Neighborhood and Mental Health among Hong Kong Elderly

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Abstract

This study investigates the association between various aspects of neighborhood and depression among Hong Kong elderly with a focus on neighborhood elderly services, a modifiable factor with policy implications. Using two waves of data from the Hong Kong Panel Study of Social Dynamics (HKPSSD), it reveals that elderly facilities aiming to encourage social participation and personal interaction are significantly related to reduced depressive symptoms. The positive impact of such elderly facilities is stronger among the disadvantaged older population living in low-SES neighborhoods. The result suggests that the concept of the neighborhood can be applied to Hong Kong, an ultra-dense Chinese metropolis.

Neighborhood and Mental Health among Hong Kong Elderly

Introduction

The recent increase in longevity is one of the humanity's greatest triumphs, but population aging is, in fact, one of its greatest challenges, and this is true worldwide both economically and socially. Such a challenge is particularly severe for Hong Kong, with the proportion of elderly people expected to reach 30% by 2034 (HKSAR Census and Statistics Department 2012). Rapid aging in Hong Kong has been accompanied by a substantial change in the provision of elderly care. In traditional Chinese culture, the family is the fundamental platform for supporting the elderly. An adult child is obligated to live with and take care of aging parents (Chu, Xie, and Yu 2011). However, the fertility rate has dramatically declined in the past four decades, which indicates shrinking support from the younger generations. Furthermore, adult children are now less likely than ever to live with their parents, due to increasing migration and emerging individualism (Logan and Bian 1999). When families are unable to provide the necessary support for the elderly, the neighborhood becomes a viable substitute for the provision of elderly care, especially in a city context.

Scholars have noted that neighborhood plays a crucial role in shaping mental health (Sampson, Morenoff, and Gannon-Rowley 2002; Kawachi and Berkman 2003). The physical and social characteristics of the neighborhood may affect mental health by placing stress on individuals or buffering the adverse consequence of stress by generating social support and connections (Diez Roux and Mair 2010). The neighborhood effect on mental health appears to be stronger among older people than among adults in the general population. Due to their declined physical functioning, reduced mobility, and shrinking social networks, elderly people are more

vulnerable to the immediate environment (Julien, Richard, Gauvin, and Kestens 2012). There is broad agreement that intervention at the neighborhood level is more cost-effective at promoting health than are psychological and pharmacological treatments because such intervention reaches a greater number of individuals (Schmid, Pratt, and Howze 1995; McNeill, Kreuter, and Subramanian 2006).

The evidence of the neighborhood effect on mental health in later life, however, has been largely established in a Western context. Knowledge regarding older Chinese adults is scant (Yen, Michael, and Perdue 2009; Chen et al. 2016). Specifically, how individual factors interact with neighborhood characteristics has yet to be uncovered. To explore this knowledge gap, this study investigates the association between neighborhood factors, individual characteristics, and depression among Hong Kong elderly, using data from the Hong Kong Panel Study of Social Dynamics (HKPSSD), the first population-based penal study in Hong Kong. Depression poses a serious threat to the quality of life of the older population. Depressed older adults are at increased risk of disability, suicide, cognitive decline, and mortality (Dinz, Butters, Albert, Dew, and Reynolds 2013; Fiske et al. 2009). Thus, neighborhood-based health promotion programs aiming to reduce depression are urgently needed to achieve successful aging and to lessen the burden on social welfare. This study focuses on the impact of elderly care facilities, a modifiable factor with policy implications. It contributes to the literature on the neighborhood effect on mental health by examining whether the concept of the neighborhood can be applied to Chinese society, which has unique family values. The results could offer scientific evidence for evaluating current practices, shedding light on cost-effective aging policies in Hong Kong.

Neighborhoods and Mental Health

In the urban sociology literature, the neighborhood is "a collection of both people and institutions occupying a spatially defined area influenced by ecological, cultural, and sometimes political forces" (in Sampson et al. 2002, p. 445). It is not a single entity, but rather "an ecological unit nested within successively larger communities" (Sampson et al. 2002). Building on a history of sociological research on urban communities, the scholars of the Chicago School long ago noticed that poverty, crime and delinquency, and health were spatially concentrated in cities (Park and Burgess 1921). They coined the phrase the "neighborhood effect" (Wilson 1987; Massey and Denton 1993; Sampson 2012).

As early as the 1930s, Chicago School researchers Robert Faris and Warrant Dunham (1939) found that areas in transition with high rates of poverty had higher rates of hospitalization for mental disorders. The association tended to persist in the same neighborhoods over time despite the turnover of residents. They argued that the lack of social integration in deprived communities contributed to the frustrated and chaotic behaviors characterizing mental disorders. Studies of neighborhoods and health rapidly grew after the 1990s, driven by a growing consensus that purely individual-base explanations for ill health were insufficient and failed to capture important health determinants (Diez Roux and Mair 2010). We need to consider not only individual characteristics but also living surroundings to understand health behaviors and outcomes (Schwartz, Susser, and Susser 1999). Health promotion programs should be incorporated into a broader social policy framework. Many public policies such as housing policies or urban planning policies may affect health through their effect on the neighborhoods in which individuals live (House, Shoeni, Kaplan, and Pollack 2008).

Numerous empirical studies have documented the relationship between the context of the

neighborhood and individual mental health (Kawachi and Berkman 2003; Richardson, Westley, Gariepy, Austin, and Nandi 2015). One study of a housing intervention, "Moving to Opportunity" (MTO), a randomized controlled trial moving families from high-poverty to low-poverty neighborhoods in five U.S. cities from 1994 to 2006, provided rigorous evidence for the neighborhood effect on subjective well-being. It revealed that participants moving to a better-off neighborhood experienced some form of mental health improvement as measured by depression, calmness, worrying, and sleep issues (Jackson, Langille, Lyons, Hughes, Martin, and Winstanley 2009).

