Received: 17 December 2019 | Revised: 21 July 2020 | Accepted: 23 July 2020

DOI: 10.1111/hsc.13136

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ORIGINAL ARTICLE

Health and Social Care in the community

WILEY

Association of living density with anxiety and stress: A cross-sectional population study in Hong Kong

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Funding information
Research Grants Council of the Hong Kong Special Administrative Region, China, Grant/Award Number: 4003-SPPR-11

Abstract

This study aims to enrich the comprehension of the effect of living density on anxiety and stress among adults in a global city. A random sample of 1,978 Hong Kong adults was interviewed in a cross-sectional population study in 2014–2015. Descriptive statistics and logistic regressions were used to investigate the association between housing variables and mental health indicators, namely, anxiety and stress. Logistic regression analysis results have shown that by controlling the confounding effect of demographic variables, income poverty, housing ownership and housing cost, the living density was significantly associated with anxiety and stress of residents. Compared with those living in high density of <7 m^2, living in medium density of ≥7 and <13 m^2 was significantly associated with lower risk of anxiety (adjusted OR 0.52, 95% CI 0.30–0.88), and the risk was less for those living in low density of ≥13 m^2 (adjusted OR 0.41, 95% CI 0.23–0.72). Meanwhile, living in low density of ≥13 m^2 was significantly associated with a lower risk of stress (adjusted OR 0.44, 95% CI 0.20–0.97). These results highlighted the significant impact of living density on personal anxiety and stress. Moreover, female, younger adults or those living in income poverty were also at risk of anxiety and stress. In conclusion, our findings implied that improving housing policies, such as building public housing with adequate living areas and market regulation of living density of private housing, would help enhance the mental well-being of residents.

KEYWORDS

anxiety, global city, Hong Kong, housing, living density, mental health, stress

1 | INTRODUCTION

1.1 | Housing and mental health

Rich literature exists in discussing the relationship between housing and mental health (Evans, Wells, & Moch, 2003; Singh, Daniel, Baker, & Bentley, 2019). Negative mental health outcomes have been generally associated with housing instability (Jacoby, Tach, Guerra, Wiebe, & Richmond, 2017) and impoverished living conditions (Kearns, Smith, & Abbott, 1993; Pevalin, Taylor, & Todd, 2008). For example, a study in Australia has shown that people with unfulfilled needs of accommodation were likely to experience high psychological distress (Isaacs, Beauchamp, Sutton, & Maybery, 2019). The enhancement of housing support and assistance generally strengthens the mental health of individuals (Mccauley, Montgomery, Mossey, & Bailey, 2015; Nelson, Aubry, & Lafrance, 2007; Watson, Fossey, & Harvey, 2019). Kyle and Dunn (2008) found that housing intervention was positively associated with the health conditions of people with mental health problems. However, numerous studies

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are needed to investigate the mental status of people living in inappropriate or precarious housing conditions. Durbin et al.(2019) have used longitudinal data and revealed that increasing housing stability could enhance mental health and reduce the stress of homeless people in Canada.

Other housing dimensions, such as housing cost and housing ownership, have also been found to be correlated with mental health. For example, research shows that poor mental health is associated with expensive housing in industrial countries. The effect of financial hardships is critical to the mental well-being of residents (Bentley et al., 2016; Taylor, Pevalin, & Todd, 2007). However, the direct effect of housing costs on mental health is ambiguous and questionable (Daniel, Baker, & Lester, 2018). The mental health level of residents may differ among various housing tenures, such as owned or rental housing. Housing tenure may present various meanings, including security and status, to the residents. Studies have shown that housing tenure were significantly associated with the mental health of residents (Baker, Bentley, & Mason, 2013; Bentley et al., 2016; Searle, Smith, & Cook, 2009; Shaw, 2004). Another longitudinal research has shown that the effect of housing problems on mental health varies among housing tenures (Pevalin, Reeves, Baker, & Bentley, 2017). Few studies have focused on the impact of housing factors on anxiety and stress. Contradictory results have been observed in previous research regarding the impact of housing factors on anxiety. For example, Suglia, Duarte, and Sandel (2011) have found no association between housing conditions and generalised anxiety disorder among women. However, Kang et al. (2016) have stated that the anxiety symptoms of the older persons was associated with their housing status, and a higher risk was observed among those living in rental housing. The housing condition can also be a stressor to individuals. A longitudinal study has shown that the mental strain for industrial workers increased when moving into small houses (Aro & Hänninen, 1984). Another study has also found that poor housing conditions may cause a negative impact on the stress level of young children (Blair, Raver, Granger, Mills-Koonce, & Hibel, 2011).

