Housing cost burden, homeownership, and self-rated health among migrant workers in Chinese cities: the confounding effect of residence duration

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Abstract

Housing is a critical social determinant of health. Research on the impact of housing on health among migrants is more complex than that of the general population because of migrants' health decline over time: while migrants exhibit a health advantage upon arrival, they gradually lose it as they stay longer in the host city. Existing studies on migrants' housing and health have paid little attention to the confounding effect of residence duration and are thus prone to misleading results. Using data from the 2017 China Migrants Dynamic Survey (CMDS), this study fills in the gap by examining how the incorporation of residence duration alters the relationship of housing cost burden and homeownership with migrant self-rated health (SRH). The study shows that migrant workers with higher housing cost burden and longer residence duration tend to have worse SRH. Incorporating residence duration attenuates the crude association between homeownership and worse SRH. The results imply that the health decline among migrants can be attributed to the discriminatory *hukou* system—a system that limits migrants' access to social welfare and puts them in a socioeconomically disadvantaged position. The study thus emphasizes the removal of structural and socio-economic barriers faced by the migrant population.

1 Introduction

China has witnessed a surge in internal migration in the past few decades, primarily from rural to urban areas. The number of internal migrant workers increased from 6 million in 1982 to 236 million in 2019, representing an increase from 1% to 17% of the Chinese population (Chan, 2013; National Bureau of Statistics of China, 2020). Most of the people migrated for better economic and employment opportunities. While migrants move to cities for a better living, the

household registration (*hukou*) system has become a barrier for them to climb up the social ladder and integrate into the local communities (Wu and Wang, 2014; Zhang et al., 2014; Zhong et al., 2017). The internal migrants are Chinese citizens, but without local *hukou*, they can only have limited access to social welfare provided by local governments (Song and Smith, 2021). Due to institutional discrimination embedded in the *hukou* system, internal migrants in China are more likely to experience housing affordability problems than local residents (Huang and Tao, 2015; Wang et al., 2010; Zheng et al., 2009).

Housing is a key social determinant of health (Shaw, 2004). Housing-related financial stress, such as a high housing cost burden and a lack of homeownership, is found to be closely related to adverse health outcomes (Burgard et al., 2012; Frank et al., 2006; Joint Center for Housing Studies, 2019; Manturuk, 2012; Meltzer and Schwartz, 2016; Wang et al., 2019, 2021). However, although the influence of financial housing stress on the health of the general population is well established in the literature (ibid.), limited study has been conducted on the migrant population. It is important to study the housing determinants of health among migrants because while migrant workers have made great contributions to the local economy (Chan, 2010; Qian and Guo, 2019), their daily exposure to precarious and insecure housing situations (Huang and Tao, 2015; Lu and Qin, 2014; Wu and Wang, 2014) may jeopardize their health and ability to work.

Research on the impact of housing on health among migrant workers is more complex than that of the general population because of the health decline among migrants over time. When studying housing and health in the general population, it is necessary to adjust for socio-economic status (SES) because wealthier individuals tend to not only have lower housing stress but also better health (Baker et al., 2013; Rohe and Lindblad, 2013). In this situation, SES is called a confounder as it is independently related to both the independent variable of interest

(housing) and the outcome (health). Additional confounders emerge when it comes to the migrant population.

A decline of health over time was observed among (im)migrants in both China and other countries (Chen, 2011; Diaz et al., 2016; Fennelly, 2007; Lu and Qin, 2014). It refers to the phenomenon that while newly arrived (im)migrants tend to have better health than their local counterparts, the health advantage of the migrant population tends to decline as they stay longer in the host city. The health advantage upon arrival can be explained by the migrant health selection, where healthier individuals are more likely to migrate (ibid.). The negative association between residence duration and migrant health is found to be attributed to continuous exposure to acculturative stress, discrimination, and insufficient health care (Ahmed et al., 2016; Leong et al., 2013; Mazur et al., 2003).

Migrants' duration of stay in the host city is not only associated with deteriorating health but also related to a higher probability of owning a home in the city (Boehm and Schlottmann, 2008). We may also expect a decrease in housing cost burden as migrants stay longer and become established in the host city. Residence duration is thus a key confounder to be considered in the study of housing stress and migrant health.

Not taking account of residence duration in the study of housing and health among the migrant population can result in misleading conclusions. For instance, if residence duration was not incorporated as a covariate in the regression analysis, a potentially positive association between homeownership and migrant health could turn out to be insignificant. Researchers might end up with biased estimates if they fail to account for the fact that migrants who own a home in the host city also tend to have stayed longer in the city and thus are more likely to lose their health advantage due to long-term exposure to poverty and a lack of access to health care. The positive health effect of owning a home and having lower housing cost burden can be

canceled out by migrants' long-term exposure to institutional barriers in the host city and thus lead to flawed research results and inaccurate policy implications.

The purpose of this study is to examine how the incorporation of residence duration alters the relationship of housing cost burden and homeownership with migrant self-rated health (SRH). Specifically, I focus on two related research questions: (1) Is there an association between housing cost burden, homeownership, and migrant workers' self-rated health (SRH)? If so, to what extent? (2) Does the inclusion of residence duration modify the relationships of housing cost burden and homeownership with migrant SRH? The 2017 China Migrant Dynamic Monitoring Survey (CMDS) is used to answer the research questions.

