Applied Research Quality Life (2018) 13:179–195
DOI 10.1007/s11482-017-9519-6

Health-Related Quality of Life in a Low-Socioeconomic Status Public Rental-Flat Population in Singapore

Liang En Wee[1] · Peter Daniel[2] · Aline Sim[2] · Rui Lee[2] · Sook Muay Tay[3] · Nan Luo[4] · Gerald Choon-Huat Koh[4]

Received: 27 April 2016 / Accepted: 6 March 2017 / Published online: 21 March 2017

Abstract Health-related quality of life (HRQoL) is a well-established measure of health and general well-being. Socioeconomic status (SES) can affect HRQoL. We sought to determine whether there were differences in HRQoL between low versus higher area-SES flat communities in Singapore. Residents in two integrated public housing precincts comprising of rental-flat blocks (low area-SES neighborhood) and neighboring owner-occupied blocks (higher area-SES neighborhood) were asked to rate their self-perceived HRQoL using the EuroQol Group five dimensions (EQ-5D) instrument. The EQ-5D assesses HRQoL in five domains (mobility, self-care, usual activities, anxiety/mood and pain) and with a global visual analogue scale (EQ-VAS). We evaluated differences in HRQoL between the rental and owner-occupied neighborhoods, and factors associated with anxiety/depression in the rental-flat neighborhood using multivariate logistic regression. The participation rate was 89.1% (634/711). In the owner-occupied neighborhood, 56.7% (216/381) were in full health, compared with 54.2% (137/253) in the rental-flat population (OR = 0.90, 95%CI = 0.66–1.24, p = 0.568). Across the five domains, staying in a rental-flat neighborhood was independently associated with anxiety/depression (adjusted odds ratio [aOR] = 1.79, 95%CI = 1.10–2.92, p = 0.019). In the rental-flat population, having anxiety/depression

✉ Liang En Wee
weeliangen@gmail.com

[1] Singhealth Internal Medicine Residency, Singapore General Hospital, 167 Jalan Bukit Merah #17-10 Tower 5, Singapore 150167, Singapore

[2] Yong Loo Lin School of Medicine, National University Health System, National University of Singapore, Singapore, Singapore

[3] Department of Anesthesia, Singapore General Hospital, Singapore, Singapore

[4] Saw Swee Hock School of Public Health, National University Health System, National University of Singapore, Singapore, Singapore

was independently associated with minority ethnicity, problems with self –care, pain/discomfort, difficulty with healthcare costs, and not being on subsidized primary care ($p < 0.05$). There was no significant difference on the EQ-VAS between the two neighborhoods ($p = 0.627$). Staying in a low area-SES neighborhood was associated with more mental health problems. In the rental-flat population, self-reported anxiety/depression was associated with minority ethnicity, physical health problems, and financial disadvantage in healthcare.

Keywords Health-related quality of life · Low income · Socioeconomic status · Anxiety

Introduction

Health-related quality of life (HRQoL) is a multi-dimensional concept that includes domains related to physical, mental, emotional, and social functioning. HRQoL can provide a patient-centered measure that complements objective disease indicators, and has been shown to predict morbidity and mortality in various populations (Hartog et al. 2016; Landman et al. 2010). The link between socioeconomic status (SES) of the individual and HRQoL is well-established. Lower individual income, education and social class are all associated with lower HRQoL. (Choi et al. 2015; Delpierre et al. 2012; Kim and Park 2015) Amongst individuals staying in low-SES areas, neighborhood-level attributes of SES were associated with poorer self-rated physical and mental health. This includes physical characteristics of the built environment, such as poor access to amenities and poor neighborhood quality, as well as characteristics of the social environment, such as neighborhood disorder, lack of social cohesion, and neighborhood deprivation.(Callahan et al. 2011; Drukker and van Os 2003; Poortinga et al. 2007) Disparities in HRQoL at the community level may possibly occur because of differences in social capital (Browne-Yung et al. 2013) and prevalence of unhealthy lifestyles (Feng and Thomas 2013) between various communities. However, the majority of these studies were conducted in Western societies; evidence from Asian societies is more limited, though a few studies suggest that social and physical factors can also influence HRQoL in Asian societies. (Lee et al. 2015; Meng and Chen 2014).

Uniquely, public housing is a critical and inescapable element of Singapore's social fabric. The majority of Singaporeans ($\geq 85\%$) stay in public housing. Geographically, public housing is scattered across urban Singapore in 26 towns/estates; each town is further subdivided into neighbourhoods, and subsequently into precincts. Each precinct contains several blocks that centre around communal facilities and are physically designed to have distinct precinct boundaries, in order to promote communal exchanges. Home ownership rates in Singapore are high (90.3%) (Department of Statistics Singapore 2015) due to government subsidies, making home ownership a key demarcator of area-level SES. For the extremely needy unable to afford their own homes, public rental flats provide heavily subsidized rentals (S$26-S$275/month) (Housing and Development Board Singapore 2013b). Only a very small proportion of the needy (3.7% of the population, 88% of whom earn less than S$670/month) (Housing and Development Board Singapore 2013a) stay in these public rental flat enclaves. To avoid concentrations of low-SES areas, the Singapore government has mixed blocks of public rental flats in the same precincts as owner-occupied flats; this is

necessitated by Singapore's high urban density. While owner-occupied and public rental flats thus share the same built environment and enjoy similar neighborhood facilities and amenities, the social environment is very different. Stigmatisation of public rental flat dwellers can cause social isolation- residents of rental flats do not feel similar levels of belonging as their neighbors staying in owner-occupied public housing.(Lin 2014) As turnover in these rental flat enclaves is high, the cyclical nature of tenancy also impedes community building (Lin 2014). Residents in these public rental flat neighborhoods have higher rates of depression (Wee et al. 2014b) and cognitive impairment (Wee et al. 2012) which can potentially affect HRQoL.(George et al. 2014) They also have poorer awareness and management of chronic disease, (Wee and Koh 2012) which can influence perceptions of self-rated HRQoL.(Venkataraman et al. 2014).