There are two broad domains of neighborhood attributes that may be relevant to mental health: features of the physical environment and features of the social environment. The physical environment includes not only the natural environment such as air and noise, but also the built environment such as access to public services. The social environment is determined by the degree and nature of interpersonal interaction, the presence of social norms, the level of safety, and the density of social organizations (Diez Roux and Mair 2010).

The physical and social characteristics of the neighborhood may affect mental health by placing stress on individuals or buffering the adverse consequences of stress by generating social support and connections (Diez Roux and Mair 2010). Unfavorable neighborhood conditions such as noise, heavy traffic, violence, and shortages of service may lead to chronic stress and trigger psychological stress responses, ultimately leading to mental disorders (Dupéré and Perkins 2007; Latkin and Curry 2003; Ross, Reynolds, and Geis 2000; Ross and Mirowsky 2001). MTO reported that better physical conditions, and especially increased safety and reduced victimization/exposure to violence, were crucial factors for positive mental health outcomes (Jackson et al. 2009). Studies of the social features of neighborhoods and mental health have

focused on social cohesion, social capital, informal social control, safety, residential stability, and various demographic measures including population density and family structure (Truong and Ma 2006). Studies have reported that social disorganization, manifested by low levels of neighborhood cohesion and safety, is associated with elevated depressive symptoms (Baum, Ziersch, Zhang, and Osborne 2009; Chen and Chen 2015; Ellaway, Macintyre, and Kearns 2001; Phongsavan, Chey, Bauman, Brooks, and Silove 2006; Ross and Mirowsky 2009; Whitley and Prince 2005). Moreover, mental health issues are more affected by the social, rather than the physical features of the neighborhood environment (Mair, Roux, and Galea 2008).

Scholars have further demonstrated that the neighborhood effects on mental health may be more prominent among the older population than among younger adults (Mair et al. 2008). According to the ecological theory of aging, old age is a critical phase in the life course that is profoundly influenced by the physical environment (Lawton 1983). On the one hand, the elderly may be more restricted to the immediate environment than young people due to retirement and decreased physical mobility. The decline in physical and cognitive functions also impedes their capacities to cope with stressors in their living surroundings (Glass and Baflour 2003). On the other hand, the elderly may experience shrinking social networks because of retirement, the death of close ones, or children moving out of the home. This may force them to rely on neighborhood resources for social support (Glass and Baflour 2003). Studies in Western societies have found that neighborhood socioeconomic status (SES), as measured by the prevalence of poverty, unemployment, and family wealth, is positively associated with elderly's mental health (Truong and Ma 2006; Yen, Micheal, and Perdue 2009). Living in a neighborhood with low collective efficacy, high residential instability, and more neighborhood problems has been found to increase the risk of depression (Ahern and Galea 2011; Aneshensel, Wight, Miller-Martinez,

Botticello, Karlamangla, and Seeman 2007).

Although the extensive and rapidly growing body of studies has broadened our knowledge of neighborhood effects and mental health, two issues require further investigation.

First, much remains unknown about the neighborhood effect on mental health in Chinese societies, especially among Hong Kong elderly. In a traditional Chinese society, it is assumed that adult children house and care for their elderly parents (Xie and Zhu 2009). However, due to declining fertility, increasing migration, congested living spaces, and emerging individualism, the family may not be able to provide the necessary support for the elderly, and the neighborhood may become a viable substitute for the provision of elderly care, especially in a city context. Ye and Chen (2014) found that neighborhood identity and a sense of belonging were positively associated with mental health among the elderly living in a district in central Shanghai. Using data collected from 400 elderly living in four low-income public rental housing estates, Chen and her colleagues (2016) reported that perceived neighborhood support networks, and proximity to community facilities, contributed to fewer symptoms of depression. These studies provided insight into the relationship between the neighborhood and elderly mental health in a Chinese setting. However, they only targeted a relatively small group of elderly and used subjective measures of neighborhood. Thus, the results may not be generalizable to the entire Chinese elderly population.

Second, most studies have defined neighborhoods with geographic boundaries as defined by the Census Bureau or subjective measurements (i.e. perceived neighborhood conditions), which may not accurately capture the neighborhood effect. Although administratively defined units such as census tracts are reasonably consistent with nested ecological structures, they are imperfect measures for reflecting the logic of street patterns and social networks of

neighborhood interactions (Sampson et al. 2002). The literature on Western countries has revealed that subjective measures of neighborhood quality are more closely associated with health outcomes than are objective measures (Weden, Carpiano, and Rovert 2008). However, such measurements may suffer from the heterogeneity issue because both perception of the neighborhood and mental health may be determined by a third factor. The challenge of defining "neighborhood" calls for a flexible approach based on theory and evidence specific to the phenomenon under study (Galster 2001). Sharkey and Faber (2014) stated that "instead of seeking an answer to the elusive question of what defines a neighborhood and how to measure it, we argue for a broader focus on the salient social processes that operate within individuals' residential settings, and the consequences for the individual." The residential environment affects residents through diverse mechanisms, including exposure to violence or pollution, interpersonal interaction, and access to opportunities. The multifaceted nature of neighborhood effects may require mixed measurements of the neighborhood in a single study. The flexible approach is increasingly being adopted in Western research (Sharkey and Faber 2014), but it is rarely used in studies on Chinese society.

