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ORIGINAL ARTICLE

Individual and neighborhood social factors of hypertension management in a low-socioeconomic status population: a community-based case–control study in Singapore

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The aim of this study was to determine hypertension awareness, treatment and control, as well as to carry out regular blood pressure (BP) screening and monitoring, in a multi-ethnic urban low-socioeconomic status (SES) Asian community; and to compare these estimates with those of a higher-SES community in the same geographic location. We studied a neighborhood of three blocks of rented public flats (lower-SES community) and three adjacent blocks of owner-occupied public flats (higher-SES community) in Taman Jurong, Singapore. BP was measured, and demographic details and reasons for irregular BP screening, monitoring and treatment were collected from 2009 to 2010. Logistic regression was used to determine predictors of hypertension management. Participation was 90.0% (359/400) for the rental flat community and 70.2% (351/500) for the owner-occupied flats. Prevalence, awareness, treatment and control in the low-SES community (rental flats) were 63.9% (228/357), 61.8% (141/228), 69.5% (98/141) and 43.9% (43/98), respectively, whereas in the neighboring community these were 65.0% (228/351), 83.3% (190/228), 85.3% (162/190) and 66.0% (107/162), respectively. Adjusting for other sociodemographic variables, awareness, treatment and control were poorer in the low-SES community. In the low-SES community, awareness was higher among diabetics, dyslipidemics, those ⩾60 years and those with regular access to doctors. Treatment was more likely among those ⩾60 years, but less likely among those needing financial aid. Control was less likely in the employed. High cost of screening and treatment, if diagnosed, was the most frequently cited barrier among the low-SES group. Hypertension management in those of lower SES is poorer than in those of higher SES. For the lower-SES population, financial barriers need to be addressed.
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INTRODUCTION

Hypertension is a common chronic condition, but treatment and control generally remain poor.[1,2] Hypertension is more widespread in urban populations,[3,4] which is significant in Asia considering the trend of rapid urbanization. In Western societies, deprived urban areas have a significant burden of undiagnosed hypertension and poor control,[5,6] with low levels of control associated with poor access to care,[7] especially among the elderly.[8] A similar situation exists in Latin American cities.[9,10] However, with regard to Asian communities, although studies have focused on urban[11–13] and, in particular, elderly populations,[14] few studies have exclusively focused on the challenge of managing hypertension in low-income urban Asian communities. Investigation of factors influencing the awareness, treatment and control of hypertension in low-income urban settings is thus of value in formulating strategies to manage hypertension in these communities, which face unique challenges in the management of chronic disease.[15]

A person's health is determined both by his or her social position and the socioeconomic characteristics of the area in which he or she lives.[16,17] Two models can potentially explain how neighborhood-level conditions and individuals' socioeconomic circumstances interact with health: the 'local social inequality' and the 'collective resources' models.[18,19] In the 'collective resources model', people living in areas with more resources utilize these resources to enjoy better health;

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whereas in the 'local social inequality model', disparities between individuals' socioeconomic position and the socioeconomic conditions of their local area interact to influence health.[18] Studies in Western populations have shown that low individual socioeconomic status (SES),[20,21] as well as area-specific measures of SES,[5,22] independently affect hypertension prevalence as well as cardiovascular disease risk.[23] However, studies on the interaction between neighborhood-level conditions, individual socioeconomic characteristics and hypertension management are lacking in the context of Asian societies.

Singapore is an example of a multi-ethnic urbanized Asian society, with Chinese, Indian and Malay populations. Although awareness, treatment and control of hypertension have been studied at the national level,[24] studies among the lower income are lacking. Similar to other Asian countries, a widening income gap exists, with a Gini coefficient of 0.478 in 2009.[25] The majority of Singaporeans ($\geqslant$85%) stay in public housing, and owing to government subsidies for public housing, home ownership is high (90.1%).[26] Public rental flats provide heavily subsidized housing (USD 40–50 per month)[27] for the needy, especially the elderly,[28] who have no assets and household income of $<$USD 1000 per month[29] (average household income is USD 3200 per month, and 88% of those staying in rental housing earn less than USD 530 per month).[30] These blocks of public rental flats are not concentrated in lower-income enclaves but are built within the same precincts as owner-occupied public housing flats. Overall, 85% of the Singaporean population stays in similarly designed public housing estates. Residents in these rental flats, therefore, have access to similar facilities as their more well-off neighbors, including primary health-care facilities. In Singapore, primary healthcare is accessed through an extensive network of private general practitioners and public outpatient polyclinics.[31] All Singaporeans are free to utilize either group of physicians for primary care, including health screening services. In public polyclinics, although fees are subsidized, there is still a co-payment component for the individual; similarly, patients seeking treatment from private clinics for their chronic diseases (for example, hypertension, diabetes) can obtain partial subsidies through the local Ministry of Health's Primary Care Partnership Scheme.[32] Thus, given the close proximity of communities in land-scarce Singapore, if area-level SES does have an effect on hypertension management, it is less likely to be mediated via the 'collective resources' model, as different communities utilize the same health-care facilities as they also share the same geographical location. Rather, it is more likely to be due to the 'local social inequality' model. This arrangement provided us with the opportunity to study awareness, treatment and control of hypertension in two communities of different SES living literally side-by-side.

As such, we investigated the relationship between individual measures of SES, area measures of SES (using status of home ownership, rental *vs.* owner-occupied as a proxy), and the prevalence, awareness, treatment and control of hypertension within one such geographically integrated Singaporean housing precinct, containing communities of both lower SES (public rental housing) and higher SES (owner-occupied public housing). We also investigated factors associated with better hypertension management within the lower-SES community (public rental housing), as well as qualitative reasons for aspects of hypertension management between the higher- and lower-SES communities. We hope that the results will be useful to those tackling the management of hypertension in similar urban low-income Asian communities.

