

Hypertension Management and Lifestyle Changes Following Screening for Hypertension in an Asian Low Socioeconomic Status Community: A Prospective Study

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Abstract

Introduction: This study investigated the effect of an access-enhanced intervention on hypertension screening and management, as well as on health behaviours among newly diagnosed hypertensives, in a multi-ethnic low socioeconomic status (SES) community. Factors associated with hypertension screening, treatment, and control in the community were also determined. **Materials and Methods:** The study involved all residents aged ≥ 40 years in 2 public rental housing precincts (low SES), between 2009 and 2011, who were followed-up prospectively for 1 year after a 6-month community-based intervention comprising a 3-month access-enhanced screening component and a 3-month follow-up (outreach) component. Blood pressure was measured at baseline and follow-up. Multivariate Cox regression determined predictors of hypertension management at follow-up. **Results:** The follow-up rate was 80.9% (467/577). At baseline, 60.4% (282/467) were hypertensive; 53.5% (151/282) were untreated; 54.2% (71/131) uncontrolled. One year later, postintervention, 51.6% (78/151) of untreated hypertensives were treated; combined with treated hypertensives previously uncontrolled, 53.0% (79/149) achieved control. Older age independently predicted treatment (adjusted relative risk, aRR = 1.98, CI, 1.08 to 3.65); majority ethnicity (aRR = 1.76, CI, 1.05 to 2.96), employment (aRR = 1.85, CI, 1.26 to 2.80) and newly treated hypertension (aRR = 1.52, CI, 1.01 to 2.32) predicted control. A total of 52.4% (97/185) were irregularly screened at baseline; at follow-up 61.9% (60/97) were regularly screened. Cost and misperceptions were common barriers to screening and treatment. Newly diagnosed hypertensives were also less likely to go for additional cardiovascular screening (aRR = 0.54, CI, 0.29 to 0.99). **Conclusion:** An access-enhanced intervention had some success in improving hypertension management within low SES communities; however, it was less successful in improving cardiovascular risk management, especially in encouraging lifestyle changes and additional cardiovascular screening amongst newly diagnosed hypertensives.

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Introduction

Hypertension is a major health burden;¹ however, treatment and control remain poor especially amongst urban populations and in particular, disadvantaged urban communities.²⁻⁴ In Asian societies, although much work has been done on hypertension in urban communities,^{2,5} few studies specifically investigate deprived urban areas,⁶⁻⁹ and there is little evaluation of potential interventions to improve cardiovascular risk management in disadvantaged populations.^{10,11} A diagnosis of hypertension can be an entry point into cardiovascular risk management in under-resourced settings,^{12,13} given the relatively low cost

of diagnosing hypertension. Examining how lifestyle and hypertension management changes following such interventions is thus of interest in reducing disparities in cardiovascular health. This is particularly pertinent in Asian societies, where there is a relative lack of studies focused on such disadvantaged populations despite the impact of socioeconomic status (SES) on disparities in cardiovascular risk profiles^{9,14,15} and rising income inequality in these rapidly urbanising societies.¹⁶

Singapore is one such example of a multi-ethnic urbanised Asian society, with Chinese, Indian and Malay populations.

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Hypertension management has been studied at the national level¹⁷ and in populations of interest (e.g. the elderly)¹⁸ but there are few studies on hypertension in low SES areas.⁹ In Singapore, hypertension is usually managed at the primary healthcare level through an extensive network of private general practitioners and public outpatient polyclinics.¹⁹ All Singaporeans are free to utilise either group of physicians for primary care. For the needy, subsidies for chronic disease management (including hypertension) are available at both private and public primary care clinics. At the public polyclinics, fees are already subsidised but there is still a co-payment component for the individual. The Chronic Disease Management Programme (CDMP), a national scheme that allows usage of Medisave (a national compulsory saving account for healthcare expenses) to cover chronic disease management in the outpatient setting, can help to reduce such out-of-pocket costs for the needy.²⁰ At private clinics, needy patients can also receive subsidised treatment at private clinics for their hypertension via the local Ministry of Health's Community Health Assist Programme (CHAS).²¹

Despite these schemes aimed at improving access to treatment for hypertension amongst the needy, recent studies have demonstrated that differences in hypertension management related to disparities in SES still exist. Hypertension management is poorer in public rental flat (low SES) neighbourhoods in Singapore,²² compared to both neighbouring higher SES areas⁹ and national estimates.¹⁷ Public rental flats provide heavily subsidised rentals (S\$26 to S\$275/month)²³ for the needy (<3% of the population, 88% of whom earn less than S\$670/month).²⁴ This is in contrast to the majority of Singaporeans (≥85%) who stay in owner-occupied public housing; 90.1% of Singaporeans own their own homes.²⁵ Despite the contrasts in hypertension management between higher and lower SES areas that were demonstrated in these studies, these studies were cross-sectional and did not investigate how hypertension management can change over time, or in response to interventions initiated in these communities.

In order to address these gaps in the current literature, we therefore report the prospective outcomes of an access-enhanced intervention with an outreach component, aimed at reducing disparities in hypertension management amongst low SES public rental flat communities in Singapore. Our aims were 3-fold: first, to determine how successful such an intervention was at improving hypertension management, by looking at the improvement in estimates of screening, treatment and control at baseline and postintervention. Second, we determined factors associated prospectively with better outcomes (i.e. going for screening, going on treatment, or achieving blood pressure (BP) control) amongst low SES participants in this intervention. Finally, we also investigated changes in health behaviours subsequent to the initial diagnosis of hypertension, in order to see if a diagnosis

of hypertension could serve as a potential entry point to better management of cardiovascular disease risk in this underserved population. Given rising income inequality in Singapore (a Gini coefficient of 0.452 in 2011),²⁶ a better understanding of how these disparities can be resolved is crucial. We hope that the results will be useful to those investigating hypertension management in similar urban low SES Asian communities.