This study attempts to address these two issues by investigating the aspects of a neighborhood affecting the mental health of the elderly population in Hong Kong, with a focus on access to elderly facilities. Using data from the second and third wave of HKPSSD, the Hong Kong Census, and data generated by the Geographic Information System (GIS), it draws a relatively complete picture of the association between neighborhood and mental health in the most developed Chinese society. Given the panel nature of HKPSSD, this study offers more rigorous evidence than many previous studies relying on cross-sectional data. The findings shed light on aging policy in Hong Kong, which aims to promote active aging through building age-

friendly neighborhoods.

Aging Policy in Hong Kong

The Hong Kong government has upheld the principle of "aging in place" in the development of elderly services since 1977. Such a policy direction has been further modified to "aging in place as the core, institutional care as a back-up," with promotion by the Special Administrative Region (SAR) government. This principle emphasizes that elderly people should live with their families or in familiar environments as they age as long as possible. Studies have revealed that 81.4 percent of the Hong Kong elderly prefer to live at home as they grow older (HKSAR Census and Statistics Department 2009). Moreover, aging in place is cost-effective because it reduces hospital and nursing home utilization without increasing costs, increases life satisfaction, and postpones cognitive decline (Béland et al. 2006).

Aging in place requires infrastructure and services to meet the varying health needs and capacities of the elderly. For the elderly with mild to severe health problems, long-term care and an enabling living environment are needed. More important, however, is to improve the quality of life of the general older population. The majority of the Hong Kong elderly are self-reliant, with less than 11 percent requiring different levels of assistance in performing daily activities (calculated from HKPSSD). In the next 10 years, most older adults entering retirement will be not only healthier but also better educated and wealthier (Chan and Cao 2015). They are capable of taking care of their own needs and may contribute their knowledge and experience to the community through active social participation.

Inspired by the concept of active aging advocated by WHO, Hong Kong has adopted an active aging policy framework and committed to building age-friendly neighborhoods since 2006

(Chan and Cao 2015). The core of such a policy framework is to construct a supportive environment to care for the elderly in their neighborhoods and to encourage them to participate in social activities. In the past decade, the Hong Kong government has rapidly increased expenditures on neighborhood-based elderly care networks consisting of two components (HKSAR Social Welfare Department, 2016).

For the general older population, the District Elderly Community Centre (DECC) and Neighborhood Elderly Centre (NEC) constitute the most important platforms for neighborhood services. One primary goal of the DECC and NEC is to encourage social participation by providing a place for social contact and organizing various recreational, social, or educational/developmental activities. To maximize the opportunity for participation, many DECC and NEC procedures involve elderly volunteers in the design of activities and the delivery of services. These elderly centers also provide support for family caregivers and information on neighborhood resources. The DECC and NEC operate on a membership basis. The annual fee is set at a low level (HKD20-25 per year), making the service accessible to most elderly people. By the end of 2016, there were 41 DECC and 170 NEC locations serving approximately 220,000 elderly people (one fifth of the older population) in Hong Kong[1] (Sau Po Center on Ageing, Department of Social Work and Social Administration, and University of Hong Kong 2011). The provision of neighborhood-based services for the general elderly is characterized by a "public model" in which services are provided by NGOs that receive funding from the government. The funding mode is tax-based and supplemented by a minor portion of user fees (Sau Po Center on

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[1] DECC and NEC are similar in terms of provision of services and financial sources. DECC is larger than NEC. The government requires that DECC and NEC serve at least 1,000 and 400 older members, respectively. Additionally, DECC is responsible for coordinating and providing support for NECs in the district.

Ageing, Department of Social Work and Social Administration, and University of Hong Kong, 2011). The DECC or NEC is usually built based on population density and the proportion of the older population in a given area.

Furthermore, elderly daycare centers (EDCs) provide a range of center-based care and support services during the daytime for seniors suffering from moderate or severe levels of impairment. Their services cover nursing care, rehabilitation, counseling and referral services, meals, and social and recreational activities. Government-subsidized EDCs provide low-cost services (HKD900-1,000 per month), but the elderly need to apply and wait for an average of seven months to be enrolled (Sau Po Center on Ageing, and Department of Social Work and Social Administration, and University of Hong Kong 2011).

Both elderly centers for the general older population and EDCs aim to facilitate aging in place. By providing various services to seniors with different health and capacities, they may improve the life quality of older residents. This study investigates the role of these neighborhood-based services in reducing depression among the elderly, using data from a citywide representative sample. Previous studies rarely followed such an approach.

Data and Variables

Data

This study uses data from the Hong Kong Panel Study of Social Dynamics (HKPSSD). HKPSSD aims to establish a city-wide representative household panel survey to track socioeconomic changes and their influences on daily life in Hong Kong. So far, three waves of data collection have been completed in 2011, 2013, and 2015, respectively. In the first wave, 7,218 adults from 3,214 households were successfully interviewed. Among them, 4,270 adults from 2,165

households were re-interviewed in the second wave. A refreshment sample of 1,007 households and 1,960 adults with new question modules were added in 2014, who together with those in the second wave were re-interviewed in the third wave in 2015, resulting in 2,404 households and 5,160 adults (see details in Wu 2016). HKPSSD provides a unique opportunity to investigate the quality of life of the elderly in Hong Kong.

