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Review

High-Rise Apartments and Urban Mental Health—Historical and Contemporary Views

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Abstract: High-rise apartment buildings have long been associated with the poor mental health of their residents. The aims of this paper are to examine whether this connection is necessarily so, by reviewing the evidence relating to the relationships between high-rise living and social wellbeing, occupant's stress levels, and the influence they have on mental health. From selected literature, psychological stress and poor mental health outcomes of the populations that live in high-rise apartments are indeed apparent, and this is particularly so for apartments in poor neighbourhoods. Yet many apartments in developed cities are in affluent areas (particularly those with views of green/blue space), where residences on higher floors are more expensive. Either way, high-rise living and mental health outcomes are a social justice issue. Our review allows us to propose two models relating to high-rise living relevant today, based on these differences.

Keywords: high-rise apartments; social justice; mental health; stress; wellbeing; socioeconomic status

1. Introduction

1.1. History

High-rise and vertical building is thought to have begun in the ancient civilizations of Egypt and the Americas with the construction of pyramids, temples and community structures. The architectural challenges of building multistorey residential buildings continued with the Roman Empire [1]. Large modern high-rise cities and suburbs began to emerge in the last century, particularly across the United States, India, China, South East Asia and South America to house booming populations and massive urban migration, with some of these experiencing overcrowding, high-crime rates and the development of slums, which has helped stigmatise the experience of living in a high-rise apartment as a negative one [2]. This stigmatisation was made worse by the calculated use of high-rise complexes to segregate disadvantaged communities. In the period between 1940 and 1980 projects—such as Pruitt-Igoe in St. Louis, Clichy-sous-Bois in Paris, the Robert Moses-constructed projects in Harlem and the Bronx, and the Robert Taylor homes in Chicago—housed segregated disadvantaged communities in high-rise 'boxes' of poorly built, badly sited and under landscaped residential complexes [3], with most ultimately housing far in excess of their intended capacity. For example, America's largest public housing project, the now demolished Robert Taylor homes, was originally designed for 11,000 people,

but at one point housed over 27,000 people, of whom 95% were unemployed [4]. The escalating level of crime was such that in one weekend 300 separate shooting incidences were reported [5].

More recently, due to inner-city land shortages and compact city policies to reduce urban sprawl, a secondary high-rise boom is occurring in many developed countries, with a greater focus on more lucrative luxury apartment developments in inner cities and more established wealthier suburbs [6,7]. Perhaps to avoid the stigma still attached to housing commission flats, developers have fashionably adopted the term 'apartment' for these modern high-rise blocks [8]. However, while luxury buildings feature elaborate landscaping, spacious living areas and two or more bedrooms [9], there is a continuing socioeconomic divide with large numbers of 'budget' high-rises still found in disadvantaged areas and/or near transport hubs [10]. These are typically more cramped and crowded with lack of family privacy and significantly smaller in floor area than detached houses [11–13].

Today, people choosing to buy or rent high-rise apartments are attracted by a number of extrinsic and intrinsic qualities, although location and cost are usually the deciding factors [14]. Extrinsic factors include perceptions about neighbourhood and other residents [15], as well as proximity to public transport, education facilities and workplaces. For some, this also includes social facilities and nightlife [16]. Not having to maintain a house or garden may also be an extrinsic benefit. Desirable intrinsic qualities that may increase a resident's quality of life include the design of the building, the layout, orientation and size of the apartment [15], views of the surrounding area and safety features such as a security person employed in a lobby.

The majority of high-rise apartment complexes are also less expensive for developers to build than detached homes, so apartments cost less to purchase, even once common land attached to the apartment building and maintained for an annual fee by an apartment owners corporation, is taken into account [7]. In general, this also translates to cheaper accommodation for rental tenants. For this reason, high-rise apartments are increasingly preferred by government agencies providing housing for socially disadvantaged people.