Materials and Methods

Study Population

The study population consisted of all Singaporean citizens/permanent residents aged >40 years, living in 2 public rental housing precincts in Singapore (Site A and Site B) from 2009 to 2011; who had participated in the screening intervention for hypertension at baseline; and who were still staying in these communities, 1 year later. Site A contains 3 blocks of public rental flats while Site B contains 2 rental blocks. We chose these 2 sites because they contained all rental blocks in their respective estates. We chose Site A (west) and Site B (east) because rental blocks in Singapore are scattered across 4 zones with the largest number of such blocks in the eastern and western zones.²³ Information on the sociodemographics of this population at baseline has been previously published.^{27,28} We focused on residents staying in the public rental blocks. In the public rental blocks in these 2 sites, a total of 693 residents were aged ≥40 years, of which 577 (83.2%) participated at baseline (2009 to 2011) and were recruited sequentially over the course of the 3 years. We used an age limit of ≥40 years based on the Singapore Ministry of Health's Clinical Practice Guidelines (MOH CPG) for cardiovascular health screening which recommend those aged 40 years and above to go for BP screening annually.²⁹

Study Methodology

Baseline Information: At baseline, all study participants participated in a 6-month screening intervention for hypertension. The intervention consisted of a home visit programme run door-to-door by teams of trained medical and nursing student volunteers, under the supervision of family physicians, in these public rental housing precincts. The intervention comprised 2 phases: an initial 3-month screening phase, and a subsequent 3-month follow-up phase.

Initial Screening Phase: In the initial screening phase, trained medical student volunteers made at least 3 visits on separate days to (i) collect baseline information (demographic, socioeconomic, and clinical information) and (ii) measure BP, in order to screen the residents for

hypertension. 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-minute interval between measurements, at least 2 measurements during each occasion, and on 2 occasions. The mean value of the readings was calculated. During blood pressure measurements, the patient was allowed to sit down for several minutes before blood pressure was measured; he or she refrained from smoking or ingesting caffeine during the 30 minutes preceding the measurement, and the sphygmomanometer was placed at heart level with he or she in the seated position. Results were reviewed by medical professionals and residents were informed of their results; including if they were newly diagnosed with hypertension. We asked residents for their reason(s) for not participating in previous BP screening 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. Residents with persistently elevated blood pressure readings were referred to the local public primary care clinic (polyclinic) for follow-up.

Subsequent Follow-Up Phase: In the subsequent follow-up phase, student volunteers made monthly visits to patients for 2 issues: (i) management of chronic diseases (e.g. hypertension, diabetes, dyslipidaemia); (ii) encourage regular cardiovascular disease screening according to frequencies recommended in national screening guidelines.²⁹ During these visits, students helped to (i) educate and encourage patients to go for regular screening; (ii) educate patients about chronic disease; (iii) advise on lifestyle changes, such

as quitting smoking and drinking, regular exercise, weight reduction, and consuming a low salt diet. Patient education materials were derived from standardised materials provided by the local Health Promotion Board (HPB) and translations into the resident's native language were made, in order to minimise communication barriers. A flowchart of the various areas of focus of the intervention is provided in Figure 1.

Generally, in the 3 monthly visits scheduled during this phase, the first visit would focus on educating patients about screening, as well as linking up the resident to financial aid/social services provided by local grassroots organisations, if necessary. The second and third visits would then focus on chronic disease management and lifestyle changes respectively, after sufficient rapport had been built up with the patient. Visits usually lasted about an hour, but varied depending on the number and complexity of issues that had to be discussed with the patient. As far as possible, patients were assigned students who could speak their native language so as to increase rapport and improve communication. All referrals and services provided in the intervention were free and provided either in the patient's home, at the local community centre a short walk away, or at their local polyclinic, so as to improve access to these services amongst the low SES.

Follow-Up At 1 Year

In this study, we had a follow-up period of 1 year from the date of recruitment. Those who had moved away, were deceased or refused to participate in follow-up were defined as lost to follow-up and excluded from further analysis. The study was thus completed in 2012 (after the last batch of residents recruited completed their 1-year follow-up).

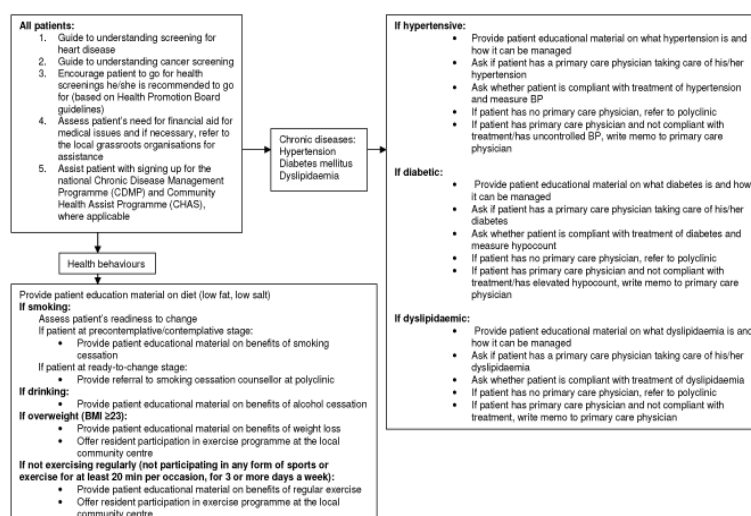


Fig. 1. Flowchart of issues covered during monthly visits in 3-month follow-up phase of intervention.

We evaluated specifically whether non-hypertensives were going for regular (yearly) hypertension screening and amongst hypertensives, whether (i) previously untreated hypertensives at baseline were now on treatment for hypertension; and (ii) whether hypertensives whose BP was previously uncontrolled at baseline had now achieved blood pressure control. As such, we repeated the baseline protocol (e.g. measuring BP, asking for reasons for not participating in regular screening/going on treatment) at the 1-year follow-up. In addition, we also evaluated utilisation of health services (screening for other cardiovascular risk factors, such as diabetes and dyslipidaemia) and changes in health behaviours (exercise, smoking, alcohol consumption, weight reduction) at follow-up amongst hypertensives. Ethics approval was obtained from the National University of Singapore Institutional Review Board, informed consent was sought and participation was voluntary.

Definitions

We divided hypertensives into 2 groups: known hypertensives at baseline, and newly diagnosed hypertensives. Known hypertension was defined as participant answering “yes” to the question “Has a physician ever told you that you have high BP?” at baseline. Newly diagnosed hypertension was defined as participant having no past history of hypertension and a systolic BP ≥ 140 mmHg or diastolic BP ≥ 90 mmHg at baseline, on measurement. 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 $\geq 90\%$ of the time?”. Amongst those on treatment at 1-year follow-up, they were further subdivided into 2 groups: newly on treatment; and previously on treatment. Those newly on treatment were newly diagnosed hypertensives; those previously on treatment were already known hypertensives at baseline. Control of hypertension was defined as being on treatment for hypertension and having an average BP reading of systolic BP < 140 mmHg and diastolic BP < 90 mmHg. Having regular screening for hypertension amongst unknown hypertensives was defined as adhering to yearly screening, as recommended by the local Ministry of Health.² Diabetes and dyslipidaemia were self-reported and defined as answering “yes” to the question “Has a physician ever told you that you have diabetes/dyslipidaemia?” at baseline. Overweight was defined as a BMI ≥ 23 kg/m².