The analysis in this chapter mainly relies on data from the third wave of HKPSSD. Overall, 1,759 older people were interviewed in Wave 3. After deleting cases with missing values in the dependent or any independent variables, the working sample is 1,608 (Wave 3 full sample thereafter). Data from Wave 2 are used to control for the respondents' previous mental status. Researchers have pointed out that studies of depression that use cross-sectional data may suffer from omitted variable bias due to the continuity of depression caused by genetic liability, personal characteristics such as negative attribution style, and environmental factors such as early adverse life experiences (Wickrama, Conger, Lorenz, and Martin 2012). Among the 1,608 older respondents in Wave 3, 1,165 completed the Wave 2 survey (Restricted Wave 3 sample thereafter).

Measurement

<u>Dependent variable</u>

This study measures mental health with depression, a psychological outcome most commonly studied in the literature on neighborhood effects on mental health (Truong and Ma 2006, Blair, Gariepy, and Schmitz 2014). Depression is the most common mental disorder among older people, affecting 1 to 5 percent of the elderly in Western countries (Julien et al. 2012). In Hong Kong, it was estimated that 3 to 6.4 percent of the elderly aged 65 and above were experiencing

depressive episodes (Lam et al. 2015). Depression is an important indicator of life quality. It is associated with increased risk of morbidity, decreased physical, cognitive and social functioning, and greater self-neglect (Fiske et al. 2009).

HKPSSD measured depression with the Hopkins Symptom Checklist (HSCL-10), which is widely used for both clinical and epidemiological purposes to measure psychological distress among adolescents and adults (Kleppang and Hagquist 2016). HSCL-10 is a four-point Likert scale consisting of 10 questions that measure 2 dimensions of mental disorder: anxiety (4 questions) and depression (6 questions). Here, the mean score of the second dimension is used as a measure of depression. Cronbach's alpha of the six items is 0.80, indicating high reliability. The prevalence of depression among respondents is about 7 percent if 1.85 is used as the cut-off value for predictions of depression (Kleppang and Hagquist 2016). The result is comparable with that released by the 2010-2013 Hong Kong Mental Morbidity Survey (Lam et al. 2015).

Neighborhood characteristics

This study focuses on features of the physical environment of the neighborhood. It defines "neighborhood" in two ways. First, to capture a neighborhood's sociodemographic characteristics, District Council Constituency Areas (DCCAs) are treated as neighborhoods and their features are measured using data from the 2011 Hong Kong Population Census. In 2015, Hong Kong was divided into 431 DCCAs under 18 districts with a population range from 11,000 to 22,000. The respondents of the working sample were spread across 343 DCCAs. Sociodemographic characteristics are captured by population density, elderly concentration (i.e., the proportion of people aged 60 and above), residential mobility (i.e., the percentage of residents living there for more than seven years), and neighborhood SES index.

The neighborhood SES index is a multi-component scale constructed using principal component analysis (PCA). Four indicators were selected to capture socioeconomic differentials across the neighborhoods, including the proportion of households in public rental housing, the proportion of households with a total monthly income of HKD30,000 or more, the proportion of the population with a tertiary education or above, and the proportion of the population in high-status occupations (i.e., managers, administrators, professionals, and associate professionals). The single principal component was then standardized so that each DCCA was assigned a socioeconomic index ranging from 0 to 100.

Second, to measure the accessibility of elderly support facilities (i.e., elderly centers and elderly daycare centers), the neighborhood is defined as the area within a radius of 1,000 meters around the respondents' apartments. A cut-off point of 1 kilometer is selected because approximately 71 percent of the elderly respondents reported that they could walk for 1 kilometer without difficulty (calculated from HKPSSD Wave 3). The addresses of these elderly facilities are geocoded and then linked to HKPSSD using ArcGIS. I measure access to elderly centers by counting the number of such centers for each elderly person. As there are fewer elderly daycare centers than elderly centers, we measure access to a daycare center with a dummy variable with a value of 1, indicating an elderly daycare center within a distance of 1 kilometer.

Table 1 presents the descriptive statistics of the working sample. Hong Kong is an ultra-dense metropolis, with a population density as high as 80,000 persons per square kilometer. A high population density may be a stressor, but it may also increase access to facilities and services. Table 1 shows that the accessibility of elderly services is relatively high in Hong Kong. Elderly people, on average, could access five elderly centers within walking distance of their

home. Also, 76 percent of them could find a daycare center in the nearby neighborhood. The concentration of the elderly largely varies across neighborhoods. The proportion of the elderly population ranges from 6 to 35 percent. Old industrial areas and neighborhoods with concentrations of public rental housing, such as Sham Shui Po and Kwun Tong, have the highest proportions of the elderly. Nearly 90 percent of residents have lived in their current apartments for at least seven years. The low residential mobility may be due to the large fraction (approximately 45 percent) of Hong Kong residents living in public rental housing and subsidized home ownership housing (Hong Kong SAR Census and Statistics Department). Public housing benefits tend to ground tenants to their current locations. Residents in public housing are less likely to move to more suitable housing units even after their life circumstances have changed (Lui and Suen 2011).

[Table 1 About Here]

Individual characteristics

Studies have revealed that people with lower educational attainment, who live alone, and who are widowed are more likely to experience depressive symptoms (Juien et al. 2012). These factors are adjusted for in this analysis. Additionally, independent living is a strong predictor of depression among the elderly (Juien et al. 2012). Therefore, we control for physical independence as measured by the Lawton Instrumental Activities of Daily Living (IADL) Scale. This scale assesses competence in skills necessary for living independently such as shopping, cooking, and managing finances and medications. IADL has a high reliability and is widely used to detect functional decline (Graf 2008). To capture the potential non-linear association between

age and depression, we divide respondents into three age groups: the young elderly (60-69 years old); the older elderly (70-79 years old); and the oldest elderly (80 years old and above). Living in public rental housing is included to reflect the respondents' SES. Table 1 shows that the mean age of the older respondents is 71 years old with a standardized deviation of 8. More than half of the elderly respondents live in public rental housing. Nearly one fifth of the elderly respondents live alone, indicating an elevated risk of isolation and insufficient family support.