A systematic review studying the relationship between housing and mental health has concluded that a housing-built environment is clearly related to mental health (Rautio, Filatova, Lehtiniemi, & Miettunen, 2018). However, another systematic review conducted by Singh et al. (2019) have suggested that only a few investigations were made to study the effect of living density on mental health, but there were some exceptions. In the Western context, some studies have focused on the relationship between overcrowding and mental health (Cable & Sacker, 2019). Evans and colleagues have conducted research and reviews on this topic (Evans, 2001; Evans, Lercher, & Kofler, 2002; Evans, Saltzman, & Cooperman, 2001; Evans et al., 2003), and found negative impact of overcrowding on psychological distress. However, these studies focused on the Western context, wherein the housing situation and the perception of residents differ from those in the Eastern or Chinese context (Forrest, La Grange, & Yip, 2002; Hu & Coulter, 2017; Xiao, Miao, Sarkar, Geng, & Yi, 2018; Xie, 2019).

What was known about this topic?

- Housing factors were generally correlated with the mental health of residents.
- The impact of living density on mental health in Asian global cities were understudied.
- Mental health issues and housing problems were among the growing concerns in Hong Kong.

What this paper has added?

- Results indicate the independent impact of living density on anxiety and stress.
- Income poverty, female and young age were associated with greater risk of anxiety and stress in the population sample.
- Our findings have implications for the importance of housing policy intervention on anxiety and stress among global cities.

1.2 | The Hong Kong context

Hong Kong is one of the most densely populated cites in the world (Chan, 1999; Hui & Yu, 2013). More than 7.4 million people live in a land area of 1,104 square kilometers. The shortage of housing and the escalating housing price and rent have caused families to live in tiny flats or rooms, and the living area per capita has been decreasing drastically for the poorest households in the past 10 years. The high density urban feature makes Hong Kong different from the West (Forrest et al., 2002). According to the Hong Kong Government's Census and Statistics Department (C&SD), the median living area per capita in Hong Kong was less than 16 square meters (C&SD, 2017), which is still dense compared with other developed Asian cities, including Tokyo, Shanghai, and Singapore (OHKF, 2018). Moreover, Hong Kong is a typical example of a global city that faces worsening housing problems, including the world's greatest housing affordability stress (Demographia, 2019), rising housing price and rent, and deteriorating housing conditions (Boyer, 2000; Fernandez & Aalbers, 2016; Smart & Lee, 2003). The housing issue has been a concern for the government and the residents (Goodstadt, 2013).

At the same time, mental health is also a growing concern in Hong Kong. A government report has shown that the number of patients with mental health problems has increased in previous years (Food & Health Bureau, 2017). To handle the mental health issue, the Hong Kong government has implemented various mental health services. Nevertheless, these interventions programs, such as increasing the number of social workers or setting up community cenres, have focused on individual services, and the impact of the housing

factors has been ignored in the discussion of mental health enhancement. Despite the growing concern on mental wellbeing, few studies in Hong Kong have focused on the impact of housing factors on the mental health of residents.

In Hong Kong, studies that focused on the association between housing and mental wellbeing are limited, with a few exceptions (Cheung, Tsoi, Wong, & Chung, 2019; Chung et al., 2020; Lam et al., 2015; Ng, Zhang, Ng, Wong, & Lee, 2018; Wang, Huang, Zhang, Wong, & Huang, 2018). In particular, Chung et al. (2020) have found that housing affordability affected physical and mental health, partially through deprivation. Wong et al. (2016) have revealed that psychological distress was associated with the perception of living environments, but not housing tenure; moreover, the effect of living density is ignored in the study. A study in Hong Kong has also shown that the depression level was significantly related to living space satisfaction but not housing tenure (Cheung et al., 2019), but the study did not examine living density in particular, and focused on a special migrant population of foreign domestic workers, rendering the findings not generalisable to the wider population. Wang et al. (2018) have investigated the correlation among housing and community conditions and health situations, but their research did not control for important economic factors and no in-depth analysis about living density was conducted.