Statistical Analysis

Descriptive statistics were computed for the study population. We analysed the predictors, after 1 year of follow-up, of (i) going on treatment amongst untreated hypertensives at baseline; (ii) achieving control of BP

amongst uncontrolled hypertensives on treatment; and (iii) going for regular screening amongst non-hypertensives not regularly screened at baseline. Predictors were identified using likelihood ratio (univariate) and Cox regression analysis (multivariate). For all multivariate models, we used $P < 0.2$ on univariate analysis (chi-square) as cut-off for entry into these models. We then compared qualitative replies of patients for not attending regular hypertension screening/not going on treatment at baseline and at 1-year follow-up, categorised them by themes and presented it as descriptive data. We also used likelihood ratio (univariate) and Cox regression analysis (multivariate) to assess predictors of going for additional cardiovascular disease screening; and predictors of changes in health behaviours (exercise) amongst hypertensives. We also compared the qualitative replies of patients for not going on regular health screening/exercise on follow-up, categorised them by themes and presented it as descriptive data. Statistical analysis was performed using Statistical Package for Social Sciences (Version 17.0, USA), and statistical significance was set at the conventional $P < 0.05$.

Results

Sociodemographic Information of the Study Population

At baseline, 577 residents staying in low SES communities (rental flats) met inclusion criteria. One year later, 80.9% (467/577) of those residents were still on follow-up. Of those lost to follow-up, 16.5% (95/577) had moved away, 0.7% (4/577) died, and 1.9% (11/577) refused follow-up. Those currently married, with higher household income, who were overweight and had a history of diabetes mellitus or dyslipidaemia were more likely to be on follow-up (Table 1). There was no difference in follow-up rates between sites. In the followed-up population, the median age was 61 (interquartile ratio, IQR = 50 to 74); the majority were of Chinese ethnicity (53.7%, 251/467), with another one third Malays (31.0%, 145/467), 12.8% (60/467) Indian and the rest of other ethnicities. Almost one third (27.6%, 129/467) were currently smoking, 4.1% were drinking (19/467), 50.3% (235/467) were not exercising regularly and 41.3% (193/467) were overweight.

Changes in Estimates of Hypertension Treatment, Control and Screening at Baseline and Postintervention

A breakdown of the followed-up population is shown in Figure 2. At baseline, the prevalence of hypertension in this population was 60.4% (282/467). Of these, 179 had a prior history of doctor-diagnosed hypertension at baseline (known hypertensives), and an additional 103 residents were newly diagnosed hypertensives from baseline blood pressure readings during screening.

Table 1. Comparison of Sociodemographic and Medical Characteristics Between Baseline Study Population And Those On Follow-Up 1 Year Later (n = 467) Amongst Residents Staying in 2 Rental Flat Communities in Singapore

Original Study Population (n = 577)				
Characteristics	Lost to Follow-Up (n = 110)	Follow-Up (n = 467)	Unadjusted Odds Ratio (95% CI)*	P Value
Site				0.124
Site A	88 (20.5)	341 (79.5)	1.00	
Site B	22 (14.9)	126 (85.1)	1.48 (0.89 – 2.46)	
Age (Years)				0.437
40 to 59, n (%)	58 (20.4)	227 (79.6)	1.00	
≥60, N (%)	52 (17.8)	240 (82.2)	1.18 (0.78 – 1.79)	
Gender, n (%)				0.269
Female	56 (17.4)	265 (82.6)	1.00	
Male	54 (21.1)	202 (78.9)	0.79 (0.52 – 1.20)	
Married, n (%)				0.049
Not currently married	70 (21.9)	249 (78.1)	1.00	
Married	40 (15.5)	218 (84.5)	1.53 (1.00 – 2.35)	
Ethnicity, N (%)				0.163
Non-Chinese	59 (21.5)	216 (78.5)	1.00	
Chinese	51 (16.9)	251 (83.1)	1.34 (0.89 – 2.04)	
Educational Attainment, n (%)				0.052
Primary education and below	90 (20.8)	343 (79.2)	1.00	
Finished secondary education	18 (13.2)	118 (86.8)	1.72 (0.98 – 2.97)	
				0.772
Tertiary education and above	2 (25.0)	6 (75.0)	0.79 (0.16 – 3.97)	
Employment, N (%)				
Unemployed	71 (19.6)	291 (80.4)	1.00	0.662
Employed	39 (18.1)	176 (81.9)	1.10 (0.71 – 1.70)	
Monthly Household Income per month, n (%)				
≤S\$500	76 (29.1)	185 (70.9)	1.00	-
>S\$500 – S\$1500	31 (11.2)	246 (88.8)	3.26 (2.06 – 5.16)	<0.001
>S\$1500	3 (7.7)	36 (92.3)	4.93 (1.47 – 16.49)	0.010
Help Needed, n (%)				0.198
Not on financial aid	75 (17.8)	347 (82.2)	1.00	
Receiving financial help†	35 (22.6)	120 (77.4)	0.74 (0.47 – 1.16)	
Blood Pressure (mmHg), Mean (SD)‡				0.165
Systolic	137.2 (21.3)	134.1 (19.1)		
Diastolic	81.62 (12.4)	80.9 (13.9)		
Body Mass Index				0.005
Not overweight	81 (22.8)	274 (77.2)	1.00	
Overweight	29 (13.1)	193(86.9)	1.97 (1.21 – 3.21)	

Table 1. Comparison of Sociodemographic and Medical Characteristics Between Baseline Study Population And Those On Follow-Up 1 Year Later (n = 467) Amongst Residents Staying in 2 Rental Flat Communities in Singapore (Con't)

Original Study Population (n = 577)				
Characteristics	Lost to Follow-Up (n = 110)	Follow-Up (n = 467)	Unadjusted Odds Ratio (95% CI)*	P Value
Self-Reported Disease				
Status at Baseline, N(%)				
No	72 (20.0)	288 (80.0)	1.00	0.459
Yes	38 (17.5)	179 (82.5)	1.18 (0.76 – 1.82)	
Diabetes Mellitus				
No	95 (20.8)	361 (79.2)	1.00	0.029
Yes	15 (12.4)	106 (87.6)	1.86 (1.04 – 2.79)	
Dyslipidaemia				
No	93 (22.4)	323 (77.6)	1.00	0.001
Yes	17 (10.6)	144 (89.4)	2.44 (1.40 – 4.24)	