Although there are considerable regional variations, the majority of people living in apartments in developed countries are singles or couples [17,18]. In Australia, only 12.5% of high-rise apartment dwellers are two-parent families [19]. Apartment living is less appealing to families, because children's activity levels are restricted [1,20], and parents are reluctant to let young children play unsupervised in common areas [18]. Apartment dwellers are typically younger people seeking proximity to central locations or older generations no longer wanting to maintain a house and garden or seeking a change in lifestyle [6,7].

The future shows a forward trend in the development of high-rise apartment buildings, and in the number of levels incorporated into each building [14,21], both to accommodate more people and to reduce the individual carbon footprint. The sustainability and quality of life in these buildings underscores the growing need for liveable high-density cities [22] to better manage urban sprawl, traffic congestion and infrastructure demands [16].

1.2. Living Conditions

High-rise apartments of four stories and above [20] have been typically constructed to solve housing and land shortages, and create affordable residential spaces. While this might provide cheaper housing, it can also produce adverse living conditions: apartments can be isolated, difficult to access, hard to ventilate, more elevated from the earth (the soil), and more quarantined from a diversity of microbes, plants and animals than traditional housing [1,23]. This burden of adversity is often greatest in socio-economic disadvantaged communities in high-density areas whose circumstances also restrict access to parks, sporting complexes, gardens or other natural spaces, with consequences for both physical and mental well-being, as well as opportunities to meet and socialise with others. Astell-Burt and Feng [24] found that residents of poor socioeconomic areas were much less likely to exercise—a known predictor of positive mental wellbeing. Many apartment buildings also discourage

or disallow pets, another factor increasing wellbeing. Dogs, for example, encourage physical and social activity (including visits to green spaces) and meeting other dog owners [25–27].

While socioeconomic disadvantage and environmental stress are associated with higher predisposition for mental health issues and drug and/or alcohol dependency, it is unclear whether the 'high-rise environment' is creating the living conditions that lead to mental ill health or whether these environments attract residents that already have mental issues. And if the latter, do these buildings make matters worse? The location, vista, floor level and size of the apartment determine the purchase price or rental yield, and therefore the social demographic that will live there. For example, apartments that were built with luxury in mind in a green interesting environment will attract an older demographic that is seeking a low maintenance property in comparison with an apartment built next to a freeway or railway station that has been built for a housing agency [10].

High-rise buildings can have direct and indirect effects on health. Polluted air quality, unsafe heating systems, the presence of toxic substances, pests, and overcrowding cause direct biological, chemical or physical effects and are easier to address than indirect effects such as individual characteristics and socio-economic circumstances [28]. This paper focuses on the indirect effects on health. We summarise the evidence for links between stress and social wellbeing in city settings, specifically the relationships between high-rise living and social wellbeing and occupant's stress levels, and their influence on mental health. We then formally review the literature on high-rise living and mental health and explore how exacerbation of mental health issues of high-rise dwellers in poor socio-economic areas could be reversed with a number of strategies.

2. The Contribution of Stress and Social Well-Being to Mental Health Problems

2.1. Stress and Mental Health

Mental health is essentially a measure of resilience, and has been defined as "the ability to adapt personally and collectively to a given environment ... to mature and fulfil potentials ... living in homeostatic balance" despite the changing environment [20]. However, there is every indication that factors in the modern environment are eroding resilience and capacity to buffer stress. This is reflected in the staggering increase in mental health disorders, especially anxiety and depression, predicted by the World Health Organisation to become one of the major threats to human health by 2020 [29,30]. This also has implications for economic prosperity, as stress, depression and anxiety are the second major cause (13.7%) of work-related issues in Europe [31].

Stress, described in 1915 by Walter Cannon as 'an acute threat to the homeostasis of an organism', contributes to physical and psychological well-being [32,33]. While humans can readily adapt to acute stress, chronic stress can negatively affect brain structure and function [33]. This can affect long term resilience and predisposition to a range of psychiatric diseases, including schizophrenia, depression, and anxiety [34,35]. Susceptibility to stress is a reflection of complex individual, community, social, and environmental factors, of which neighbourhood factors are clearly important. Mental health disorders are more prevalent in urban areas, although the influence of urban structure is not well known [36].

