Families, Neighbors and the Social Network of Older Adults:

Evidence from Social Housing in Singapore

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1. Introduction

In newly industrialized economies (NIE) in East Asia, economic growth and demographic changes are leading to longer life and fewer children. Inadvertently, this has led to erosion in the traditional support system for older members of the family. Given the cultural beliefs of Confucian values - filial piety, the younger members of the family provided time, money, goods, instrumental and emotional support and connections for the older adults. Two to three generations tended to co-reside in order to provide this care and support. However with later marriage and lower fertility, it is now more likely that older adults in East Asian NIE have smaller families and may live alone. As a consequence these individuals may feel they have fewer social interactions as they age where they may lack companionship, feel left out and isolated from others. A sense of loneliness prevails particularly when the aged individual loses a spouse to death.

The narrative of loneliness and loss in old age – grown children who have left the nest, widowhood - occurs in different ways and at different rates for individuals from different socio-economic status (SES) groups. Individuals can adapt to the aging process with changes in their behavior and environment. Older adults may compensate for a loss of social interaction when their families become smaller by interacting more with friends with the same SES. Or they may interact more with friends from different SES who are within close proximity, the neighborhood. The social capital derived from neighbors then reduces the sense of loneliness in old age. In the context of the newly industrialized economy of the Singapore island nation, state intervention may actually improve adaptation to the complex dynamics of aging. Using state social housing policy, this empirical paper aims to investigate how the social interactions between older adults aged 60 and above and their neighbors in apartment building blocks compensate for less family interaction. This can be expressed as two research questions. First, does the older adult build a social network where the SES of the network has little influence? Second, does the presence of apartment building neighbors complement the family in the older adult's social network to reduce a sense of loneliness; and improve health and well being?

In the Singapore city-state, the state Housing Development Board (HDB) provides guarantees of housing for its citizens given massive land shortages. The inalienable right to housing was achieved

through the construction of affordable public housing which began in 1960. Starting from the 1980s, the HDB shifted its focus to building communities within self-contained towns. In spatial terms, because of close proximity each HDB apartment building has become a neighborhood block; and a cluster of neighborhood blocks has become a community equipped with social services for the elderly and children. HDB allocation of housing for older adults in early life has been based on the criteria of income of the household head and household size. Each family has been randomly assigned to an apartment building block which consists of different built up area sizes. As such the allocation is plausibly exogenous - a young family with unobserved preferences would not be able to influence which apartment building they were assigned to and eventually grew old in. Using the Interactive Biopsychosocial Model (IBM) by Lindau et al (2003) in the conceptual framework and HDB social housing allocation as an instrument, I study the proposed relationship between income and social class and the older adult's social network on outcomes in old age.

The rest of the paper is set up in the following way. Section 2 introduces the conceptual framework of IBM from biology and medicine and how this is approached from the Singapore context. In Section 3, I describe the empirical strategy and the dataset – the Singapore Social Isolation, Health and Lifestyles Survey 2009 (SIHLS). Descriptive statistics are in Section 4. Section 5 provides the findings from the ordinary least squares (OLS) and instrumental variable (IV) estimation. In Section 6, I carry out preliminary work on linking the results on self rated loneliness to self rated health. A discussion of the preliminary conclusions is in Section 7.

2. Conceptual Framework

I use the Interactive Biopsychosocial Model (IBM) by Lindau et al (2003) from the biology and medicine disciplines to guide my conceptual framework. Older adult health and well being are conceptualized as being produced in a social and cultural context, using the resources of the individual, family and social environment. This is captured in the IBM as:

1. An orientation towards health rather than illness
2. Analytic capacity for outcomes of health or illness
3. Parity among the three domains of capital (biophysical, psychocognitive and social) as factors in an individual's health endowment
4. Consideration of causality and feedback between various types of capital and health

5. Conceptualization of individual health or illness embedded in the intimate dyad, the family or other social networks
6. Interdependency of social and life course dynamics
7. The potential of capital inputs to act as assets or liabilities

Based on this model, biophysical, psychocognitive and social capital make up an individual's health endowment. Biophysical capital includes genetic composition, physiology, physique, sensory function, nourishment, strength and appearance, all of which affect an individual's physical and physiological capacity for health. Psychocognitive capital includes intelligence, emotional well-being, happiness, attitudes, perceptions and evaluations. Social capital refers to the networks of interactions and relationships with others (kin, friends and neighbors), some of whom may themselves be connected, and to the quality of those relationships.

In this paper, I use the operational definitions social capital, social interactions and social networks interchangeably. The socio-cultural context which can also be thought of in terms of an individual's SES is the broader environment of social locations (ethnic, religious, gender, political or economic class) which carry social expectations, norms and differential access to scarce resources that influence health and well being. Empirically, Shaw et al (2007) find that with advancing age, SES and gender explain for some of the declines in contact with friends, support satisfaction and anticipated support. For this paper I focus on causality and feedback between social networks and well being as measured by a lower sense of loneliness. Also I attempt to conceptualize older individual health and well being that are embedded in the social network that consist of family and neighbors.

3. Empirical Strategy and Data

I carry out OLS and IV estimation using the SIHLS 2009 cross sectional data of older Singaporeans aged 60 and above. In the SIHLS, there is a wealth of information concerning the older adult's physical and mental health profile; the extent of social isolation within and between different socio-economic groups; and the different types of interactions between health status, income, social engagement, housing, network support and loneliness. In 2011, a second wave of data will be collected which will then enable panel data analysis. The SIHLS is similar in design to the US National Social Life, Health and Aging Project (NSHAP).

