



# Housing and Subjective Well-Being in Hong Kong: A Structural Equation Model

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## Abstract

The relationship between housing and subjective well-being is receiving growing attention in social research and social policy. However, the mechanisms among housing and subjective well-being, and the mediating role of housing factors between income and subjective well-being was unclear in previous studies. This study aims to investigate the relationship between income, housing, and subjective well-being, and their interacting effects among housing dimensions in Hong Kong, an example of a global city with a dense population and unaffordable housing. A random sample survey of 1480 adult participants in Hong Kong was used for the analysis. Structural equation modelling was applied in studying the path relationships among the key variables. Subjective well-being was predicted by income and housing factors, including housing expense, living density, housing environment problems, and housing satisfaction. The results showed that the impact of income on subjective well-being was partially mediated by housing factors. In group analysis by housing tenure, the housing factors exerted a larger influence on the private rental housing group. This study contributed to highlighting the role of housing factors in happiness studies and the importance of the interaction among housing factors and housing tenures in analyses. The implications of these results and their limitations are discussed.

**Keywords** Housing · Subjective well-being · Structural equation modelling · Housing tenure · Hong Kong

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## Introduction

Subjective well-being (SWB) is receiving growing attention in social science research and social policy design (Ding et al., 2020; dosSantos et al., 2019; Ludwigs et al., 2018). Moreover, SWB has been commonly used as an overall assessment of well-being within other domains of life (Diener, 2000; Gür et al., 2020). The terms SWB, happiness, and quality of life are often used interchangeably (Das, 2008; Lee & Park, 2010). Numerous studies have examined the determinants of SWB (Copestake et al., 2009; Fleche et al., 2012; Sarracino, 2013), and increasing attention has been paid to the relationship between housing and SWB (Bougouffa & Permana, 2018; Clapham et al., 2018; Foye, 2017; Herbers & Mulder, 2017; Zulaica & Oriolani, 2019). Scholars have commonly supported the theory that housing elements are key components of SWB (Mitra, 2016; Pradhan & Ravallion, 2000; vanPraag & Ferrer-i-carbonell, 2006).

Housing provides a place for building family relationships, friendships, and community linkages. A better housing situation generally enhances personal freedom, as well as happiness (Clapham, 2010). To study the relationship between housing and SWB, scholars have suggested several objective and subjective features of housing, such as housing tenure, living density, housing environment, and housing satisfaction (Clapham et al., 2018; Herbers & Mulder, 2017; Ibem & Amole, 2014; Peck & Kay Stewart, 1985). These housing factors were commonly associated with SWB in previous studies, and research generally supported the idea that housing is a crucial element contributing to SWB (Das, 2008; Lee & Park, 2010; Zebardast, 2009). However, the complicated mechanism between housing factors and SWB needs further research (Clapham et al., 2018; Foye, 2017). In the following, the relationship between different housing factors and SWB will first be reviewed. Research related to association among income, housing and SWB will then be studied. After examining the context of Hong Kong and related studies, the research gap and aims of this study will be highlighted.

## Housing Factors and Subjective Well-Being

This section provides a review of the literature regarding the association between SWB and different housing factors, including living space, housing expense, housing satisfaction and housing tenure. This aims at providing a background for further analysis.

First, researchers have examined the relationships between living space, housing environment and SWB. Foye (2017) proposed two pathways for the impact of living space on SWB. One is that an increase in living space can promote activity and freedom. The other is status, which is determined by the relative social position to other relevant individuals. Using UK household panel survey data, Foye (2017) showed that the size of the living space is weakly positively associated with SWB, although this result applied to men but not to women. Nevertheless, it was suggested that further research is needed to explore the effect of housing factors on housing

satisfaction and SWB (Foye, 2017). Another study in South Korea supported the theory that a better residential environment contributes positively to SWB. Results revealed that the happiness of households grows with an increase in living area up to a certain limit, and the impact of living space diminishes after that threshold (Rudolf & Potter, 2015). Research in China also showed similar results: among housing factors, living space and housing environment were found to be particularly important to happiness (Zhang et al., 2018). The physical housing environment, including housing equipment and facilities, also significantly correlated with a subjective assessment of living satisfaction in another study (Amérigo & Aragones, 1997).

Second, the impact of housing expense on SWB is complicated. Generally, SWB is positively associated with less expensive, more affordable housing (Florida et al., 2013). However, some scholars have argued that housing expense is associated with a higher quality of life, and leads to better SWB (Rentfrow et al., 2009). Another study in the US showed that housing prices were not significantly associated with life satisfaction; however, the housing expense to income ratio was negatively associated with SWB for those spending more than 35% of their income on housing (Lawless & Lucas, 2011).

Third, scholars have suggested that subjective housing satisfaction was a key component of overall SWB (Das, 2008; Peck & Kay Stewart, 1985; Zebardast, 2009). Generally, housing satisfaction was found to positively associate with SWB (Das, 2008; Tsurumi & Managi, 2017; Westaway, 2006). For example, a study on urban areas in Nigeria showed that satisfaction with various aspects of housing, such as housing size and housing service and management, were strong predictors of the overall subjective life satisfaction of residents, which was one key element of SWB (Ibem & Amole, 2013, 2014). A recent study in Norway also supported that housing satisfaction was a significant predictor of SWB (Mouratidis, 2020).

