2021 have insufficient space, sometimes considerably. Through the local plan process, such housing could be identified, and measures could be taken to improve nearby open space provision. Where properties are unreasonably small, housing enforcement powers should be used. Government could consider incorporating the NDSS requirements into the proposed 'national development management' policies which will apply to planning permissions across England in future.

Windows: Central government have required since June 2020 that all new housing created under PD allows adequate natural light to all habitable rooms. We remain concerned that provision of natural light may be achieved without having a window that people can open or view the outdoors through (e.g. through a light well). The PD regulations could be strengthened to ensure adequate window arrangements, building on guidance and requirements used by most local authorities such as encouraging dual aspect windows. Integrated design approaches would help balance natural light, noise and thermal comfort considerations and this could be required as part of the national development management policies and emerging design code work.

Amenities: Access to amenities and greenspace cannot adequately be considered through current PD regulations. These gaps could be addressed through future amendments to the regulations so that PD housing is afforded the same consideration as ordinary housing. We recommend that local authorities consider opportunities to increase amenities and greenspace (including play space for children) near large PDR housing developments.

Ventilation and thermal comfort: Although issues of ventilation and thermal comfort are covered by the Building Regulations in England, previous research (Clifford et al., 2018) has questioned the enforcement of Building Regulations in PD housing. Given the health risks, we recommend that local authorities maximise their ability to monitor these conversions through the use of conditions on prior approvals. Such conditions would require applicants to notify local authorities of the commencement and completion of works to implement schemes and ensure this information is shared between planning and building control teams as appropriate.

Housing enforcement: Although there have been recent improvements to PD regulations, this does not eliminate the risk of future or existing poor-quality conversions. The Housing Act 2004, Housing Health and Safety Rating System, Decent Homes Standard and Homes (Fitness for Human Habitation) Act give local authorities considerable housing enforcement powers for privately rented as well as social housing. Some of the issues raised in our research data, such as insufficient space and natural light, and problems with noise, thermal comfort and ventilation, are covered by the HHSRS, for example. There may also be relevant powers under enforcement of Building Regulations. We recommend that local authorities take proactive action, supported by central government providing adequate resourcing. Visiting PD housing created from 2013-2021 may be a particular priority for housing enforcement teams.

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Data

Due to the nature of the research and associated ethical procedures for data privacy, supporting data are not available.

Ethics statement

This research received ethical approval from the UCL IEDE local research ethics committee, reference 20211115_IEDE_STA_ETH

CRedit authorship contribution statement

Helen Pineo: Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Ben Clifford:** Writing – original draft, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Max Eyre:** Writing – original draft, Software, Formal analysis, Data curation. **Robert W. Aldridge:** Writing – review & editing, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.wss.2024.100192.

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