For IV estimation, I use HDB social housing allocation as an instrument for the social network. In Becker and Murphy's theoretical formulation on which neighborhoods people choose to live in (2001), the decision is based on the individual's SES which then leads to housing segregation. Families with a high SES will then prefer to live in the same homogeneous neighborhood as other high SES families who have the same tastes and preferences, while low SES families will sort and end up living in the same neighborhoods as other families with low SES. Families with a high SES have higher formal educational levels and are likely to have better access to resources that influence health and well being. The social network built up amongst high SES families in a neighborhood should then reinforce health levels. But low SES families are just as likely to have high levels of health as the total stock of health that an individual has is a choice variable (Grossman, 1999). Building social capital within a neighborhood and older adult health then suffer from an endogeneity problem – omitted variable bias and reverse causality. However this problem is managed when using HDB social housing allocation as a source of exogenous variation.

Because of land shortage in the Singapore city state, HDB manages the amount of public housing stock. This consists of 90% of the total housing stock in the market. The monthly income of the household head that is below a given threshold and the family size form the criteria of housing assignment to a given neighborhood. Beyond the given income threshold, families will then purchase housing from the private housing stock which makes up the remaining 10% of the total housing stock. In public housing, a married couple without children will be assigned to a 1 – 2 room apartment while a couple with children will be assigned to a 3 – 4 room apartment. This assignment is independent of the family's ethnic, religious or political class. Also this assignment rule is meant to minimize the probability of ghettoization by ethnic group where in Singapore there are three distinct groupings, Chinese, Malay and Indian. As such, HDB housing allocation is a valid instrument for social capital because it is correlated with SES and it is plausibly exogenous because it is not directly correlated with health and well-being but through its correlation with SES.

To instrument the older adult's social network with HDB housing allocation, I measure SES using the household head's level of educational attainment and occupation type. I do not use the direct measures of income in the SIHLS dataset as this is current available income and not income at the time of HDB allocation to housing. Occupation type is defined as the occupation that the older

adult has engaged in for the most number of years. I justify this SES measure in the Singapore context because the links between educational level, personal income and occupational prestige are strong. The factor analysis in a sociological study by Quah et al (1991) confirm that "the highest level of education completed" forms part of the same social class dimension with "gross monthly income" and occupational prestige as measured by the respondents' "abbreviated occupational scale". My identifying assumption is that the older adult first started his / her family in early life in the given apartment building block and neighborhood and has remained in the same place of residence over decades, building social capital. Based on HDB (2003 and 2008) interviews with residents, it is found that the longer the residence in the same apartment block neighborhood, the greater the sense of belonging. This is especially for residents aged 55 and above with a length of residence that is 10 years or more. Also the HDB finds that older adults prefer to own as opposed to rent their apartment or to reside with their children. Thus the individual is aging in place and building a stronger social network. Furthermore, this identifying assumption is reasonable as Singapore suffers from high density living and acute land shortage for public housing, which would deter changing the location of residence. I restrict the sample where the apartment is owned by the older adult and s/ he remains the head of household. The older adult has not moved into another place of residence where s / he is no longer the head of household. The restricted sample size is then 2,659.

Most studies of social relationships in later life focus on the amount (e.g. number of individuals, frequency of contact) or content (practical help, advice) of social contact, not on individuals' perceived social isolation (Hughes et al, 2004). Consideration for perceived social isolation is crucial because aging is viewed as an inevitable mutual withdrawal or disengagement. Based on the disengagement theory of aging (Cummings, Dean, Newell and McCaffrey, 1960), there is decreased interaction between the aging individual and others in the social system; but when disengagement is complete, the equilibrium which existed in middle age between the individual and his / her society will give way to a new equilibrium characterized by a greater distance and an altered type of relationship. This altered state is arguably isolation where the aged individual may be without any form of support. Given the availability of data, I am able to study older Singaporean adults' social relationships in terms of their subjective assessments of their isolation using multiple indicators. Subjective interpretations of social relationships are likely to be a key to understanding the impact of

social connections on well-being. When one's intimate and social needs are not adequately met, a complex set of feelings termed loneliness occurs that motivates one to seek the fulfillment of these needs (Baumeister and Leary, 1995; Weiss, 1973). The core experience is being isolated socially and absent both relational and collective connectedness (Russell, Peplau and Cutrona, 1980; Hawkley et al., 2004). Feelings of loneliness are not synonymous with being alone but instead involve feelings of isolation, feelings of disconnectedness and feelings of not belonging.

The dependent variable is the older adult's social network and this is defined as three separate self rated measures of loneliness, i) companionship ii) not left out and iii) not isolated. Also there is a fourth operational definition which consists of an aggregation of these three separate measures, a loneliness scale. The higher the degree of companionship, the higher the degree of not feeling left out and the higher degree of not being isolated increase the strength of the older adult's social network. Accordingly at the aggregate level, the lower the overall sense of loneliness, the stronger the social network. These specifications follow from the aggregate loneliness scale used in the NSHAP (Cornwall and Waite, 2009).

Consider then the following reduced form specification:

$$y_{1i} = \alpha_0 + \beta_1\alpha_{1i} + \beta_2\alpha_{2i} + \beta_3\alpha_3 + \beta_4\alpha_{4i} + \beta_5\alpha_{5i} + \mu_1 \quad \ldots(1)$$

where

y_{1i} = different measures of the older adult's self-rated measures of social network

α_{0i} = constant

β_{1i} = the older adult's SES

β_{2i} = the housing type that the family is allocated to by HDB

β_3 = aged 60 and above; age 75 and above

β_{4i} = social network that consists of the older adult's spouse, the family household size (co-residence with children and grandchildren) and apartment building neighbors

β_{5i} = exogenous covariates (gender and ethnicity)

As the HDB allocation instrument is uncorrelated with the error term μ_1 but is correlated with the endogenous explanatory variables, I state this condition by writing the endogenous explanatory variables as a linear function of the exogenous variables and an error term:

$$y_{2i} = \pi_0 + \pi_1 z_{1i} + \pi_3 z_3 + \pi_4 z_4 + v_2 \quad \ldots(2)$$

In the next section I proceed to provide the summary statistics for the variables in the reduced form specification.