Fourth, housing tenure, is another factor whose effect on SWB has been investigated. SWB was found to be associated with home ownership, which not only provided an absolute benefit to the owners but also a related benefit, such as individual social status in the society. Research revealed home ownership is both a positional good and social norm. The SWB of a person was affected by a comparison with the housing status of relevant others. (Foye et al., 2018). A study in China supported the idea that owning a house was positively associated with SWB but varied across different housing tenures (Wu et al., 2019). Other research in China also found that home ownership is positively associated with overall SWB (Hu & Ye, 2020). In addition, renters were found to be more at risk of residential insecurity and uncertainty, which further negatively impacted their SWB. The wealth related to housing ownership was also an important factor associated with SWB (Clapham et al., 2018; Wu et al., 2019). However, several researchers have argued that housing tenure shows no significant impact on subjective quality of life (Patterson et al., 2013). The relationship between housing tenure and SWB is, therefore, unclear.

Fifth, numbers of studies have investigated the combined effect of housing factors on SWB, instead of examining independent factors (Azimi & Esmaeilzadeh, 2017; Hu & Ye, 2020). For example, a study using structural equation modelling (SEM) tested the relationship between housing tenure, crowding of house, type of dwelling, home environment quality, and SWB. Results demonstrated that SWB was

positively associated with living area per capita, while negatively associated with living in an apartment; however, housing ownership was not associated with SWB (Caffaro et al., 2019). Another study in Europe found that the magnitude of housing factors' impact on SWB varied across countries with different levels of housing market regulations and different housing quality. For example, in countries with more regulation of the housing market, the negative effect of renting on SWB was smaller. In countries with a generally higher level of housing quality, the impact of living area was weaker (Herbers & Mulder, 2017). Moreover, a study in China also revealed that housing factors such as housing quality, home ownership, and community facilities all had crucial impacts on living satisfaction. However, the magnitude of the impact of housing factors on satisfaction was different across regions (Ren et al., 2019).

### **Income, Housing, and Subjective Well-Being**

Income was frequently significantly associated with SWB (Bellani & D'Ambrosio, 2011; Boarini et al., 2012; Sarracino, 2013; Stevenson & Wolfers, 2013; Yu et al., 2019), as well as with housing factors (Riazi & Emami, 2018; Stephens & Leishman, 2017; Stephens & vanSteen, 2011; Tunstall et al., 2013). For example, income was found associated with housing satisfaction in previous studies (Knöchelmann et al., 2020; Lee & Park, 2010). Thus, in the study of housing and SWB, income was commonly seen as a crucial factor affecting both housing factors and SWB. Numbers of studies investigated the relationship between income, housing, and SWB (Moisio, 2004; Posel & Rogan, 2016; Sandbæk, 2013). Research in South Africa showed that there was a significant relationship between income and SWB, and SWB was also affected by housing factors other than money. For example, housing ownership, building structure, and indoor housing facilities were found to be associated with SWB, in addition to income (Posel & Rogan, 2016). Another survey in Norway examined the relationship between housing problems, income poverty, and subjective poverty. Results showed that the low-income group faced a higher risk of housing deprivation and subjective poverty than the general population (Sandbæk, 2013). Moreover, the effect of housing factors on subjective satisfaction was found to be larger for low-income families than for the high-income group (Zhang et al., 2018). In addition, housing factors were also found to be mediators between income and SWB. Research in the US showed that housing satisfaction significantly contributed to the SWB of respondents and also mediated the effect of residents' characteristics, such as household income, on their SWB (Lee & Park, 2010). However, not much research has focused on the mediating role of housing factors, and the interaction among housing factors. This needs further investigation.

### **The Context of Hong Kong**

Hong Kong is one of the most densely populated cities in the world (Chan, 1999; Hui & Yu, 2013), and it is a typical example of a global city, with rising house prices and rent, worsening housing conditions, and financialisation of housing (Aalbers,

2017; Boyer, 2000; Fernandez & Aalbers, 2016; Smart & Lee, 2003). According to a survey conducted by Dermographia (2019), houses in Hong Kong were the most unaffordable among 293 metropolitan housing markets in the world. With a shortage of housing and escalating housing prices and rent, families are forced to live in tiny flats or rooms with a poor housing environment. The median living area per capita in Hong Kong is less than 16 square metres (Census & Statistical Department, 2017), which is relatively denser than other Asian cities, such as Singapore, Tokyo and Shanghai (OHKF, 2018). This high-density urban feature of Hong Kong differs from the Western context (Forrest et al., 2002). Although the Hong Kong government is highly concerned about housing issues, housing problems remain unsolved (Goodstadt, 2013).

Despite the growing interest in research into SWB in Asia (Ngoo et al., 2020; Yuan et al., 2020), there is not much research focusing on housing and SWB in Hong Kong, with few exceptions. A recent study reported that housing environment was an influential factor in quality of life; the effect was particularly significant for those living in public housing. The housing environment factors used in the survey included housing size, privacy, ventilation, and noise. These were found to be significant environmental factors of quality of life (Gou et al., 2018). Results also showed that people living in public rental housing were much more concerned about certain housing factors, such as size and noise, than residents living in private housing (Gou et al., 2018). Another recent study in Hong Kong examined the quality of urban life and highlighted the importance of housing factors, including affordability, adequacy of space, and the indoor and outdoor environment, in a subjective assessment of quality of life (Low et al., 2018). The housing factors used in the previous research described above are considered in the analytical framework in this study.