We use ordinary least squares (OLS) regression to estimate the association between neighborhood characteristics, individual attributes, and depression. To correct for intercorrelation between respondents from the same household and neighborhood, the standard errors are adjusted for the DCCA and the household cluster effect.

Empirical Results

Neighborhood characteristics and depression at aggregate level

To investigate whether depression is unevenly distributed across neighborhoods, we calculate the average score of depression for each DCCA. Figure 1 illustrates that depressive symptoms may be less prevalent in better-off neighborhoods such as those in central areas (along with Victoria Harbor). The crosses represent the locations of elderly centers (DECCs and NECs). Without adjusting for any factors, neighborhoods with more elderly centers report a lower level of depression.

[Figure 1 About Here]

Next, we use OLS estimation to better understand how neighborhood characteristics are

associated with depression at DCCA level. The results in Table 2 show that increased access to elderly services is related to lower levels of depression, but the association is only significant for elderly centers aiming to encourage the social participation of the general elderly population. The elderly in neighborhoods with higher SES experience fewer depressive symptoms on average. This difference is partly due to affluent neighborhoods being able to provide high-quality social services and facilities and psychological resources such as a sense of safety and mutual trust; additionally, affluent neighborhoods are less likely to experience environmental hazards (Ross and Mirowsky 2009; Mair et al. 2008). The results also show that neighborhoods in Hong Kong with higher population densities have a lower prevalence of depression. Population density is not necessarily a stressor. Instead, it may indicate a mature neighborhood whose dynamic environment and connectedness benefit mental health.

[Table 2 About Here]

Neighborhood characteristics and depression at individual level

Analysis at the individual level provides more rigorous results by adjusting for a wide range of individual characteristics. Model 1 in Table 3 shows that a higher density of elderly centers significantly predicts lower levels of depression. The impact of elderly centers is consistent when controlling for a full set of individual characteristics (Model 2) and previous depressive symptoms (Model 3). Model 3 shows that elderly centers aiming to engage the elderly population in various social activities are effective at reducing depression among the Hong Kong elderly. One extra-elderly center within walking distance of an elderly's home could decrease his/her depression by one-third of the standard deviation. However, elderly daycare centers that

mainly focus on care services may not be able to enhance the psychological well-being of the elderly.

Model 1 shows that the older elderly may suffer from more syndromes of depression than their counterparts (Model 1), but the association between age and depression disappears after living arrangement and physical function are controlled for (Model 2). This result suggests that the older elderly are more vulnerable to depression because they experience more severe functional declines and more negative life events such as being widowed. To improve the life quality of the elderly, it is crucial to provide them with sustainable social support, barrier-free homes, and neighborhoods that facilitate independent living. The Model 3 includes the depressive symptoms in the previous wave. The literature reveals that current depression largely depends on past mental status because certain factors affecting depression, such as genetic attributes and personality, are relatively stable over time (Wickrama et al. 2012). Depressed elderly people have reported reduced participation in social activities (Holtfreter, Reisig, and Turanovic 2017). Thus, they may be less affected by the surrounding environment than their healthy counterparts. The estimation of the relationship between neighborhood and depression may be biased without controlling for previous depressive symptoms. The result in Model 4, Table 3 shows that association between elderly centers and depression is still significant after past depression is considered.

[Table 3 About Here]

Model 4 investigates whether the effect of elderly centers on depression varies across neighborhoods with different SES. Studies have documented that neighborhood characteristics

may affect one another. For instance, public facilities may bring greater benefits to less affluent neighborhoods because residents in disadvantaged neighborhoods have less access to such facilities and services and may be more sensitive to the improvement (Diez Roux and Mair 2010). Model 4 shows that the influence of elderly centers on mental health decreases as a neighborhood becomes wealthy. As illustrated in Figure 2, an increased number of elderly centers leads to the sharpest decline in depression in the low-SES neighborhood (whose SES index score falls into the bottom third). The result suggests that the provision of elderly care services should give priority to low-SES neighborhoods.

[Figure 2 About Here]

Neighborhood characteristics and depression: By housing condition

We further explore whether the relationship between elderly centers and depression differs for the elderly living in public rental facilities and private homes. In Hong Kong, the least affordable city to buy a home globally (Cox and Pavletich 2015), housing condition is an important indicator of SES. In Hong Kong, 53 percent of elderly respondents in the working sample live in public rental housing. Their income and educational attainment are significantly lower than those of their counterparts living in private housing. They also are more likely to receive comprehensive social security social assistance (see Table A1). The results in Table 4 indicate that elderly centers are a greater determinant of the mental health of the elderly living in public rental housing, especially in lower-SES neighborhoods. There are two possible explanations for this. First, disadvantaged people have limited access to diverse resources and support. Thus, they may rely more on public services and facilities in their immediate surroundings. Second,

residents of the public rental housing may experience frequent interpersonal interaction. The homogeneity of residents may facilitate mutual support and trust. In addition, public housing facilities are often characterized by open and shared spaces within the building that provide an opportunity for interacting with neighbors (Liu 2010). As a result, information about elderly services circulates quickly.