4. Descriptive Statistics

As HDB public housing is assigned based on socio-economic status which I proxy by educational attainment and occupational type, Table 1 provides information on the distribution of these variables in the observed data. As I do not have information concerning the household size of the older adult in early life at the time of assignment to HDB housing, I am unable to include this in the description. I assume that an older adult and his / her family in an apartment with more rooms would have had a larger household size in early life.

Table 1

Educational Level	HDB Public Housing				Private Housing Market
	1 - 2 BR	3 BR	4BR	5BR	
University College and Above	1	3	19	82	0
Junior College / Senior High	0	17	32	43	60
Vocational School	0	2	1	3	2
Secondary School / Junior High	13	167	230	175	115
Primary School / Elementary	65	422	338	135	61
No Formal Education	61	273	235	69	23
Total	140	884	855	507	261

Occupational Type	HDB Public Housing				Private Housing Market
	1 - 2 BR	3 BR	4BR	5BR	
High Skilled					
Professional	2	21	26	42	100
Admin & Management	7	25	50	57	77
Associate Professional & Technicians	4	50	63	60	32
Clerical	3	38	33	28	26
Sales & Services	22	170	184	94	38
Low Skilled					
Production Craftsmen	26	252	220	62	14
Cleaners & Laborers	46	177	127	33	4
Homemaker	15	133	120	52	39
Other	15	38	25	16	13
Total	140	904	848	444	343

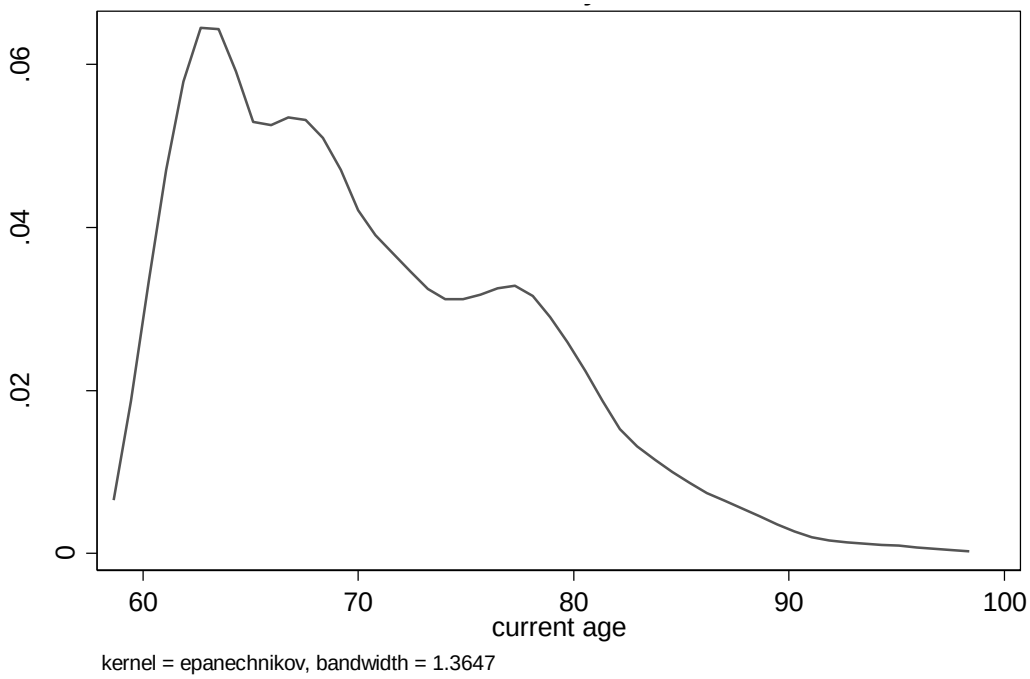
Notes: The higher skilled and lower skilled classifications follow from the Singapore Ministry of Manpower. "Production Craftsmen" occupational type includes craftsmen, transport workers, agricultural and fishery workers. "Other" occupational type includes individuals who are or were self-employed, are civil servants are in the army.

From Table 1, it can be seen that a majority of older adults have an educational level of up to secondary school / junior high and they tend to reside in 3BR or 4BR apartments. This suggests that in early life, the household consisted of a nuclear family of 3 – 4 such as parents with a child or parents with 2 children. Also only 5% of older adult led households reside in a small 1 - 2BR apartment. The older adults in the small 1 – 2BR apartments tend to have a very limited amount of formal education, suggesting a lower SES. In terms of occupational type, Table 1 shows that 51% of older adults in public housing were or currently are in low skilled occupations compared to 49% older adults in high skilled occupations. This strongly implies a heterogeneous SES mix in public housing. In contrast, of all older adults in the private housing market, 79% had or have high skilled occupations. But the private housing market only makes up about 10% of the total housing stock in the observed data.

Next I present the descriptive statistics for age and age grouping in the observed data. This provides an overview on whether the older adults studied are the youngest old, 60 – 74 years or older / oldest old 75 years and above. The age groupings have implications for the health and functional status of the individuals which may affect how often they may be able to leave the apartment to visit

neighbors, friends and relatives; and the extent to which social interactions may be limited to within the home. Graph 1 provides the distribution of age where a majority of the older adults observed is between 60 – 70 years old.