Living in high-rise flats or apartments has been associated with higher rates of psychological distress [37]. This is multifactorial and may relate to concerns about housing, feeling trapped in deprived social environments [37], fears of falling from windows or balconies, being trapped by fire, earthquake, or terror attacks [1,38], and fears of acquiring a communicable disease through sharing elevator buttons, door handles and hallway air [1].

Of particular concern to public health are high-rise buildings that were constructed during the post-war boom of the 1950–1970s of which many are in poor condition, house disadvantaged communities and are located in low socioeconomic suburbs [28]. Architects in the 1970s raised concerns that "there is abundant evidence to show that high buildings make people crazy" [39]. Even today,

there is a prevailing reputation of high-rise housing as socially isolating living environments, drug and crime havens and generally unhealthy places [28,40].

2.2. Mental Health and High-Rise Living

2.2.1. Floor Level

First, we examined the role of floor level on mental health outcomes. One of the most comprehensive studies on this relationship was examined by Evans et al. [12] who conducted a critical review of the evidence on mental health and housing (including type, floor level and housing quality). They found that six out of eight studies reported residents of higher floor levels to have poorer mental health compared to residents of lower floors. Another study in Germany randomly allocated the wives of British and Canadian servicemen to floors in three to four level blocks of flats. The women on the fourth floor reported twice the levels of psychological distress as those living on the ground floor [41]. In a study of 964 adults living in high-rise flats in Scotland residents from the fifth floor upwards experienced twice the number of symptoms of poor mental health as those on lower floors and detached houses [42]. Similarly, a study found women on higher floors to have greater levels of emotional strain in a study of 442 public housing residents [43].

Evans et al. [12] surmised that more mental health problems are experienced by families living on upper floor levels. Panczak et al. [28] used data of 1.5 million people from the Swiss National Cohort in a more recent study that looked at whether floor level was linked to cardiovascular disease and found instead that people living on the eighth floor and above had a substantially increased chance of suicide by jumping. It may be argued that this was because of easy access to a place of great height but those people living above the eighth floor may have been socially isolated which contributed to their mental health issues. From the fifth floor and upwards residents become disconnected with what is going on in the world around them as they cannot see what is happening on the ground [22,28,44].

In regards to floor level, it is not known whether people with existing mental health conditions choose to live on higher floors, or whether this contributes to their condition via isolation factors; although Moore [45] found that neurotic personalities living in flats were more likely to experience psychiatric illness compared to stable personalities.

2.2.2. Street and Surroundings

Next, we examined whether poor socioeconomic 'streets' similarly contain socially disadvantaged residents as has been shown for high-rise buildings. According to McCarthy et al. [37] symptoms of mental disorders are less likely to be found in streets of similar householders than in high-rise flats located within 'inner-city problem' estates. Rates of psychological distress were compared for different dwelling types located in 'easy to let' and 'difficult to let' council areas and those who lived in 'difficult to let' high-rise housing were shown to be particularly vulnerable. One of the issues with unsatisfactory housing is that when residents get better opportunities and have the resources to move out, they leave the more disadvantaged residents, thereby creating social ghettos [37]. These people may not have a choice in their housing arrangements compared to residents of high-rise buildings in more affluent areas. From the above literature, it appears to be that the types of areas people inhabit are more closely associated with mental illness. For example, Ellaway [46] reported that residents' negative perceptions of their surroundings were associated with poor mental health. A study of four disadvantaged sites in Melbourne, Australia (two high-rise and two detached homes) found that high-rise dwellers had greater negative perceptions of the neighbourhood that led to poor health and well-being than did residents in detached homes, thus leading to the conclusion that a concentration of disadvantaged people in a high-rise building not only increases crime and insecurity for the surrounding area but decreases mental health for the residents [47].

2.3. Thematic Review

The literature was searched for articles assessing the relationship between high-rise housing and mental health and overall 25 relevant journal articles were found, including those already mentioned. Synthesis of key themes, study focus and health outcomes of the 25 journal articles are presented in Table 1. The method and full findings can be found in Appendix A. The majority of studies were conducted by surveys, either self-reported or by interview. The limitations of the searched literature were that not all studies could be retrieved in full detail, and it was not clear how many floor levels were in some of the earlier studies of flats.