1.3 | Aims of the study

Most of the research on housing and mental health have overlooked the importance of living density and did not control for other crucial factors like income poverty and housing tenure, in the analysis. The literature review above shows the research gap for studying the impact of living density on mental health in the Eastern or Chinese context (Hu & Coulter, 2017; Xiao et al., 2018). Therefore, this study aims to examine the impact of living density on anxiety and stress level among Hong Kong residents, controlling for other potential confounding factors. Given the growing prevalence of patients with anxiety and stress, our findings will be important for policymakers and social workers to realise the individual and structural risk factors of mental distress and promote the mental health of people.

2 | METHODS

2.1 | Data and sample

In this study, the data used were collected from the project titled "Trends and Implications of Poverty and Social Disadvantages in Hong Kong: A Multi-Disciplinary and Longitudinal Study." The project was a randomly sampled study in which 25,000 addresses and 200 segments were first obtained from the C&SD of Hong Kong, based on its frame of living quarters (i.e., residential dwellings). We then adopted a two-stage stratification for our sample using living location and housing types of the residents. In the first stage, a random sample of living quarters was selected and all households within the selected living quarters were first included. In the second stage, a respondent aged 18 or above in each household was recruited. If there were more than one adult, the one whose birthday was coming up next was selected. We obtained informed consents from all recruited participants with explanations of the aim and related information of the study. The responses were obtained through face-to-face interviews conducted by professionally trained interviewers at the homes of the respondents. The responses were recorded in a questionnaire of paper format. The survey interviews were voluntary, and participants could withdraw any time at will.

In the survey, 3,791 valid cases were obtained out of 4,947 addresses. The response rate was 60.2%, and a total of 2,282 adults were successfully interviewed. Among them, 1,978 cases were asked to answer the questions related to housing and mental health. These respondents were chosen for the analysis in this study. Please refer to a previous study by Chung et al. (2018) for further details of the sampling method.

2.2 | Ethical consideration

This study was approved by the Survey and Behavioral Research Ethics Committee of the Chinese University of Hong Kong in June 2012.

2.3 | Measures

2.3.1 | Demographic and socioeconomic variables

The demographic and socioeconomic characteristics of the interviewees were used for the analysis, including age, sex, marital status, educational level, and income level. Age was divided into "18 to 40," "41 to 59," and "60 or above." Sex was either "male" or "female." Employment status was categorised into "full-time work," "part-time work," or "unemployed/economically inactive." Marital status was categorised into "married/cohabiting" and "single/separated/divorced/widowed." Educational level was categorised into "primary," "secondary," and "tertiary or above." The income level was one of the crucial factors that could have an impact on the mental health of residents and were controlled in the analysis. The equivalised household income (EHI) was used to measure the income poverty level. It was calculated by dividing the household income by the square root of the number of household members. Cases with a monthly EHI less than the median monthly EHI in this study (HK$6,059.2) were categorised as income poor for analysis.

2.3.2 | Housing-related variables

Housing tenure

In this study, there are two types of housing tenure, namely rented or owned living space, which might have distinct associations with mental health status.

Housing cost

The main housing cost for residents in Hong Kong was the rent or mortgage. The respondents were first divided into two groups, namely, those who needed and those who did not need to pay rent or mortgage. Those who needed to pay were then further regrouped into four quartiles based on the actual housing payment.

2.3.3 | Explanatory variable – living density

Living density was estimated as the living area per capita in this study. The interviewees were asked "how large is your living space?", and there were 10 groups for the answer options, ranging from "smaller than 20 m^2" to "100 m^2 or above." The mid-point of each living density group was used to estimate the living area, ranging from "15 m^2" to "105 m^2," and they were treated as continuous. The living density was then calculated by dividing the living area by the number of household members in their corresponding families.