METHODS

The study population involved all residents aged 40 years and above, living in all six blocks of a socially integrated housing precinct in Taman Jurong Constituency, Singapore. Three blocks comprised of two room heavily subsidized public rental flats (forming the lower-SES community), whereas another three blocks of three room owner-occupied public housing flats, immediately adjacent, formed the higher-SES community. The age limit was set based on the Singapore Ministry of Health's Clinical Practice Guidelines for community health screening, which recommend those aged 40 years and above to go for blood pressure (BP) screening annually.[33] From January 2009 to June 2010, trained student volunteers made at least three visits on separate days during weekends to these residents to (1) collect baseline information, such as sociodemographic information (for example, ethnicity, past medical history), individual socioeconomic indicators (education level, employment status, monthly household income, needing financial, physical or social help), and information on health screening participation rates/perceived barriers and (2) encourage the resident to have BP taken. Volunteers were trained to measure BP over 3 months by certified nursing and medical professionals. Systolic and diastolic BP was taken using mercury sphygmomanometers, with at least a 2-min interval between measurements, at least two measurements during each occasion and on two occasions. The mean value of the readings was calculated. During BP measurements, the patient was allowed to sit down for several minutes before BP was measured; patient refrained from smoking or ingesting caffeine during the 30 min preceding the measurement, and the sphygmomanometer was placed at heart level with patient in the seated position. Results were reviewed by medical professionals, and residents were informed of their results: For those with normal BP, results were notified via mail; for those with abnormal BP, residents were informed personally and follow-up sessions were arranged at public primary care clinics. We also asked residents for their reason(s) for not participating in previous BP screening/monitoring regularly and recorded their qualitative replies; if the resident was a known hypertensive, we also asked whether the resident was on regular medical treatment and if not, why. Regular screening and monitoring was defined as adhering to the frequencies recommended in the Ministry of Health's Clinical Practice Guidelines as above. We then performed thematic analysis to generate a list of reasons for non-participation in hypertension screening and monitoring/non-compliance with treatment for hypertension and grouped them for quantitative analysis. Ethics approval was obtained from the National University of Singapore Institutional Review Board, informed consent was sought and participation was voluntary.

Definitions

Hypertension was defined as a systolic BP $\geqslant$140 mm Hg or diastolic BP $\geqslant$90 mm Hg or participant answering 'yes' to the question 'Has a physician ever told you that you have high BP?'. Awareness of hypertension was defined as a participant answering 'yes' to the question 'Has a physician told you that you have high BP?'. Unawareness of hypertension (newly diagnosed hypertension) was defined as a participant answering 'no' to the question 'Has a physician told you that you have high BP?' and subsequently found to have systolic BP $\geqslant$140 mm Hg or diastolic BP $\geqslant$90 mm Hg during the study. Treated hypertension was defined as a participant answering 'yes' to the question 'Are you on medication from a western-trained physician for your high BP and take that medication $\geqslant$90% of the time?' Finally, control of hypertension was defined as being on treatment for hypertension and having an average BP reading of systolic BP $\leqslant$140 mm Hg and diastolic BP $\leqslant$90 mm Hg.

Statistical analysis

Descriptive statistics were computed for the study population. We then used backward logistic regression to determine the most parsimonious model of independent factors (including demographic factors, rental (lower area SES) *vs.* owner occupied (higher area SES) and individual measures of SES associated with prevalence, awareness, treatment and control of hypertension, as well as regular BP screening and monitoring, within the entire study population, using the $P<0.2$ on univariate analysis (χ^2-test) as cut-off for entry into multivariate models. Where there was collinearity between indicators of SES such as needing financial aid, education level, employment status and household income $<$S$1500 (magnitude of correlation coefficient, $|r|<0.6$), we chose the collinear variable with the smallest *P*-value on bivariate analysis for inclusion in the final multivariate model.[34] As area-level indicator of SES (rental *vs.* owner-occupied public housing) was the most consistent SES indicator significantly associated with awareness, treatment control, screening and

monitoring of hypertension, we used the subset of the study population staying in the lower-SES (rental flats) community to examine the univariate associations between sociodemographic variables and awareness, treatment and control of hypertension, as well as regular BP screening and monitoring, using χ^2-analysis. Statistical analysis was performed using Statistical Package for Social Sciences (Version 17.0, IBM Corporation, USA), and odds ratios (ORs) and their 95% confidence intervals (CIs) are reported, and statistical significance was set at the conventional $P<0.05$.

RESULTS

The majority of eligible residents in our study population participated in the study (participation rate=78.9% (710/900), based on census data). The participation rate for the lower-SES (rental flat) community was 90.0% (359/400), whereas for the higher-SES (owner-occupied flats) it was 70.2% (351/500). Participation rates were higher in the lower-SES community probably because of the availability of free BP screening. The profile of participants is detailed in Table 1. As expected, the rental flat community was less socioeconomically advantaged, having lower household income, educational attainment and increased need for financial aid. However, those staying in owner-occupied housing had higher rates of known hypertension and dyslipidemia. There was no significant difference between the mean systolic and diastolic BP, on measurement, between the two communities.

Table 1 Profile of study population (*N*=710)

Characteristic	*Lower socioeconomic status (rental blocks) (*N=*359)*	*Higher socioeconomic status (owner-occupied blocks) (*N=*351)*	P-*value*
Age (years), median (interquartile range)			
40–49, *n* (%)	104 (29.0)	63 (17.9)	<0.001
50–59, *n* (%)	75 (20.9)	126 (35.9)	
60–69, *n* (%)	52 (14.5)	64 (18.2)	
⩾70, *n* (%)	128 (35.7)	98 (27.9)	
Gender, n (%)			
Male	162 (45.1)	140 (39.9)	0.172
Married, n (%)			
Married	160 (44.6)	231 (65.8)	<0.001
Ethnicity, n (%)			
Chinese	198 (55.0)	239 (68.1)	<0.001
Malay	105 (29.3)	77 (21.9)	
Indian	44 (12.3)	7 (2.0)	
Others	12 (3.4)	28 (8.0)	
Educational attainment, n (%)			
Finished secondary education	55 (15.3)	94 (26.8)	<0.001
Employment, n (%)			
Currently employed	131 (36.5)	140 (39.9)	0.355
Monthly household income, n (%)			
⩽$500 per month	162 (45.1)	84 (23.9)	<0.001
>$500 per month, ⩽$1500 per month	190 (52.9)	64 (18.2)	
> $1500 per month, ⩽$2000 per month	4 (1.1)	98 (27.9)	
>$2000 per month	3 (0.8)	105 (29.9)	
Help needed, n (%)			
Need financial help[a]	102 (28.4)	56 (16.0)	<0.001
Need physical help[b]	15 (4.2)	14 (4.0)	1.000
Need social help[c]	17 (4.7)	7 (2.0)	0.060
Lifestyle habits, n (%)			
History of smoking	113 (31.5)	105 (29.9)	0.684
History of drinking	58 (16.2)	49 (14.0)	0.463
Blood pressure (mm Hg), mean (s.d.)			
Systolic	135.85 (19.84)	135.55 (14.01)	0.080
Diastolic	81.18 (13.60)	82.08 (8.75)	0.304
Self-reported disease status, n (%)			
Hypertension	141 (39.3)	190 (54.1)	<0.001
Diabetes mellitus	76 (21.2)	63 (17.9)	0.258
Dyslipidemia	89 (24.8)	127 (36.2)	0.001
Presence of doctor to give advice on health-related issues, n (%)[d]			
Yes	40 (11.2)	105 (30.5)	<0.001