Table 1. Summary of key themes, mental health study focus, high-rise health outcome (in comparison to low-rise/detached houses) for 25 found articles from 1967 onwards assessing the relationship between high-rise housing and mental health across a broad spectrum of mental health categories (<less, >greater).

Key Theme	Mental Health Study Focus	High-Rise Health Outcome	References
Social wellbeing	Social isolation/less social interaction	>social isolation	Fanning [41]
		<social support and involvement	Wilcox and Holahan [48]
		<social interaction	Zalot and Webber [49]
		<social networks	McCarthy and Saegert [50]
		<social support	Churchman and Ginsberg [51]
		<social contact	Levi, et al. [52]
		>poor social outcomes	Kearns, et al. [18]
		>social isolation	Chile, et al. [40]
Social wellbeing	Alienation	>feelings of alienation	Amick and Kviz [53]
Psychological health	Nervous disorders	>neurotic scores	Bagley [54]
Psychological health	Psychological problems i.e., depression	>depression	Moore [55]
		>depression	Richman [56]
		>emotional strain	Gillis [43]
		>psychological distress	McCarthy and Saegert [50]
		<depression after moving out	Littlewood and Tinker [13]
		>psychological distress	McCarthy, et al. [37]
		>psychological distress	Husaini, et al. [57]
		< stress coping skills	Dasgupta, et al. [58]
		>mental symptoms	Hannay [42]
		>worse psychosocial outcomes	Kearns, et al. [18]
Psychological health	Suicide	>suicide by jumping on higher floors	Panczak, et al. [28]
Psychological health	Self-rated health	<self-rated health	Verhaeghe, et al. [44]
Psychiatric health	Psychiatric problems	>neurotic personalities likely to experience psychiatric illness	Moore [45] Edwards, et al. [59]
Sense of place	Perceptions of neighbourhood factors that influence health	>perceived negative influence	Warr, et al. [47]
Sense of control	Sense of efficacy (control)	>sense of efficacy after moving out	Rosenbaum, et al. [60]

The studies in Table 1 clearly show an exacerbation of mental health problems in high-rise buildings in comparison to low-rise or detached houses. Psychological problems (58%) and social isolation (35%) featured prominently in the literature as areas of difficulty for apartment dwellers, and contributing to this are socio-economic factors and building design. Chile et al. [40] found consistent experience and expression of social isolation across all age groups. Although there are many factors that contribute to social isolation in high-rise apartment living, social isolation in itself is shown to be an important factor that contributes to mental health problems of high-rise dwellers [18,40].

It may be harder to form a community in high-rise apartments as it feels as if one is living with many strangers [18,50].

Many of the early study subjects of high-rise apartments were women, and Richman [56] found that complaints of depression were common. Gillis [43] found that higher floor levels predicted higher levels of emotion strain, and Littlewood and Tinker [13] found that women showed fewer symptoms of depression after moving out of high-rise apartments.

3. Proposed Causal Sequences

The factors examined in this review are stress, social wellbeing and mental health, and how or whether living in high-rise buildings might be related to them. There are clearly a number of confounding factors—such as the design of the buildings (although no studies have been found on the link between building design and mental health), the place in which they are situated and the type of person living in them—which may be modifying these relationships. Furthermore, the design of many studies does not include prior status of health, and greater than 80% are correlative only.

Drawing from the early research conducted in the 1970s and 1980s, (mostly studied on non-affluent areas), and the construction of modern high-rise apartments in western developed countries, a divide exists today between 'rich and poor', particularly in the area of public housing [61]. We use the flow diagrams below (Figures 1 and 2) to represent both sides of this divide and form the beginnings of a hypothesis on the causal pathways and compounding effects of high-rise apartment living that could be inferred by social justice and affluence [24].