I begin the article by reviewing the linkages between financial housing stress, health, and migration. Followed by the literature review are an overview of the data sources, data cleaning process, and descriptive statistics of migrant workers in the sample. I then present results from the logistic regressions on migrant health. I conclude with a summary of findings and a discussion on the research and policy implications.

2 Financial Housing Stress, Health, and Migration

Linking housing cost burden, homeownership, and health

Multiple pathways have been identified that link housing cost burden with people's health conditions. First, households with high housing cost burdens tend to spend less on food and health care (Fletcher et al., 2009; Frank et al., 2006; Joint Center for Housing Studies, 2019; King, 2018). Less spending on food and health care can lead to adverse physical health outcomes. It is especially the case for migrants who live in large cities where the cost of living is higher. Second, residential instability resulted from high housing cost burden shows a negative association with health. Burgard et al. (2012) found that people who have recently experienced homelessness have a higher probability of reporting fair or poor health. Empirical evidence suggests that the negative effect of housing instability on health is mediated by a

decrease in the sense of control and an increase in anxiety and stress (Daoud et al., 2016; Nettleton and Burrows, 1998; Ross and Squires, 2011).

Homeownership is found to have a positive impact on mental health, even after adjusting for selection bias (Rohe and Lindblad, 2013). Manturuk (2012) noted that homeownership is an endogenous variable correlated with other individual and household characteristics that may influence a person's health. Using propensity score matching to correct for the selection bias, Manturuk found that homeownership has an indirect impact on mental health that is fully mediated by the perceived sense of control.

The relationship between homeownership and people's physical health is less clear. On the one hand, Lindblad and Quercia (2015) found that homeownership exerts a positive influence on people's physical health, after controlling for sense of control and other potential confounders. On the other hand, by conducting in-depth interviews in three British regions, Smith et al. (2003) showed that the effect of homeownership on physical health can be negative when the mortgage payment stress is high. It is thus important to look at both homeownership and housing cost burden in the study of housing determinants of health.

Studies on the housing determinants of health in the Chinese context started to emerge in recent years as high-quality survey data became available. The current research mainly focuses on physical housing conditions such as overcrowding, availability of tap water, and access to a private bathroom (Chen et al., 2021; Li and Liu, 2018; Wang et al., 2019; Xiao et al., 2020). A much smaller proportion of the empirical evidence establishes relationships between housing-related financial strains and health. Xie et al. (2021) found that, unlike research in other countries where homeowners exhibited better mental health than renters, homeowners in Guangzhou demonstrated a higher level of perceived stress. Y. Wang et al. (2021) examined the association between housing affordability and health using the 2016 wave of the China Family Panel Studies (CFPS). The authors found that unaffordable housing has a

negative impact on the mental health of urban residents, adjusting for physical housing conditions and neighborhood environment. The study also investigated the impacts of housing affordability across different subgroups of the population (such as male vs. female, low-income vs. high income, and single vs. married) and uncovered significant inter-group differences in the housing effect on health. While Y. Wang et al. (2021) did not include migrant workers as a subgroup of their study, it is reasonable to expect the relationship between housing affordability and health to differ between migrant workers and local residents due to the *hukou*-based discrimination faced by the former group.