We therefore investigated the differences in HRQoL between individuals living in public rental-flat blocks (low area-SES) and those living in neighbouring owner-occupied blocks, using the EuroQol Group five dimensions (EQ-5D-5 L) HRQoL instrument (Herdman et al. 2011), a standardized questionnaire comprising five dimensions (mobility, self-care, usual activities, anxiety/depression, pain/discomfort), as well as a visual analogue scale (VAS) for assessing global health. We hope that these results will better aid our understanding of the relationship between HRQoL and area-SES, especially in urbanized Asian societies.

Methods

Study Population

The study population consisted of all Singaporean citizens/permanent residents aged 40–60 years, living in two integrated public housing precincts in Singapore, recruited in 2015. In Singapore, due to high urban density, blocks of public rental housing (low area-SES) and public owner-occupied housing (higher area-SES) occupy the same geographical space, forming integrated public housing precincts. Site A, in central Singapore, was located in a mature housing estate (developed before 1980) and contained 2 blocks of public rental flats and 1 block of owner-occupied housing; Site B, in eastern Singapore, was located in a middle-aged housing estate (developed in 1980s–1990s) and contained 2 blocks of public rental flats and 1 block of owner-occupied housing. We chose one site each from mature and middle-aged housing estates, because we wanted to control for differences in public housing design (generally, shifts towards more open designs and higher construction quality in later years) which might result in differences in perceived HRQoL. We divided residents into those <60 years and those ≥60 years, as those aged ≥60 years are designated as "senior citizens" by government agencies and are eligible for certain subsidies.

Data Collection Procedures

In this cross-sectional survey, information such as sociodemographic data/medical history was collected in door-to-door visits via interviewer-administered standardized questionnaires in English, Chinese and Malay. Indicators of individual-level SES

included: employment, being a recipient of financial aid or social assistance, household income, education and tenure (having stayed ≥10 years in the neighborhood). Indicators of area-level SES included: staying in a public rental flat block (vs. staying in an owner-occupied flat), and staying in a mature housing estate (vs. staying in a middle-aged housing estate). Residents were asked for their full self-reported medical history and health behaviours. Co-morbidity burden was scored according to the Charlson's Comorbidity Index (CCMI).(Charlson et al. 1987) Social network was measured using the Lubben Social Network Scale-6 (LSNS-6).(Lubben et al. 2006) Residents were also asked about primary care characteristics (eg. whether they were on the Community Health Assist Scheme (CHAS), which is a scheme that allows low-income Singaporeans to receive subsidised primary care and health screening at private general practitioner clinics in their neighborhoods (Ministry of Health Singapore 2015); whether they had additional medical insurance coverage (on top of Medishield, the national health insurance scheme); whether they were on regular follow-up with a family physician (at least once in the past 6 months), and if they had difficulty with cost of healthcare. In our previous study, residents in rental flat neighborhoods had lower access to Western-trained family physicians, with costs of healthcare being an issue.(Wee et al. 2014a) Interviewers were medical students who underwent standardized training prior to study commencement.

The HRQoL Instrument

Residents in both communities were asked to rate their self-perceived HRQoL using the 5 level version of the EQ-5D (EQ-5D-5 L), a standardized questionnaire comprising five dimensions (mobility, self-care, usual activities, anxiety/depression, pain/discomfort), also referred to as the EQ-5D descriptive system, as well as a visual analogue scale (VAS). There are five response levels for each dimension (1: no problems; 2: slight problems; 3: moderate problems; 4: severe problems; 5: extreme problems). Responses to the five dimensions can be used to calculate an index score anchored at 0 (death) and 1 (full health, that is, no problems in any of the five dimensions). In this study, we used a 'crosswalk' algorithm (van Hout et al. 2012) and a locally developed EQ-5D value set (Luo et al. 2014) such that the index score indicates the value or utility of the measured health status to the general public of Singapore. Using the VAS, residents were asked to rate how good or bad their health was on that day of interview on a scale of 1 to 100. A score of 100 was defined as the best health the resident could imagine while a score of 0 was defined as the worst health the resident could imagine. The EQ-5D-5 L and its early version, EQ-5D-3 L, questionnaire has been validated in Singaporean English, Chinese, and Malay versions.(Luo et al. 2003a, b; Luo et al. 2015a, b; Wang et al. 2015; Wee et al. 2007).

Statistical Analysis

Descriptive statistics were computed for the study population, comparing sociodemographic factors between low area-SES neighborhoods (rental flats) and higher area-SES neighborhoods (owner-occupied). We then investigated the association between area-SES (rental vs. owner-occupied flat neighborhood) and being in a state of full health, and reporting any problem in any of the five domains of the EQ-5D

(mobility, self-care, usual activities, anxiety/depression, and pain). We used the Chi-square test to examine univariate associations. We also used t-test to examine whether area-SES was associated with differences in the EQ-5D index and VAS scores. As staying in a lower area-SES neighborhood was associated with problems on anxiety/depression in univariate analysis, we used backward logistic regression to investigate whether this association persisted on multivariate analysis after controlling for clustering by block level and various indicators of individual-level SES, area-level SES, sociodemographic factors, primary care characteristics, and other domains of the EQ-5D. Finally, we used Chi-square test to investigate the factors associated with problems with anxiety/depression in the lower area-SES rental flat neighborhood on univariate analysis, and backward logistic regression for multivariate analysis. The criterion for initial entry of variables into multivariate models was $p < 0.1$ on univariate analysis. All statistical analysis was performed using STATA (Version 14.0, USA) and statistical significance was set at $p < 0.05$.