Figures 1 and 2 explain the difference between where a high-rise apartment is situated (low socioeconomic or affluent area) as to what type of demographic might live in an apartment in that area. For example a high-rise in a low socioeconomic area may have environmental health concerns, limited green space, a higher likelihood of renters rather than owners, and occupant dissatisfaction with living space and neighbourhood. This is in contrast to a high-rise in an affluent area that may have interesting views, generous living space, social amenities and nearby green space. From the type of person living in the apartment in combination with the features and landscape of the apartment building, this may then determine whether a person develops a mental health disorder.

Figure 1. A possible causal sequence of high-rise apartments in poor socioeconomic areas where environmental health problems, dissatisfaction of living space, limited green space and a higher likelihood of renting may lead to social isolation, security fears and declining mental health status.

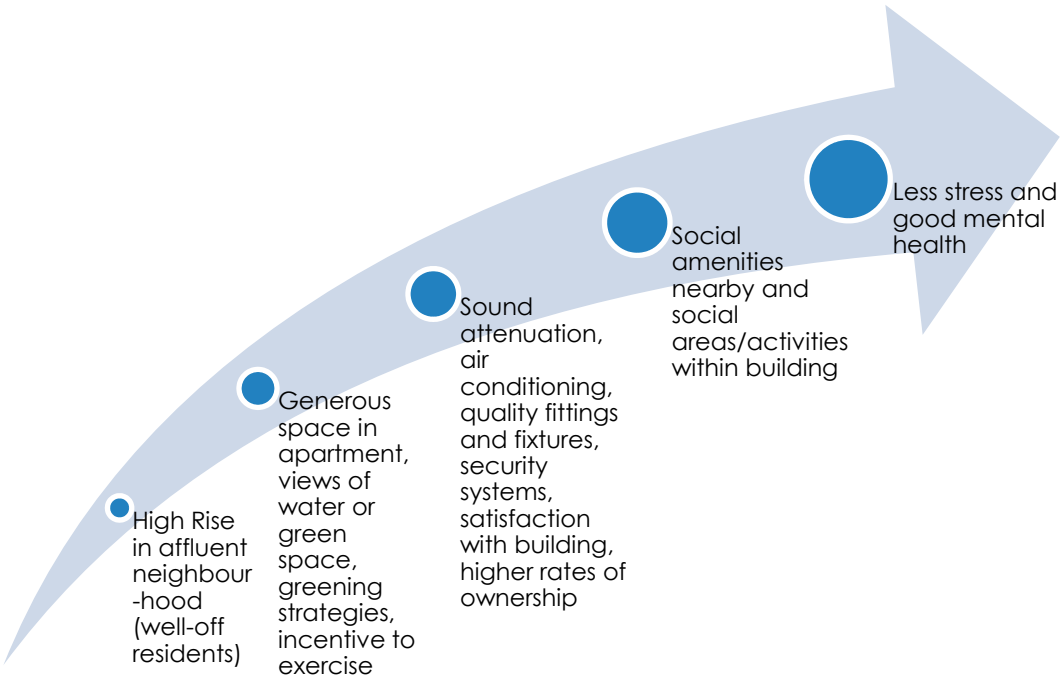

Figure 2. A possible causal sequence of high-rise apartments in affluent areas where good environmental health, satisfaction of living space, access to green space and social amenities that lead to higher ownership, may lead to less stress and good mental health.

4. Housing Interventions to Increase Wellbeing

4.1. Relocation

The demographic concepts described above has lead Gifford [1] to question whether moving people from high-rise apartments in a poor socio-economic area into luxury apartments would improve their mental health. To some degree, the high-rise residents could escape at least some negative effects on mental wellbeing, however if mental disorders/drug and alcohol problems are already established, the benefits may be more limited. In other words, the outcomes of living in a high-rise apartment are moderated to some extent by the 'characteristics and qualities of the residents themselves' [1]. However, two studies have found that residents of high-rise public housing who relocated to detached (stand-alone) homes as opposed to other high-rise buildings showed improved mental health [13,60]. Using 267,000 responses to the Kessler 10 Psychological Distress Scale, Astell-Burt and Feng [24] also found that people on low incomes living in affluent areas were less likely to experience psychological distress than those living in low socioeconomic areas. Collectively these findings suggest that extrinsic living factors remain an important determinant in mental well-being. The Gautreaux Program in Chicago in the United States saw over 3500 families randomly moved from high-rise deprived areas to either other high-rises or suburbs and followed up over a longitudinal study. It was found during telephone interviews of 100 mothers and children who moved to the suburbs, that they felt the high-rise buildings were like 'a restrictive prison environment', and once they moved they gained a new sense of efficacy due to freedom from fear [60]. The reverse is also possible, with depression emerging after being moved from an affluent neighbourhood to one of poor socioeconomic status.