### **Research Gap, Aims of Study, and Research Hypothesis**

The literature review has revealed that income and housing factors are generally associated with SWB; however, the mechanism among them and the mediating role of housing factors between income and SWB was unclear in previous studies. When there is mediating effect, the relationship between income and SWB can be partially explained by housing factors. This not only aimed to verify the association among income, housing factors and SWB, but also highlighted the importance of housing factors in promoting SWB. Moreover, the relationships between income, housing, and SWB are rarely examined in global cities with growing housing problems. The interaction of housing factors was also overlooked in previous research. This provides the research gap for investigation in this study.

This study aims to investigate the relationship between income, housing, and SWB, and the interacting effects among housing dimensions in Hong Kong, an example of a global city. The study uses SEM to examine the path impacts, mediating effects, and interacting effects of housing factors. As previous studies showed that the significance of housing factors varied with different housing tenures (Gou et al., 2018; Wu et al., 2019), this study further tests whether the paths among income, housing factors, and SWB are different in various housing

tenure groups. The conceptual framework was informed by the literature review, especially by the more recent studies (Caffaro et al., 2019; Foye, 2017; Low et al., 2018).

Specifically, this study aims to test the following hypotheses, which were derived from the literature reviewed.

**Hypothesis 1** Income and housing factors are significant predictors of SWB.

**Hypothesis 2** Housing factors mediate the association between income and SWB.

**Hypothesis 3** Significant associations are found among the interactions of housing factors.

**Hypothesis 4** The path weightings are significantly different for various housing tenures.

## Methods

### Data and Sample

The dataset used in this study was collected by the project titled ‘Trends and Implications of Poverty and Social Disadvantages in Hong Kong: A Multidisciplinary and Longitudinal Study’, which aimed to investigate the trends in poverty, living situation, and well-being. Surveys were administered to a random sample of Hong Kong households, which were selected from 25,000 addresses from the Census and Statistics Department using a two-stage stratified method, by living quarters and by district. The first and second waves of the study were conducted from June 2014 to August 2015 and from February 2016 to March 2017, respectively. In the first stage, a random sample of living quarters was selected. All households living in the quarters were selected for the survey. The sampling procedure of the first wave of the survey had already been denoted in detail elsewhere (Chan & Wong, 2020; Chan et al., 2020; Wong & Chan, 2019). Face-to-face interviews were conducted by trained interviewers. The total number of adults interviewed in the first wave was 2282, with a response rate of 60.2%. In the second stage, a respondent aged 18 or above from each household in the first wave was recruited. If there was more than one adult, the one whose birthday was next was selected. This sampling aims to represent all adults aged 18 or above in Hong Kong. Among the respondents, 1476 cases were successfully re-interviewed in the second wave of survey. As the questions focusing on SWB were only addressed in the second wave, these second wave data were used in this study. The sociodemographic characteristics of the sample and comparison with the Hong Kong adult population in the period of data collection can be found in the Appendix Table 8.

## Measures

### Income

Considering the differences in the household size and composition of families, the equivalised household income (EHI) was used to measure the income level. The EHI was calculated by dividing the household income before tax by the square root of the number of household members. To compare with other variables with smaller values, the EHI took a natural logarithm for calculation in SEM.

### Subjective Well-Being (SWB)

This measurement followed the guidelines of the OECD for measuring SWB (OECD, 2013). Three questions were asked: 'Overall, how satisfied are you with life as a whole these days?' (SWB1), 'Overall, to what extent do you feel the things you do in your life are worthwhile?' (SWB2), and 'How about happy?' (SWB3). The respondents answered on a scale from 0 to 10, zero meaning 'not at all satisfied' and 10 meaning 'completely satisfied'. The Cronbach's alpha of these three items was 0.828, which represented a high level of reliability for measuring SWB. These items were used to construct the measurement of SWB.

### Housing Expense

The residents either rented or owned their home; housing expense means, therefore, the monthly rent paid by the renters or the mortgage paid by the owners. This expense also included electricity and water fees, management fees, and government rates. The *housing expense per capita* was obtained by dividing the housing expense by the number of family members. It took a natural logarithm for calculation to compare it with other variables in SEM.

### Living Density

The respondents were asked, 'How large is your living space?', with 10 answer options from '<20 m<sup>2</sup>' to '100 m<sup>2</sup> or above'. The absolute living area was estimated at the midpoint of the responses. The lower limit was marked as 15 m<sup>2</sup>, and the upper one was 105 m<sup>2</sup>. In this study, living density was measured by the *floor area per capita*, which was obtained by dividing the living area by the number of family members. It also took a natural logarithm for calculation in SEM.

### Housing Environment Problem Index (HEPI)

The respondents were asked nine questions about the problems they faced in their living quarters, including poor ventilation, too dark, damp walls and ceilings, rot in window frames, lack of privacy, and rats and insects. The answers for these

questions were summarised to construct the *HEPI*, scored from 0 to 9. Higher scores implied a worse housing environment. The Cronbach's alpha of those items was 0.744, suggesting relatively high reliability in the measurement.

## Housing Satisfaction

To measure housing satisfaction, the respondents were asked, 'How satisfied are you with this area as a place to live?', and the answers ranged from 1 ('very dissatisfied') to 5 ('very satisfied'). Higher scores showed that the residents had higher housing satisfaction.