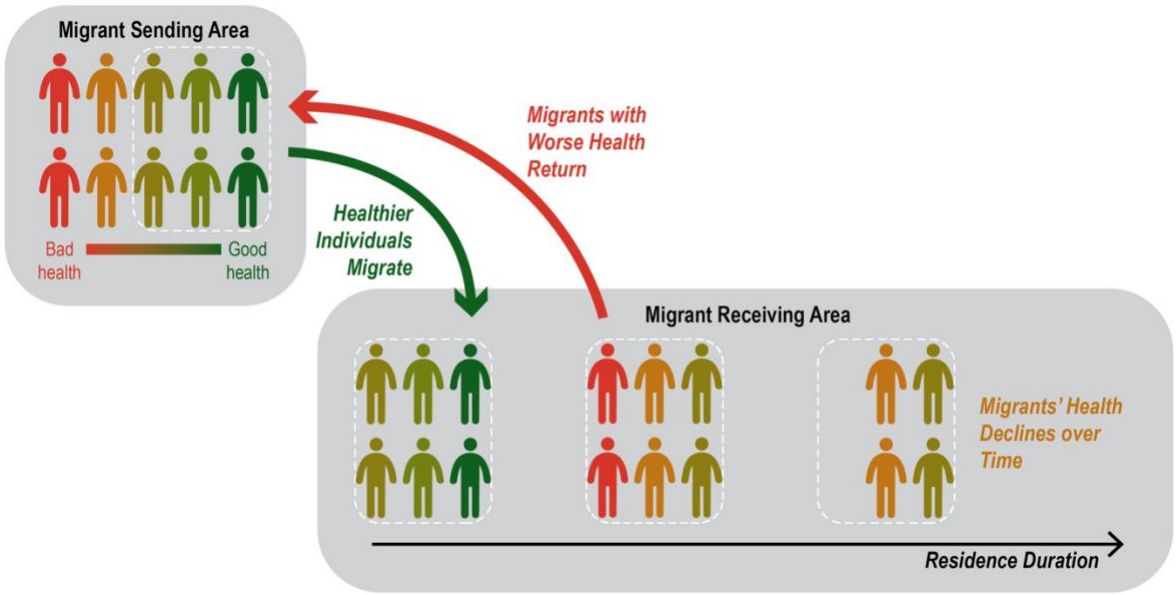
The hukou system

It is common for (im)migrants to have limited access to social welfare in their destinations. In China, migrant workers face greater affordability and health challenges compared to local residents because of the discriminatory *hukou* system. The *hukou* system, established in the late 1950s, assigns each individual a household registration identity, primarily based on place of birth (Song and Smith, 2021).[1] Individual hukou is directly tied to the social welfare that a person can access, which includes but not limited to health care, pension benefits, and housing assistance (Chen and Fan, 2016; Song, 2014; Zhou and Cheung, 2017). Owing to the lack of local *hukou*, migrants are not eligible for most of the subsidized housing programs in large Chinese cities (Huang and Tao, 2015; Wang and Goetz, 2021). Limited access to housing and health care resources in the destination can exacerbate the financial housing stress of migrant workers and result in negative health outcomes. While being healthier than the local population due to self-selection in the migration process (Chen, 2011; Hu et al., 2008), migrants' health deteriorates as they stayed longer in the host society. The phenomenon is also known as the health decline among migrants, which is detailed below.

Health decline among migrants

Socio-economic status (SES) is a confounder that most studies on the housing determinants of health control for as it is associated with both people's health and their financial housing stress (Baker et al., 2013; Rohe and Lindblad, 2013). When we confine the research subject to migrant workers, additional individual-level characteristics need to be accounted for due to the health decline among migrants over time.

Figure 1. The health decline among migrants over time



The health decline was first recognized in western countries where (im)migrants enter the host society with better health but then gradually lose their health advantage and converge to the health level of the natives (Escobar et al., 2000; Fennelly, 2007; Kennedy et al., 2015; McDonald and Kennedy, 2004; Parker Frisbie et al., 2001; Razum et al., 2000). The health advantage of the immigrant population has been ascribed to the self-selection in the migration process in which younger and healthier people are more likely to migrate and (im)migrants with deteriorating health conditions often choose to return to their hometowns (Figure 1). As migrants stay longer in the receiving area, their health gradually deteriorates. The health decline is found to be associated with continuous exposure to acculturative stress, discrimination, and

inadequate access to health care and other social assistances (Ahmed et al., 2016; Leong et al., 2013; Mazur et al., 2003). The health decline has also been observed among the internal migrants in China. Using data from a household survey conducted in Beijing, Chen (2011) finds that the physical health advantage of urban-to-urban migrants in Beijing diminished as their residence duration increased. Xie (2019) uses a fifteen-city migrant survey conducted in China between 2008 and 2009 and find that longer residence duration was associated with worse mental health among migrants.

Residence duration in the host city can affect both migrants' housing stress and their health. Longer residence duration is not only linked with deteriorating health, but also found to be associated with higher probability of owning a home in the destination (Boehm and Schlottmann, 2008). Both immigrants in the US and internal migrants in China are found to rapidly progress into homeownership as they reside longer in the receiving areas (Fang and Zhang, 2016; Myers and Liu, 2005). Housing cost burden also fluctuates with migrant's length of stay in the destination. In the study of immigrant housing experience in the U.S., McConnell and Akresh (2010) found that immigrant housing cost burden varies by the time they spent in the country. They noted that immigrants who stayed in the U.S. between 5 to 10 years have higher housing cost burdens, while immigrants in the country for more than 10 years have lower housing cost burdens than immigrants who arrived less than a year (ibid.). It is thus necessary to control for the confounding effect of residence duration in the study of the housing determinants of health among migrants.

Existing studies on financial housing stress and health fail to account for the health decline among migrants and are thus prone to biased results. Miranda et al. (2017) examine whether the association between homeownership and self-rated health differs by immigration status in the US. Without controlling for residence duration, the authors find that homeownership's association with better self-rated health is limited to US citizens. For non-

citizen immigrants, homeownership is not protective for self-rated health. The result is problematic because it fails to control for the fact that non-citizen homeowners also tend to have longer residence duration in the US and thus are more likely to subject to health decline due to limited access to health care and other social benefits. If the duration of residence is not taken into account in the statistical modelling process, the positive effect of homeownership on (im)migrant health is likely to be canceled out by (im)migrant homeowners' longer exposure to acculturative stress and inadequate health care. Some studies (Li and Liu, 2018; Xie, 2019) include residence duration as a covariate but have not probed into how the incorporation of residence duration would alter the association between housing stress and health among (im)migrants. This paper aims to fill in the gap by examining the confounding effect of residence duration and how it relates to migrant's housing cost burden, homeownership, and health.

3 Data and Methods

The study uses data from the 2017 China Migrants Dynamic Survey (CMDS)--a nationally representative survey conducted by the National Health Commission of China. The survey took the 2016 data on internal migrants reported by 31 provinces in mainland China as the sampling frame. A stratified three-stage probability proportional to size (PPS) technique was used to sample migrants who were 15 years old and over who had stayed in the host city for at least one month without being granted local *hukou* (students and soldiers were excluded). The survey questions covered a broad range of topics, including basic demographic information of the respondents and their family members, employment, migration, health, and social integration. Because the survey did not include residents with local *hukou*, this paper focuses on the migrant worker population itself and explores the within-group differences.