4.2. Green Space

Another potential intervention relates to the amount of green space surrounding residential buildings. If greening strategies were employed around the high-rise buildings so that residents could be exposed to green space, studies have shown that they would report fewer symptoms of psychological distress [29]. An explanation for the better mental health of residents of high-rise buildings in more

affluent areas (with generally more environmental biodiversity) is the psychophysiological stress reduction theory. The theory proposes that contact with nature can shift highly stressed people to a more positive emotional state [62,63]. Van den Berg et al. [64] suggest that the general health of populations in lower socio-economic areas would benefit the most from having green spaces in their living environment.

No research to support the positive impact of access to green space interventions for high-rise dwellers could be found.

5. Further Research

Relocation, as discussed above, warrants a longitudinal study to determine if residents would still experience social isolation and psychological stress after the apparently positive social transition. For green space interventions, carefully controlled comparative studies would need to take into account the likelihood that wealthier high-rise dwellers may be more able to access help for mental health issues, and have access to private transport to visit green spaces and other community facilities. With cross-sectional designs, because of the 'moment in time' aspect of these type of studies there is the classical debate that residents who have poor mental health may choose to live in high-rise apartments and upper floors due to the causality of associations [11,12,44], however this debate may have unfounded claims. Gifford [1] ascertains that no causal conclusions between high-rise apartment living and mental health can be drawn because of the uncertainty over whether any study of high rise apartments meets standard criteria for scientific hypothesis testing, which is often because researchers have been forced to use research designs that are sub-optimal. The majority of studies used self-reported surveys that are still being used in valid research today. Verhaeghe et al. [44] state that most architectural studies claiming that 'high buildings make people crazy' are old and do not take into account socioeconomic position however most high-rise buildings of the post-war construction boom were built in more deprived areas and therefore comparative socioeconomic studies were not considered. Although observational or longitudinal design would be beneficial, the weight of replication of the cross-sectional studies with similar conclusions means that those results should still be taken into account, particularly when informing socioeconomic policy. Additional studies involving floor level and comparisons between high-rise apartment locations (while controlling for socioeconomic status) would be useful to investigate possible interventions and to add to the literature for a more definitive conclusion.

6. Conclusions

Inequitable approaches to urban design have a powerful influence in perpetuating social disadvantage and mental adversity. The socioeconomic status of intended residents remains a dominant undercurrent in divergent approaches to high-rise building design in high-density urban cities. With increasing urban migration, this will amplify health inequities, stress, crime and poverty, making cities increasingly "unhealthy" unless new approaches are mandated. Our investigation of the relationships between high-rise living and social and mental wellbeing revealed clear evidence that location plays a key role in the socioeconomic structure of the building. Poorly thought-out placement of high-rise buildings can have an adverse socioeconomic effect on city areas with a flow-on effect to the people living in those areas. In addition, a concentration of disadvantaged residents in one high-rise building increases the risk of adverse mental health outcomes.