Study Ethics

Ethics approval was obtained from the NUS Institutional Review Board (application approval number B-16-072), informed consent was sought and participation was voluntary.

Results

General Population Characteristics

The participation rate was 89.1% (634/711). The sociodemographic profile of study participants is found in Table 1**.** Generally, residents of the lower area-SES neighborhoods (rental flat blocks) tended to have stayed for shorter durations in the neighborhoods, no additional medical insurance coverage (besides Medishield) and had higher proportions of minority ethnicities, unmarried residents, recipients of financial aid/social assistance, lower educational qualification, smaller household sizes and smaller social networks. There was no difference in age between rental and non-rental flat populations. Stratifying our age data into four categories (aged 40–50 years; aged 51–60 years; aged 61–70 years; aged >70 years), we found on univariate analysis that age was associated strongly with the physical domains of HRQoL. There was a clear trend in the proportions of those experiencing mobility issues, which increased from 9.7% in the aged 40-50 bracket, to 34.7% in the aged >70 bracket ($p < 0.0001$). Similar trends were reported for self-care (increasing from 1.6% to 11.7% in the aged >70 bracket, $p < 0.0001$) and for activity (increasing from 4.8% to 16.3% in those aged >70, $p < 0.0002$). However, there were no significant differences in problems with anxiety/mood ($p = 0.064$) or pain ($p = 0.576$), by age.

Association between Area-SES and Domains of HRQoL

On univariate analysis, there was no difference in the proportions of those in a state of perfect health between residents in a low area-SES rental flat community, compared

Table 1 Sociodemographic factors in two integrated public housing estates in Singapore in 2015 ($N = 634$)

	Owner-occupied blocks (higher area-SES), N (%) ($N = 381$)	Rental flat blocks (low area-SES), N (%) ($N = 253$)	OR (95% CI)	*p*-value
Site				
Mature housing estate	53.3 (203/381)	49.0 (124/253)	1.00	0.330
Middle-aged housing estate	46.7 (178/381)	51.0 (129/253)	1.19 (0.86–1.63)	
Tenure				
< 10 years in the neighborhood	31.2 (119/381)	62.0 (147/237)	1.00	<0.001
≥ 10 years in the neighborhood	68.8 (262/381)	38.0 (90/237)	0.28 (0.20–0.39)	
Primary care characteristics				
Subsidies and insurance				
Has additional medical insurance coverage (on top of Medishield[1])				
No additional insurance coverage	82.4 (314/381)	89.3 (226/253)	1.00	0.017
Has additional insurance coverage	17.6 (67/381)	10.7 (27/253)	0.56 (0.35–0.90)	
On subsidized primary care (CHAS scheme)				
Not on CHAS scheme	62.2 (237/381)	54.9 (139/253)	1.00	0.070
On CHAS scheme	37.8 (144/381)	45.1 (114/253)	1.35 (0.98–1.86)	
Perceived difficulty with healthcare costs				
No	81.9 (312/381)	79.8 (202/253)	1.00	0.536
Yes	18.1 (69/381)	20.2 (51/253)	1.14 (0.76–1.71)	
Regular primary care				
Not on regular primary care followup	64.6 (246/381)	62.8 (159/253)	1.00	0.674
On regular primary care followup	35.4 (135/381)	37.2 (94/253)	1.08 (0.77–1.50)	
Demographic characteristics				
Age				

Table 1 (continued)

	Owner-occupied blocks (higher area-SES), N (%) (*N* = 381)	Rental flat blocks (low area-SES), N (%) (*N* = 253)	OR (95% CI)	*p*-value
< 60 years	37.5 (143/381)	44.3 (112/253)	1.00	0.098
≥ 60 years	62.5 (238/381)	55.7 (141/253)	0.76 (0.55–1.05)	
Mean age (S.D)	63,44 (0.71–13.81)	61.12 (15.98–1.10)	2.22 (−0.20–4.64)	0.072
Ethnicity				
Non-Chinese	25.5 (97/381)	45.8 (116/253)	1.00	<0.001
Chinese	74.5 (284/381)	54.2 (137/253)	0.40 (0.29–0.57)	
Marital status				
Not married	31.0 (118/381)	49.8 (126/253)	1.00	<0.001
Married	69.0 (263/381)	50.2 (127/253)	0.45 (0.33–0.63)	
Gender				
Female	57.7 (220/381)	56.9 (144/253)	1.00	0.870
Male	42.3 (161/381)	43.1 (109/253)	1.03 (0.75–1.43)	
Religious				
No	69.0 (263/381)	70.4 (178/253)	1.00	0.792
Yes	31.0 (118/381)	29.6 (75/253)	0.94 (0.66–1.33)	
Socioeconomic characteristics				
Occupation				
Unemployed	66.4 (253/381)	58.5 (148/253)	1.00	0.044
Employed	33.6 (128/381)	41.5 (105/253)	1.40 (1.01–1.95)	
Financial aid				
Not on financial aid	91.9 (350/381)	76.3 (193/243)	1.00	<0.001
On financial aid	8.1 (31/381)	23.7 (60/243)	3.51 (2.20–5.60)	

Table 1 (continued)