In addition to the cross-sectional data on migrant workers, I also collected supplementary city-level data on population size from municipal statistical yearbooks. Given

that the housing affordability problem among migrant workers is the most pronounced in large cities[2], I confined my study to the 50 largest Chinese cities by population in 2017 (Figure 2). These cities are not only vibrant regional economic centers but also major destinations for internal migration in China. Approximately 460 million people lived in these cities in 2017, constituting 33% of China's total population.

I excluded respondents who identified themselves as unemployed due to the lack of data on their working conditions[3]. To calculate the housing cost relative to income, I remove individuals who reported zero or negative income from the sample[4]. Moreover, I exclude respondents with the top 0.1% of housing cost burden values to avoid distortion resulting from extreme values[5]. Individuals with missing values in the variables of interest were also removed[6]. After data cleaning, I obtained a dataset of 78,081 migrant workers (Table 1).

Figure 2. The 50 largest Chinese cities by population

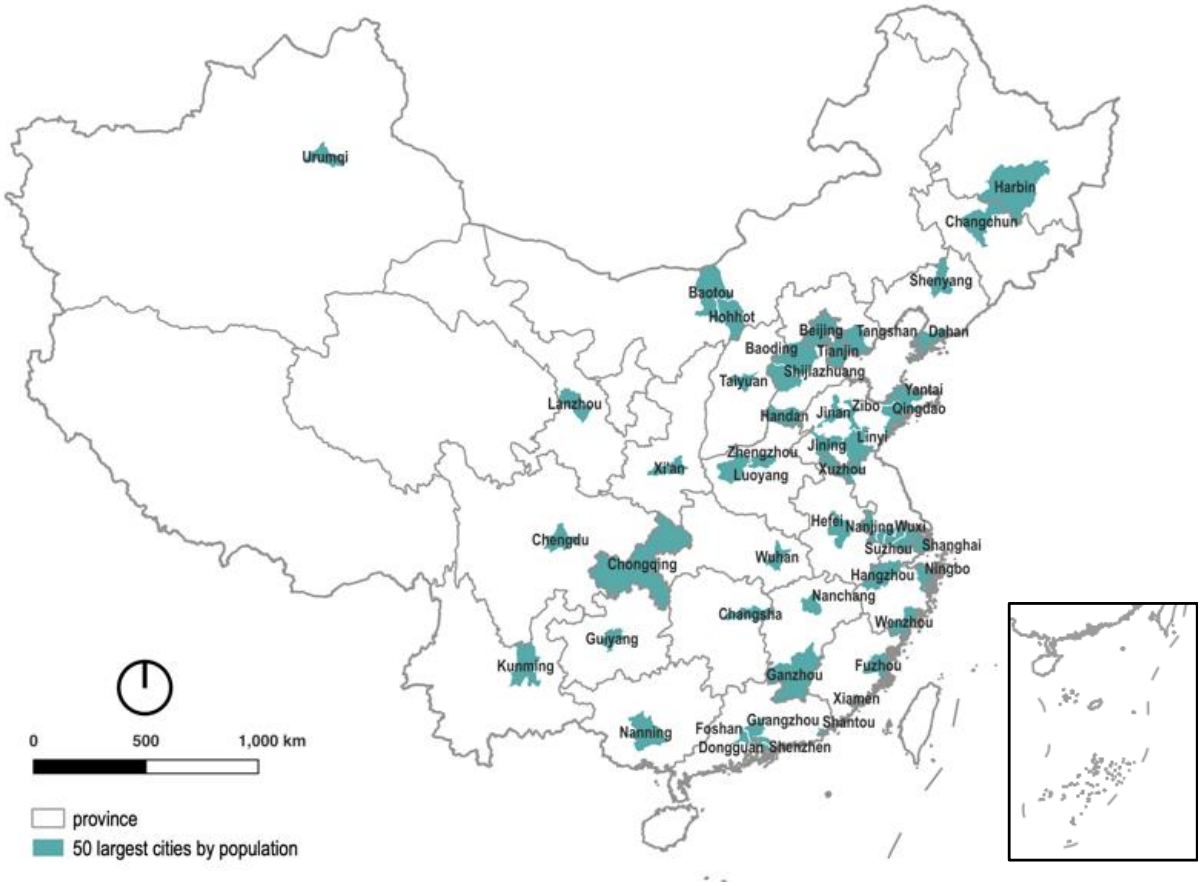


Table 1. Descriptive statistics and bivariate analyses (n=78,081)