For the division of living density, the Housing Authority of Hong Kong used 7 m^2 as the division cutoff, where overcrowding was regarded as living density above this figure. (Wong & Chan, 2019). On the other hand, the C&SD also adopted 7 m^2 and 13 m^2 as cutoff for the division of the living area in their official surveys and reports. (C&SD, 2017). We took reference to these cutoffs, and the living density in this study were categorised into three groups of "<7 m^2", "≥7 m^2 and <13 m^2," and "≥13 m^2."

2.3.4 | Dependent variables

A validated Chinese-translated version of DASS-21 (the Depression Anxiety Stress Scale) was used to measure the mental health of the respondents (Moussa, Lovibond, & Laube, 2001). Based on a four-point rating scale, the respondents in this study were asked how much they agreed with the statement in the past week, from 0 (did not apply) to 3 (applied most of the time). The scores for each corresponding question were added together and multiplied by two. The total scores were divided into subscales, which were found reliable and valid to the Asian population (Tran, Tran, & Fisher, 2013). A higher score indicated cases with severe symptoms (Henry & Crawford, 2005). Standardised clinical cutoffs were used for the subscales. In this survey, we collected data on anxiety and stress. The divisions for anxiety were "normal" (0–7), "mild" (8–9), "moderate" (10–14), "severe" (15–19), and "extremely severe" (≥20), while the divisions for stress were "normal" (0–14), "mild" (15–18), "moderate" (19–25), "severe" (26–33), and "extremely severe" (≥34) (Lovibond & Lovibond, 1995). In our analysis, the DASS subscales were further divided into two groups – i.e., cases with scores from "mild" to "extremely severe" were grouped together as having anxiety and stress as in a previous study (Wong et al., 2018).

2.4 | Statistical analysis

The data was weighed according to the distribution of sex and age in the Hong Kong census data in mid-2014 to enhance the representativeness of the sample. After omitting the missing data, 1,978 responses were used in the statistical analysis. Descriptive statistics were estimated, including the demographic and socioeconomic characteristics, income poverty, housing characteristics, and the mental health-related levels of anxiety and stress. Two models of logistic regression were progressively performed to examine the associations of living density with the mental health-related outcomes of anxiety and stress. In Model 1, the impact of demographic characteristic and socioeconomic status on the DVs were examined. In Model 2, housing-related variables, including living density and level of housing cost, were used as IVs to measure their impact on the mental health of residents, controlling for the demographic characteristic and socioeconomic status.

3 | RESULTS

3.1 | Descriptive statistics

3.1.1 | Demographic characteristics and socioeconomic status

We present the weighted results in Table 1. In this sample, 45.3% were male and 54.7% were female. For the age, 40.2% of them were aged 18–40, 35.2% were aged 41–59, and 24.5% were aged 60 or above. In terms of educational attainment, the primary, secondary, and tertiary levels or above represented 25.1%, 55.1%, and 19.9% of the sample, respectively. For marital status, 62.4% of them were married, whereas 37.6% were single, separated, divorced, or widowed. The mean value of EHI was HKD 14,215 (*SD* = 9,562) with 14.4% of the respondents living in relative income poverty.

3.1.2 | Housing characteristics

The participants lived in various types of housing, including public rental housing (51.4%), subsidised home ownership housing (18.2%), private rental housing (10.5%), and private owned housing (19.9%) (Table 2). The mean value of the living density was 15.0 m^2 per capita. 6.6%, 48.1%, and 45.3% of the respondents lived in flats with <7 m^2, ≥7 m^2 to <13 m^2, and ≥13 m^2 per capita, respectively (Table 2). 61.9% rented their housing, while 38.1% owned their homes. 63.1% had monthly housing expenses (including rents or mortgage repayments), while 36.9% did not have any housing expenses (Table 2).