	Owner-occupied blocks (higher area-SES), N (%) (*N* = 381)	Rental flat blocks (low area-SES), N (%) (*N* = 253)	OR (95% CI)	*p*-value
Social assistance				
Not receiving social assistance	91.6 (349/381)	79.8 (202/253)	1.00	<0.001
Receiving social assistance	8.4 (32/381)	20.2 (51/253)	2.75 (1.71–4.42)	
Monthly household income				
≤ $500	48.0 (183/381)	45.5 (115/253)	1.00	-
≥ $500, <$1000	8.7 (33/381)	17.0 (43/253)	2.07 (1.25–3.45)	0.005
≥ $1000	43.3 (165/381)	37.5 (95/253)	0.92 (0.65–1.29)	0.618
Education				
Primary and below	48.6 (185/381)	58.9 (149/253)	1.00	0.012
Secondary and above	51.4 (196/381)	41.1 (104/253)	0.66 (0.48–0.91)	
Social characteristics				
Number of people in household				
≤ 2 people	49.9 (190/381)	59.7 (151/253)	1.00	0.018
> 2 people	50.1 (191/381)	40.3 (102/253)	0.67 (0.49–0.93)	
Participating in community activities				
No	89.5 (341/381)	87.7 (222/253)	1.00	0.521
Yes	10.5 (40/381)	12.3 (31/253)	1.19 (0.72–1.96)	
Lubben's Social Network Scale-6 (LSNS6)				
≥ 12	50.7 (193/381)	60.1 (152/253)	1.00	0.023
< 12	49.3 (188/381)	39.9 (101/253)	0.68 (0.49–0.94)	
Functional status				
Visual impairment				

Table 1 (continued)

	Owner-occupied blocks (higher area-SES), N (%) (*N* = 381)	Rental flat blocks (low area-SES), N (%) (*N* = 253)	OR (95% CI)	*p*-value
No	78.5 (299/381)	79.1 (200/253)	1.00	0.921
Yes	21.5 (82/381)	20.9 (53/253)	0.97 (0.66–1.43)	
Hearing impairment				
No	89.5 (341/381)	86.2 (218/253)	1.00	0.211
Yes	10.5 (40/381)	13.8 (35/253)	1.37 (0.84–2.22)	
Medical characteristics				
Charlson Comorbidity Index (CCMI)				
CCMI = 0	70.9 (270/381)	75.5 (191/253)	1.00	0.204
CCMI > 0	29.1 (111/381)	24.5 (62/253)	0.79 (0.55–1.13)	
Hypertension				
No hypertension	65.6 (250/381)	67.2 (170/253)	1.00	0.732
Has hypertension	34.4 (131/381)	32.8 (83/253)	0.93 (0.67–1.31)	
Diabetes				
No diabetes	86.4 (329/381)	85.0 (215/253)	1.00	0.643
Has diabetes	13.6 (52/381)	15.0 (38/253)	1.19 (071–1.76)	
Hyperlipidemia				
No hyperlipidemia	60.1 (229/381)	63.5 (160/253)	1.00	0.405
Has hyperlipidemia	39.9 (152/381)	36.5 (92/253)	0.87 (0.62–1.20)	

[1] Medishield: National compulsory health insurance scheme

[2] CHAS: Community Health Assist Scheme, a scheme which allows lower-income Singaporeans to pay subsidized rates for primary care at private general practitioner (GP) clinics

against an adjacent higher area-SES owner-occupied flat community (odds ratio, OR = 0.90, 95%CI = 0.66–1.24, $p = 0.568$) **(**Table 2**).** The top three health states in higher area-SES owner-occupied communities were: "full health" (56.7%, 216/381), "slight problems with pain" (11.0%, 42/381) and "slight problems with mobility" (4.2%, 16/381). The top three health states in low area-SES rental flat communities were "perfect health" (54.2%, 137/253), "slight problems with pain" (7.5%, 19/253), "slight problems with mobility and pain" (4.3%, 11/253), and "slight problems with anxiety/mood" (4.3%, 11/253). For specific EQ-5D domains, between the low area-SES (rental) and higher area-SES (owner-occupied) communities, there were no differences in the proportions of those who had issues with mobility, self-care, usual activities or pain (all $p > 0.05$). There was also no difference in EQ-5D-VAS scores between the low area-SES community (mean = 63.2, S.D. = 20.2) and higher area-SES community (mean = 62.5, S.D. = 20.4) ($p = 0.627$). There was no difference in EQ-5D index scores between the low area-SES community (mean = 0.83, S.D. = 0.28) and higher area-SES community (mean = 0.86, S.D. = 0.27) ($p = 0.185$). However, a higher

Table 2 Comparison of self-rated HRQoL using the EQ-5D-5 L in low area-SES (rental flat) and higher area-SES (owner-occupied) communities ($N = 634$)

	Owner-occupied blocks (higher area-SES), N (%) ($N = 381$)	Rental flat blocks (low area-SES), N (%) ($N = 253$)	OR (95% CI)	*p*-value
Full health				
No	43.3 (165/381)	45.8 (116/253)	1.00	0.568
Yes	56.7 (216/381)	54.2 (137/253)	0.90 (0.66–1.24)	
Mobility				
No problems	78.2 (298/381)	78.3 (198/253)	1.00	1.00
With any problems	21.8 (83/381)	21.7 (55/253)	1.00 (0.68–1.47)	
Self-care				
No problems with self-care	95.5 (364/381)	94.1 (238/253)	1.00	0.460
Problems with self-care	4.5 (17/381)	5.9 (15/253)	1.35 (0.66–2.75)	
Usual activities				
No problems with usual activities	91.9 (350/381)	87.7 (222/253)	1.00	0.101
Problems with usual activities	8.1 (31/381)	12.3 (31/253)	1.58 (0.93–2.67)	
Anxiety/depression				
No anxiety/depression	88.7 (338/381)	82.2 (208/253)	**1.00**	**0.026**
With any anxiety/depression	11.3 (43/381)	17.8 (45/253)	**1.70 (1.08–2.67)**	
Pain/discomfort				
No pain/discomfort	69.6 (265/381)	67.6 (171/253)	1.00	0.601
With any pain/discomfort	30.4 (116/381)	32.4 (82/253)	1.10 (0.78–1.54)	
Global score	Mean (S.D)	Mean (S.D)		
EQ health index	0.86 (0.27)	0.83 (0.28)	0.022 (−0.14–0.072)	0.185
EQ-VAS	62.5 (20.4)	63.2 (20.2)	-0.80 (−4.0–2.4)	0.627