*Unadjusted odds ratio of being followed-up at 1 year, calculated using chi-square test

†Receiving financial help was defined as: being a recipient of Public Assistance or other forms of financial assistance from the local community centre (grassroots organisation)

‡Calculated using t-test

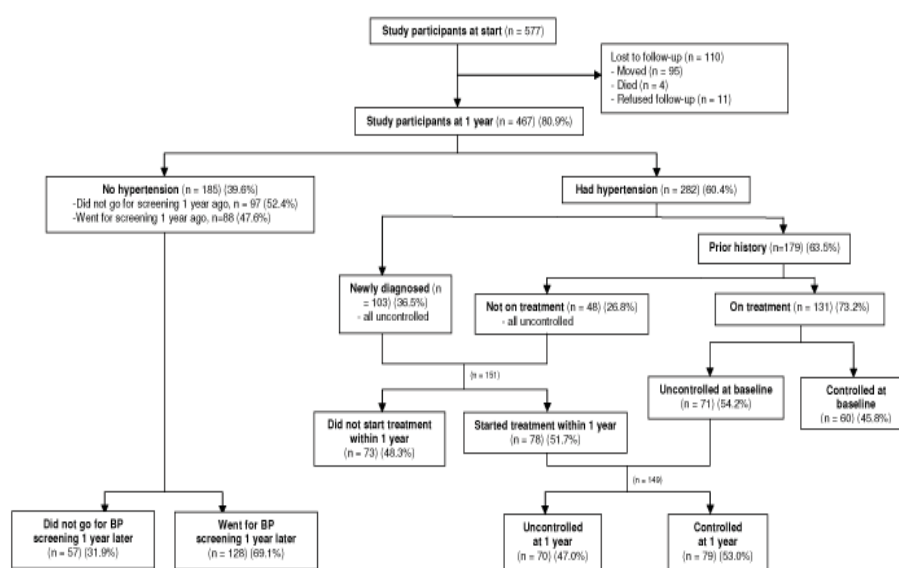


Fig. 2. Flowchart showing outline of study population.

Amongst the known hypertensives (n = 179), at baseline, 26.8% (48/179) were not on treatment. Of those 131 hypertensives who were previously treated, at baseline 54.2% (71/131) had uncontrolled BP. At follow-up postintervention, of the 151 untreated hypertensives at baseline (comprising all 103 newly diagnosed hypertensives and 48 known hypertensives), 48.3% (73/151) were still not on treatment, 1 year on. Adding the 78 newly treated hypertensives to the original 71 known hypertensives

with uncontrolled BP at baseline resulted in a total of 149 residents. Of these, 1 year on, 47.0% (70/149) still had uncontrolled BP.

Amongst the 185 residents with no hypertension at baseline, 52.4% (97/185) had not gone for their yearly regular BP screening at baseline; and at follow-up 1 year later, 31.9% (57/185) had not gone for their regular BP screening.

Table 2. Reasons For Not Going for Regular Hypertension Screening Amongst Non-Hypertensives and Reasons For Not Going for Treatment Amongst Hypertensives at Baseline and 1 Year Postbaseline, Amongst Adults ≥ 40 Years Staying in 2 Public Rental Flat Neighbourhoods in Singapore

Reasons For Not Attending Regular Hypertension Screening at Baseline (n = 97), n (%)		Reasons For Not Attending Regular Hypertension Screening 1 Year Postbaseline (n = 57), n (%) [*]		Reasons For Not Going For Treatment at Baseline (n = 48), N (%) [†]		Reasons For Not Going For Treatment 1 Year Postbaseline (n = 73), n (%) [‡]	
Cost		Cost		Cost		Cost	
Cost of screening test too expensive	23/97 (23.7) ²	Cost of screening test too expensive	6/57 (10.5) ³				
Cost of further treatment, if screening is positive, too expensive	19/97 (19.6) ³	Cost of further treatment, if screening is positive, too expensive	5/57 (8.8)	Problem with money because of high costs of chronic medication	12/48 (25.0) ¹	Problem with money because of high costs of chronic medication	18/73 (24.7) ³
Waiting for free screening	0/97 (0.0)	Waiting for free screening	1/57 (1.8)				
Perceptions		Perceptions		Perceptions		Perceptions	
Not necessary as I am healthy	28/97 (28.9) ¹	Not necessary as I am healthy	15/57 (26.3) ²	I do not think that taking medication will benefit me	8/48 (16.7) ³	I do not think that taking medication will benefit me	18/73 (24.7) ³
Not necessary as I am not at risk	13/97 (13.4)	Not necessary as I am not at risk	4/57 (7.0)	I prefer to take non-western medication as it is more efficacious	11/48 (22.9) ²	I prefer to take non-western medication as it is more efficacious	30/73 (41.1) ¹
Not necessary as I am too young	10/97 (10.3)	Not necessary as I am too young	0/57 (0.0)	I do not like the side effects of my medication	3/48 (6.3)	I do not like the side effects of my medication	5/73
Lack of time		Lack of time		Lack of time/inconvenient		Lack of time/inconvenient	
Too busy to go/no time	19/97 (19.6) ³	Too busy to go/no time	18/57 (31.6) ¹				
Inconvenience		Inconvenience					
Screening is inconvenient	9/97 (9.3)	Screening is inconvenient	6/57 (10.5)	I have no time/it is inconvenient to take medication	6/48 (12.5)	I have no time/it is inconvenient to take medication	3/73 (4.1)
Don't have a caregiver to go with	11/97 (11.3)	Don't have a caregiver to go with	1/57 (1.8)				

Note: The superscript numbers are the top 3 groups of reasons for not going for regular screening or for not taking medication

^{*}Amongst those who did not participate in regular hypertension screening a year later

[†]Although there were 151 hypertensives not on treatment at baseline, of those 103 were newly diagnosed with hypertension and hence excluded from this analysis. Only results for the 48 residents with prior history of doctor-diagnosed hypertension at baseline who were not on treatment are presented in this table.

[‡]Reasons for not going on treatment amongst those who still did not go on treatment for hypertension at follow-up a year later (including both newly diagnosed hypertensives and those with prior history of doctor-diagnosed hypertension at baseline.)