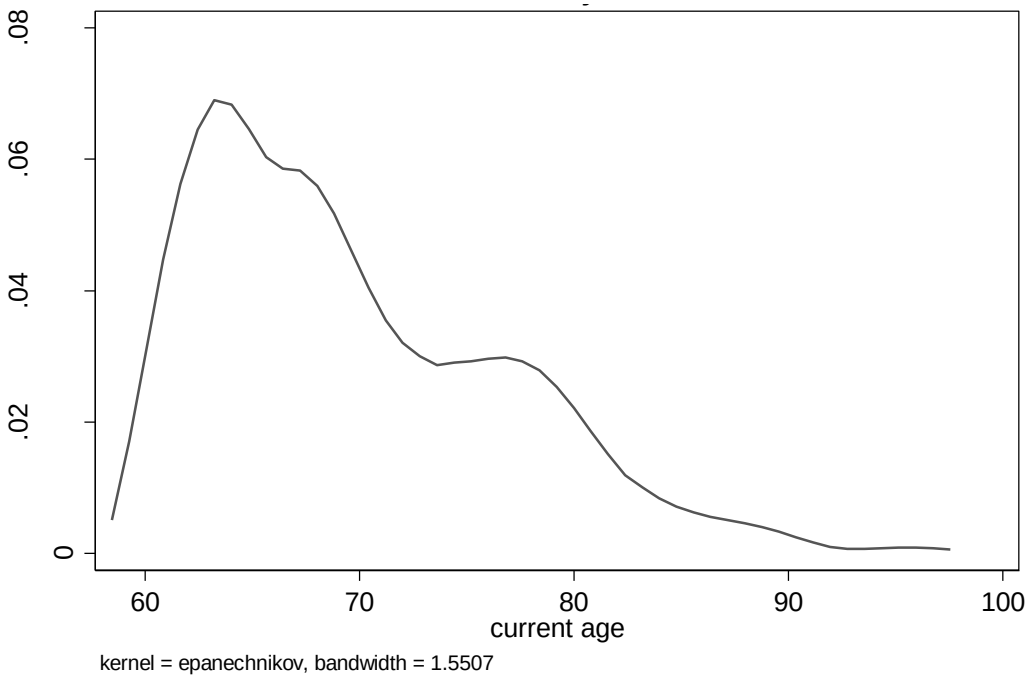
Graph 1 Age Distribution, All Individuals



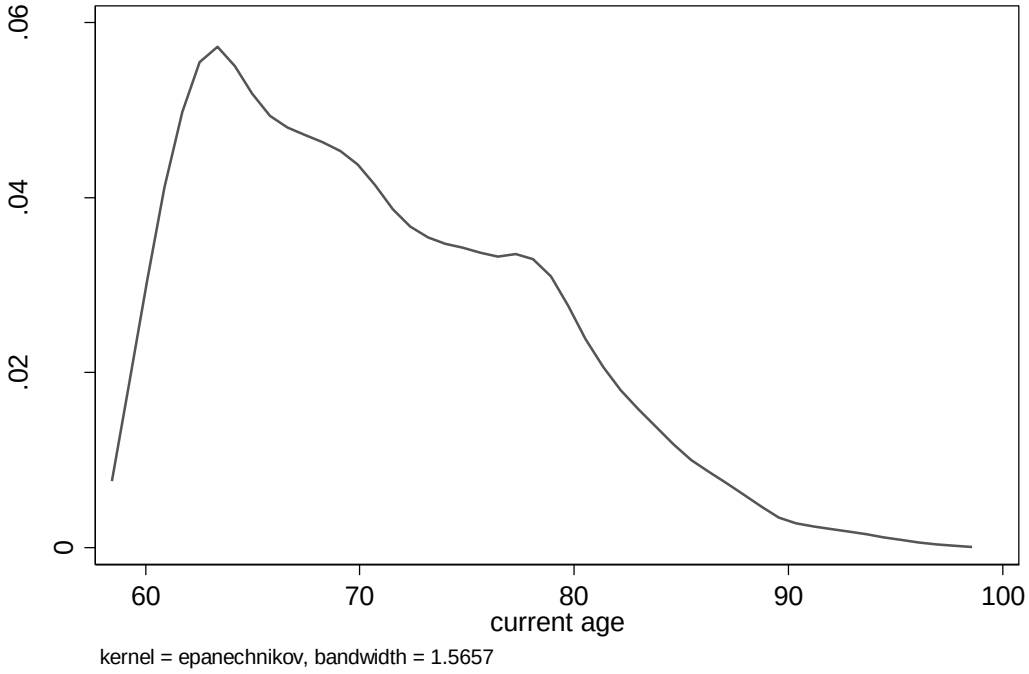
This means that many of them are the youngest old and may probably still be economically active and have many social activities outside the home. Only a small proportion is the oldest old and they may have health and functional status limitations; and fewer activities. The oldest old may have difficulties with social interactions outside of the home because they may be less physically mobile. Movement through HDB apartment blocks may require walking through long corridors and up and down stairs to access elevators.

When I disaggregate the age distribution by gender as seen in Graphs 2 and 3, the proportion of males aged 60 – 80 is higher than the proportion of females in the same age range.

Graph 2 Age Distribution, Females



Graph 3 Age Distribution, Males



Also Graph 2 shows that there is a substantial reduction of older women observed in the older / oldest old age grouping of 75 and above.

The following Table 2, Table 3 and Table 4 describe the different types of social connections that make up the older adult's social network – whether the older adult still has a spouse; the family household co-residing; and the tendency to have daily contact with apartment block neighbors.

Table 2 Older Adult Marital Status

Marital Status	HDB Public Housing				Private Housing Market
	1 - 2 BR	3 BR	4BR	5BR	
Married	79	629	675	365	287
Widowed	34	184	142	61	40
Separated / Divorced	13	19	17	5	5
Never Married	14	52	14	13	11
Total	140	884	848	444	343

From Table 2, the majority of older adults are married. However about 16% of older adults are widowed which may affect or exacerbate the feelings of loss and isolation felt in old age. From the HDB 2008 interviews with households, older adults expressed a preference first and foremost to reside with their spouse and to a lesser extent with their adult children or other family members. This implies that marriage is the most important part of an older adult's social connections.