Bold entries indicate entries for which the *p*-value was significant (<0.05)

proportion of residents in the rental flat communities had problems with anxiety/mood, compared to those in owner-occupied communities (OR = 1.70, 95%CI = 1.08–2.67, p = 0.026) **(**Table 2**).** On multivariate analysis, adjusting for individual-level SES (monthly household income), other domains of EQ-5D (mobility, self-care, usual activities, pain/discomfort), primary care characteristics (perceived difficulty with healthcare costs), and social characteristics (number of people in household), staying in the lower area-SES community was independently associated with having problems with anxiety/mood (adjusted odds ratio, aOR = 1.79, 95%CI = 1.10–2.92, p = 0.019) **(**Table 3**).**

Associations with Having Anxiety/Mood Problems on the EQ-5D-5 L in Low Area-SES Communities

Within the low area-SES rental flat community, 17.8% (45/253) had problems with anxiety/mood. On multivariate analysis, within the rental flat community, being of minority ethnicity (aOR = 3.70, 95%CI = 1.75–8.33, p = 0.001), having problems with self-care (aOR = 4.50, 95%CI = 1.28–15.78, p = 0.019) and having problems with pain (aOR = 2.09, 95%CI = 1.01–4.45, p = 0.048) were independently associated with having problems with anxiety/mood. In addition, while having difficulty with health costs was independently associated with having problems with anxiety/mood (aOR = 3.73, 95%CI = 1.69–8.23, p = 0.001), having access to subsidized primary care at a private general practitioner (GP) via the CHAS scheme was independently associated with having no problems with anxiety/mood (aOR = 0.37, 95%CI = 0.17–0.82, p = 0.014) **(**Table 4**).**

Discussion

Adjusting for individual-level SES and other sociodemographic characteristics, staying in the low area-SES community was independently associated with self-reported anxiety/depression on the EQ-5D, but not in other domains including mobility, self-care, usual activities, and pain/discomfort. This was divergent from other studies in Western societies which showed significant disparities in HRQoL across both physical and psychological measures of health. (Callahan et al. 2011; Drukker and van Os 2003; Poortinga et al. 2007) While our previous study on chronic pain demonstrated no difference in pain prevalence between the rental-flat population (low area-SES) and adjacent owner-occupied precincts (higher area-SES), (Wee et al. 2016) we were surprised that the divergences in HRQoL were mainly centered around the area of mental health. This is possibly borne out of the unique situation in highly-urbanised Singapore with its densely packed neighborhoods and central role of public housing. While the block is the basic neighborhood unit in highly urbanized Singapore, public rental flat blocks are not concentrated into enclaves but are scattered across Singapore, located within the same precincts as other blocks of higher area-SES owner-occupied housing. Thus, very different communities share the same physical environment and infrastructure. This may contribute to “flattening” of some of the divergences caused by lack of access to facilities and physical barriers, especially in the domains of mobility and usual activities. However, because of higher levels of turnover in the

Table 3 Factors independently associated with problems with anxiety/mood on the EQ-5D-5 L in low area-SES (rental flat) and higher area-SES (owner-occupied) communities ($N = 634$)

	aOR[a] (95% CI)	*p*-value
Socioeconomic characteristics		
Individual-SES		
Monthly household income		
≤ $500	1.00	-
≥ $500, <$1000	0.84 (0.39–1.78)	0.646
≥ $1000	**0.52 (0.29–0.94)**	**0.030**
Area-SES		
Type of neighborhood (public rental or owner-occupied)[↓]		
Owner-occupied flat (higher area-SES)	**1.00**	**0.019**
Rental flat (lower area-SES)	**1.79 (1.10–2.92)**	
Self-rated health(EQ-5D-5 L)		
Mobility[↓]		
No problems with mobility	1.00	0.072
Problems with mobility	1.76 (0.95–3.26)	
Self-care[↓]		
No problems with self-care	1.00	0.728
Problems with self-care	1.19 (0.45–3.26)	
Usual activities[↓]		
No problems with usual activities	1.00	0.377
Problems with usual activities	1.42 (0.65–3.07)	
Pain[↓]		
No problems with pain	**1.00**	**0.001**
Problems with pain	**2.53 (1.47–4.39)**	
Primary care characteristics		
Perceived difficulty with healthcare costs[↓]		
No	**1.00**	**0.008**
Yes	**2.07 (1.21–3.55)**	
Social characteristics		
Number of people in household		
≤ 2 people	**1.00**	**0.003**
> 2 people	**2.30 (1.34–3.98)**	

Bold entries indicate entries for which the *p*-value was significant (<0.05)