3.1.3 | Outcome measurement – mental health

Both the anxiety and the stress DASS sub-scores ranged from 0 to 21. The mean value of the DASS-Anxiety and DASS-Stress were 1.007

TABLE 1 Demographic information and Socioeconomic status (SES) of respondents

		Weighted %	*N*
Gender (*N* = 1,978)	Male	45.3	896
	Female	54.7	1,082
Age (*N* = 1,978)	18–40	40.2	796
	41–59	35.2	697
	≥60	24.5	485
Educational attainment (*N* = 1,966)	Primary	25.1	493
	Secondary	55.1	1,083
	Tertiary or above	19.9	391
Employment status (*N* = 1,977)	Full-time work	43.5	860
	Part-time work	8.8	175
	Not working/ economic inactive	47.7	943
Marital status (*N* = 1,975)	Married/cohabit	62.4	1,232
	Single/separated/ divorces/ widowed	37.6	743
Poverty status (*N* = 1,839)	Relatively poor	14.4	265
	Relatively non-poor	85.6	1,575

TABLE 2 Housing characteristics of respondents

	Weighted %	*N*
Rent or own (*N* = 1,964)		
Rental housing	61.9	1,217
Owned housing	38.1	747
Paying rent or mortgage (*N* = 1,978)		
No need to pay rent or mortgage	36.9	730
Need to pay rent or mortgage	63.1	1,248
Living density (*N* = 1,975)		
Living area per capita < 7 m^2	6.6	130
Living area per capita ≥7 m^2, <13 m^2	48.1	951
Living area per capita ≥ 13 m^2	45.3	894
	Mean	*SD*
Living area (in m^2) (*N* = 1,975)	44.00	20.00
Living area per capita (in m^2) (*N* = 1,975)	14.96	9.11
Housing cost of those who needed to pay (*N* = 1,248)		
First quartile (<$1,375)	1,057.03	233.12
Second quartile ($1,375–2,000)	1,698.57	195.78
Third quartile ($2,001-$3,000)	2,487.64	297.76
Fourth quartile (>$3,000)	7,806.97	4,795.76

(*SD* = 2.335) and 1.381 (*SD* = 3.027), respectively. 89.9% of our respondents had normal level of anxiety, whereas 10.1% had mild, moderate, severe, or extremely severe level of anxiety. 94.2% had normal level of stress, whereas 5.2% had mild, moderate, severe, or extremely severe level of stress (Table 3). The DASS-Anxiety sub-score had a Cronbach's α of 0.829, and the DASS-Stress sub-score had a Cronbach's α of 0.893, indicating high measurement reliability for both sub-scales.

3.2 | Logistic regression analysis

3.2.1 | Probability of anxiety

In the univariate model, sex, income level, and living density were significantly associated with anxiety. In Model 1, education, employment status, and marital status did not have significant effects on anxiety. Female had larger association with anxiety than male (adjusted OR 1.66, 95% CI [1.19–2.32]). Compared with those aged 18 to 40, respondents aged 60 or above were less associated with anxiety (adjusted OR 0.45, 95% CI [0.26–0.78]). The variable of relative income poverty showed a significant effect on anxiety (adjusted OR 1.91, 95% CI [1.24–2.93]). The impact of income level remained statistically significant among various models. In Model 2, the housing-related variables were added. After controlling for the confounding effects of demographic variables and income poverty, the effect of ownership and housing cost were non-significant, whereas the impact of living density was still significant. Compared with those living in areas with a density of <7 m^2, the impact of living in density ≥7 m^2 and <13 m^2 (adjusted OR 0.52, 95% CI [0.30–0.88]) and ≥13 m^2 (adjusted OR 0.41, 95% CI [0.23–0.72]) on anxiety was significantly smaller. (Table 4).

3.2.2 | Probability of stress

Similarly, sex, age, income level, and living density were significantly associated with stress in the univariate model. In Model 1, female showed larger association with stress than male (adjusted OR 1.77, 95% CI [1.14–2.75]) and those aged above 60 had weaker association with stress than those aged 18 to 40 (adjusted OR 0.29, 95% CI [0.13–0.63]). Income poverty was significantly associated with stress (adjusted OR 2.18, 95% CI [1.24–3.81]), and the effect was larger than that in the univariate crude model. In Model 2, regardless of whether the residents owned or rented their homes, the level of housing cost was not significantly associated with stress. Only the living density exhibited an association with stress. Compared with those living in areas with a density of <7 m^2, the impact of living in density ≥13 m^2 on stress was significantly smaller (adjusted OR 0.44, 95% CI [0.20–0.97]) (Table 5).