## Housing Tenure

In the dataset, the tenures of housing were divided into three groups, namely, 'public rental housing', 'private rental housing', and 'owned housing'.

## Analytic Strategy

The associations among variables were tested via SEM with the assistance of AMOS software. First, a confirmatory factor analysis was performed for the latent variable SWB to eliminate factors with low weight loading. This ensured that the constructs in the models were well-explained by those observed variables. Second, SEM was formed with the variables of income, housing factors, and SWB, and tested with a dataset of the overall sample. The impact of housing factors on SWB was compared with that of income on SWB to measure the effect of mediation. Third, SEM was conducted using a group comparison of housing tenure to test whether the mediating effects and the strength of paths were different among housing tenures. The housing tenures 'private rental housing', 'public rental housing' and 'owned housing' were used in the group comparison analysis.

In each SEM model, the regression weight among variables, the direct and indirect effects on the endogenous variable, and the goodness of fit of model were obtained. The chi-square test was inappropriate for evaluating the model fit for the large sample size (Byrne, 2001). The model for the goodness of fit indices is considered a good fit for the RMSEA value  $< 0.08$  (Hu & Bentler, 1999). The IFI, TLI, and CFI are satisfied if they are higher than 0.90 (Bentler, 1990). The goodness of fit index (GFI) and adjusted GFI (AGFI) are considered acceptable if the value is  $> 0.90$  (Hooper et al., 2008). The analysis used bootstrap method with 200 samples and 95% confident interval to estimate significance levels of path effects in SEM.

## Results

### Means, Standard Deviation, and Correlations Among Key Variables

The means and standard deviations (SDs) of the key variables by housing tenures and of the overall sample are listed in Table 1. The correlations among the log of

**Table 1** Means and standard deviation of key variables by housing types

	Overall		Private rental housing ( <i>N</i> =119)		Public rental housing ( <i>N</i> =891)		Owned housing ( <i>N</i> =465)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
EHI	12,469.0	8059.8	14,291.3	10,572.3	10,846.1	5838.3	15,235.4	10,052.9
Housing expense per head (HKD)	673.2	917.7	2076.7	1849.1	589.6	446.2	475.6	931.3
Living area per head (square meter)	15.7	11.4	15.5	11.94	12.73	6.43	21.4	15.78
HEPI (0–9)	0.87	1.50	2.29	2.52	0.68	1.19	0.88	1.48
Housing satisfaction (1–5)	3.81	0.86	3.14	1.02	3.86	0.83	3.91	0.79
SWB1: life satisfaction (0–10)	6.72	1.73	6.56	1.90	6.54	1.70	7.11	1.68
SWB2: life worthwhile (0–10)	6.71	1.80	6.56	1.90	6.54	1.70	7.11	1.68
SWB3: happy (0–10)	6.72	1.90	6.85	1.87	6.55	1.79	6.97	1.76

EHI, housing expense, living density, HEPI, housing satisfaction, and observed variables used in the construct of SWB are listed in Table 2. Pearson's correlation is used to analyse the correlation among variables.

## Measurement Model

For the measurement model of SWB, the descriptive results of the construct are listed in Table 3. Those factors with loadings larger than the minimum acceptable loading of 0.30 (Hair et al., 2014; Tabachnick & Fidell, 2019) were included in the analysis. The factor loadings of the observed variables for SWB ranged from 0.69 to 0.87. All factor loadings were significant ( $p < 0.001$ ) in the measurement model, and the model was saturated. This implied good fit between the observed data and the model. The measurement model of latent construct needs to be verified before being merged into the structural model.

## Overall Model

In the overall model with a total sample, the model demonstrated a good model fit ( $df = 6.40$ ,  $p < 0.001$ ; RMSEA = 0.061, RMR = 0.045, CFI = 0.979, AGFI = 0.962, GFI = 0.989). The chi square and p-value can be overlooked because of the relatively large sample size ( $> 200$ ) (Bollen & Long, 1993; Maruyama, 1998). All the indexes are of good standard for adoption, indicating that the overall model is good. The standardised results of the structural model are shown in Fig. 1 and Table 4.

**Table 2** Means, standard deviation and correlation among observed variables

	1	2	3	4	5	6	7	8
1. Log of equivalized income	1.00							
2. Log of Housing expense per capita	-0.00	1.00						
3. Log of Living density	-0.07**	0.08**	1.00					
4. HEPI (0–9)	0.05	-0.07**	-0.21**	1.00				
5. Housing Satisfaction (1–5)	-0.04	0.03	0.33**	-0.53**	1.00			
6. SWB1: life satisfaction (0–10)	-0.18**	-0.05*	0.04	-0.11**	0.11**	1.00		
7. SWB2: life worthwhile (0–10)	-0.18**	-0.04	-0.04	0.01	0.02	0.70**	1.00	
8. SWB3: happy (0–10)	-0.16**	-0.06*	-0.07*	-0.05*	0.13**	0.60**	0.56**	1.00

\* $p < 0.05$ ; \*\* $p < 0.01$

All the paths to the latent variable in the measurement model were significant, with factor loadings from 0.69 to 0.87. About 6% of the variance of SWB was explained by the exogenous variables. The direct paths of income, housing expense, and housing satisfaction to SWB were significant. Income showed the largest impact on SWB among all exogenous variables ( $\beta = 0.22$ ,  $p < 0.001$ ), and the regression weights of housing expense and housing satisfaction on SWB were  $-0.07$  and  $0.09$ , respectively.