Table 3. Univariate Predictors of Going On Hypertension Treatment Amongst Untreated Hypertensives at Baseline (n = 151); Achieving Hypertension Control Amongst Uncontrolled Hypertensives on Treatment (n = 149) and Going for Regular Hypertension Screening Amongst Non-Hypertensives at Baseline (n = 185), Amongst Adults ≥40 Years Staying in 2 Public Rental Flat Neighbourhoods in Singapore

Factors	Hypertensives at Baseline (n = 282)					No Hypertension at Baseline (n = 185)						
	Going On Hypertension Treatment Amongst Untreated Hypertensives (n = 151)			Achieving Hypertension Control Amongst Uncontrolled Hypertensives on Treatment (n = 149)		Going For Regular Hypertension Screening Amongst Non-Hypertensives After 1-Year Follow-Up (n = 185)						
	No (n = 73) n (%)	Yes (n = 78) n (%)	Crude RR (95% CI)	P Value	No (n = 70) n (%)	Yes (n = 79) n (%)	Crude RR (95% CI)	P Value	No (n = 57) n (%)	Yes (n = 128) n (%)	Crude RR (95% CI)	P Value
Demographic Characteristics												
Site												
A	53 (48.2)	57 (51.8)	0.99 (0.68 – 1.43)	0.948	51 (45.1)	62 (54.9)	0.86 (0.59 – 1.24)	0.424	46 (34.6)	87 (65.4)	1.64 (0.92 – 2.90)	0.080
B	20 (48.8)	21 (51.2)	1.00		19 (52.8)	17 (47.2)	1.00		11 (21.2)	41 (78.8)	1.00	
Age (Years)												
40 – 59	47 (57.3)	35 (42.7)	1.52 (1.07 – 2.17)	0.016	25 (44.6)	31 (55.4)	0.86 (0.44 – 1.67)	0.657	35 (31.3)	77 (68.8)	1.04 (0.67 – 1.62)	0.873
≥60	26 (37.7)	43 (62.3)	1.00		45 (48.4)	48 (51.6)	1.00		22 (30.1)	51 (69.9)	1.00	
Gender												
Female	43 (50.6)	42 (49.4)	1.11 (0.79 – 1.56)	0.531	39 (47.6)	43 (52.4)	1.03 (0.73 – 1.45)	0.875	33 (32.7)	68 (67.3)	1.14 (0.74 – 1.77)	0.547
Male	30 (45.5)	36 (54.5)	1.00		31 (46.3)	36 (53.7)	1.00		24 (28.6)	60 (71.4)	1.00	
Ethnicity												
Non-Chinese	35 (53.0)	31 (47.0)	1.19 (0.86 – 1.65)	0.310	38 (59.4)	26 (40.6)	2.42 (1.25 – 4.70)	0.008	33 (37.1)	56 (62.9)	1.48 (0.96 – 2.30)	0.075
Chinese	38 (44.7)	47 (55.3)	1.00		32 (37.6)	53 (62.4)	1.00		24 (25.0)	72 (75.0)	1.00	
Marital Status												
Not married	42 (50.6)	41 (49.4)	1.11 (0.79 – 1.55)	0.539	35 (42.7)	47 (57.3)	0.82 (0.58 – 1.15)	0.245	36 (40.9)	52 (59.1)	2.51 (1.32 – 4.77)	0.004
Married	31 (45.6)	37 (54.4)	1.00		35 (52.2)	32 (47.8)	1.00		21 (21.6)	76 (78.4)	1.00	
Socioeconomic Status												
Employment												
Unemployed	41 (46.6)	47 (53.4)	0.92 (0.66 – 1.28)	0.610	52 (55.3)	42 (44.7)	1.69 (1.11 – 2.57)	0.007	45 (42.5)	61 (57.5)	2.80 (1.59 – 4.92)	<0.001
Employed	32 (50.8)	31 (49.2)	1.00		18 (32.7)	37 (67.3)	1.00		12 (15.2)	67 (84.8)	1.00	

Table 3. Univariate Predictors of Going On Hypertension Treatment Amongst Untreated Hypertensives at Baseline (n = 151); Achieving Hypertension Control Amongst Uncontrolled Hypertensives on Treatment (n = 149) and Going for Regular Hypertension Screening Amongst Non-Hypertensives at Baseline (n = 185), Amongst Adults ≥ 40 Years Staying in 2 Public Rental Flat Neighbourhoods in Singapore (Cont)

Factors	Hypertensives at Baseline (n = 282)					No Hypertension at Baseline (n = 185)						
	Going On Hypertension Treatment Amongst Untreated Hypertensives (n = 151)			Achieving Hypertension Control Amongst Uncontrolled Hypertensives on Treatment (n = 149)		Going For Regular Hypertension Screening Amongst Non-Hypertensives After 1-Year Follow-Up (n = 185)						
	No (n = 73) n (%)	Yes (n = 78) n (%)	Crude RR (95% CI)	P Value	No (n = 70) n (%)	Yes (n = 79) n (%)	Crude RR (95% CI)	P Value	No (n = 57) n (%)	Yes (n = 128) n (%)	Crude RR (95% CI)	P Value
Educational Status												
Primary education and below	55 (47.4)	61 (52.6)	0.92 (0.63 – 1.34)	0.677	57 (48.7)	60 (51.3)	1.20 (0.76 – 1.90)	0.415	41 (33.1)	83 (66.9)	1.26 (0.77 – 2.06)	0.340
Secondary education and above	18 (51.4)	17 (48.6)	1.00		13 (40.6)	19 (59.4)	1.00		16 (26.2)	45 (73.8)	1.00	
Household Income (monthly)												
<\$500	30 (50.0)	30 (50.0)	1.06 (0.76 – 1.48)	0.741	26 (46.4)	30 (53.6)	0.98 (0.67 – 1.40)	0.917	17 (26.6)	47 (73.4)	0.80 (0.50 – 1.30)	0.359
\$500 – \$1500	43 (47.3)	48 (52.7)	1.00		44 (47.3)	49 (52.7)	1.00		40 (33.1)	81 (66.9)	1.00	
Financial Aid												
Not needed	56 (50.0)	56 (50.0)	1.15 (0.77 – 1.71)	0.490	46 (41.8)	64 (58.2)	0.68 (0.49 – 0.95)	0.034	37 (27.8)	96 (72.2)	0.72 (0.47 – 1.12)	0.164
Needed	17 (43.6)	22 (56.4)	1.00		24 (61.5)	15 (38.5)	1.00		20 (38.5)	32 (61.5)	1.00	
Lifestyle Factors												
Current Smoker												
No	49 (45.0)	60 (55.0)	0.79 (0.56 – 1.10)	0.179	51 (44.0)	65 (56.0)	0.76 (0.53 – 1.09)	0.167	36 (28.8)	89 (71.2)	0.82 (0.53 – 1.28)	0.395
Yes	24 (57.1)	18 (42.9)	1.00		19 (57.6)	14 (42.4)	1.00		21 (35.0)	39 (65.0)	1.00	
Current Drinker												
No	70 (48.6)	74 (51.4)	1.13 (0.47 – 2.71)	0.766	66 (46.5)	76 (53.5)	0.81 (0.42 – 1.58)	0.581	53 (29.8)	125 (70.2)	0.52 (0.26 – 1.03)	0.142
Yes	3 (42.9)	4 (57.1)	1.00		4 (57.1)	3 (42.9)	1.00		4 (57.1)	3 (42.9)	1.00	
Regular Exercise												
No	34 (45.9)	40 (54.1)	0.91 (0.65 – 1.26)	0.563	39 (49.4)	40 (50.6)	1.12 (0.79 – 1.57)	0.535	29 (33.0)	59 (67.0)	1.14 (0.74 – 1.76)	0.548
Yes	39 (50.6)	38 (49.4)	1.00		31 (44.3)	39 (55.7)	1.00		28 (28.9)	69 (71.1)	1.00	