4 | DISCUSSION

The aim of this study was to investigate the association between living density and the mental health of residents in Hong Kong. The findings revealed that sex, age, income level, and living density were separately associated with the anxiety and stress levels.

TABLE 3 Mental health situation: DASS (Anxiety and Stress) score

	Weighted %	*N*
DASS – anxiety: normal	89.9	1,773
DASS – anxiety: mild/moderate/severe/extreme severe	10.1	199
DASS – stress: normal	94.2	1,858
DASS – stress: mild/ moderate/ severe/extreme severe	5.2	114
	Mean	*SD*
DASS – anxiety score (*N* = 1,972)	1.007	2.335
DASS – stress score (*N* = 1,972)	1.381	3.027

In this study, the results showed that not all demographic factors were associated with mental health – i.e., educational level, employment, and marital status were not significantly associated with anxiety and stress. However, females were at risk of mental distress. Even in the adjusted models, the association was still significant. Those aged 60 or above were at a smaller risk than young adults. For the economic situation, the income-poor group may have 1.91 times higher odds of being anxious and stressed than the non-income-poor group in Model 1. These odds showed that being female, younger adults, and income poor were associated with higher risk, thus deserving more resources than other groups to support their mental health.

The analysis on the impact of structural or housing factors was the focus of this study. In previous studies, housing tenure was generally found to be associated with mental health (Baker et al., 2013; Bentley et al., 2016). However, in this study, whether the respondents were living in owned or rental housing was not significantly associated with mental health. Similarly, the level of housing costs was also not significantly associated with anxiety or stress, which might echo previous research that questioned the direct effect of housing expenses on mental well-being (Daniel et al., 2018). This observation might reflect the situation among some of the low-income families in Hong Kong living in low-rent public housing.

This study might be consistent with the result from a previous research, which found an association of housing factors with anxiety and stress (Aro & Hänninen, 1984; Blair et al., 2011; Kang et al., 2016). The present research highlighted the impact of living density by controlling for the confounding effects of various socioeconomic factors. Aside from the impact of sex, age, and income, living density showed an independent and significant impact on anxiety and stress. The level of the impact of anxiety and stress gradually increased with increasing living density. Thus, a less dense living space is a protective factor for residents from contracting mental distress. The result also suggests a possible threshold for minimum living density, – i.e., living area per capita <7 m^2 to protect people from mental problems. This finding is important to other global cities which face similar housing problems such as rising rent and deteriorating housing situation.

4.1 | Policy implications

This study highlights the importance of the housing-related factors for enhancing the mental well-being of residents. For policy interventions, this study indicates that the government should take the need for living space enhancements into account in its mental health policies. First, stronger governmental regulation should be imposed on private rental market, especially for living density and rent. In Hong Kong, there was no strict housing regulations on living density and rent level. The housing prices have increased about six times and the rent have increased about three times from 2003 to their highest point in 2019 (Rating & Valuation Department, 2019). Residents, especially those in low-income groups, have been forced by the market to live in smaller and denser housing. Market regulation on living density can protect the basic housing rights of residents and rent regulation can be implemented to prevent a potential increase in rent by the landlords.

Second, building more public housing is one way to ensure the minimum living space and affordability for people with mental health needs. However, despite the existing regulation of the living density for public housing, a long queue still exists in the waiting list for reallocation. Families living in public housing flats with a living density less than 7 m^2 need to wait for the Housing Authority to allocate another housing space for them. The waiting time has become even longer recently (Legislative Council, 2019). Thus, the Housing Authority should consider increasing the construction of decent housing to reallocate families in dense public housing flats to larger flats. Other housing services and assistance, such as rental subsidy and supported housings, may also help those at risk of mental problems (Mccauley et al., 2015; Nelson et al., 2007; Watson et al., 2019).