[Table 4 About Here]

Discussion and Conclusion

Rapid aging has compelled policymakers and researchers worldwide to develop concepts, programs, and services to keep senior residents physically and psychologically healthy. Hong Kong, whose residents enjoy the world's longest life expectancy, has been experiencing formidable challenges from population aging. Inspired by the concept of active aging advocated by the WHO, Hong Kong has launched various initiatives such as neighborhood network building projects to make its neighborhoods more "age-friendly," with the purpose of improving well-being by encouraging the elderly to participate in social activities (Hong Kong Information Services Department 2014).

This study investigates the association between various aspects of neighborhood and depression among Hong Kong elderly using a city-wide representative dataset with a focus on elderly care facilities, a modifiable factor with policy implications. It reveals that elderly centers aiming to encourage social participation and personal interaction are significantly related to reduced depressive symptoms. The positive impact of such elderly facilities is stronger among the disadvantaged older population living in low-SES neighborhoods.

The result suggests that the concept of the neighborhood can be applied to modernized Chinese societies like Hong Kong.

We are fully aware that individuals make choices and sort themselves by place. Thus, estimates of the neighborhood effect on depression may be confounded. However, we speculate that selection bias may be less severe in this analysis because more than half of the older respondents were living in public rental housing and had limited opportunities to choose their preferred neighborhood. According to current public housing policies, applicants can only choose one broad district for their future housing allocation (public rental housing facilities are grouped into four broad districts). Once an older applicant is allocated an apartment, transfer applications to another facility are unlikely. Even if the elderly person is eligible for a transfer, the waiting time can be long due to a shortage of public housing, and there is no guarantee that the new residence will match his or her preferences (Lui and Suen 2011). Moreover, selection bias does not deny the existence of the neighborhood effect. Instead, it "is itself a form of neighborhood effect" (Sampson 2012, p. 308). Selection bias is a social process that itself is implicated in creating the very structures that then constrain individual behavior. Moving decisions are influenced by resources, preferences, and changing life circumstances, but they are also conditioned by the interaction of individual characteristics within the wider structural context that governs consequential life decisions (Sampson 2012, p. 288).

These findings shed light on programs and services that improve life quality for the elderly. Resources should be allocated to services and facilities that encourage social participation, mutual support, and interpersonal interaction in the older population. Urban planners need to consider choosing the right location for neighborhood facilities. Priority should be given to lower-SES neighborhoods.

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Figures and Tables

Figure 1 Population Depression and Distribution of Elderly Centers in Hong Kong
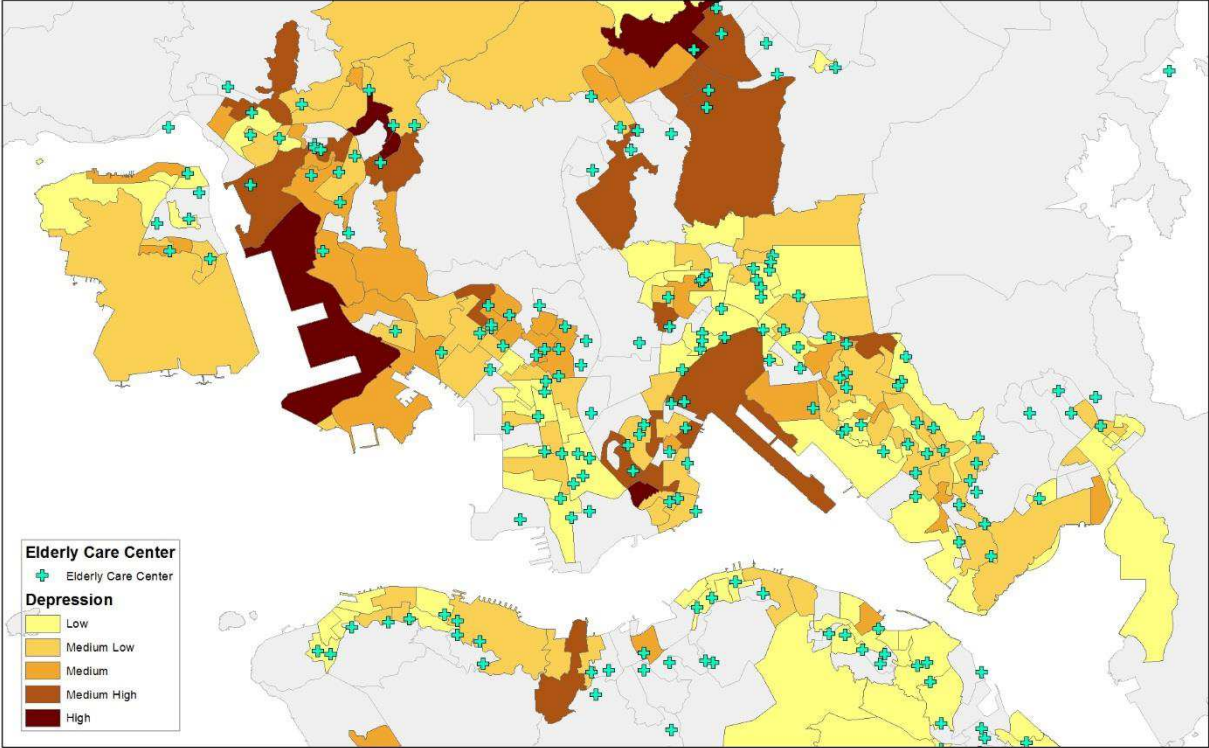
Figure 2 Number of Neighborhood Elderly Centers and Depression among Hong Kong Elderly: By
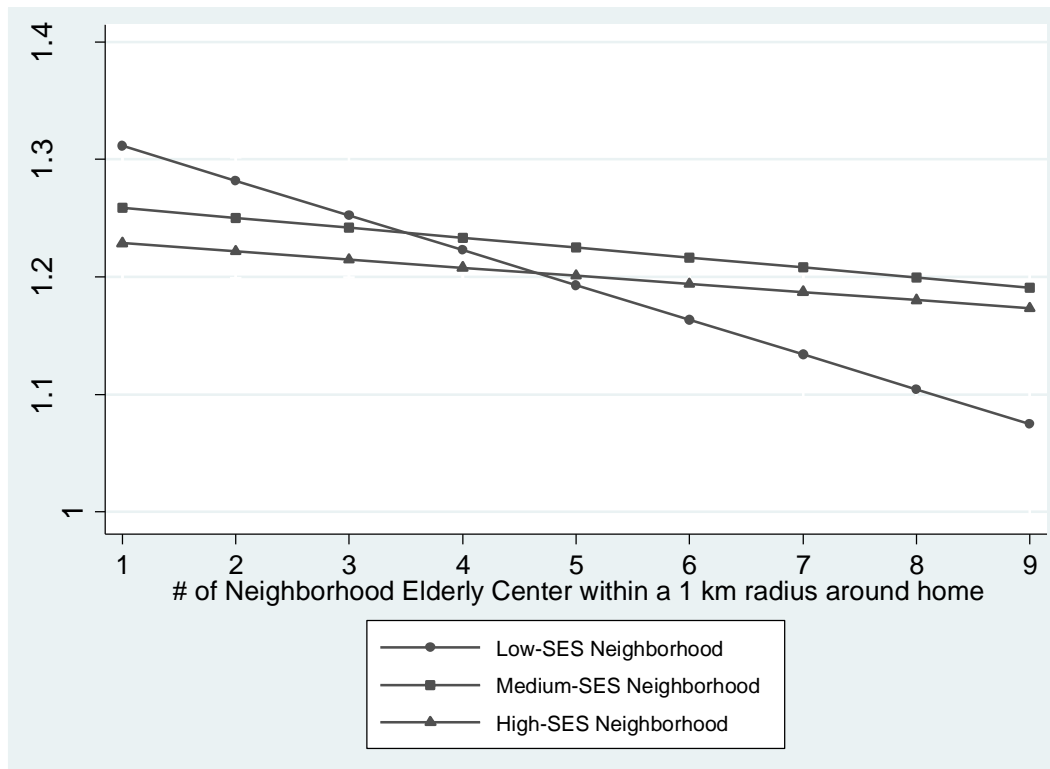
Neighborhood SES