Table 3 Older Adult Household Size

Household Size	HDB Public Housing				Private Housing Market
	1 - 2 BR	3 BR	4BR	5BR	
1	37	109	40	17	10
2	75	357	251	105	96
3	16	246	239	138	103
4	7	108	172	86	61
5	1	42	79	45	26
6	0	13	41	22	22
>6	4	9	26	31	22
Total	140	884	848	444	340

Table 3 shows that over 33% of older adult households consist of 2 individuals co-residing; this is the largest segment in the different types of living arrangements. Most of the individuals in this

segment consist of married couples. 28% of total households are 3 person households that consist of a married couple and adult child; or a married couple and maid who provides old age care. A smaller 16% consists of 4 person households and the proportion of larger household sizes then declines. Or put another way, large household sizes with multiple generations co-residing is less common.

Table 4 Number of Older Adults Interacting with Apartment Block Neighbors on a Daily Basis

Household Size	HDB Public Housing				Private Housing Market
	1 - 2 BR	3 BR	4BR	5BR	
More than 50% Likely, Each Day	110	665	667	359	270
Less than 50% Likely, Each Day	30	219	181	85	73

From Table 4 the number of older adults willing and likely to engage with their neighbors each day is substantially high. Over 67% of older adults in public housing and 78% in private housing perceive themselves as being more than likely to be in daily contact with neighbors. For older adults in HDB housing, the daily social interaction is likely to take place along the apartment building corridors, through senior center activity center visits at the ground floor level of the apartment building, the neighborhood market, restaurants and public spaces (HDB 2008). This again implies that older adults are likely to interact with people from different walks of life.

In the next section I proceed to present the OLS and IV estimates for the multiple indicators of loneliness; and the overall loneliness scale. First I present the estimates for the relationship between SES and the older adult's social network as measured by loneliness. Second, I investigate the dynamics of the older adult's social network when there is heterogeneous SES.

5. Results

Table 5 provides the estimates for the older adult's sense of companionship, to what extent s / he feels that there is companionship in old age.

Table 5

Dependent Variable = Companionship (self-rated)
(Standard errors are in parentheses)

	(i) OLS	(ii) IV	(iii) OLS	(iv) IV
Socio-Economic Status	.0005	.0027	.0006	.0028
(SES)	(.0015)	(.0028)	(.0015)	(.0028)
Social Housing (HDB)	.0123		.0118	
	(.0177)		(.0177)	
Age – 60 to 74	-.0045*	-.0040		
	(.0023)	(.0024)		
Age – More than 75			-.0607	-.0542
			(.0381)	(.0390)
Female	.1541***	.1684***	.1578***	.1713***
	(.0369)	(.0398)	(.0367)	(.0395)
Chinese Ethnicity	-.1741***	-.1717***	-.1750***	-.1726***
	(.0396)	(.0392)	(.0396)	(.0392)
Social Network				
Married	.2958***	.2962***	.2985***	.2984***
	(.0424)	(.0424)	(.0424)	(.0424)
Household Size	.0518***	.0547***	.0526***	.0553***
	(.0120)	(.0115)	(.0120)	(.0115)
Neighbors	.0063	.0065	.0067	.0068
	(.0137)	(.0137)	(.0137)	(.0137)
SES instrumented by HDB Housing Allocation		Yes		Yes
Constant	4.2852	4.2371	3.9735	3.9629
	(.2022)	(.2200)	(.0923)	(.0980)
R^2	.05	.05	.05	.05
Observations	2,549	2,549	2,549	2,549

Notes: Chinese ethnicity is a dummy variable, Chinese = 1, Malay and Indian, otherwise = 0. The Chinese ethnic group in Singapore is the majority at 75%.

Across columns (i) – (iv), SES has a negligible effect on the older adult's sense of companionship in later life, controlling for gender and ethnicity. Columns (i) and (ii) provide the OLS and IV estimates for the youngest old and columns (iii) and (iv) provide the same specifications for the oldest old. Regardless of whether the individual is the youngest old or oldest old, SES has a negligible influence of a sense of companionship. In comparing the two age groupings, the disengagement theory appears to be occurring where being older has a negative relationship with a sense of

companionship. The coefficient size is smaller for the age group 60 to 74 and is larger for the age group 75 and above. The estimates are similar for both OLS and IV in both specifications which suggest minimal omitted variable bias. However the age group variable is not statistically significant. But being an older woman does have a substantially positive effect on a sense of companionship controlling for the other variables in the specifications. The coefficient size of this exogenous covariate controlling for other variables is similarly large across columns (i) and (iv) and all are statistically significant at the 1% level. This strongly implies that older women enjoy a greater feeling of companionship within their social networks compared to older men. However this is negated if the older adult is of Chinese ethnicity, an exogenous covariate. A substantially large coefficient size in the opposite direction between ethnicity and self-rated companionship is found. The OLS and IV estimates are statistically significant at the 1% level. It is then inferred that if an older adult is not of Chinese ethnicity, then there is a better sense of companionship in later life.

In terms of the dynamics of the older adult's social network, marriage has the strongest positive effect on companionship. This result is consistent across columns (i) to (iv) and statistically significant at the 1% level. The magnitude of this coefficient ameliorates the negative effects of aging and ethnicity on a sense of companionship. Thus, it is not surprising that growing old, being married and staying married create the greatest sense of companionship. However there is very likely to then be a great sense of loss and isolation when the older adult is widowed. In comparison to marriage, the number of family members co-residing and daily contact with apartment neighbors have a much smaller positive effect on companionship in later life. But the positive effect of household size is statistically significant at the 1% level. The number of family members living under one roof and the daily interactions possible contribute in some small way to the feelings of companionship.

In the following Table 6, I present the output where the dependent variable is the older adult self-rated measure of not feeling left out. In comparison to the self rated measure of companionship, the most noticeable difference is that SES has a positive and statistically significant effect on not feeling left out.