Among the housing factors, income only showed significant impact on living density ( $\beta = -0.07$ ,  $p < 0.05$ ). In terms of the interaction among housing variables, almost all the paths were significant except the impact of housing expense on housing satisfaction. Living density had a relatively large impact on HEPI ( $\beta = -0.20$ ,  $p < 0.001$ ) and housing satisfaction ( $\beta = -0.23$ ,  $p < 0.001$ ), and HEPI further showed large influence on housing satisfaction ( $\beta = -0.49$ ,  $p < 0.001$ ). About 33% of the variance of housing satisfaction was explained by the other housing variables (Fig. 1 and Table 4).

Income had the largest total effect on SWB in the model ( $\beta = 0.22$ ,  $p < 0.01$ ), while among the housing variables, housing satisfaction had a relatively large total effect on SWB ( $\beta = 0.09$ ,  $p < 0.01$ ). The total effect of housing expense, living

**Table 3** Standardized factor loadings of observed variables on constructs

Latent construct	Observed variable	Factor loading
Subjective Well-being (SWB)	SWB1: 'Overall, how satisfied are you with life as a whole these days?'	0.87
	SWB2: 'Overall, to what extent do you feel the things you do in your life are worthwhile?'	0.81
	SWB3: 'How about happy?'	0.69

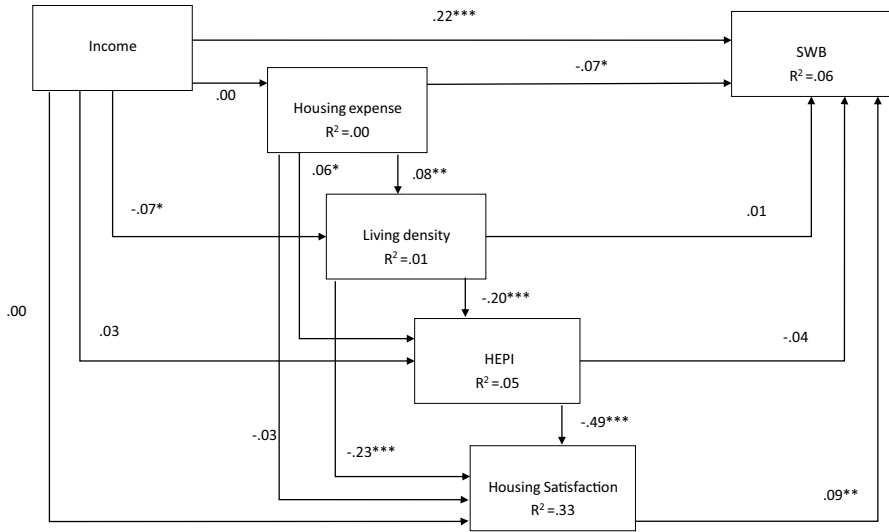


Fig. 1 Overall model. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ . Source Table 4

density, and HEPI on SWB were  $-0.06$ ,  $0.05$ , and  $-0.08$ , respectively. In terms of the interaction of housing factors, living density exerted a large total effect on HEPI ( $\beta = -0.20$ ,  $p < 0.01$ ) and housing satisfaction ( $\beta = 0.32$ ,  $p < 0.01$ ), while HEPI also

Table 4 Path coefficients, standard errors, and critical ratios of the overall model

	$\beta$	S.E	C.R
Housing expense ← Income	-0.002	0.041	-0.091
Living density ← Income	-0.069*	0.022	-2.662
Living density ← Housing expense	0.083**	0.014	3.211
HEPI ← Income	0.031	0.062	1.223
HEPI ← Housing expense	-0.057*	0.040	-2.242
HEPI ← Living density	-0.200***	0.073	-7.799
HS ← Income	-0.002	0.030	-0.087
HS ← Living density	0.227***	0.036	10.395
HS ← HEPI	-0.488***	0.012	-22.385
HS ← Housing expense	-0.027	0.019	-1.253
SWB ← Income	0.220***	0.068	7.968
SWB ← Housing expense	-0.068*	0.043	-2.473
SWB ← Living density	0.010	0.084	0.327
SWB ← HS	0.093**	0.059	2.784
SWB ← HEPI	-0.037	0.033	-1.149

HEPI Housing Environment Problem Index, HS housing satisfaction;  $\beta$  standardized coefficients, S.E. standard error, C.R. critical ratio

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

showed a large effect on housing satisfaction ( $\beta = -0.49, p < 0.01$ ). On the other hand, the impact of income on SWB was mediated through living density, HEPI, and housing satisfaction; however, the magnitude of the impact was relatively weak. The indirect effect of income on SWB was  $-0.01$ . Other housing factors, including living density ( $\beta = 0.04, p < 0.01$ ) and HEPI ( $\beta = -0.05, p < 0.01$ ), demonstrated a larger indirect impact on SWB than income (Table 5).

## Group Models

The sample of respondents was divided into three groups by housing tenures, namely, private rental housing, public rental housing, and owned housing. The results provided a good fit for all models. For comparison, the model explained 22%, 8%, and 2% of the variance of SWB for the private rental housing group, public rental housing group, and owned housing group, respectively. The model explained the variance in housing variables for the private housing group more than for the other groups. For this group, it explained 13%, 12%, 21%, and 60% of the variance of housing expense, living density, housing environment problems, and housing satisfaction, respectively.