Table 1: Descriptive Statistics of the Elderly (60 +) in Hong Kong: HKPSSD

Variable	Wave 3 full sample (N=1,608)		Restricted wave 3 sample [1] (N=1,165)	
	Mean	Std. Dev.	Mean	Std. Dev.
Depression (1-4 point)	1.19	0.35	1.21	0.36
Neighborhood characteristics				
# of elderly centers within a radius of 1km from home	4.99	2.80	4.96	2.82
Elderly daycare center within a radius of 1km from home (Yes=1)	0.76		0.76	
Neighborhood SES index [2]	34.65	22.23	34.77	22.32
Elderly concentration (% aged 60+)	0.20	0.06	0.20	0.06
Residential stability (% 7+ years)	0.89	0.04	0.88	0.05
Population density (1,000 person/km2)	79.32	58.12	81.25	58.76
Individual characteristics				
Male	0.48		0.48	
Age	70.94	8.25	71.71	7.82
Completed Junior High School	0.37		0.37	
Married	0.70		0.69	
Living in public rental housing	0.53		0.52	
Living alone	0.18		0.20	

Note: (1) Respondents in wave 3 who reported mental health status in Wave 2. (2) Number of DCCAs in full sample and restricted sample are 343 and 240, respectively.

Table 2 Coefficients of OLS Regression for Population Depression on Neighborhood Characteristics, HKPSSD Wave 3

VARIABLES	Wave 3 full sample	Restricted wave 3 sample
# of elderly centers within 1km	-0.012*	-0.013*
	(0.005)	(0.006)
Elderly daycare center within 1km (Yes=1)	-0.012	-0.031
	(0.030)	(0.037)
Neighborhood SES index (/100)	-0.178*	-0.288***
	(0.069)	(0.084)
Elderly concentration (% aged 60+)	0.510*	0.518+
	(0.232)	(0.272)
Residential stability (% >7 years)	-0.305	-0.304
	(0.328)	(0.362)
Population density (10k person/km2)	-3.751*	-5.632*
	(1.770)	(2.227)
Constant	1.532***	1.666***
	(0.306)	(0.364)
Observations	343	240
Adj. R-squared	0.064	0.035

Note: Unit of Analysis is DCCA. Robust standard errors in parentheses.