Table 3. Univariate Predictors of Going On Hypertension Treatment Amongst Untreated Hypertensives at Baseline (n = 151); Achieving Hypertension Control Amongst Uncontrolled Hypertensives on Treatment (n = 149) and Going for Regular Hypertension Screening Amongst Non-Hypertensives at Baseline (n = 185), Amongst Adults ≥40 Years Staying in 2 Public Rental Flat Neighbourhoods in Singapore (Cont'd)

Factors	Hypertensives at Baseline (n = 282)						No Hypertension at Baseline (n = 185)					
	Going On Hypertension Treatment Amongst Untreated Hypertensives (n = 151)			Achieving Hypertension Control Amongst Uncontrolled Hypertensives on Treatment (n = 149)			Going For Regular Hypertension Screening Amongst Non-Hypertensives After 1-Year Follow-Up (n = 185)					
	No (n = 73) n (%)	Yes (n = 78) n (%)	Crude RR (95% CI)	P Value	No (n = 70) n (%)	Yes (n = 79) n (%)	Crude RR (95% CI)	P Value	No (n = 57) n (%)	Yes (n = 128) n (%)	Crude RR (95% CI)	P Value
Medical History												
Hypertension												
Newly Diagnosed												
Known hypertensives	19 (39.6)	29 (60.4)	0.76 (0.30 – 1.19)	0.140	NA	NA	NA	NA	NA	NA	NA	NA
Newly diagnosed hypertensive	54 (52.4)	49 (47.6)	1.00									
Newly on Treatment												
Previously treated hypertensives	NA	NA	NA	NA	39 (54.9)	32 (45.1)	1.38 (0.98 – 1.95)	0.063	NA	NA	NA	NA
Newly treated hypertensives					31 (39.7)	47 (60.3)	1.00					
Went For Screening at Baseline (1 Year Ago)												
Did not go for screening	NA	NA	NA	NA	NA	NA	NA	NA	37 (38.1)	60 (61.9)	1.68 (1.06 – 2.66)	0.022
Went for screening									20 (22.7)	68 (77.3)	1.00	
Diabetes Mellitus												
No	64 (52.0)	59 (48.0)	1.61 (0.92 – 2.85)	0.055	43 (43.4)	56 (56.6)	0.80 (0.57 – 1.13)	0.222	48 (29.4)	115 (70.6)	0.72 (0.41 – 1.26)	0.285
Yes	9 (32.1)	19 (67.9)	1.00		27 (54.0)	23 (46.0)	1.00			13 (59.1)	1.00	
Dyslipidaemia												
No	61 (51.3)	58 (48.7)	1.75 (0.79 – 3.91)	0.165	39 (42.9)	52 (57.1)	0.80 (0.57 – 1.12)	0.207	49 (34.0)	95 (66.0)	1.74 (0.90 – 3.38)	0.067
Yes	12 (37.5)	20 (62.5)	1.00		31 (53.4)	27 (46.6)	1.00		8 (19.5)	33 (80.5)	1.00	

NA: not applicable; RR: relative risk

Changes in Reasons for Not Going for Regular Blood Pressure Screening and Not Going On Treatment for Hypertension in a Low SES Community at Baseline and Post-intervention

The shifts in reasons cited by members of this low SES community, at baseline and follow-up for irregular screening and not going on treatment for hypertension are listed in Table 2. Amongst non-hypertensives, at baseline, the most commonly cited reasons for irregular screening were: cost (both cost of test as well as further treatment); misperceptions (“not necessary as I am healthy”); and lack of time. One year postintervention, while concerns about cost diminished somewhat, misperceptions and the lack of time remained major issues.

Amongst those who were hypertensives, a somewhat similar pattern was seen with regards to going on hypertension treatment. Cost of treatment and misperceptions (“I do not think that taking medication will benefit me”; “I prefer to take non-western medication”) were the top reasons at both baselines for not going on treatment. One year later, while the percentage of those facing cost issues remained relatively unchanged, a significant and increased proportion still had misperceptions (e.g. that traditional medication was more efficacious for hypertension, and that western medicine would not benefit them).

Factors Prospectively Associated with Treatment, Control and Screening for Hypertension at 1-year Follow-Up

The factors predictive of going on hypertension treatment, achieving BP control and going for screening postintervention in our prospective study are presented in Table 3 (univariate) and Table 4 (multivariate). Older age was an independent predictor of going on treatment (adjusted relative risk, aRR = 1.98, 95% CI, 1.08 to 3.65, $P = 0.028$) amongst untreated hypertensives; while being of majority (Chinese) ethnicity and employment at baseline were independent predictors of achieving hypertension control amongst previously uncontrolled hypertensives and going for screening amongst non-hypertensives. In addition, newly treated hypertensives (started treatment within the 1-year follow-up period) were more likely to have controlled BP on follow-up compared to those who were previously on treatment at baseline (aRR = 1.52, 95% CI, 1.01 to 2.32, $P = 0.047$); but newly diagnosed hypertensives were not more likely to go on treatment for hypertension.