Apart from policy-level intervention, the findings of this study also have implications for social work practices. Social workers have played key roles in promoting the mental health of people, especially in delivering mental health support services and housing policy advocacy (Mccauley et al., 2015). Our findings recognised the group of households that were at risk of mental distress, which included not only young female adults but also those living in income poverty and in houses with dense living spaces. These results also revealed the problems faced by families living in private, subdivided flats or in overcrowded public housing flats. Interpersonal conflicts among family members living in limited living spaces may also exist, which may affect family relationships and place extra stress and anxiety on them. Moreover, this research highlights the significance of living density on the mental wellbeing of the individuals. Aside from focusing on the direct service provision, greater attention should be paid to the

TABLE 4 Logistic regression model (DV: DASS – Anxiety)

Variables	Crude OR 95% CI	Model 1 adjusted OR 95% CI	Model 2 adjusted OR 95% CI
Demographic and SES			
Gender			
Male	1	1	1
Female	1.78*** [1.31–2.43]	1.66*** [1.19–2.32]	1.70*** [1.20–2.37]
Age			
18–40	1	1	1
41–59	1.06 [0.76–1.47]	1.00 [0.68–1.47]	1.06 [0.71–1.57]
≥60	0.80 [0.54–1.18]	0.45*** [0.26–0.78]	0.55* [0.31–0.98]
Education			
Primary	1	1	1
Secondary	0.83 [0.59–1.16]	0.77 [0.50–1.19]	0.8 [0.52–1.24]
Tertiary or above	0.74 [0.48–1.15]	0.66 [0.36–1.19]	0.74 [0.40–1.36]
Employment status			
Full-time work	1	1	1
Part-time work	0.99 [0.56–1.77]	0.79 [0.43–1.45]	0.78 [0.42–1.43]
Not working/economic inactive	1.33 [0.98–1.81]	1.12 [0.77–1.63]	1.10 [0.75–1.60]
Marital status			
Married/cohabit	1	1	1
Single/separated/divorces/widowed	1.28 [0.95–1.72]	1.27 [0.91–1.78]	1.38 [0.98–1.96]
Income poverty			
NOT relatively poor	1	1	1
Relatively poor	1.86* [1.29–2.70]	1.91*** [1.24–2.93]	1.99*** [1.28–3.09]
Housing characteristics			
Ownership			
Rent	1		1
Own	1.20 [0.88–1.63]		0.72 [0.42–1.23]
Housing cost			
No rent or mortgage	1		1
First quartile (<$1,375)	1.47 [0.94–2.20]		1.42 [0.74–2.27]
Second quartile ($1,375–2,000)	1.14 [0.74–1.76]		1.33 [0.68–2.59]
Third quartile ($2,001-$3,000)	1.35 [0.87–2.12]		1.63 [0.82–3.22]
Fourth quartile (>$3,000)	1.16 [0.73–1.82]		1.30 [0.73–2.32]
Living density			
Living area per capita < 7 m^2	1		1
Living area per capita ≥ 7 m^2, <13 m^2	0.52* [0.32–0.86]		0.52* [0.30–0.88]
Living area per capita ≥ 13 m^2	0.41*** [0.25–0.69]		0.41*** [0.23–0.72]

Note: Significant level, Odd ratio (OR) and 95% confidence interval (CI) for DASS-Anxiety. Model 1 = Demographic +Socioeconomic status; Model 2 = Model 1 + Housing Characteristics.

*$p < .05$.

**$p < .01$.

***$p < .001$.

TABLE 5 Logistic regression model (DV: DASS – Stress)