The impact of income on SWB demonstrated a large and positive weight in the model for the private rental housing group ( $\beta = 0.37, p < 0.001$ ) and the public rental housing group ( $\beta = 0.20, p < 0.001$ ), but the path was non-significant for the owned housing group ( $\beta = 0.10, p > 0.05$ ). In terms of the impact of income on housing factors, income showed significant influence on housing expense ( $\beta = 0.35, p < 0.001$ ) and housing satisfaction ( $\beta = 0.15, p < 0.05$ ) for the private rental housing group but was not significant for the other two groups. In contrast, income exerted significant impact on living density for the public rental housing ( $\beta = -0.21, p < 0.001$ ) and owned housing groups ( $\beta = -0.21, p < 0.001$ ) but not the private rental housing group.

**Table 5** Standardized total and indirect effect of overall model

	Income	Housing expense	Living density	HEPI	HS
Total effect					
Housing expense	-0.002	0.000	0.000	0.000	0.000
Living density	-0.069*	0.083**	0.000	0.000	0.000
HEPI	0.045*	-0.074*	-0.200**	0.000	0.000
HS	-0.039	0.028	0.324**	-0.488**	0.000
SWB	0.214**	-0.062*	0.047	-0.083**	0.093**
Indirect effect					
Housing expense	0.000	0.000	0.000	0.000	0.000
Living density	0.000	0.000	0.000	0.000	0.000
HEPI	0.014*	-0.017**	0.000	0.000	0.000
HS	-0.038**	0.055**	0.097**	0.000	0.000
SWB	-0.006	0.006	0.038**	-0.046**	0.000

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

In terms of the impact of housing factors on SWB, HEPI showed a relatively large and significant impact on SWB for the private rental housing group ( $\beta = -0.27$ ,  $p < 0.05$ ), but the impact was relatively small for the public rental housing group ( $\beta = 0.09$ ,  $p < 0.05$ ) and non-significant for the owned housing groups ( $\beta = 0.07$ ,  $p > 0.05$ ). In contrast, housing satisfaction had a significant impact on SWB for the public rental housing group ( $\beta = 0.11$ ,  $p < 0.01$ ) but was non-significant for the other two groups.

In relation to the interactions among housing factors, the paths from housing expense to living density, from living density to HEPI and housing satisfaction, and from HEPI to housing satisfaction were all significant for models of the three housing tenures. Generally, the path loadings in the private rental housing group were larger than in the other two groups. For example, for the private rental housing group, living density showed a large negative impact on HEPI ( $\beta = -0.43$ ,  $p < 0.001$ ), and HEPI further negatively impacted housing satisfaction ( $\beta = -0.60$ ,  $p < 0.001$ ). Living density also had a direct positive impact on housing satisfaction ( $\beta = 0.24$ ,  $p < 0.001$ ) (Fig. 2 and Table 6).

Comparing the direct and indirect effects among variables, the factor loadings for the private rental housing group were considerably stronger than for the other groups. In the private rental housing group, income exerted a large total effect on SWB ( $\beta = 0.37$ ,  $p < 0.01$ ), housing expense ( $\beta = 0.35$ ,  $p < 0.01$ ), and housing satisfaction ( $\beta = 0.30$ ,  $p < 0.01$ ). Housing factors, including living density ( $\beta = 0.11$ ,  $p < 0.05$ ) and HEPI ( $\beta = -0.24$ ,  $p < 0.01$ ), also demonstrated a relatively large total effect on SWB. Living density also showed a moderate indirect effect on SWB ( $\beta = 0.087$ ,  $p < 0.05$ ) through HEPI and housing satisfaction. The total effect of living density on HEPI and housing satisfaction were  $-0.43$  and  $0.50$ , respectively (Table 7).

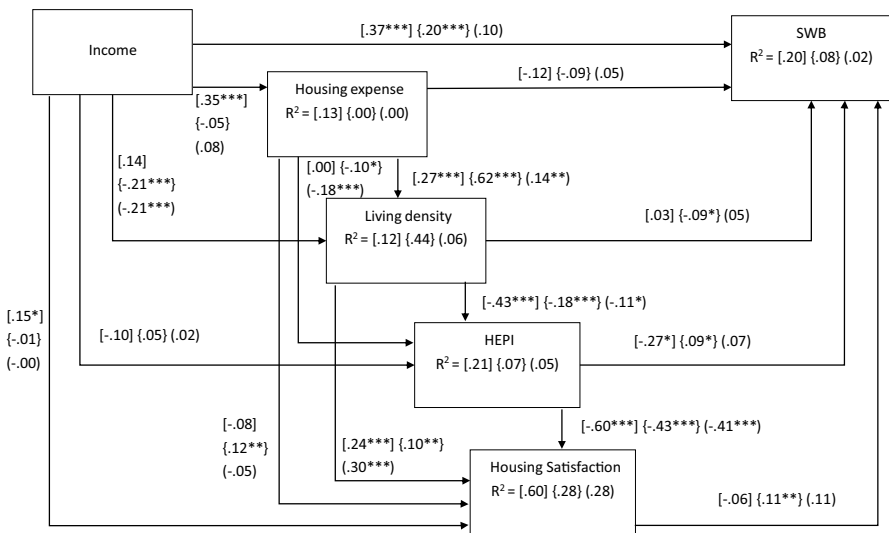


Fig. 2 Group Models. [ ]: private rental; { } : public rental ; ( ) : owned. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ . Source Table 6