[a] Controlling for the following factors: for individual-level SES: monthly household income, education, employment status, duration of residence. For area-level SES, controlling for the following factors: type of neighborhood (rental vs. owner-occupied flat community); mature vs. middle-aged housing estate. For sociodemographic factors: number of people in household, size of social network (quantified by LSNS-6), comorbidity burden (quantified by CCMI). For primary care characteristics: perceived difficulty with healthcare costs. For HRQoL: problems with mobility, self-care, activities, pain. These factors were controlled for in multivariate clustered logistic regression model

[↓] $p > 0.05$ on univariate analysis using chi-square test

Table 4 Factors independently associated with problems with anxiety/mood on the EQ-5D-5 L in low-SES (rental flat) communities ($N = 253$)

	No problems with anxiety/mood, N(%) ($N = 208$)	Problems with anxiety/mood, N (%) ($N = 45$)	OR (95% CI)	*p*-value	aOR[a] (95% CI)	*p*-value
Demographic characteristics						
Ethnicity						
Non-Chinese	71.6 (83/116)	28.4 (33/116)	**1.00**	**<0.001**	**1.00**	**0.001**
Chinese	91.2 (125/137)	8.8 (12/137)	**0.24 (0.12–0.49)**		**0.27 (0.12–0.57)**	
Self-rated health(EQ-5D-5 L)						
Self-care						
No problems with self-care	84.0 (200/238)	16.0 (38/238)	**1.00**	**0.008**	**1.00**	**0.019**
Problems with self-care	53.3 (8/15)	46.7 (7/15)	**4.61 (1.58–13.45)**		**4.50 (1.28–15.78)**	
Pain						
No problems with pain	87.7 (150/171)	12.3 (21/171)	**1.00**	**0.001**	**1.00**	**0.048**
Problems with pain	70.7 (58/82)	29.3 (24/82)	**2.96 (1.53–5.72)**		**2.09 (1.01–4.45)**	
Primary care characteristics						
Perceived difficulty with healthcare costs (in 2015)						
No	87.1 (176/202)	12.9 (26/202)	**1.00**	**<0.001**	**1.00**	**0.001**
Yes	62.7 (32/51)	37.3 (19/51)	**4.02 (1.99–8.10)**		**3.73 (1.69–8.23)**	
On subsidized primary care (CHAS scheme)						
Not on CHAS scheme	77.7 (108/139)	22.3 (31/139)	**1.00**	**0.047**	**1.00**	**0.014**
On CHAS scheme	87.7 (100/114)	12.3 (14/114)	**0.49 (0.25–0.97)**		**0.37 (0.17–0.82)**	

Bold entries indicate entries for which the *p*-value was significant (<0.05)

[a] Controlling for ethnicity, self-care, pain, perceived difficulty with healthcare costs, on subsidized primary care (CHAS scheme) in multivariate clustered logistic regression model

rental flat blocks and social stigmatization that accrues to residents staying in a rental flat community (even if they may fare similarly on markers of individual-level SES, such as income), the social environment can be very different even though the external built environment is the same. This may contribute to the disparities seen in the anxiety/mood domain of HRQoL,Although the government has taken care to site rental blocks in the same neighborhoods as owner-occupied blocks, ensuring equal access to amenities, the internal built environment can be different. Rental housing design in Singapore typically consists of a slab block with a single or double loaded corridor; corridors can be dark and less welcoming, compared to owner-occupied blocks with more open and airy designs.(Lin 2014) These differences in the internal built environment may also serve as barriers to community building, which could potentially explain the differences seen in anxiety/mood. With regards to anxiety/depression, our previous studies also demonstrated higher rates of depressive symptoms in these lower area-SES rental flat neighborhoods, even after controlling for individual-level SES. (Wee et al. 2014b) Cognitive impairment was also higher in these rental flat neighborhoods,(Wee et al. 2012) which can also contribute to poorer HRQoL. (Pan et al. 2015) Possibly greater turnover in the rental flat neighborhood likely contributed to poorer social networks, reducing emotional resilience and exerting adverse effects on psychological well-being.

Within the lower area-SES rental flat community, being of minority ethnicity was associated with self-reported anxiety/depression. In the national population, HRQoL levels differed between ethnic groups. However, mental HRQoL as measured by the SF-36 was higher in participants of minority ethnicity, relative to those of majority ethnicity; perhaps because of the tendency of minority ethnicities to have larger family units which afford larger support networks. (Leow et al. 2013) However, in our study population which was of lower-SES compared with the national average, having a larger household was independently associated with anxiety/depression. Perhaps in lower-SES strata, the financial burden from supporting more household members outweighs the greater social support associated with larger households, leading to an overall effect of greater anxiety from financial issues. Issues with pain, self-care and anxiety/depression appear inter-linked. Our other studies on depression and chronic pain in this population also show associations with functional limitation. (Wee et al. 2016; Wee et al. 2014b) Notably, worries about the costs of healthcare were independently associated with anxiety/depression in this low-SES area. Conversely, having access to subsidized primary care at a private general practitioner (GP) via the CHAS scheme was independently associated with lower rates of anxiety/depression. Our previous studies showed that residents of low-SES rental flat populations were more likely to turn to family and friends for medical assistance, as opposed to western-trained doctors, with costs cited as one of the key reasons for this.(Wee et al. 2014a) In a local study of diabetic patients in primary care, primary care characteristics such as confidence in doctor and satisfaction with the clinic were related to better quality of life.(Quah et al. 2011) In a 2008 study, growing concerns about the affordability of primary care were noted,(Lim and Joshi 2008) with the affordability of care at public institutions linked to public perceptions of a good healthcare system.(Joshi et al. 2009) Thus, it appears that primary care characteristics, such as affordability and accessibility, can significantly impact HRQoL in the domain of anxiety/depression in low-SES neighborhoods.