[a]Needing financial help was defined as being a recipient of Public Assistance or other forms of financial assistance from the local community center (grassroots organisation).
[b]Needing physical help was defined as needing physical assistance in activities of daily living.
[c]Needing social help was defined as being a recipient of assistance from the local Family Service Centre, voluntary welfare organizations supported by the Singaporean Ministry of Community Development, Youth and Sports to provide a range of social services to promote the well-being of families (for example, counseling services).
[d]Presence of doctor to give advice on health-related issues was defined as seeing a Western-trained medical professional on a regular basis for advice on health-related issues (for example, diet, exercise, smoking cessation, health screening and so on).

Table 2 Prevalence, awareness, treatment, control, monitoring and screening of hypertension between rental (lower socioeconomic status) and owner-occupied (higher socioeconomic status) blocks

	Prevalence of hypertension (N=710), n *(%)*	*Awareness of hypertension (N=456),* n *(%)*	*Treatment of known hypertensives (N=331),* n *(%)*	*Control of BP in treated hypertensives (N=260),* n *(%)*	*Yearly monitoring of BP in known hypertensives (N=331),* n *(%)*	*Yearly hypertension screening among those with no history of hypertension (N=379),* n *(%)*
Rental blocks (lower socioeconomic status)	228/359 (63.5)	141/228 (61.8)	98/141 (69.5)	43/98 (43.9)	77/141 (54.6)	77/218 (35.3)
Owner-occupied blocks (higher socioeconomic status)	228/351 (65.0)	190/228 (83.3)	162/190 (85.3)	107/162 (66.0)	176/190 (92.6)	84/161 (52.2)
Total	456/710 (64.2)	331/456 (72.6)	260/331 (78.5)	150/260 (57.7)	253/331 (76.4)	161/379 (42.5)

Abbreviation: BP, blood pressure.

Estimates for prevalence, awareness, treatment and control of hypertension in both communities are given in Table 2. The overall prevalence of hypertension was 64.2% (456/710). In the lower-SES community, among hypertensive participants, 61.8% (141/228) were aware of their hypertensive status. Of those who were aware of their hypertensive status, 69.5% (98/141) were on treatment for their hypertension. Of those who were hypertensive and on treatment, 43.9% (43/98) had their BP under control at the time of examination. After adjusting for other statistically significant sociodemographic factors (for example, age), we found that both individual measures of SES and area measures of SES (rental *vs.* owner-occupied public housing) were independently associated with hypertension prevalence, awareness, treatment and control, as well as going for regular hypertension screening and monitoring. Staying in a lower-SES community (rental flat; adjusted OR=0.52, CI=0.33–0.82, $P<0.005$) and needing social help (adjusted OR=0.35, CI=0.15–0.83, $P<0.017$) was associated with lower prevalence of hypertension, whereas being employed was associated with increased prevalence of hypertension (adjusted OR=1.59, CI=1.09–2.30, $P<0.005$). While awareness of hypertension was lower in the lower-SES community (adjusted OR=0.25, CI=0.12–0.45, $P<0.001$), those on financial aid had higher awareness of hypertension (adjusted OR=2.07, CI=1.09–3.93, $P=0.026$). Treatment (adjusted OR=0.23, CI=0.10–0.56, $P<0.001$) and control of hypertension (adjusted OR=0.37, CI=0.22–0.65, $P<0.001$), as well as regular screening for hypertension among unknown hypertensives (adjusted OR=0.49, CI=0.29–0.81, $P<0.005$) and monitoring of BP among known hypertensives (adjusted OR=0.09, CI=0.05–0.18, $P<0.001$) were all poorer in the lower-SES community compared with those staying in the higher-SES community. Similarly, estimates for treatment, control, regular screening and regular monitoring were poorer among those with lower individual SES: treatment (adjusted OR=0.40, CI=0.18–0.88, $P=0.024$) and regular hypertension screening (adjusted OR=0.30, CI=0.18–0.50, $P<0.001$) was poorer among the unemployed; whereas control (adjusted OR=0.53, CI=0.29–0.95, $P=0.032$) and monitoring of BP (adjusted OR=0.51, CI=0.27–0.96, $P=0.035$) were poorer among those needing financial aid (Table 3).