**Table 6** Path coefficients, standard errors, and critical ratios of the comparison model

	Private rental housing			Public rental housing			Owned housing		
	$\beta$	S.E	C.R	$\beta$	S.E	C.R	$\beta$	S.E	C.R
Housing expense $\leftarrow$ Income	0.354***	0.1119	4.114	-0.054	0.026	-1.617	0.077	0.093	1.666
Living density $\leftarrow$ Income	0.141	0.091	1.524	-0.208***	0.018	-8.321	-0.205***	0.041	-4.547
Living density $\leftarrow$ Housing expense	0.270**	0.066	2.925	0.622***	0.023	24.868	0.142**	0.020	3.142
HEPI $\leftarrow$ Income	-0.100	0.328	-1.134	0.046	0.070	1.366	0.019	0.107	0.412
HEPI $\leftarrow$ Housing expense	-0.003	0.243	-0.029	-0.102*	0.114	-2.429	-0.181***	0.053	-3.939
HEPI $\leftarrow$ Living density	-0.429***	0.330	-4.933	-0.177***	0.129	-4.077	-0.112*	0.119	-2.412
HS $\leftarrow$ Income	0.151*	0.095	2.388	-0.009	0.043	-0.308	-0.004	0.050	-0.110
HS $\leftarrow$ Living density	0.242***	0.104	3.555	0.112**	0.080	2.903	0.300***	0.056	7.361
HS $\leftarrow$ HEPI	-0.601***	0.027	-9.145	-0.428***	0.021	-14.464	-0.410***	0.022	-10.175
HS $\leftarrow$ Housing expense	-0.075	0.070	-1.167	0.120**	0.070	3.222	-0.047	0.025	-1.150
SWB $\leftarrow$ Income	0.369***	0.253	3.708	0.202***	0.094	5.453	0.095	0.116	1.886
SWB $\leftarrow$ Housing expense	-0.124	0.181	-1.251	-0.090	0.154	-1.930	0.045	0.058	0.891
SWB $\leftarrow$ Living density	0.025	0.282	0.228	-0.096*	0.174	-1.984	0.004	0.137	0.073
SWB $\leftarrow$ HS	-0.061	0.236	-0.436	0.114**	0.073	2.744	0.111	0.108	1.906
SWB $\leftarrow$ HEPI	-0.273*	0.089	-2.085	-0.089*	0.050	-2.179	0.065	0.056	1.157

HEPI Housing Environment Problem Index, HS housing satisfaction;  $\beta$  standardized coefficients, S.E. standard error, C.R. critical ratio

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

**Table 7** Standardized total and indirect effect of private rental housing group

	Income	Housing expense	Living density	HEPI	HS
Total effect					
Housing expense	0.354**	0.000	0.000	0.000	0.000
Living density	0.236*	0.270*	0.000	0.000	0.000
HEPI	-0.202*	-0.118**	-0.429**	0.000	0.000
HS	0.303**	0.061	0.500**	-0.601**	0.000
SWB	0.368**	-0.088*	0.112*	-0.237**	-0.061
Indirect effect					
Housing expense	0.000	0.000	0.000	0.000	0.000
Living density	0.096*	0.000	0.000	0.000	0.000
HEPI	-0.102	-0.116*	0.000	0.000	0.000
HS	0.152*	0.137*	0.258**	0.000	0.000
SWB	-0.001	0.035	0.087*	0.037	0.000

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

## Discussion and Conclusion

We tested the hypotheses using SEM analysis. The results of the overall model support the first part of H1, that income is a significant predictor of SWB, but only partially support housing factors as significant predictors. Among the housing factors, housing expense and housing satisfaction show a significant direct impact on SWB, and living density and housing environment have indirect impacts on SWB. In regards to our second hypothesis, we found that housing factors weakly mediate the association between income and SWB. The mediating effect of housing factors is stronger and more significant for the private rental housing group than for the overall model, which partially supports H2. There are clear interactions among housing factors for all models, supporting H3. In terms of our fourth hypothesis, the factor loadings are indeed significantly different for the various housing tenures and are stronger for the private rental housing group, and H4 is supported.

The results of the SEM models reveal the key role of income in SWB. Overall, income is positively associated with SWB, which corresponds with the results of many previous studies (Diener et al., 2013; Veenhoven & Hagerty, 2006). This study further reveals the mechanism of the impact of income on SWB through various housing factors. The mediating impact of housing depends on different housing dimensions. Generally, living area contributes an important mediating effect between income and SWB, especially in the private rental housing group. Living area exerts an indirect impact on SWB through housing environment and housing satisfaction, echoing previous studies (Foye, 2017; Rudolf & Potter, 2015; Zhang et al., 2018) which support an association between living space, housing environment, and SWB. The results demonstrate that a small living area significantly associates with housing environment

problems and lower housing satisfaction, thereby negatively influencing the SWB of individuals.