This study has several limitations. This was a cross-sectional study, not a cohort study; thus we can only identify correlation, but not causation. For instance, though having pain was associated with having anxiety, we cannot identify if anxiety exacerbated pain problems, or if pain contributed to anxiety. Furthermore, this study was carried out in two geographical sites and the sample size was small; we were unable to obtain a nationally representative sample of the rental flat population in Singapore because of logistical difficulties, as rental flats are scattered across the entire country. However, we note that our study population potentially typifies a rental-flat population in Singapore, being fairly similar in terms of sociodemographic makeup when compared against national data on low-income neighborhoods. (Housing and Development Board Singapore 2013a).

In conclusion, although overall HRQoL was similar between residents living in low-SES rental and higher-SES owner-occupied flats in Singapore, the former tend to have a higher prevalence of mental or emotional problems as compared to the latter. In the rental flat community, being of minority ethnicity, having problems with self-care, pain, and having difficulties with healthcare costs were independently associated with those health problems, while having access to subsidized primary care was independently associated with absence of those health problems. More needs to be done to alleviate worries related to healthcare costs in the lower area-SES community and reduce disparities in HRQoL.

Acknowledgements We thank the Neighborhood Health Screening Organising Committee; Saw Swee Hock School of Public Health; Yong Loo Lin School of Medicine, National University of Singapore for providing the non-financial resources to organize this program and supporting this study.

Compliance with Ethical Standards

Conflict of Interest The authors report no conflict of interest.

Funding Saw Swee Hock School of Public Health provided funding support for the purchasing of medical consumables. WLE was supported by a Pitch-For-Funds grant from the Division of Medicine, Singapore General Hospital, Singapore.

References

Browne-Yung, K., Ziersch, A., & Baum, F. (2013). 'Faking til you make it': Social capital accumulation of individuals on low incomes living in contrasting socio-economic neighbourhoods and its implications for health and wellbeing. *Social Science & Medicine, 85*, 9–17.

Callahan, L., Martin, K., Shreffler, J., Kumar, D., Schoster, B., Kaufman, J., & Schwartz, T. (2011). Independent and combined influence of homeownership, occupation, education, income, and community povertyon physical health in persons with arthritis. *Arthritis Care Res (Hoboken), 63*, 643–653.

Charlson, M., Pompei, P., Ales, K., & MacKenzie, C. (1987). A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *Journal of Chronic Diseases, 40*, 373–383.

Choi, Y., Kim, J., & Park, E. (2015). The effect of subjective and objective social class on health-related quality of life: New paradigm using longitudinal analysis. *Health and Quality of Life Outcomes, 13*, 121.

Delpierre, C., Kelly-Irving, M., Munch-Petersen, M., Lauwers-Cances, V., Datta, G., Lepage, B., & Lang, T. (2012). SRH and HrQOL: Does social position impact differently on their link with health status? *BMC Public Health, 12*, 19.

Department of Statistics Singapore (2015). Home Ownership Rate of Resident Households. http://www.singstat.gov.sg/statistics/visualising-data/charts/home-ownership-rate-of-resident-households. Accessed 22 June 2015.

Drukker, M., & van Os, J. (2003). Mediators of neighbourhood socioeconomic deprivation and quality of life. *Social Psychiatry and Psychiatric Epidemiology, 38*, 698–706.

Feng, X., & Thomas, A. (2013). Neighborhood socioeconomic circumstances and the Co-occurrence of unhealthy lifestyles: Evidence from 206,457 Australians in the 45 and up study. *PloS One, 8*, e72643.

George, P., Heng, B., Wong, L., & Ng, C. (2014). Determinants of health-related quality of life among community dwelling elderly. *Annals of the Academy of Medicine, Singapore, 43*, 3–10.

Hartog, L., Landman, G., Cimzar-Sweelssen, M., Knipscheer, A., Groenier, K., Kleefstra, N., et al. (2016). Health-related quality of life, rehabilitation and mortality in a nursing home population. *The Netherlands Journal of Medicine, 74*(6), 247–256.

Herdman, M., Gudex, C., Lloyd, A., Janssen, M. F., Kind, P., Parkin, D., et al. (2011). Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). *Quality of Life Research, 20*(10), 1727–1736.

Housing & Development Board Singapore (2013a). Public housing in Singapore: Residents' profile, housing satisfaction and preferences: HDB sample household survey 2013. Singapore: Housing & Development Board Singapore.

Housing & Development Board Singapore (2013b, May 15). Rents & deposits. http://www.Hdb.Gov.sg/fi10/fi10323p.Nsf/w/RentDirectHDBRentDeposit?OpenDocument. Acccessed 22 June 2015.

Joshi, V., Chen, Y., & Lim, J. (2009). Public perceptions of the factors that constitute a good healthcare system. *Singapore Medical Journal, 50*(10), 982–989.

Kim, J., & Park, E. (2015). Impact of socioeconomic status and subjective social class on overall and health-related quality of life. *BMC Public Health, 15*, 783.

Landman, G., van Hateren, K., Kleefstra, N., Groenier, K., Gans, R., & Bilo, H. (2010). Health-related quality of life and mortality in a general and elderly population of patients with type 2 diabetes (ZODIAC-18). *Diabetes Care, 33*(11), 2378–2382.

Lee, J., Park, J., & Kim, M. (2015). Social and physical environments and self-rated health in urban and rural communities in Korea. *International Journal of Environmental Research and Public Health, 12*, 14329–14341.