We suggest a series of feasible strategies that may be considered—ideally with urban planners working closely with the communities they serve to co-create healthier environments. Preferably these strategies, wherever applied, should be evaluated for their impact on mental health outcomes. One strategy is to encourage a mixed tenancy of affluent and disadvantaged residents or a mix of privately owned and rented apartments with a view to maintaining this mixed quota. Another is using relocation of residents of high-rise buildings in poor socioeconomic areas to either detached homes or perhaps other high-rise buildings in more affluent areas. A strategy that encourages exposures to

environmental biodiversity (natural environment consisting of trees, plants, grass and species richness) may enhance urban design to benefit the mental health of high-rise dwellers in low socioeconomic areas. This is particularly important in cities with land and resource scarcity that inhibit designing new green spaces or new lower density suburban hubs. It would also help to bridge the gap between wealthy and low socioeconomic areas of a high-density city and can be achieved retrospectively by utilising greening strategies such as streetscaping, redesigning unused grey spaces, living walls, or communal rooftop gardens. For high-rise apartments without balconies, it is advised to develop communal green space around the apartment building and encourage indoor plants. Finally education for strata corporations is also suggested to allow residents to keep pets and grow plants themselves.

Overall, our review shows that social justice has a part to play in redefining equitable high-rise apartment living for better mental health outcomes.

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Appendix A. Investigation of Literature

Methods

The literature was searched using the Web of Science and Pubmed databases. A Google Scholar search was also conducted to help identify any 'grey' literature or papers not in major journals. Key literature was also hand searched for relevant supporting literature not previously identified. Papers were included if they were in English and peer-reviewed journal articles. A time limit was not set as there were a limited number of articles in recent years, and for this reason, reviews were included. Search terms used were 'apartment', 'high-rise', 'condominium' 'high density', 'multi-family', 'urban', 'housing', and 'wellbeing', 'mental health', 'stress' using a variety of combinations to target key references. Identification of areas for future exploration is discussed. Key papers for floor level and mental health were graded according to the criteria in Table A2.

Table A1. Key paper grading criteria of high-rise apartment studies.

A GRADE	B GRADE	C GRADE	D GRADE
contains a comparison between high-rise and low-rise	contains a comparison between high-rise and mid-rise	contains a comparison between high-rise floor levels	contains high-rise data only

Table A2. Summary of findings for articles assessing the relationship between high-rise housing and mental health (n = 25).

Reference and Study Design	Grade	Sampling Method	Type of Housing	Subject's Age, Gender and Ethnicity	Number of People	Health Specialty	Findings of Note
[41] Random Assignment	A	Doctor's Records	Flats vs. houses	Women with medical issues (first consults) from the United Kingdom/Canada	1500	Mental/Psychoneurotic	Social isolation of women in flats
[53] Cross-sectional	A	Survey	High-rise vs. low-rise	Public housing residents (United States)	915	Alienation	Significantly higher levels of alienation in high rise buildings
[54] Cross-sectional	A	Survey	High-rise vs. two stories with a garden	Women (United Kingdom)	69/43	Neuroticism and Medical Doctor (MD) visits	House dwellers had fewer neurotic scores and fewer visits to MD with nervous disorders
[56] Cross-sectional	A	Survey	High-rise vs. low-rise v. houses	Women (United Kingdom)	75	Psychological problems	More loneliness and depression complaints from women in high-rises
[55] Cross-sectional	A	Survey	Flats vs. houses	British and Canadian servicemen's wives	169	Depression	Women living in houses had less depression than those living in flats
[45] Cross-sectional	A	Survey	Flats vs. houses	British and Canadian servicemen's wives	167/167	Psychiatric illness	Neurotic personalities living in flats more likely to experience psychiatric illness than stable personalities in flats. No similar difference in house dwellers
[42] Cross-sectional	A, C	Psychiatric Screening Survey	High-rise Floor 5+ v. Floors 1–4 vs. detached homes	Random adults from a health centre (Glasgow, Scotland)	964	Mental symptoms	People on the 5th floor or above had twice the number of mental symptoms as those on lower floors (or in other types of housing)
[48] Cross-sectional	A	Survey	High-rise vs. low-rise dormitories	Students (2nd-year freshmen) in the United States	110	Social interaction/social support	High rise dwellers found to have less social support and less socially involved
[43] Cross-sectional	A, C	Survey	Eight types of public housing Inc. high-rise	Public housing residents, Canada	442	Psychological strain	Floor level predicts higher levels of emotional strain for women
[49] Cross-sectional	A	Survey	High-rise vs. detached homes	Canada	87	Social interaction	Residents of detached homes had more contact with neighbours
[50] Random assignment	A	Survey	High-rise (14 stories) vs. low-rise (three stories)	Adults, mostly of Puerto Rican or African American descent	60	Psychological distress, social support	Greater social overload, less social networks, less attachment to the community