In contrast with income, housing expense is negatively associated with SWB in this study, meaning higher housing costs lead to a lower level of SWB. This is consistent with a previous study (Florida et al., 2013) which supported the idea that affordable housing may promote the SWB of households. It also echoes Zhang's (2018) study arguing that although lower housing expense may lead to lower housing satisfaction, it may not further lead to lower SWB, as this study showed. One possible explanation is that although the low-income family households squeeze their housing costs and choose lower quality housing, the level of SWB is also affected by other housing factors. Housing expense is usually correlated with other housing factors, such as housing size and living environment (Ren et al., 2019; Sunega & Lux, 2016).

Another important finding in this study is the various path weightings in the models of different housing tenures. The path weightings are generally stronger for private rental housing groups and weaker for the other two housing tenures. This result echoes previous findings showing the crucial role of housing tenure in influencing the SWB of residents (Hu & Ye, 2020; Wu et al., 2019). In this study, a greater amount of the variance of SWB is explained by the housing variables in the private rental housing group than in the public rental housing group. The SWB of owner-occupiers, however, is the least explained among these models. This implies that the relatively high level of SWB of these residents was not well-explained by income and the four housing factors. Further studies are therefore needed to explore the underlying factors associated with SWB for this group. For example, the wealth and capital accumulated by the housing owners were not considered in this study, but they may critically impact the SWB of households.

It is worth noting that the path weightings from housing factors to SWB were relatively small in the overall model. The overall model may underestimate the impact of housing factors on SWB and the explained variance of SWB. This is because the actual proportions of private rental housing, public rental housing, and owned housing residents in Hong Kong were around 20%, 30%, and 48%, respectively (2% were temporary and non-domestic housing residents), according to the By-census 2016 data (Census & Statistics Department, 2017). However, the proportion of private rental housing in the sample in this study is around 8%, which is much lower than the actual proportion in Hong Kong.

These findings are especially important to Hong Kong, as well as to other global cities facing similar housing problems. The financialisation and increase of private rental housing sector has become a serious issue throughout the world, specifically under the influence of globalisation (Sassen, 2011; Valença, 2015; Wong & Chan, 2019). Housing costs have increased, and the housing environment has worsened. Private housing tenants have suffered more from housing problems than residents in other housing tenure. The low-income households in private housing need to wait public rental housing for a long period of time. In Hong Kong, the average waiting time for public housing for general applicants

increased from around 1.8 years in 2008 to 5.5 years in 2020, according to the latest statistics from the Hong Kong Housing Authority (2020). Moreover, the rent index of domestic private housing rose from 73.6 in 2003 to 194.5 in 2019 (Rating & Valuation Department, 2019). Many low-income households have limited housing choices and reside in small living areas because of this continued increase in housing prices and rent and the waiting time for public housing. This study highlights the negative impacts of the increasing proportion of private rental housing on the SWB of residents living in private rental housing.

To conclude, the findings of this study are important to global cities, such as London, New York City and Tokyo, facing similar housing problems as Hong Kong, including increasing proportion of private rental housing, increasing housing prices and rent, and worsening living environments. This study contributes to highlighting the crucial role of housing factors in affecting SWB and the interactions between housing factors. The study also found that the impact of housing factors is highly related to the housing tenure, with the negative impacts of housing factors on SWB being stronger for the private rental group. This not only informs researchers in housing or poverty studies but also gives policy makers a perspective on how housing affects the promotion of happiness or quality of life. The policy implication of the aforementioned findings is that, to promote SWB, besides implementing policy to enhance the income level of households, housing policies are also critically important. Progressively increasing the supply of public rental housing or instigating tighter regulations on rent and minimum living area can provide stable living arrangements and low housing prices and rent for tenants. The provision of social housing by non-governmental organisations with regulated living areas, housing costs, and indoor facilities is another alternative. With a larger living area, lower housing expense, and fewer housing environment problems, households may have higher levels of SWB, based on the analysis of this study's results.

This work has several limitations that must be considered when interpreting its findings. First, the data set was a cross-sectional sample, which limits the capacity to establish causal relationships among the variables. Further longitudinal or qualitative research can be conducted to study the causal relationships between housing factors and SWB in more depth. Second, we were not able to analyse all the housing factors related to SWB, including the wealth in housing or asset value of the owned housing, due to limited data availability. Further research on the relationship among income, wealth in housing and SWB is suggested. Third, the measurement of SWB were based on three distinct dimensions of SWB (Sirgy, 2012). The result impact of income and housing factors on each single factor warrants further investigation. Finally, the proportion of private rental housing in the sample was smaller than the actual proportion of the overall Hong Kong population. The overall model may therefore underestimate the impact of housing on SWB in Hong Kong.

## Appendix

**Table 8** Sociodemographic characteristics of the sample and comparison with the Hong Kong adult population

	% in the sample	% in Hong Kong adult population
Gender		
Male	40.0	45.1
Female	60.0	54.9
Age		
18–29	10.0	17.5
30–39	9.8	18.1
40–49	20.9	18.0
50–59	19.1	20.0
60–69	19.4	14.1
70 or above	20.7	12.1
Marital status		
Married/cohabit	60.8	58.4
Single/separated/divorces/widowed	39.2	41.6
Education		
Primary or below	35.4	27.3
Secondary	50.9	43.6
Tertiary or above	13.8	29.0
Economic activity status		
Economically active	45.4	51.2
Economically inactive	54.6	48.8

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### Declarations

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

**Conflict of interest** The authors declare that they have no conflict of interest.

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