Variables	Crude OR 95% CI	Model 1 adjusted OR 95% CI	Model 2 adjusted OR 95% CI
Demographic and SES			
Gender			
Male	1	1	1
Female	1.91**[1.27–2.86]	1.77**[1.14–2.75]	1.79*[1.15–2.80]
Age			
18–40	1	1	1
41–59	0.88 [0.58–1.33]	1.02 [0.61–1.70]	1.10 [0.65–1.85]
≥60	0.53*[0.31–0.92]	0.29**[0.13–0.63]	0.38**[0.17–0.86]
Education			
Primary	1	1	1
Secondary	0.81 [0.51–1.28]	0.67 [0.37–1.22]	0.72 [0.39–1.31]
Tertiary or above	1.31 [0.78–2.21]	1.07 [0.51–2.26]	1.20 [0.55–2.60]
Employment status			
Full-time work	1	1	1
Part-time work	0.56 [0.22–1.42]	0.39 [0.14–1.08]	0.39 [0.14–1.08]
Not working/economic inactive	1.35 [0.91–2.00]	1.20 [0.75–1.92]	1.20 [0.74–1.93]
Marital status			
Married/cohabit	1	1	1
Single/separated/ divorces/widowed	1.46 [1.00–2.14]	1.37 [0.89–2.11]	1.52 [0.97–2.39]
Income poverty			
NOT relatively poor	1	1	1
Relatively poor	1.79* [1.11–2.89]	2.18** [1.24–3.81]	2.39** [1.35–4.24]
Housing characteristics			
Ownership			
Rent	1		1
Own	1.16 [0.78–1.72]		0.65 [0.31–1.34]
Housing cost			
No rent or mortgage	1		1
First quartile (<$1,375)	1.24 [0.70–2.17]		1.39 [0.60–3.25]
Second quartile ($1,375–2,000)	1.33 [0.78–2.25]		1.67 [0.72–3.86]
Third quartile ($2,001-$3,000)	1.01 [0.55–1.88]		1.26 [0.50–3.15]
Fourth quartile (>$3,000)	1.20 [0.68–2.13]		1.52 [0.74–3.14]
Living density			
Living area per capita < 7 m^2	1		1
Living area per capita ≥ 7 m^2, <13 m^2	0.69 [0.36–1.32]		0.72 [0.35–1.48]
Living area per capita ≥ 13 m^2	0.48* [0.25–0.95]		0.44* [0.20–0.97]

Note: Significant level, Odd ratio (OR) and 95% confidence interval (CI) for DASS-Stress.
Model 1 = Demographic +Socioeconomic status; Model 2 = Model 1 + Housing Characteristics.
*$p < .05$.
**$p < .01$.
***$p < .001$

structural determinants of health, especially policies that aim to enhance the living environment of service users. The impact of housing on mental health problems deserve additional attention.

4.2 | Strengths and limitations

The major strength of this study is the random sampling of the population. The results can be generalised for the analysis of the relationship between the housing situations and the mental health conditions in Hong Kong, which is a global city set within a Chinese context. We also found an independent effect of the housing factors on mental health-related outcomes. However, several limitations have been noted in the study. First, the data obtained are cross-sectional, which cannot establish the temporality between the explanatory and dependent variables. Further investigation is needed to find the dynamics and progress within the relationship between housing factors and mental well-being. Second, due to the length of our survey, the measurements of mental health focused on the anxiety and stress level of the residents; however, depression had not been measured, as such, the impact of housing on depression cannot be assessed. Further investigations on the association between living density and depressive symptoms are warranted. Nevertheless, as anxiety and stress gave rise to many adverse health outcomes, including depression, this study highlighted the importance of housing perspectives in health studies.

5 | CONCLUSION

This study has shown that female, young adults, and income poor are at risk of anxiety and stress. The independent effect of living density is more significant than housing tenure and housing cost. The effect not only raises concern to the mental well-being of the female, the young adults, and the income poor, but also to the structural impact of the housing environment on mental health. Traditional mental health policies have been limited to individual interventions and direct healthcare services; therefore, additional efforts must be exerted on the regulation of the housing market and public housing provisions.

ACKNOWLEDGMENTS

The work was supported by a grant from the Central Policy Unit of the Government of the Hong Kong Special Administrative Region and the Research Grants Council of the Hong Kong Special Administrative Region, China (Project No. 4003-SPPR-11).

CONFLICT OF INTEREST

No potential conflict of interest was founded.

AUTHORS CONTRIBUTIONS

Siu Ming Chan was responsible for literature search, data analysis, data interpretation and writing of this paper. Hung Wong and Roger Chung were responsible for the overall research design, data collection of the data set. Tat Chor Au-Yeung was responsible for part of the literature search and comments on write-up. All authors read and approved the final manuscript.

ETHICAL APPROVAL

This study was approved by the Survey and Behavioral Research Ethics Committee of The Chinese University of Hong Kong in Jun 2012.

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How to cite this article: Chan SM, Wong H, Chung R, Au-Yeung TC. Association of living density with anxiety and stress: A cross-sectional population study in Hong Kong. *Health Soc Care Community*. 2020;00:1–11. https://doi.org/10.1111/hsc.13136