Leow, M., Griva, K., Choo, R., Wee, H., Thumboo, J., Tai, E., & Newman, S. (2013). Determinants of health-related quality of life (HRQoL) in the multiethnic Singapore population - a National Cohort Study. *PloS One, 8*, e67138.

Lim, J., & Joshi, V. (2008). Public perceptions of healthcare in Singapore. *Annals of the Academy of Medicine, Singapore, 37*(2), 91–95.

Lin, H. (2014). Study of the community: rental and owner blocks- discussion of how the built environment affects community bonding among rental blocks residents. (Masters), National University of Singapore, Singapore.

Lubben, J., Blozik, E., Gillmann, G., Iliffe, S., von Rentel, N., Kruse, W., et al. (2006). Performance of an abbreviated version of the Lubben social network scale among three European community-dwelling older adult populations. *Gerontologist, 46*, 503–513.

Luo, N., Chew, L., Fong, K., Koh, D., Ng, S., Yoon, K., et al. (2003a). Validity and reliability of the EQ-5D self-report questionnaire in Chinese-speaking patients with rheumatic diseases in Singapore. *Annals of the Academy of Medicine, Singapore, 32*, 685–690.

Luo, N., Chew, L., Fong, K., Koh, D., Ng, S., Yoon, K., et al. (2003b). Validity and reliability of the EQ-5D self-report questionnaire in English-speaking Asian patients with rheumatic diseases in Singapore. *Qual Life Research, 12*, 87–92.

Luo, N., Wang, P., Thumboo, J., Lim, Y., & Vrijhoef, H. (2014). Valuation of EQ-5D-3L health states in Singapore: Modeling of time trade-off values for 80 empirically observed health states. *PharmacoEconomics, 32*(5), 495–507.

Luo, N., Wang, Y., How, C., Wong, K., Shen, L., Tay, E., et al. (2015a). Cross-cultural measurement equivalence of the EQ-5D-5L items for English-speaking Asians in Singapore. *Quality of Life Research, 24*(6), 1565–1574.

Luo, N., Wang, Y., How, C., Wong, K., Shen, L., Tay, E., et al. (2015b). Interpretation and use of EQ-5D-5L response labels varied with survey language among Asians in Singapore. *Journal of Clinical Epidemiology, 68*(10), 1195–1204.

Meng, T., & Chen, H. (2014). A multilevel analysis of social capital and self-rated health: Evidence from China. *Health & Place, 27*, 38–44.

Ministry of Health Singapore (2015). What is the Community Health Assist Scheme (CHAS). https://www.chas.sg/content.aspx?id=303. Acccessed 22 June 2015.

Pan, C., Wang, X., Ma, Q., Sun, H., Xu, Y., & Wang, P. (2015). Cognitive dysfunction and health-related quality of life among older Chinese. *Scientific Reports, 25*, 17301.

Poortinga, W., Dunstan, F., & Fone, D. (2007). Perceptions of the neighbourhood environment and self rated health: A multilevel analysis of the Caerphilly health and social needs study. *BMC Public Health, 7*, 285.

Quah, J., Luo, N., Ng, W., How, C., & Tay, E. (2011). Health-related quality of life is associated with diabetic complications, but not with short-term diabetic control in primary care. *Annals of the Academy of Medicine, Singapore, 40*(6), 276–286.

van Hout, B., Janssen, M., Feng, Y., Kohlmann, T., Busschbach, J., Golicki, D., et al. (2012). Interim scoring for the EQ-5D-5L: Mapping the EQ-5D-5L to EQ-5D-3L value sets. *Value in Health, 15*(5), 708–715.

Venkataraman, K., Khoo, C., Wee, H., Tan, C., Ma, S., Heng, D., et al. (2014). Associations between disease awareness and health-related quality of life in a multi-ethnic Asian population. *PloS One, 26*, e113802.

Wang, Y., Tan, N., Tay, E., Thumboo, J., & Luo, N. (2015). Cross-cultural measurement equivalence of the 5-level EQ-5D (EQ-5D-5L) in patients with type 2 diabetes mellitus in Singapore. *Qual Life Outcomes, 13*(1), 103.

Wee, L., & Koh, G. (2012). Individual and neighborhood social factors of hypertension management in a low-socioeconomic status population: A community-based case-control study in Singapore. *Hypertension Research, 35*(3), 295–303.

Wee, H., Loke, W., Li, S., Fong, K., Cheung, Y., Machin, D., et al. (2007). Cross-cultural adaptation and validation of Singapore Malay and Tamil versions of the EQ-5D. *Annals of the Academy of Medicine, Singapore, 36*, 403–408.

Wee, L., Yeo, W., Yang, G., Hannan, N., Lim, K., Chua, C., et al. (2012). Individual and area level socioeconomic status and its association with cognitive function and cognitive impairment (low MMSE) among community-dwelling elderly in Singapore. *Dement Geriatr Cogn Dis Extra, 2*(1), 529–542.

Wee, L., Lim, L., Shen, T., Lee, E., Chia, Y., Tan, A., & Koh, G. (2014a). Choice of primary health care source in an urbanized low-income community in Singapore: A mixed-methods study. *Family Practice, 31*(1), 81–91.

Wee, L., Yong, Y., Chng, M., Chew, S., Cheng, L., Chua, Q., et al. (2014b). Individual and area-level socioeconomic status and their association with depression amongst community-dwelling elderly in Singapore. *Aging & Mental Health, 18*(5), 628–641.

Wee, L., Sin, D., Cher, W., Li, Z., Shibli, S., & Koh, G. (2016). Chronic pain in a low socioeconomic status population in Singapore: A cross-sectional study. *Pain Medicine, 17*, 864. doi:10.1093/pm/pnv115.