Table 6

Dependent Variable = Not Left Out (self-rated)

(Standard errors are in parentheses)

	(v) OLS	(vi) IV	(vii) OLS	(viii) IV
Socio-Economic Status	.0031*	.0082**	.0039**	.0086**
(SES)	(.0017)	(.0032)	(.0017)	(.0032)
Social Housing (HDB)	.0272		.0250	
	(.0197)		(.0197)	
Age – 60 to 74	-.0186***	-.0173***		
	(.0026)	(.0027)		
Age – 75 and above			-.2430***	-.2282***
			(.0420)	(.0432)
Female	.2091***	.2406***	.2276***	.2554***
	(.0409)	(.0442)	(.0408)	(.0438)
Ethnicity	-.0938**	-.0892**	-.0972**	-.0928**
	(.0437)	(.0434)	(.0439)	(.0435)
Social Network				
Married	.0899*	.0906*	.1024**	.1021**
	(.0473)	(.0473)	(.0474)	(.0475)
Household Size	.0098	.0163	.0119	.0178
	(.0133)	(.0127)	(.0133)	(.0128)
Neighbors	.2436***	.2431***	.2482***	.2475***
	(.0139)	(.0139)	(.0139)	(.0139)
SES instrumented by HDB Housing Allocation		Yes		Yes
Constant	4.4353	4.3269	3.1516	3.1324
	(.2241)	(.2443)	(.0988)	(.1043)
R^2	.15	.14	.14	.14
Observations	2,659	2,659	2,659	2,659

Notes: Chinese ethnicity is a dummy variable, Chinese = 1, Malay and Indian, otherwise = 0. The Chinese ethnic group in Singapore is the majority at 75%.

When assessing the estimates for SES across columns (v) to (viii), the IV estimates are slightly higher than the OLS estimates which may be because of attenuation bias. Nonetheless the SES coefficient sizes are larger and statistically significant compared to the SES coefficient sizes from Table 5. A possible interpretation is that a higher SES group comes together and then the older adult does not feel in any way left out when within his / her reference group. However the positive effect of a homogenous SES group for the social network is very small and can be cancelled out by aging. As with the relationship between aging and companionship, the relationship between aging and not feeling left out is negative and statistically significant. Furthermore, the negative relationship is worsened when the individual is older than 75. While the age group 60 to 74 has a negative

coefficient size of 0.01, the age group 75 and above suffers from a much larger coefficient size in the region of 0.2. The OLS estimate is higher than the IV estimates for the age group 75+ where the OLS estimate is overstating the relationship because of the presence of omitted variables. Overall, the effect of late life is substantial on perceiving oneself being left out and this is statistically significant at the 1% level. Fortunately older women suffer far less from feeling left out and this strong result can be seen across all four specifications in Table 6. This positive pattern is consistent with older women feeling positive about companionship in later life. Comparing further the two different indicators of overall loneliness in Tables 5 and 6, it appears that the Chinese ethnic group tends to have less companionship and to feel left out more. But the extent of feeling left out is lower than the feeling of less companionship.

When considering the social network and not feeling out, unexpectedly marriage has a much smaller effect. The coefficient size is approximately 0.08 and is statistically significant. In contrast being married on a sense of companionship has a larger coefficient size of 0.29. This can be interpreted to mean that marriage provides exactly the fellowship of companions but this still may not prevent an older adult from feeling left out. Perhaps an older adult needs to look beyond marriage to feel included in the larger society and this may come from neighbors and friends. This appears to be the case as family members living together does not stop an older adult from feeling left out. As consistent with this interpretation, the tendency to have daily contact with neighbors has the strongest positive effect of not feeling left out, or in other words of feeling belonging within a community. Across columns (v) to (viii), neighbors provide the greatest sense of being included and these estimates are consistent and statistically significant at the 1% level. Given that the majority of older adults reside in HDB public housing in Singapore and are of different SES, it can be strongly inferred that SES has very little influence on building one's social network.

Next in Table 7, I present the estimates for the dependent variable, the self rated measure of not being isolated. This is the third indicator that makes up the overall loneliness scale from NSHAP. Similar to the self rated measure of not feeling left out, SES has a positive and statistically significant effect on one not being isolated. This suggests that two indicators from the loneliness scale are positively affected by SES to a small extent but for one indicator, companionship, hardly any relationship can be detected.

Table 7

Dependent Variable = Not Isolated (self-rated)
(Standard errors are in parentheses)

	(ix) OLS	(x) IV	(xi) OLS	(xii) IV
Socio-Economic Status	.0042**	.0070**	.0050**	.0073**
(SES)	(.0017)	(.0031)	(.0017)	(.0031)
Social Housing (HDB)	.0148		.0126	
	(.0195)		(.0196)	
Age – 60 to 74	-.0197***	-.0190***		
	(.0025)	(.0026)		
Age – 75 and above			-.2638***	-.2564***
			(.0417)	(.0428)
Female	.1592***	.1764***	.1777***	.1918***
	(.0405)	(.0437)	(.0404)	(.0434)
Ethnicity	-.0785*	-.0760*	-.0824*	-.0802*
	(.0433)	(.0429)	(.0435)	(.0431)
Social Network				
Married	.0796*	.0800*	.0916*	.0914*
	(.0469)	(.0469)	(.0470)	(.0470)
Household Size	.0090	.0125	.0111	.0141
	(.0131)	(.0126)	(.0132)	(.0126)
Neighbors	.2518***	.2515***	.2565***	.2561***
	(.0138)	(.0138)	(.0138)	(.0138)
SES instrumented by HDB Housing Allocation		Yes		Yes
Constant	4.5484	4.4892	3.1928	3.1831
	(.2221)	(.2420)	(.0980)	(.1033)
R^2	.16	.16	.15	.15
Observations	2,659	2,659	2,659	2,659

Notes: Chinese ethnicity is a dummy variable, Chinese = 1, Malay and Indian, otherwise = 0. The Chinese ethnic group in Singapore is the majority at 75%.