As area-level indicators of SES (rental *vs.* owner-occupied) was the most consistent indicator associated with various components of hypertension management, we focused on the segment of our population staying within rental flats to investigate the sociodemographic factors associated with better management of hypertension. Within the rental flat community, the factors associated on univariate analysis with awareness, treatment and control of hypertension, as well as regular BP screening and monitoring, are listed in Table 4. After multivariate analysis, the independent factors associated in the

Table 3 Individual and area socioeconomic indicators and demographic factors independently associated with hypertension prevalence, awareness, treatment, control, monitoring and screening in an urban multi-ethnic Asian community in Taman Jurong, Singapore (*N*=710)

Associated sociodemographic factors	*Adjusted OR (95% CI)*[a]	P-*value*
Prevalence of hypertension, n (%)[b]		
Age ⩾60 years	3.29 (2.26–4.78)	<0.001
Living in rental flat	0.52 (0.33–0.82)	0.005
Employed	1.59 (1.09–2.30)	0.015
Need social help	0.35 (0.15–0.83)	0.017
Has diabetes mellitus	3.36 (1.97–5.71)	<0.001
Awareness of hypertension, n (%)		
Age ⩾60 years	3.17 (1.85–5.44)	<0.001
Living in rental flat	0.25 (0.12–0.45)	<0.001
Need financial aid	2.07 (1.09–3.93)	0.026
Has diabetes mellitus	14.40 (4.18–49.61)	<0.001
Has dyslipidemia	6.86 (2.82–16.71)	<0.001
Has regular access to a doctor	14.40 (4.18–49.61)	<0.001
Treatment of known hypertensives, n (%)[b]		
Age ⩾60 years	5.51 (2.73–11.14)	<0.001
Living in rental flat	0.23 (0.10–0.56)	0.001
Employed	2.50 (1.13–5.52)	0.024
Has regular access to a doctor	2.52 (1.13–5.66)	0.026
Control of BP in treated hypertensives, n (%)		
Age ⩾60 years	3.74 (2.03–6.90)	<0.001
Living in rental flat	0.37 (0.22–0.65)	0.001
Need financial aid	0.53 (0.29–0.95)	0.032
Yearly monitoring of BP in known hypertensives, n (%)		
Age ⩾60 years	3.14 (1.64–6.00)	0.001
Married	2.85 (1.52–5.34)	0.001
Living in rental flat	0.09 (0.05–0.18)	<0.001
Need financial aid	0.51 (0.27–0.96)	0.035
Yearly hypertension screening among those with no history of hypertension, n (%)		
Married	3.74 (2.23–6.28)	<0.001
Living in rental flat	0.49 (0.29–0.81)	0.005
Employed	3.31 (2.00–5.50)	<0.001
Has dyslipidemia	2.65 (1.40–5.03)	0.003
History of smoking	0.31 (0.18–0.54)	<0.001

Abbreviations: BP, blood pressure; CI, confidence interval.
[a]Odds ratios (OR) adjusted for all independent co-variates in the final parsimonious multivariate model presented.
[b]We only found collinearity between 'neighborhood' (that is, rental- *vs.* owner-occupied flats) and 'household income' for prevalence and treatment of hypertension; as such, we excluded 'household income' from the final models for prevalence and treatment of hypertension. No other significant collinearity ($|r|>0.6$) was found between indicators of individual socioeconomic status such as employment, educational level, being on financial aid and household income.

Table 4 Univariate associations with awareness, treatment and control of hypertension in a low-socioeconomic status community living in public rental flats in Taman Jurong, Singapore (*n*=359), as well as BP monitoring in known hypertensives and BP screening among those with unknown hypertensive status

	Awareness of hypertension (n=141)			*Treatment of known hypertensive (n=98)*			*Control of BP in treated hypertensive (n=43)*			*Monitoring of BP in known hypertensive (n=77)*			*Screening for hypertension in those without hypertension history (n= 77)*		
Factors	*Aware,* n *(%)*	*Crude OR (95% CI)*	P-*value*	*Treated,* n *(%)*	*Crude OR (95% CI)*	P-*value*	*Controlled,* n *(%)*	*Crude OR (95% CI)*	P-*value*	*Monitored,* n *(%)*	*Crude OR (95% CI)*	P-*value*	*Screened* n *(%)*	*Crude OR (95% CI)*	P-*value*
Age (years)															
40–59	46 (47.9)	2.73 (1.57–4.75)	**0.001**[a]	26 (59.1)	2.69 (1.22–5.95)	**0.022**[a]	9 (37.5)	1.51 (0.59–4.00)	0.477	24 (52.2)	1.11 (0.55–2.26)	0.857	48 (36.6)	0.91 (0.51–1.62)	0.773
⩾60	93 (71.5)			70 (79.5)			33 (47.8)			51 (54.8)			29 (34.5)		
Gender															
Female	82 (64.1)	0.81 (0.47–1.38)	0.493	59 (76.6)	0.66 (0.31–1.43)	0.328	30 (52.6)	0.47 (0.20–1.09)	0.094	43 (52.4)	1.23 (0.63–2.42)	0.608	47 (41.2)	0.60 (0.34–1.06)	0.088
Male	59 (59.0)			39 (68.4)			13 (34.2)			34 (57.6)			30 (29.7)		
Marital status															
Unmarried	80 (58.8)	1.38 (0.79–2.39)	0.269	55 (74.3)	0.87 (0.41–1.88)	0.845	31 (57.4)	1.28 (0.57–2.94)	0.678	36 (45.0)	2.51 (1.25–5.01)	0.011[a]	30 (25.4)	2.76 (1.55–4.90)	**0.001**[a]
Married	61 (66.3)			43 (71.7)			21 (51.2)			41 (67.2)			47 (48.5)		
Ethnicity															
Non-Chinese	60 (61.2)	1.03 (0.60–1.77)	1.00	41 (71.9)	1.17 (0.54–2.55)	0.696	21 (52.5)	0.60 (0.27–1.37)	0.297	26 (43.3)	2.18 (1.10–4.31)	0.027[a]	38 (38.0)	0.84 (0.48–1.46)	0.570
Chinese	80 (62.0)			57 (75.0)			22 (40.0)			50 (62.5)			39 (33.9)		
Education															
Did not complete secondary school	122 (62.2)	0.89 (0.41–1.90)	0.845	84 (73.0)	1.03 (0.34–3.11)	1.00	43 (53.1)	0.47 (0.37–0.59)	<0.001	64 (52.5)	1.96 (0.70–5.50)	0.223	65 (36.7)	0.80 (0.38–1.68)	0.582
Completed secondary school	19 (59.4)			14 (73.7)			0 (0.0)			13 (68.4)			12 (31.6)		
Employment															
Unemployed	103 (68.7)	0.43 (0.25–0.76)	0.004	70 (72.9)	1.04 (0.44–2.44)	1.00	39 (57.4)	0.13 (0.04–0.41)	<0.001[a]	52 (50.5)	1.89 (0.87–4.10)	0.128	38 (31.1)	1.60 (0.91–2.80)	0.115
Employed	38 (48.7)			28 (73.7)			4 (14.8)			25 (65.8)			39 (41.9)		
Household income															
⩽$500 per month	66 (61.7)	NC	0.440	40 (66.7)	1.81 (0.84–3.92)	0.170	23 (57.5)	0.42 (0.18–0.97)	0.060	29 (43.9)	2.27 (1.15–4.47)	0.019	27 (29.0)	NC	0.144
⩾$500 per month, ⩽$1500 per month	75 (62.5)			58 (78.4)			20 (36.4)			48 (64.0)			46 (40.0)		
⩽$2000 per month	0 (0.0)			0 (0.0)			0 (0.0)			0 (0.0)			3 (75.0)		
⩾$2000 per month	0 (0.0)			0 (0.0)			0 (0.0)			0 (0.0)			1 (33.3)		
Financial help															
No	97 (59.5)	1.43 (0.78–2.62)	0.292	74 (81.3)	0.29 (0.13–0.65)	0.003[a]	35 (49.3)	0.52 (0.20–1.35)	0.237	57 (58.8)	0.59 (0.29–1.20)	0.150	63 (40.1)	0.48 (0.24–0.94)	0.037
Yes	44 (67.7)			24 (55.8)			8 (33.3)			20 (45.5)			14 (24.1)		
Physical help															
No	131 (60.1)	1.66 (1.49–1.86)	0.015	91 (72.8)	1.31 (0.26–6.61)	1.00	40 (45.5)	0.90 (0.19–4.17)	1.00	71 (54.2)	1.27 (0.34–4.70)	1.00	75 (35.7)	1.20 (0.20–7.34)	1.00
Yes	10 (100.0)			7 (77.8)			3 (42.9)			6 (60.0)			2 (40.0)		
Social help															
No	133 (60.7)	5.17 (0.64–42.10)	0.158	94 (74.6)	0.34 (0.08–1.44)	0.210	42 (46.2)	0.39 (0.004–3.85)	0.624	72 (54.1)	1.41 (0.32–6.15)	0.728	73 (35.4)	1.46 (0.38–5.60)	0.725
Yes	8 (88.9)			4 (50.0)			1 (25.0)			5 (62.5)			4 (44.4)		
Presence of doctor to offer medical advice															
No	120 (59.1)	4.84 (1.40–16.76)	0.007[a]	82 (72.6)	1.21 (0.41–3.58)	1.00	36 (45.0)	1.06 (0.35–3.23)	1.00	66 (55.0)	0.90 (0.36–2.28)	1.00	68 (34.9)	1.68 (0.65–4.34)	
Yes	21 (87.5)			16 (76.2)			7 (46.7)			11 (52.4)			9 (47.4)		