Variable	Weighted Mean/percentage	Unweighted Mean/percentage	Average Marginal Effect (AME) †
Self-rated health (%)			
Good	85.6	85.8	
Fair/poor/very poor	14.4	14.2	
Housing cost burden (mean)	12.5 (11.9)	13.8 (12.9)	-0.006***
Homeownership (%)			
Homeowner	16.8	22.7	-0.018***
Non-homeowner	83.2	77.3	
Residence duration			
<1 year	15.9	14.9	
1 to <5 years	36.5	40.5	-.015***
5 to <10 years	23.9	24.1	-.041***
>=10 years	23.7	20.5	-.074***
Demographics			
Age (year, mean)	35.8 (9.6)	35.3 (9.7)	-0.070***
Gender (%)			
Female	44.1	43.8	-0.006*
Male	55.9	56.2	
Marital status (%)			
Married	80.4	79.2	-0.061***
Not married	19.6	20.8	
Household size (mean)	3.1 (1.2)	3.0 (1.2)	-0.061***
Education (%)			
High school and above	43.5	45.0	0.052***
Middle school and below	56.5	55.0	
Monthly earnings (thousand yuan, mean)	5.5 (4.7)	4.9 (4.1)	0.024***
Work hours (mean)	54.8 (17.2)	55.1 (17.5)	-0.017***
Occupation (%)			
Senior Official/Manager/Professional	12.0	11.2	
Clerical Support Worker	1.6	1.7	0.019*
Service and Sales Worker	51.0	59.0	-0.028***
Agricultural/Forestry/Fishery Worker	0.7	0.8	-0.110***
Manufacturing/Transport/Construction Worker	29.4	22.3	-0.020***
Other	5.3	5.0	-0.050***
Labor contract (%)			
Yes	83.9	81.5	0.025***
No	16.1	18.5	
Agricultural hukou (%)			
Yes	80.4	76.9	-0.021***
No	19.6	23.1	
Family member with local hukou (%)			
Yes	5.4	6.9	-0.002
No	94.6	93.1	

Note: Standard deviations are in parentheses.
† Unweighted bivariate logistic regressions. AMEs for continuous variables are for a standard deviation increase.
*p<0.05, **p<0.01, ***p<0.001 (two-tailed test).

Self-rated health (SRH) was used to capture the migrant's overall health status. As an assessment of individuals' subjective health at the time of the survey, SRH is a reliable

predictor of mortality and other health outcomes (Benyamini, 2011). CMDS asked migrant workers to rate their health on a four-point scale ranging from 1 (very poor) to 4 (good). About 85.6% of the migrant workers in the sample reported themselves as having good health. Because SRH is a highly skewed variable, I created a binary variable with 1 indicating good health and 0 indicating fair/poor/very poor health. The dichotomization of SRH has been used in prior research in the fields of urban and housing studies (Collins et al., 2009; Kemppainen et al., 2020).

Logistic regression is used to assess the association between financial housing stress with an individual's self-rated health. The logistic regression model has the following general specification:

$$\begin{aligned} Logit(Good\ health) = {} & \beta_0 + \beta_1(Housing\ cost\ burden) \\ & + \beta_2(Homeownership) \\ & + \beta_3(Demographics) \\ & + \beta_4(City\ fixed\ effects) \\ & + \beta_5(Residence\ duration) \end{aligned} \quad (1)$$

Housing cost burden refers to the percentage of household income used on housing-related costs. It is calculated by dividing a household's monthly housing cost (on rent or mortgage payment) over its monthly income. Some employers provide rental subsidies or free dormitories for migrant workers. For migrant workers who received either type of rental support, a question was asked in the survey about the estimated market value of the rental support they received. I took the reported amount of rental assistance into account in the computation of the housing cost burden[7]. It is worth noting that the housing cost does not include utility costs due to limited data availability. Homeownership is defined as owning a residence in the host city. As shown in Table 1, the weighted homeownership rate for migrant workers in the sample was 16.8% in 2017, significantly lower than the 80.8% overall homeownership rate in urban China (Gan, 2018).

Thirty percent of household income is commonly used as an upper threshold of housing affordability, indicating that households that pay over the limit as financially burdened (Leishman and Rowley, 2012; Schwartz and Wilson, 2008; Stone, 2006). Applying the thirty percent criterion, about 8.4% of the migrant workers were cost-burdened in 2017. This proportion is consistent with the previous literature on migrants' housing affordability in China (Huang and Tao, 2015; Li and Liu, 2018). When breaking down by homeownership (Table 2), the proportion of the cost-burdened is higher among the homeowners than the non-homeowners. Bivariate logit analysis shows that, on average, the probability of being housing cost burdened is 0.079 higher for migrants who own a home in the host city ($p<0.001$). Housing cost burden was treated as a continuous variable in the regression analysis. I have run models in which housing cost burden was coded as a categorical variable (using 30% of household income as the threshold). The size and direction of coefficients were consistent regardless of the housing cost burden measure utilized (see Appendix, Table A1).

Table 2. Housing cost burden, by homeownership

		Not cost burdened	Cost burdened (> 30% of income)
Weighted	Homeowner	83.4	16.6
	Non-homeowner	93.3	6.7
Unweighted	Homeowner	83.5	16.5
	Non-homeowner	91.4	8.6

Note: Relative frequency within each row.

Residence duration is treated as a categorical variable to make the analysis comparable to prior research (McConnell and Akresh, 2010). To ensure the robustness of the results, I have run models in which residence duration was coded as a continuous variable (see Appendix, Table A2). The results were consistent regardless of the residence duration measure used. The crosstabulation between homeownership status and residence duration suggests that, aligning with prior research (Boehm and Schlottmann, 2008) the probability of being a homeowner increases as migrant workers stay longer in the host city (Table3). Migrant housing cost burden varies by the time that they spent in the host city. Different from immigrants in the United