Table 6 and Table 7 show similar results for all variables specified in terms of direction and magnitude. The goodness of fit for the specifications where the dependent variables are not left out and not isolated are similar in the range of 0.14 – 0.16 while the goodness of fit when the dependent variable is companionship is only 0.05. What is perhaps most interesting then is how substantial a role neighbors play in the older adult's social network. There are substantially positive effects of daily contact with neighbors on the older adult not feeling left and not feeling isolated. From Table 6 and 7, consider that the negative coefficients for aging as in individuals who are the older / oldest old are similar in magnitude to the positive coefficients of daily contact with neighbors. It is then posited that the interaction with neighbors in apartment building living can contribute to slowing down the disengagement process in late life. In the following Table 8, I aggregate these multiple indicators, i) companionship, ii) not feeling left out and iii) not being isolated into the overall loneliness scale to determine if the previous results hold.

Table 8

Dependent Variable = Overall Lack of Loneliness (self-rated)
(Standard errors are in parentheses)

	(xiii) OLS	(xiv) IV	(xv) OLS	(xvi) IV
Socio-Economic Status	.0029	.0096	.0034	.0098
(SES)	(.0040)	(.0073)	(.0040)	(.0073)
Social Housing (HDB)	.0365		.0351	
	(.0461)		(.0461)	
Age – 60 to 74	-.0142**	-.0126**		
	(.0061)	(.0064)		
Age – 75 and above			-.1898*	-.1707*
			(.0990)	(.1013)
Female	.2798**	.3223**	.2915**	.3312**
	(.0957)	(.1034)	(.0953)	(.1025)
Ethnicity	-.6379***	-.6310***	-.6407***	-.6339***
	(.1027)	(.1019)	(.1028)	(.1019)
Social Network				
Married	.5973***	.5984***	.6055***	.6054***
	(.1102)	(.1101)	(.1102)	(.1102)
Household Size	.1429***	.1514***	.1451***	.1531***
	(.0311)	(.0299)	(.0311)	(.0298)
Neighbors	.0549	.0555	.0562	.0566
	(.0356)	(.0357)	(.0356)	(.0357)
SES instrumented by HDB Housing Allocation		Yes		Yes
Constant	13.3502	13.2079	12.3774	12.3460
	(.5247)	(.5709)	(.2397)	(.2544)
R^2	.05	.05	.05	.05
Observations	2,549	2,549	2,549	2,549

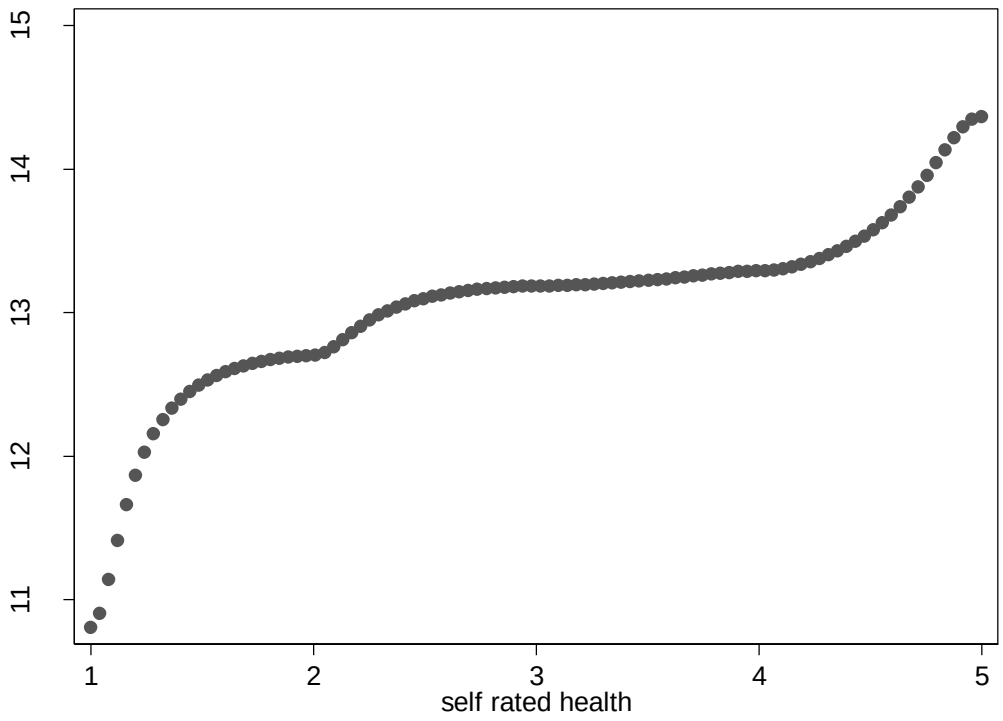
Notes: Chinese ethnicity is a dummy variable, Chinese = 1, Malay and Indian, otherwise = 0. The Chinese ethnic group in Singapore is the majority at 75%.

Table 8 shows that the relationship between SES and overall lack of loneliness is negligible. In other words, one's SES does not matter for one's social interactions in old age. Also Table 8 shows that older women experience less loneliness compared to older men. The most noticeable results for the aggregation of the different indicators of loneliness are the exogenous covariate, ethnic group and the endogenous explanatory variables, being married and household size. A sense of loneliness is overwhelmingly strong for the Chinese ethnic group compared to the Malay ethnicities and Indian ethnicities. This is statistically significant at the 1% level across columns (xiii) to (xvi). A possible explanation is that this may be a statistical artifact from the summation of the multiple indicators for the overall loneliness scale. As such the 0.6 coefficient size may not necessarily reflect the true extent of the loneliness that the Chinese ethnic group feels in old age. But this striking result does merit future investigation of the well being of the older Chinese.