Table 4 (Continued)

Factors	Awareness of hypertension (n=141)			Treatment of known hypertensive (n=98)			Control of BP in treated hypertensive (n=43)			Monitoring of BP in known hypertensive (n=77)			Screening for hypertension in those without hypertension history (n= 77)		
	Aware, n (%)	Crude OR (95% CI)	P-value	Treated, n (%)	Crude OR (95% CI)	P-value	Controlled, n (%)	Crude OR (95% CI)	P-value	Monitored, n (%)	Crude OR (95% CI)	P-value	Screened n (%)	Crude OR (95% CI)	P-value
Smoked before															
No	95 (58.6)	1.62 (0.88–2.99)	0.134	66 (75.0)	0.76 (0.35–1.68)	0.541	30 (46.9)	1.22 (0.51–2.90)	0.668	45 (47.4)	2.54 (1.20–5.36)	0.019	57 (38.3)	0.70 (0.38–1.31)	0.284
Yes	46 (69.7)			32 (69.6)			13 (41.9)			32 (69.6)			20 (30.3)		
Diabetes mellitus															
No	86 (51.8)	7.31 (3.15–16.99)	<0.001[a]	62 (76.5)	0.65 (0.30–1.41)	0.321	30 (48.4)	0.69 (0.29–1.64)	0.517	50 (58.1)	0.69 (0.35–1.37)	0.304	72 (37.1)	0.53 (0.19–1.51)	0.338
Yes	55 (88.7)			36 (67.9)			13 (39.4)			27 (49.1)			5 (23.8)		
Dyslipidemia															
No	82 (50.6)	8.22 (3.54–19.08)	<0.001[a]	55 (72.4)	1.09 (0.51–2.37)	0.847	23 (43.4)	1.19 (0.53–2.70)	0.836	44 (53.7)	1.10 (0.56–2.15)	0.864	63 (34.1)	1.69 (0.78–3.69)	0.219
Yes	59 (89.4)			43 (74.1)			20 (47.6)			33 (55.9)			14 (46.7)		

Abbreviations: BP, blood pressure; CI, confidence interval; NC, cannot be calculated; OR, odds ratio.
[a]Significant on multivariate analysis.

separate models for hypertension awareness, treatment and control were as follows: awareness of hypertension was higher among diabetics (adjusted OR=6.51, CI=2.59–16.37, $P<0.001$), dyslipidemics (adjusted OR=6.74, CI=2.74–16.59, $P<$ 0.001), those $\geqslant$60 years (adjusted OR=3.08, CI=1.61–5.91, P=0.001) and those with regular access to a doctor (adjusted OR=5.63, CI=1.43–22.14, P=0.013). Being on treatment for hypertension was more likely among those $\geqslant$60 years (adjusted OR=2.33, CI=1.08–5.01, P=0.031), but less likely among those needing financial aid (adjusted OR=0.39, CI=0.18–0.83, P=0.016). Controlled BP in treated hypertensives was less likely in the employed (adjusted OR=0.13, CI=0.04–0.41, $P<0.001$).

Of those who were not previously diagnosed to have hypertension (n=218), 64.7% (141/218) had not gone for BP screening in the past one year as recommended by the Ministry of Health's Clinical Practice Guidelines. Of the 141 known hypertensives, 45.4% (64/141) were not regularly monitoring their BP (that is, have at least one BP check in the past one year). Being married (adjusted OR=2.64, CI=1.48–4.71, P=0.001) was associated with participating in regular screening, while those who needed financial aid were less likely to go for regular screening (adjusted OR=0.52, CI=0.26–0.98, P=0.048). Among known hypertensives, regular BP monitoring was associated with being married (adjusted OR=2.37, CI=1.17–4.80, P=0.016) and being of Chinese ethnicity (adjusted OR=2.10, CI=1.05–4.23, P=0.036).