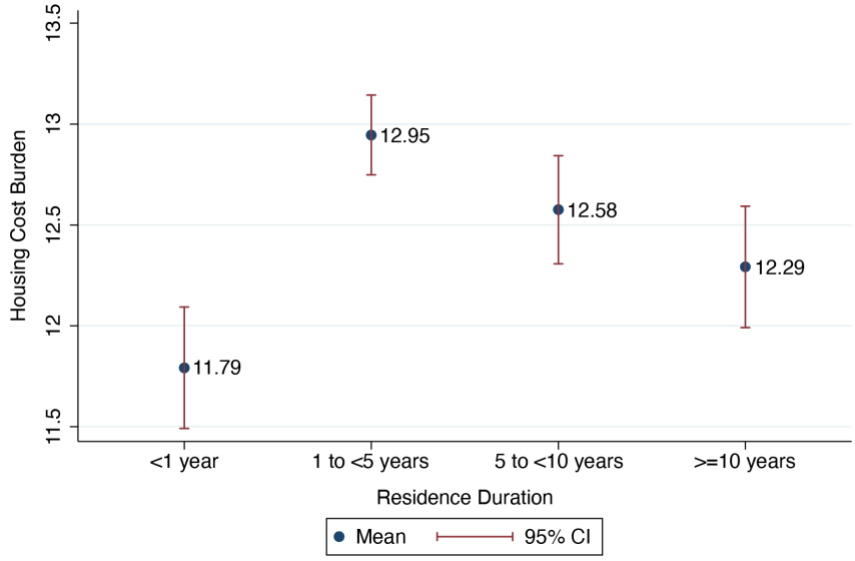
States (McConnell and Akresh, 2010), internal migrants in China have the lowest housing cost burden upon arrival (Figure 3). The average housing cost burden of migrants who stayed in the host city between 1 to 5 years is statistically higher than that of migrants who arrived at the host city in less than one year ($p<0.001$). However, the average housing cost burden of long-term migrants (>=10 years) is not statistically different from that of the newly arrived migrants.

Table 3. Homeownership, by residence duration

		Non-homeowner	Homeowner
Weighted	<1 year	94.6	5.4
	1 to <5 years	87.5	12.5
	5 to <10 years	80.2	19.8
	>=10 years	71.8	28.2
Unweighted	<1 year	91.4	8.6
	1 to <5 years	81.2	18.8
	5 to <10 years	72.2	27.8
	>=10 years	65.4	34.6

Note: Relative frequency within each row.

Figure 3. Housing cost burden, by residence duration (weighted)



I also controlled for demographic covariates, which include age, gender (female=1), marital status (married=1), household size, education attainment (high school and above=1), monthly earnings, work hours[8], occupation, labor contract (yes=1), type of hukou (agricultural=1)[9], and family member with local hukou (yes=1)[10]. The categorical variable occupation is employed to isolate the cross-occupation heterogeneity in health risks. The

occupation covariate can partially capture the effect of physical work demand on health, since some occupations (e.g., agricultural workers) tend to have higher physical demand and worse working environment than others (Fan et al., 2015; Liu et al., 2012; Yu et al., 2012). City fixed effects were included to control for all between-city differences.

Unweighted data were employed in the regression analyses. I did not use sampling weights because (1) unnecessary weighting results in inefficient estimators without reducing bias (Bollen et al., 2016); (2) further comparison of marginal effects of variables of interest shows that the differences between the weighted and unweighted models are not statistically significant (see Appendix, Table A3).

4 Results

The temporal dimension of financial housing burden and health

Longer residence duration is associated with a shifting level of housing cost burden, a higher probability of owning a home in the host city, and a lower probability of having good health. The relationship between residence duration and housing cost burden changes over time. Newly arrived (<1 year) and long-term (>=10 years) migrant workers have the lowest level of housing cost burden, while migrant workers who stayed in the host city between 1 to 5 years are, on average, the most housing cost burdened (Figure 3). Longer residence duration results in a higher probability of being a homeowner (Table 3). For a standard deviation increase in a migrant's residence duration (about 5.8 years), the migrant's probability of being a homeowner rises by 0.080 ($p<.001$). The same amount of increase in the residence duration decreases the migrant's probability of reporting good health by 0.027 ($p<.001$). The results are consistent with prior research on residence duration and its relationship with migrant homeownership (Boehm and Schlottmann, 2008; Myers and Liu, 2005) and health (Chen, 2011; Diaz et al., 2016).

Lower housing cost burden, better health

Four nested models of housing cost burden and homeownership on migrant SRH were tested (Table 4). The first model includes only housing cost burden and homeownership as the explanatory variables. Demographic covariates were added in the second model, and then city fixed effects in the third model. Residence durations were incorporated in the fourth model. It is worth noting that nested model comparisons are problematic for logistic regressions because of the possible heterogeneity in the residual variances (Kuha and Mills, 2020; Long and Mustillo, 2018; Mood, 2010). When comparing the coefficients of different models on the same sample, y- or fully-standardization can solve the problem of unobserved heterogeneity. Here, I present the fully standardized coefficients. From Model 1 to 4, the Bayesian information criterion (BIC) indicates an increase in the model fit to the data, adjusting for model complexity.

The regression results suggest that the negative association between housing cost burden and migrant SRH is persistent, even after controlling for demographics, city fixed effects, and residence duration ($p<.001$ in Model 1-4). In Model 4, a one standard deviation increase in housing cost burden is associated with, on average, a 0.0259 standard deviation decrease in the log odds of being in good health ($p<0.001$). Higher housing cost burden, on average, leads to worse health among migrant workers.