Table A2. *Cont.*

Reference and Study Design	Grade	Sampling Method	Type of Housing	Subject's Age, Gender and Ethnicity	Number of People	Health Specialty	Findings of Note
[13] Longitudinal	A	Survey	High-rise vs. detached homes	Women	Unknown	Depression	Fewer symptoms of depression after moving out of high-rise
[59] Cross-sectional	A	Survey	Multi-family dwellings vs. single family dwellings.	Canadian families	560	Psychiatric problems	More psychiatric problems amongst men in multi-family housing, no difference in women
[37] Cross-sectional	D	Self-reported survey	Eight types of housing area	Adults, local authority housing, United Kingdom	674 (383 households)	Psychological distress	Symptoms most prevalent in 'difficult to let' housing—location rather than type
[51] Cross-sectional	A	Survey	High-rise vs. low-rise owned apartments	Women, Israel	344	Social interaction	High-rise dwellers encountered more people, and more who were strangers
[57] Cross-sectional	A	Survey	High-rise vs. detached homes	Elderly men and women, South Africa	600	Psychological distress	High rise residents in low SES areas experienced more psychological distress
[52] Cross-sectional	A, B	Survey	High-rise v. mid-rise vs. low-rise	Adults, children and elderly, China	503	Mental health	More social contact with neighbours in low rise v. mid-rise and high-rise
[58]	D	Survey	High-rise	Elderly men, India	100	Mental health	Residents failed to cope with the stress produced by living in high-rise buildings
[47] Cross-sectional	A	Survey	High-rise vs. detached homes	Adults in four socio-economically disadvantaged sites in Melbourne, Australia	1199	Perceptions of neighbourhood factors that influence health	Residents of high-rise towers were more likely than other residents to nominate proximal aspects of the neighbourhood as having a perceived negative influence on health.
[60] Random Assignment	A	Interview	High-rise vs. detached homes	Gautreaux Program—Mothers and children, Chicago, United States	100	Sense of efficacy (control)	Residents who moved out of high-rises into detached homes reported a greater sense of efficacy including freedom from fear.

Table A2. *Cont.*

Reference and Study Design	Grade	Sampling Method	Type of Housing	Subject's Age, Gender and Ethnicity	Number of People	Health Specialty	Findings of Note
[18] Cross-sectional	A	Survey with interview	14 social housing areas, high-rise to low-rise	Glasgow, United Kingdom	1392 high rise/1848 houses	Residential, social, psychosocial	Poor social outcomes in high rise flats (for all factors), some psychosocial outcomes worse in high rise flats.
[28] Cross-sectional	A, C	Survey	High-rise of four floors and above, Comparison of floors 1–15	Census data, Switzerland	1,500,015 (160,629 high rise buildings)	Mortality	Mortality from all causes higher in ground floor dwellers. Suicide by jumping increased on higher floors at a rate of 0.41%.
[40] Cross-sectional	D	Self-reported Survey. Interview, Focus Groups	High-rise	Auckland, New Zealand	429 Surveys, 30 interviews, four focus groups	Social isolation	The experience and expression of social isolation was consistent across all age groups, with highest correlation between functional social isolation and "being student", and older adults (60+ years), length of tenure in current apartment and length of time residents have lived in the inner-city.
[44] Cross-sectional	A	Self-reported Survey	High-rise vs. low-rise	Census data and Belgium Register, Belgium	2,998,227 Male 3,104,593 Female	Self-rated health	Residents' worse self-rated health in high-rise buildings can be explained by the strong demographic and socioeconomic segregation between high- and low-rise buildings in Belgium. A weak, but robust positive curvilinear relationship between floor level and self-rated health within high-rise buildings.

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