The qualitative reasons for not going on hypertensive treatment or participating in regular hypertension screening/monitoring, for patients in both the lower- and higher-SES communities are detailed in Table 5. In the rental flat community, among unknown hypertensives who did not go for regular BP screening in the past 1 year (n=141), the top three reasons for non-adherence to regular BP screening were as follows: 'too busy to go/no time', 'testing too expensive' and 'cost of further treatment, if positive, too expensive'. Although a lack of time was also the top reason cited among those staying in owner-occupied public housing, cost of screening and further treatment was not an issue. Among known hypertensives from the rental flat community who were not monitoring their BP regularly (n=64), the top three reasons were similar: 'too busy to go/no time', 'monitoring too expensive' and 'cost of further treatment, if positive, too expensive'. These issues were also faced by the community staying in owner-occupied housing, with the exception of the cost of further treatment. With regard to treatment, the reasons for not taking BP medications $\geqslant$90% of the time among known hypertensives in the rental flat community (n=43) were as follows: 30.2% (13/43) did not think that the medicine would benefit them, 25.6% (22/43) had problems with the cost of chronic medication and 11.6% (5/43) preferred to take non-Western medication. These reasons were not shared by known hypertensives staying in owner-occupied housing.

DISCUSSION

The prevalence of hypertension in this low-SES community is high. Within the subset of the study population staying in public rental flats (lower-SES community), the absolute prevalence of hypertension was 63.5%; it was 48.5% in the 40–49 age bracket, before rising to 62.7% and 69.2% in the 50–59 and 60–69 age brackets, respectively. Comparing against the 2004 National Health Survey,[35] which reported figures of 21.9, 36.2 and 56.1% in the same respective age brackets, the prevalence of hypertension was higher in this low-income community compared with the general population, similar to the results of other studies.[5,9,20]

The awareness, treatment and control of hypertension were far from ideal among those with lower-SES and those staying in a low SES area,

Table 5 Reasons for not going on pharmacological treatment, participating in regular screening or monitoring of hypertension among both lower socioeconomic status (staying in public rental flats) and higher socioeconomic status (staying in owner-occupied housing) communities in Taman Jurong, Singapore

Reason for not participating in regular yearly blood pressure screening among those with no history of hypertension	*Rental flat population (N=141),* n *(%)*	*Owner-occupied flat population (N=77),* n *(%)*
Too busy to go/no time	59 (41.8)[1]	35 (45.5)[1]
Testing too expensive	58 (41.1)[2]	—
Cost of further treatment, if positive, too expensive	56 (39.7)[3]	—
Too young	27 (19.1)[4]	—
Do not have a companion/caregiver to go with	25 (17.7) [5]	—
Screening is inconvenient	—	23 (29.8)[2]
Do not know where to go for screening	—	17 (22.0)[3]
Reason for not participating in regular blood pressure monitoring among those with history of hypertension	*Rental flat population (N=64),* n *(%)*	*Owner-occupied flat population (N=14),* n *(%)*
Too busy to go/no time	26 (40.6)[1]	14 (100.0)[1]
Monitoring too expensive	22 (34.3)[2]	7 (25.0)[2]
Cost of further treatment, if positive, too expensive	22 (34.3)[2]	—
Monitoring is inconvenient	12 (18.8)[3]	7 (25.0)[2]
Do not have a companion/caregiver to go with	12 (18.8)[3]	—
Reason for not going on regular pharmacological treatment for hypertension among known hypertensives	*Rental flat population (N=43),* n *(%)*	*Owner-occupied flat population (N=28),* n *(%)*
I do not think that taking medication has benefited me	13 (30.2)[1]	—
Problem with money because of high costs of chronic medication	22 (25.6)[2]	—
I prefer to take non-Western medication	5 (11.6)[3]	—
My blood pressure has gone down after medication, so I do not need to continue	3 (7.0)[4]	14 (50.0)[1]
I find it too inconvenient/troublesome	3 (7.0)[4]	8 (28.5)[2]
I do not like the side effects of my medication	—	8 (28.5)[2]

Note: Participants may report more than one reason. The superscript number next to figures is the rank order of the reason by frequency. The top five reasons for the rental flat population in each category are reported.

whether compared against their better-off neighbors or against national averages as a whole. While individual indicators of SES were also associated with awareness, treatment and control of hypertension, area-level indicator of SES (rental flats *vs.* owner-occupied public housing) was the most consistent socioeconomic indicator associated with hypertension awareness, treatment and control. In our study, awareness, treatment and control of hypertension stood at 61.8%, 69.5% and 43.9%, respectively, in the rental flat community; which was poor compared with those in the higher-SES community (owner-occupied public housing). About 38% of hypertensives in the rental flat were previously undiagnosed, probably because of the low uptake of screening for hypertension in this community (64.7% did not go for yearly BP checks, as opposed to the national average of 36.1%[36] and 47.8% in the higher-SES community). The link between poor health screening take-up and lower SES is well established.[37] Cost and inconvenience were the top barriers cited for not participating in regular hypertension screening in the lower-SES community, as compared with their neighbors in the higher-SES community, where cost issues were not important. Family support appears to be important in encouraging BP monitoring/screening, as evidenced by the increased take-up of BP screening/monitoring among married individuals.

More can be done to improve awareness, detection and subsequent treatment of BP in hypertensives picked up on screening, among those of lower SES. With regard to hypertension treatment, the issue was not just cost alone; lack of belief in the efficacy of anti-hypertensives and preferences for non-Western medicine were also important reasons for not complying with drug treatment. Clearly, patient education is as important as cost reduction in encouraging more hypertensives in the lower-SES community to start on pharmacological treatment. Treatment was better in the elderly, consistent with results of other Asian studies.[38]

Significantly, in the low-SES community, improved finances were associated with increased treatment, but employment was associated with poorer control. This was surprising, as other studies in the general Singaporean population show that employment and higher financial status were generally associated with better hypertension control.[24,39] While financial status affects the ability of hypertensives in this low-income community to afford medical treatment for hypertension, it is possible that because the majority of jobs available to this low-income community involve long hours, physical work,[40] shift work[41] and high stress[42] (all of which have been shown in the literature to be associated with increased risk of cardiovascular disease and higher BP), employment has a negative impact on their control of hypertension. Better control needs to be encouraged among the segment of this community who are currently employed.