The association between homeownership and health changes significantly after controlling for residence duration. In Model 1, the log odds of reporting good health for migrant homeowners are, on average, about a 0.0336 standard deviation lower compared to that for migrant non-homeowners ($p<0.001$), suggesting that owning a home in the host city is associated with worse health outcomes among migrant workers. The negative association between homeownership and good SRH no longer exists after residence duration is added to the model. Incorporating residence duration as a covariate greatly attenuates the negative association between homeownership and good health, which is observed when comparing the coefficients and p-values of Model 3 (-0.0129, $p<0.05$) and Model 4 (-0.0068, $p=0.277$). The

linkage between owning a home in the host city and worse health is no longer statistically significant after all covariates are included.

Table 4. Logistic regressions on good health (n=78,081)

	Model 1	Model 2	Model 3	Model 4
Housing cost burden	-0.0250***	-0.0411***	-0.0257***	-0.0259***
Homeowner	-0.0336***	-0.0409***	-0.0129*	-0.0068
Demographics				
Age		-0.2599***	-0.2797***	-0.2698***
Female		-0.0422***	-0.0488***	-0.0486***
Married		-0.0079	0.0115	0.0131
Household size		-0.0029	-0.0065	-0.0021
High school degree and higher		0.0060	0.0135*	0.0129
Monthly earnings		0.0650***	0.0595***	0.0600***
Work hours in the past week		-0.0458***	-0.0424***	-0.0409***
Occupation (ref. Official/manager/professional)				
Clerical support worker		0.0141*	0.0183**	0.0180**
Service/sales worker		0.0360***	0.0409***	0.0418***
Agricultural/forestry/fishery worker		-0.0052	-0.0087	-0.0093
Manufacturing/transport/construction worker		0.0235*	0.0209*	0.0204*
Other		-0.0023	-0.0005	-0.0002
Labor contract		0.0282***	0.0246***	0.0262***
Agricultural hukou		-0.0283***	-0.0030	-0.0027
Family member with local hukou		0.0017	-0.0089	-0.0075
Residence duration (ref. <1 year)				
1 to <5 years				-0.0134
5 to <10 years				-0.0328***
>=10 years				-0.0480***
City fixed effects			Yes	Yes
Pseudo R2	0.0009	0.0477	0.0851	0.0858
BIC	63751	60935	59104	59088

Note: Coefficients are fully standardized.
*p<0.05, **p<0.01, ***p<0.001 (two-tailed test).

The confounding effect of residence duration

Because logistic regressions are nonlinear in terms of the relationship between predictors and the probability of the outcome, we cannot only compare the fully standardized regression coefficients within each model to assess the cross-model difference (Mize et al., 2019). To assess a variable's effect change across different models, marginal effects are useful because they quantify effects in probabilities (instead of log odds) and they avoid the unobserved heterogeneity problem when comparing logit coefficients (Karlson et al., 2012). In Table 5, I examine how the average marginal effects (AMEs) of housing cost burden and

homeownership change when covariates are added to the model. The AME tells us how much the predicted probability would change for a discrete change in the variable of interest, averaging across all respondents. The AME of housing cost burden (+SD) does not change when residence duration is introduced to the model (Model4 - Model3), indicating no confounding effect of residence duration on the relationship between housing cost burden and migrant SRH.

Table 5. Cross-model difference in the average marginal effects (AMEs) of housing cost burden and homeownership on good health

Panel A: AME	Model 1 Housing cost burden + Homeownership	Model 2 + Demographics	Model 3 + City fixed effects	Model 4 + Residence duration
Housing cost burden (+SD)	-0.0056***	-0.0093***	-0.0057***	-0.0057***
	(0.0013)	(0.0012)	(0.0012)	(0.0012)
Homeowner	-0.0182***	-0.0223***	-0.0068*	-0.0035
	(0.0031)	(0.0034)	(0.0033)	(0.0033)
Panel B: Cross-model differences		Model2 - Model1	Model3 - Model2	Model4 - Model3
Housing cost burden (+SD)		-0.0037***	0.0036***	-0.0000
		(0.0004)	(0.0004)	(0.0000)
Homeowner		-0.0041**	0.0155***	0.0033***
		(0.0015)	(0.0014)	(0.0005)

Notes: Seemingly unrelated estimation (SUEST) is used to combine estimates from Model 1-4 and compare marginal effects. Standard errors are in parentheses.
*p<0.05, **p<0.01, ***p<0.001 (two-tailed test).

The comparison of marginal effects suggests that adjusting for residence duration significantly altered the effect of homeownership. A direct test of the difference in the AME of homeownership from Model 4 to Model 3 shows that adding residence duration significantly decreases the effect size of homeownership by 0.0033 (p<.001; see Panel B of Table 4). The significant change in AME indicates that the adverse health consequence associated with homeownership in Models 1-3 may be attributed to longer residence duration among migrant homeowners.

5 Discussion

In this article, I present results from a series of nested logistic regression models that examines how the incorporation of residence duration alters the relationship of housing cost burden and homeownership with migrant self-rated health (SRH). In general, migrant workers with higher housing cost burden and longer residence duration tend to have worse SRH. There is no statistically significant relationship between homeownership and migrant SRH. While the bivariate analysis suggests a negative relationship between homeownership and health, the inclusion of residence duration in the multivariate analyses significantly attenuated the association between owning a home and worse SRH among migrant workers. This implies that the crude association between homeownership and worse health may be explained by longer residence duration in the host city among migrant homeowners.