Factors Associated with Utilisation of Health Services and Health Behaviours Amongst Hypertensives

The independent factors associated with utilisation of health services (going for regular cardiovascular disease screening) amongst hypertensives are shown in Table 5.

Table 4. Sociodemographic Factors Independently Associated With Going On Hypertension Treatment Amongst Untreated Hypertensives at Baseline (n = 151); Achieving Hypertension Control Amongst Uncontrolled Hypertensives On Treatment (n = 149) and Going For Regular Hypertension Screening Amongst Non-Hypertensives at Baseline (n = 185), Amongst Adults ≥ 40 Years Staying in 2 Public Rental Flat Neighbourhoods in Singapore

Associated Sociodemographic Factors	Adjusted RR (95% CI)*	P Value
On Treatment For Hypertension Amongst Untreated Hypertensives at Baseline (n = 151)		
Demographic factors:		
Age ≥ 60 years (vs reference group: age <60 years)	1.98 (1.08 – 3.65)	0.028
Achieved Hypertension Control Amongst Uncontrolled Hypertensives On Treatment (n = 149)		
Demographic factors:		
Chinese ethnicity vs reference group: non-Chinese ethnicity	1.76 (1.05 – 2.96)	0.030
Socioeconomic factors:		
Currently working vs reference group: not currently working	1.85 (1.26 – 2.80)	0.005
Hypertension		
Newly treated hypertensive vs reference group: previously-treated hypertensive	1.52 (1.01 – 2.32)	0.047
Screening of Blood Pressure Amongst Non-Hypertensives at Baseline (n = 185)		
Demographic factors:		
Chinese ethnicity vs reference group: non-Chinese ethnicity	1.91 (1.08 – 3.40)	0.027
Socioeconomic factors:		
Currently working vs. reference group: not currently working	1.45 (1.02 – 2.05)	0.036

*RR adjusted for all independent co-variables in the final parsimonious multivariate model (ie all variables presented in the table for each model)

RR: relative risk

Table 5. Sociodemographic Factors Independently Associated With Cardiovascular Disease Screening and Exercise Participation Amongst Hypertensives Unscreened and Not Exercising Regularly at Baseline, Amongst Adults ≥ 40 Years Staying in 2 Public Rental Flat Neighbourhoods in Singapore

Associated Factors	Adjusted RR (95% CI)*	P Value
Screening Participation		
Cardiovascular Disease		
Going for Diabetes Screening Amongst Non-Diabetic Hypertensives Unscreened at Baseline (n = 112)		
Medical factors:		
Newly diagnosed hypertensive vs reference group: previously diagnosed hypertensive†	0.61 (0.37 – 0.97)	0.048
Going for dyslipidemia screening amongst non-dyslipidemic hypertensives unscreened at baseline (n = 117)		
Medical factors:		
Newly diagnosed hypertensive vs reference group: previously diagnosed hypertensive†	0.54 (0.29 – 0.99)	0.049
Exercise Participation		
Exercising Amongst Hypertensives Previously Not Having Regular Exercise at Baseline (n = 147)		
Geographical factors:		
Staying in Site B vs reference group: staying in Site A§	0.50 (0.30 – 0.83)	0.007
Socioeconomic factors:		
Household income of >\$500 vs reference group: household income of <\$500†	1.34 (1.04 – 2.10)	0.045

*RR adjusted for all independent co-variates in the final parsimonious multivariate model (i.e all variables presented in the table for each model).

† $P < 0.05$ on univariate analysis

‡ $P < 0.01$ on univariate analysis

§ $P < 0.001$ on univariate analysis

With regards to cardiovascular disease risk, at baseline 70.2% (198/282) of hypertensives had no history of concurrent diabetes mellitus, while 63.5% (179/282) had no history of concurrent dyslipidaemia. Amongst non-diabetic hypertensives, at baseline, 56.6% (112/198) were not being regularly screened for diabetes mellitus, while amongst non-dyslipidaemic hypertensives, 65.4% (117/179) were not being regularly screened for dyslipidaemia. After 1 year post-intervention, 53.6% (60/112) had gone for diabetes mellitus screening and 36.8% (43/117) had gone for dyslipidaemia screening. Notably, newly diagnosed hypertensives were less likely to go for both diabetes mellitus screening (aRR = 0.61, 95% CI, 0.37 to 0.97, $P = 0.048$) and dyslipidaemia screening (aRR = 0.54, 95% CI, 0.29 to 0.99, $P = 0.049$).

While cost was a common reason for not going for diabetes mellitus/dyslipidaemia screening amongst both newly diagnosed and previously diagnosed hypertensives, newly diagnosed hypertensives tended to have more misconceptions about diabetes mellitus/dyslipidaemia screening, with higher proportions perceiving it as unnecessary because they were healthy/not-at-risk; and a higher proportion had no time to go for cardiovascular screening (Table 6). With regards to lifestyle modification, at baseline, 52.1% (147/282) of hypertensives were not exercising regularly. On follow-up, 1-year post-intervention, 67.3% (99/147) were exercising regularly. Those with higher household income were more likely to be having

regular exercise (Table 5). We also assessed other health behaviours: smoking, alcohol consumption, and weight reduction. At baseline, 24.5% (69/282) of hypertensives smoked; 1 year later 17.4% (12/69) had quit smoking; 4.3% (12/282) were drinking at baseline and on follow-up, 16.7% (2/10) had quit drinking. At baseline, 46.8% (132/282) of hypertensives were overweight; on follow-up 9.1% (12/132) were no longer overweight. Because the numbers were small, we did not further analyse factors associated with quitting smoking/drinking and weight reduction amongst hypertensives in this low SES community.