*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Table 3 Coefficients of OLS Regression for Depression on Neighborhood and Individual Characteristics among Hong Kong Elderly

VARIABLES	Restricted W 3 sample				W3 Full sample
	Model 1	Model 2	Model 3	Model 4	Model 5
# of elderly centers within 1km	-0.013**	-0.011*	-0.011*	-0.023**	-0.022***
	(0.005)	(0.004)	(0.004)	(0.007)	(0.006)
Elderly daycare center within 1km (Yes=1)	-0.034	-0.033	-0.031	-0.039	-0.016
	(0.030)	(0.029)	(0.027)	(0.027)	(0.023)
Neighborhood SES index (/10)	-0.261***	-0.098	-0.043	-0.239*	-0.212*
	(0.063)	(0.073)	(0.069)	(0.105)	(0.094)
Elderly concentration	0.358	0.242	0.303	0.368+	0.352*
	(0.218)	(0.211)	(0.200)	(0.203)	(0.171)
Residential stability	-0.202	-0.152	-0.141	-0.231	-0.213
	(0.266)	(0.261)	(0.260)	(0.268)	(0.239)
Population density (10 k/km2)	-3.869*	-2.565	-1.191	-1.560	-2.534+
	(1.928)	(1.833)	(1.762)	(1.758)	(1.480)
Depression in the previous wave			0.177***	0.176***	
			(0.028)	(0.028)	
# of Services within 1km * Neighborhood SES				0.041*	0.034*
				(0.017)	(0.015)
Male	-0.037+	-0.015	-0.006	-0.006	-0.014
	(0.020)	(0.021)	(0.020)	(0.020)	(0.017)
Age group (ref.=60-69)					
Aged 70-79	0.072**	0.032	0.032	0.034	0.049*
	(0.023)	(0.023)	(0.023)	(0.022)	(0.020)
Aged 80+	0.125***	0.028	0.011	0.013	0.024
	(0.034)	(0.035)	(0.033)	(0.033)	(0.028)
Completed High School		-0.023	-0.018	-0.018	-0.028
		(0.023)	(0.021)	(0.021)	(0.019)
Married		-0.032	-0.024	-0.024	-0.031
		(0.030)	(0.029)	(0.029)	(0.025)
Living alone		0.071+	0.062+	0.064+	0.083**
		(0.037)	(0.036)	(0.036)	(0.032)
Std. Activities of Daily Living Score		-0.077**	-0.073**	-0.073**	-0.071***
		(0.024)	(0.023)	(0.023)	(0.019)
Living in public rental housing		0.084**	0.076**	0.082**	0.071**
		(0.030)	(0.028)	(0.029)	(0.026)
Constant	1.495***	1.402***	1.106***	1.242***	1.454***
	(0.259)	(0.252)	(0.244)	(0.257)	(0.236)
Observations	1,165	1,165	1,165	1,165	1,608
Adj. R-squared	0.044	0.087	0.158	0.160	0.087

Note: Robust standard errors in parentheses. Standard errors are adjusted for DCCA and household cluster effects. *** p<0.001, ** p<0.01, * p<0.05, + p<0.1.

Table 4 Coefficients of OLS Regression for Depression on Neighborhood and Individual Characteristics among Hong Kong Elderly: By Housing Type

VARIABLES	Living in public rental housing			
	Yes		No	
# of elderly centers within 1km	-0.024***	-0.051***	-0.002	0.006
	(0.007)	(0.011)	(0.004)	(0.010)
Elderly daycare center within 1km (Yes=1)	-0.020	-0.035	-0.045	-0.043
	(0.049)	(0.049)	(0.029)	(0.029)
Neighborhood SES index (/100)	0.102	-0.698**	-0.075	0.011
	(0.124)	(0.236)	(0.074)	(0.127)
Elderly concentration	0.918**	0.975***	-0.241	-0.260
	(0.284)	(0.282)	(0.252)	(0.249)
Residential stability	-0.931*	-1.123*	0.083	0.127
	(0.453)	(0.464)	(0.289)	(0.299)
Population density (10 k/km2)	-0.654	-1.598	-0.258	-0.200
	(2.571)	(2.598)	(2.036)	(2.044)
# of Services within 1km * Neighborhood SES		0.154***		-0.017
		(0.043)		(0.021)
Depression in previous wave	0.251***	0.250***	0.050	0.052
	(0.037)	(0.036)	(0.032)	(0.032)
Male	0.008	0.006	-0.019	-0.019
	(0.031)	(0.031)	(0.024)	(0.024)
Age group (ref.=60-69)				
Aged 70-79	0.040	0.048	0.036	0.036
	(0.033)	(0.033)	(0.027)	(0.028)
Aged 80+	0.006	0.001	0.034	0.032
	(0.049)	(0.048)	(0.042)	(0.042)
Completed Junior High School	0.006	0.009	-0.047*	-0.047*
	(0.036)	(0.036)	(0.022)	(0.022)
Married	-0.024	-0.020	-0.032	-0.033
	(0.043)	(0.043)	(0.034)	(0.034)
Living alone	0.043	0.050	0.095*	0.093*
	(0.054)	(0.053)	(0.043)	(0.042)
Std. Activities of Daily Living Score	-0.102**	-0.102**	-0.025	-0.026
	(0.032)	(0.032)	(0.024)	(0.024)
Constant	1.676***	1.999***	1.161***	1.086***
	(0.422)	(0.444)	(0.269)	(0.297)
Observations	612	612	553	553
Adj. R-squared	0.206	0.217	0.061	0.060

Note: Robust standard errors in parentheses. Standard errors are adjusted for DCCA and household cluster effects. *** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Table A1. Differences in SES Between the Elders Living in Public Rental Housing and Private Housing: HKPSSD Wave 3

	Living in public rental housing	Living in private housing	Difference
Individual monthly income	3661.661	7041.967	3380.305***
Complete Secondary High School	0.292	0.470	0.177***
Housing ownership	0.114	0.948	0.834***
CSSA	0.254	0.024	-0.230***
Having domestic helper	0.033	0.103	-0.070***
Years living in current apartment	19.977	21.935	1.958**

Note: *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.1$