The health decline among migrant workers in Chinese cities can have multiple explanations, all of which can be tied back to the discriminatory *hukou* system. First, for migrant workers, long-term residence in the host city often means persistent exposure to inadequate health care (Hesketh et al., 2008; Lu and Qin, 2014; Song and Smith, 2021) and *hukou*-based discrimination in the housing system (Huang and Tao, 2015; Huang and Yi, 2015). Long-term exposure to inadequate health care can compound with housing-related factors such as high housing cost burden or a lack of homeownership, leading to adverse health outcomes among migrants. Second, in the Chinese context, once migrants obtain local hukou, they are no longer considered as migrants anymore. Migrants with higher educational attainment and earnings are more likely to transition into local residents, thus are not included in CMDS. Long-term migrants who have not yet obtained the local hukou are more likely to be socioeconomically disadvantaged. Third, newly arrived migrants and long-term migrants may have different reference groups when they rate their health. It is possible that newly arrived migrants compare themselves with peers in the sending areas, and long-term migrants compare themselves with locals in the receiving cities. All explanations above can be traced back to the

discriminatory *hukou* system, which limits migrants' access to social welfare (including health care and housing assistance) and puts them in a socioeconomically disadvantaged position in the first place. The study thus calls for the removal of structural and socio-economic barriers embedded in the *hukou* system in order to advance the overall health of the migrant population.

The study also underscores the importance of adjusting for residence duration in the study of housing and health among migrants. Existing studies on migrants' housing status and health have rarely accounted for the confounding effect of migrants' length of stay in the host city and no study has probed into how the exclusion of residence duration may affect the relationship between housing-related factors and health. This study shows that residence duration in the host city plays a significant role in sorting individuals into different homeownership and health statuses. Long-term migrant are more likely to own a home in the host city and have worse health compares to newly arrived migrants. If we do not take migrant homeowners' long residence duration into account in the statistical analysis, homeownership's protective effect on health may be canceled out by migrant homeowners' longer exposure to inadequate health care and precarious housing conditions in the destinations. Therefore, to examine the relationship between housing and migrant health, researchers need to control for not only SES, but also residence duration and other migration characteristics that may constitute alternative explanations for this relationship.

Nevertheless, the extent to which we can adjust for the confounding effects hinges on the data we could access. While being up-to-date and having comprehensive geographical coverage, CMDS is a destination-based survey which cannot capture migrants who have returned to their hometowns due to health deterioration (Song and Smith, 2021). Given the missing return migrants in the survey data, the association between migrant's financial housing stress and health is likely to be biased towards the null. Moreover, CMDS does not provide information about physical housing conditions and neighborhood environment, which are

found to be potential confounders in the analysis of housing affordability and health (Li and Liu, 2015; Xie, 2019). Future research is thus needed (1) to include return migrants in the survey design; (2) to incorporate physical housing features, neighborhood characteristics in the analysis; (3) to test the moderating role of physical housing features on financial housing stress, controlling for migration-related confounders; (4) to examine the causal pathway underlying the association between residence duration, financial housing stress, and health among migrant workers in Chinese cities.

Notes

[1] It is possible for migrants to transfer *hukou* from their hometown to the host city, but the chances are low in large cities due to the demanding criteria set by municipal governments (Liu and Shi, 2019).

[2] Since 2014, it has become increasingly easy for migrant workers to obtain local hukou in small- and medium-sized cities (Chen and Fan, 2016). It is likely that the effects of financial housing stress on health among migrant workers in small- and medium-sized cities are similar to those among local residents.

[3] About 16% of the migrants in the 50-city sample were unemployed at the time of the survey. Among those who were unemployed, about 13% had been looking for job in the past month, about 3% had lost the ability to work.

[4] Since people who report zero or negative income are likely to be housing cost burdened, removing these individuals may potentially bias my results toward the null (i.e., there is no association between housing cost burden and migrant health).

[5] The association between housing cost burden and migrant health becomes statistically insignificant when including the top 0.1% housing cost burden cases (see Appendix, Table A4). The housing cost burden of these extreme cases (n=78) ranges from 105 to 4560. Four extreme

cases have a housing cost burden greater than 1000. If excluding the four cases, the regression results (see Appendix, Table A5) are consistent with the results that I present in the main text.

[6] After removing unemployed individuals and individuals with extreme housing cost burden values, only three observations in the sample have missing values in the variables of interest.

[7] The estimated value of housing support was added both to the numerator (housing cost) and the denominator (household income).

[8] Work hours was employed as a continuous variable in the analyses in the main text. I have run models in which work hours was coded as a categorical variable (using 40 hours as the threshold). The size and direction of coefficients were consistent regardless of the work hours measure utilized (see Appendix, Table A6).

[9] There was an agricultural and non-agricultural divide (or urban-rural divide) in the *hukou* system, where people with urban *hukou* were entitled to social welfare benefits while those with rural *hukou* were not (Whyte, 2010). While the agricultural and non-agricultural classification was officially abolished in 2014 (Goodburn, 2014), the urban-rural divide may take decades to bridge. People with agricultural *hukou* may be more likely to sacrifice their health when encounter housing affordability problems.

[10] Family members include immediate family members (spouse, parents, grandparents, children, grandchildren, siblings, and in-laws) who lived or did not live in the same household with the respondent, and other relatives who lived in the same household with the respondent at the time of the survey.

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