The limitations of our study are as follows. Our definition of treated hypertension incorporated elements of both prescription of pharmacological treatment as well as medication compliance; it would have been more informative if these two components had been captured separately. Our measures of area SES only used home ownership status as an indicator, which is important in the Singaporean context given high home ownership rates and has been used elsewhere,[18] but may not be directly comparable with studies in other countries. Furthermore, although other studies have used single measures of area SES (for example, per capita gross domestic product in area of residence,[17] percentage of residents living below the poverty level,[22] poorer cities[43]), other studies used a combination of measures,[18,19,23] which

might offer a more nuanced perspective. However, the information needed to construct such indices of neighborhood poverty was lacking in our population due to a paucity of studies on individual *vs.* area SES in Asian societies. Also, we compared estimates of awareness, treatment and control in this low-income population with those of their better-off neighbors staying in the same geographical location, which might not be fully representative of national demographic patterns as a whole. However, we note that socioeconomic indicators in the population staying in owner-occupied public housing were in some measures poorer than national averages (for example, only 29.9% had a mean household income of $\geqslant$USD 1000, as opposed to the national average of USD 3200 per month). As such, our results may be underestimates of the differences with regard to hypertension management between this low-income stratum of society and the more affluent general population. Furthermore, this was a single-site study, and hence the results might not be fully generalizable to the whole of the Singaporean rental flat population. Rental flat applicants, however, are non-systematically allocated to available flats within four geographical zones covering the whole island;[29] hence, it would be likely that the demographics would be largely similar across individual rental flat communities. Indeed, the demographics of our study population were similar to those of the rental flat population as a whole (for example, 70% of residents above 50 years of age).[28] Also, considering that it took a year of groundwork (in 2008) to build up trust with these residents to let us into their homes, it would be resource-intensive to replicate this in multiple sites. Studying this segment of the population has its own unique challenges, in which trust has to be slowly earned and is not automatically gained.

In conclusion, hypertension screening, awareness, treatment and control were poor among both individuals with low SES and individuals staying in a low-SES community. More needs to be done to improve the management of hypertension in lower-income and lower socioeconomic strata in urbanized societies, particularly in Asia. There are gaps at several levels; in particular, more needs to be done to assist this group in going for regular hypertension screening and complying with antihypertensive regimes. In this at-risk population, hypertension should not be managed in isolation but in tandem with other cardiovascular risk factors. Cost, inconvenience and misperceptions are all significant barriers that need to be addressed, both in encouraging better treatment and control of hypertension among known hypertensives and in targeting measures to prevent the development of hypertension (for example, through lifestyle modification) and encouraging early detection through regular screening. Hopefully, suitable interventions, targeted at the lower-socioeconomic strata of society, can overcome these barriers and go some way toward reducing health disparities.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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1 Whelton PK, He J, Muntner P. Prevalence, awareness, treatment and control of hypertension in North America, North Africa and Asia. *J Hum Hypertens* 2004; **18**: 545–551.
2 Pereira M, Lunet N, Azevedo A, Barros H. Differences in prevalence, awareness, treatment and control of hypertension between developing and developed countries. *J Hypertens* 2009; **27**: 963–975.
3 Hou X. Urban-rural disparity of overweight, hypertension, undiagnosed hypertension, and untreated hypertension in China. *Asia Pac J Public Health* 2008; **20**: 159–169.
4 Wang Z, Wu Y, Zhao L, Li Y, Yang J, Zhou B. Trends in prevalence, awareness, treatment and control of hypertension in the middle-aged population of China, 1992–1998. *Hypertens Res* 2004; **27**: 703–709.
5 Murray ET, Diez Roux AV, Carnethon M, Lutsey PL, Ni H, O'Meara ES. Trajectories of neighborhood poverty and associations with subclinical atherosclerosis and associated risk factors: the multi-ethnic study of atherosclerosis. *Am J Epidemiol* 2010; **171**: 1099–1108.
6 Pavlik VN, Hyman DJ, Vallbona C, Toronjo C, Louis K. Hypertension awareness and control in an inner-city African-American sample. *J Hum Hypertens* 1997; **11**: 277–283.
7 Angell SY, Garg RK, Gwynn RC, Bash L, Thorpe LE, Frieden TR. Prevalence, awareness, treatment, and predictors of control of hypertension in New York City. *Circ Cardiovasc Qual Outcomes* 2008; **1**: 46–53.
8 Wieck KL. Hypertension in an inner-city minority population. *J Cardiovasc Nurs* 1997; **11**: 41–49.
9 Fleischer NL, Diez Roux AV, Alazraqui M, Spinelli H. Social patterning of chronic disease risk factors in a Latin American city. *J Urban Health* 2008; **85**: 923–937.
10 Davies AR, Miranda JJ, Gilman RH, Smeeth L. Hypertension among adults in a deprived urban area of Peru—undiagnosed and uncontrolled? *BMC Res Notes* 2008; **1**: 2.
11 Mohan V, Deepa M, Farooq S, Datta M, Deepa R. Prevalence, awareness and control of hypertension in Chennai—The Chennai Urban Rural Epidemiology Study (CURES-52). *J Assoc Physicians India* 2007; **55**: 326–332.
12 Jo I, Ahn Y, Lee J, Shin KR, Lee HK, Shin C. Prevalence, awareness, treatment, control and risk factors of hypertension in Korea: the Ansan study. *J Hypertens* 2001; **19**: 1523–1532.
13 Dodani S, Mistry R, Khwaja A, Farooqi M, Qureshi R, Kazmi K. Prevalence and awareness of risk factors and behaviours of coronary heart disease in an urban population of Karachi, the largest city of Pakistan: a community survey. *J Public Health (Oxf)* 2004; **26**: 245–249.
14 Zhang X, Zhu M, Dib HH, Hu J, Tang S, Zhong T, Ming X. Knowledge, awareness, behavior (KAB) and control of hypertension among urban elderly in western China. *Int J Cardiol* 2009; **137**: 9–15.
15 Ahluwalia IB, Tessaro I, Greenlund KJ, Ford ES. Factors associated with control of hypertension, hypercholesterolemia, and diabetes among low-income women in West Virginia. *J Womens Health (Larchmt)* 2010; **19**: 417–424.
16 Marmot M, Wilkinson RG. *Social Determinants of Health*. Oxford University Press: New York, 1999.
17 Chaix B, Chauvin P. Tobacco and alcohol consumption, sedentary lifestyle and overweightness in France: a multilevel analysis of individual and area-level determinants. *Eur J Epidemiol* 2003; **18**: 531–538.
18 Stafford M, Marmot M. Neighbourhood deprivation and health: does it affect us all equally? *Int J Epidemiol* 2003; **32**: 357–366.
19 Riva M, Bambra C, Curtis S, Gauvin L. Collective resources or local social inequalities? Examining the social determinants of mental health in rural areas. *Eur J Public Health* 2011; **21**: 197–203.
20 Grotto I, Huerta M, Sharabi Y. Hypertension and socioeconomic status. *Curr Opin Cardiol* 2008; **23**: 335–339.
21 Minor D, Wofford M, Wyatt SB. Does socioeconomic status affect blood pressure goal achievement? *Curr Hypertens Rep* 2008; **10**: 390–397.
22 Chaix B, Bean K, Leal C, Thomas F, Havard S, Evans D, Jégo B, Pannier B. Individual/neighborhood social factors and blood pressure in the RECORD Cohort Study: which risk factors explain the associations? *Hypertension* 2010; **55**: 769–775.
23 Cubbin C, Sundquist K, Ahlén H, Johansson SE, Winkleby MA, Sundquist J. Neighborhood deprivation and cardiovascular disease risk factors: protective and harmful effects. *Scand J Public Health* 2006; **34**: 228–237.
24 Wu Y, Tai ES, Heng D, Tan CE, Low LP, Lee J. Risk factors associated with hypertension awareness, treatment, and control in a multi-ethnic Asian population. *J Hypertens* 2009; **27**: 190–197.
25 Singstat.gov.sg [Internet]. Singapore: Department of Statistics, Government of Singapore; c2009–10 [updated 19 February 2010 ; cited 15 April 2010]. Available from: http://www.singstat.gov.sg/news/news/op19022010.pdf.
26 Singstat.gov.sg [Internet]. Singapore: Department of Statistics, Government of Singapore; c2009–10 [updated 5 February 2010; cited 15 February 2010]. Available from: http://www.singstat.gov.sg/stats/keyind.html.
27 Hdb.gov.sg [Internet]. Singapore: Housing and Development Board, Government of Singapore; c2009–10 [updated 19 January 2010; cited 15 April 2010]. Available from: http://www.hdb.gov.sg/fi10/fi10323p.nsf/w/RentDirectHDBRentDeposit?OpenDocument.
28 Housing and Development Board, Singapore. *Public Housing in Singapore: Residents' Profile, Housing Satisfaction and Preferences: HDB Sample Household Survey 2008*. Housing Development Board: Singapore, 2009.
29 Hdb.gov.sg [Internet]. Singapore: Housing and Development Board, Government of Singapore; c2009–10 [updated 19 January 2010; cited 15 April 2010]. Available from: http://www.hdb.gov.sg/fi10/fi10323p.nsf/w/RentDirectHDBEligibility?OpenDocument.