As consistent with previous results, marriage substantially lowers feelings of loneliness in old age. However a new finding is that household size has a positive and sizeable effect that is statistically significant at the 1% level. This result was not found in the output Tables 5 – 7. While household size did have a positive and statistically significant effect on a sense of companionship, this effect was small. Miniscule effects were found for not feeling left out and not being isolated. One of the ways to interpret this is that at the aggregate level, living with children and grandchildren can reduce loneliness but the precise pathways explaining the dynamics of living together is difficult to ascertain. Also consideration has to be given for the size of apartments that Singaporeans live in. Multiple generations living together in small apartments in the island state can be uncomfortable and this can be a trade off with not feeling lonely.

6. Self Rated Loneliness (SRL) and Self Rated Health (SRH)

Graph 4 Kernel Regression of Self Rated Loneliness and Self Rated Health



In this preliminary attempt, I now attempt to establish a linkage between overall self rated loneliness (SRL) which explains for the social network and self rated health (SRL). Conceptually this follows

from Lindau et al (2003) and Waite and Das (2010). I run a non-parametric kernel regression between SRL and SRH and find that there is a non-linear positive relationship. For lower scores of overall lack of loneliness, Graph 4 shows that there is a sharp and increasing relationship with health. In the region of 12 – 14 on the lack of loneliness scale, the rate of increase with health is smaller. But in the highest regions of both variables, the rate of increase is higher than the middle regions but lower than the lowest region. This less than perfectly linear relationship suggests that when there is extreme loneliness, older adult subjective health suffers substantially. But on average, loneliness and health may have a less distinct relationship. If this is the case, I carry the same OLS and IV estimation but now on self rated health. The results are in the following Table 9.

Table 9

Dependent Variable = Health (self-rated)
(Standard errors are in parentheses)

	(xiii)	(xiv)	(xv)	(xvi)
	OLS	IV	OLS	IV
Socio-Economic Status	.0053**	.0176***	.0056***	.0177***
(SES)	(.0015)	(.0028)	(.0015)	(.0028)
Social Housing (HDB)	.0663***		.0654***	
	(.0174)		(.0174)	
Age – 60 to 74	-.0135***	-.0104***		
	(.0022)	(.0024)		
Age – 75 and above			-.2178***	-.1792***
			(.0370)	(.0384)
Female	.4082***	.4849***	.4152***	.4880***
	(.0361)	(.0394)	(.0359)	(.0389)
Ethnicity	.0906**	.1017**	.0862**	.0978**
	(.0386)	(.0387)	(.0386)	(.0387)
Social Network				
Married	.0016	.0031	.0021	.0013
	(.0417)	(.0422)	(.0417)	(.0422)
Household Size	-.0217*	-.0060	-.0206*	-.0053
	(.0117)	(.0113)	(.0117)	(.0113)
Neighbors	.0528***	.0517***	.0548***	.0529***
	(.0123)	(.0124)	(.0123)	(.0124)
SES instrumented by HDB Housing Allocation		Yes		Yes
Constant	3.6053	3.3413	2.7049	2.6548
	(.1978)	(.2179)	(.0869)	(.0927)
R^2	.09	.07	.09	.07
Observations	2,659	2,659	2,659	2,659

Notes: Chinese ethnicity is a dummy variable, Chinese = 1, Malay and Indian, otherwise = 0. The Chinese ethnic group in Singapore is the majority at 75%.

The new results are interesting as SES has a positive relationship with SRH that is statistically significant at the 1% level controlling for other variables. Statistical significance for SES was not found in any of the previous specifications. However the coefficient size remains very small. What stands out next is that being an older Chinese now has a positive relationship with how the individual assesses his / her health. While the effect size is relatively small, this result is statistically significant at the 5% level. This could possibly be taken to mean that the older ethnic Chinese may report acute feelings of isolation and loneliness and yet rate themselves as being healthy.

In terms of the relationship between the social network and SRH, marriage no longer plays a role. Perhaps worse is that the larger the household size, the worse the older adult feels about his / her health. This negatively relationship is statistically significant for the OLS estimates in column (xiii) and (xv) but ceases to be statistically significant for the IV estimates in column (xiv) and (xvi). But the bright note is that daily contact with apartment neighbors has a positive and statistically significant on subjective health.

7. Preliminary Conclusions

The narrative of loneliness and loss in old age – grown children who have left the nest, widowhood - occurs in different ways and at different rates for individuals from different socio-economic status (SES) groups. Individuals can adapt to the aging process with changes in their behavior and environment. In the Confucian values based society of Singapore, this empirical paper has investigated how older adults adapt through their social networks. Using the HDB social housing allocation as a source of exogenous variation, I find that the socio-economic status of older adults has very little influence on how and where they build their social networks. Given the high density apartment living in Singapore, individuals of heterogeneous SES come together to live and grow old together.

In terms of what constitutes the social network of older adults aged 60 and above, the spouse, family members and apartment neighbors all contribute to the strength of this network. The spouse plays the crucial role in companionship, continuing to reside together in old age. The children play a far less important role in providing this sense of companionship. However the children and grandchildren who live with the older adult reduce the sense of feeling left out and isolated.

Apartment neighbors complement the spouse and children in terms of daily contact outside of the home. Greetings and salutations occur in the common corridor, the senior activity center of the neighborhood and in public spaces such as the neighborhood market and park. Daily contact with the neighbors contributes to a greater sense of belonging within a community. Collectively, this social network ameliorates the sense of disengagement and pulling away from social systems in late life. This is the case for individuals aged 60 – 74 but to a much lesser extent for individuals age 75+. Older women particularly enjoy this strongly positive relationship between the social network and health and well being. Also the social network appears to promote a better sense of health and well being. But in this preliminary work, this may only be the case for older adults with very low or very high subjective health and not for older adults with average subjective health.

As the dataset used for this empirical work is a cross sectional from 2009, the specifications will be re-estimated when new data has been collected in 2011. Using the same IV estimation on panel data, future work will enable control of fixed effects and causal inference to be made.

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