30 Department of Statistics, Singapore. *Key Household Income Trends, 2008*. Department of Statistics: Singapore, 2009.
31 Lim MK. Transforming Singapore health care: public-private partnership. *Ann Acad Med Singapore* 2005; **34**: 461–467.
32 Moh.gov.sg [Internet]. Singapore: Ministry of Health, Government of Singapore; c2009–10 [updated 2007; cited 9 September 2011]. Available from: http://www.moh.gov.sg/content/moh_web/home.html.
33 Ministry of Health, Singapore. *Health Screening: Clinical Practice Guidelines*. Ministry of Health: Singapore, 2003.
34 Chan YH. Biostatistics 202: logistic regression analysis. *Singapore Med J* 2004; **45**: 148–153.
35 Ministry of Health, Singapore. *National Health Survey 2004*. Ministry of Health: Singapore, 2005.
36 Ministry of Health, Singapore. *National Health Surveillance Survey 2007*. Ministry of Health: Singapore, 2009.
37 Rodríguez-Artalejo F, Díez-Gañán L, Basaldua Artiñano A, Banegas Banegas JR. Effectiveness and equity of serum cholesterol and blood pressure testing: a population-based study in Spain. *Prev Med* 2003; **37**: 82–91.
38 Wong MC, Jiang JY, Griffiths SM. Adherence to combination therapy among ethnic Chinese patients: a cohort study. *Hypertens Res* 2010; **33**: 416–421.
39 Carlsson AC, Wändell PE, Journath G, de Faire U, Hellénius ML. Factors associated with uncontrolled hypertension and cardiovascular risk in hypertensive 60-year-old men and women—a population-based study. *Hypertens Res* 2009; **32**: 780–785.
40 Virkkunen H, Harma M, Kauppinen T, Tenkanen L. Shift work, occupational noise and physical workload with ensuing development of blood pressure and their joint effect on the risk of coronary heart disease. *Scand J Work Environ Health* 2007; **33**: 425–434.
41 Ha M, Park J. Shiftwork and metabolic risk factors of cardiovascular disease. *J Occup Health* 2005; **47**: 89–95.
42 Peter R, Alfredsson L, Knutsson A, Siegrist J, Westerholm P. Does a stressful psychosocial work environment mediate the effects of shift work on cardiovascular risk factors? *Scand J Work Environ Health* 1999; **25**: 376–381.
43 Wennerholm C, Grip B, Johansson A, Nilsson H, Honkasalo ML, Faresjö T. Cardiovascular disease occurrence in two close but different social environments. *Int J Health Geogr* 2011; **10**: 5.