Discussion

Effects of a Free, Access-Enhanced Intervention with Education and Screening Components on Hypertension Management in a Low SES Community

At baseline, the prevalence of hypertension in this low SES community was 60.4%, 36.5% of which were newly diagnosed after screening. This was high compared to national estimates for the prevalence of hypertension (23.5% amongst adults aged 30 to 69 years).³⁰ Initial estimates at baseline for treatment, control and screening for hypertension were 73.2%, 45.8%, and 52.4%, respectively. Post-intervention, after 1 year, 51.7% of untreated hypertensives were now on treatment; 53.0% of hypertensives with uncontrolled BP at baseline had now achieved control; and 69.1% of non-hypertensives were now being screened. Compared against national estimates

Table 6. Reasons For Not going For Regular Cardiovascular Screening and Regular Exercise, Amongst Hypertensives ≥ 40 Years Staying in 2 Public Rental Flat Neighbourhoods in Singapore

Reasons	Not Attending Regular Diabetes Screening at Follow-Up Amongst Non-Diabetic Hypertensives n (%)		Not Attending Regular Dyslipidaemia Screening at Follow-Up Amongst Non-Dyslipidaemic Hypertensives n (%)		Reasons	Reasons For Not Regularly Exercising at Follow-Up Amongst Hypertensives n (%)	
	Newly Diagnosed Hypertensives	Previously Diagnosed Hypertensives	Newly diagnosed Hypertensives	Previously Diagnosed Hypertensives		Site A	Site B
N	35	17	50	24		20	28
Cost					Cost		
Cost of screening test too expensive	6/35 (17.1)	5/17 (29.4) ²	8/50 (16.0)	1/24 (4.2)	NA	NA	NA
Cost of further treatment, if screening is positive, too expensive	9/35 (25.7) ³	5/17 (29.4) ²	13/50 (26.0)	7/24 (29.2) ¹			
Waiting for free screening	1/35 (2.9)	2/17 (11.8)	0/50 (0.0)	0/24 (0.0)			
Perceptions					Perceptions		
Not necessary as I am healthy	14/35 (40.0) ¹	7/17 (41.2) ¹	28/50 (56.0) ¹	6/24 (25.0) ²	Not necessary as I am healthy	2/20 (10.0)	0/28 (0.0)
Not necessary as I am not at risk	8/35 (22.9)	2/17 (11.8)	15/50 (30.0) ³	3/24 (12.5)	Not used to exercise routine	0/20 (0.0)	1/28 (3.6)
Never heard of screening	0/35 (0.0)	0/17 (0.0)	0/50 (0.0)	0/24 (0.0)			
Not necessary as I am too young/ too old	0/35 (0.0)	0/17 (0.0)	0/50 (0.0)	0/24 (0.0)	I have health conditions that make it difficult for me to exercise	3/20 (15.0) ³	3/28 (10.7)
Screening is not important	2/35 (5.7)	2/17 (11.7)	3/50 (6.0)	2/24 (8.3)			
Screening is not effective in detecting condition	1/35 (2.9)	1/17 (5.9)	1/50 (2.0)	2/24 (8.3)	I am too tired after a day's work to exercise	7/20 (35.0) ¹	4/28 (14.3) ³
Cannot do anything if condition detected	0/35 (0.0)	0/17 (0.0)	0/50 (0.0)	4/24 (16.7)			
Lack of Time					Lack of Time		
Too busy to go/no time	10/35 (28.6) ²	3/17 (17.6) ³	17/50 (34.0) ²	5/24 (20.8) ³	Too busy to go/no time	3/20 (15.0) ³	14/28 (50.0) ¹
Inconvenience					Inconvenience		
Screening is inconvenient	2/35 (5.7)	1/17 (5.9)	4/50 (8.0)	0/24 (0.0)	Exercising is inconvenient	5/20 (25.0) ²	5/20 (17.9) ²
Don't have a caregiver to go with	0/35 (0.0)	0/17 (0.0)	0/50 (0.0)	0/24 (0.0)			

Note: ^{1,2,3}Top 3 groups of reasons for not going for regular screening or not regularly exercising.

for treatment, control and screening for hypertension which were 84.4%, 27.1%, 17 and 63.9%,³¹ respectively, while there was improvement postintervention, especially in the aspect of screening, more can be done to improve management of hypertension in these low SES communities, particularly in increasing the numbers of hypertensives on treatment.

In particular, analysis of the changes in patient beliefs pre- and post-intervention revealed some limitations. Despite patient education during the intervention and gains that were made (e.g. decreased concerns about

screening costs), a substantial proportion of patients still had misperceptions about the necessity of screening and benefits of medication compliance, even after monthly visits for 6 months at which these points were reiterated by the volunteers. The relative intractability of some of these misperceptions persisted throughout the 1 year of follow-up despite efforts to minimise communication and language barriers, such as the use of standardised pictorial aids, and translation of all patient education materials into the patient's native language. In particular, increased

numbers of patients expressed a preference for traditional medicine over western medications. Physicians working with these communities should be aware of the possibility that patients may resort to traditional medicines and counsel them accordingly, given that patients often do not discuss their use of traditional medicine with their doctors.³² This is especially important in multicultural communities where a diversity of traditional medicine is widely available.

Groups at Greater Risk of Poorer Hypertension Management in Low SES Communities

In this prospective study, older age predicted greater likelihood of treatment, while those of majority ethnicity (Chinese) and higher individual SES (employment) were more likely to have controlled BP and go for hypertension screening. These findings largely mirrored those of other local studies, which showed that older age was associated with going on treatment,⁹ and that minorities and the unemployed had poorer hypertension management.^{9,17} More needs to be done to assist vulnerable groups within these low SES communities in managing hypertension.

Difficulties with Modifying Health Behaviours and Utilising Health Services in Those of Lower SES Even After a Diagnosis of Hypertension

Surprisingly, newly diagnosed hypertensives (those who were diagnosed with hypertension during the screening intervention) were less likely to go for regular screening for other cardiovascular disease risk factors, 1 year on. This was contrary to other studies that showed higher uptake of preventive services amongst those newly diagnosed with hypertension in other populations.^{33,34} In this low SES setting, we postulate that perhaps patients newly diagnosed with hypertension did not want to go for additional screening to know their full cardiovascular disease risk profile, as they already faced challenges coping with the recent diagnosis of hypertension. These difficulties were likely not just financial, but probably encompassed psychological elements, such as difficulty in coming to terms with³⁵ and understanding implications of their diagnosis.³⁶ There was also much difficulty in getting hypertensives in this low SES population to change health behaviours. Hypertension is just one part of the picture of managing cardiovascular risk. It appears that in this low SES community, a new diagnosis of hypertension did not serve as an impetus towards overall better management of cardiovascular disease risk. Newly diagnosed hypertensives in these communities thus need assistance in not just managing their hypertension, but also their other cardiovascular risk factors as well.

Study Limitations

The limitations of our study are as follows. There could have been selection bias due to loss-to-follow-up. Those who were likely to have better management of chronic disease (such as those were currently married and those with higher household income) were more likely to remain in the study, which might have resulted in better hypertension management post-intervention. However, it should be noted that the population that remained on follow-up was still a relatively deprived one, with indicators of individual SES (e.g. household income, employment status, financial aid status) well below national norms. The follow-up period was relatively short; thus we were unable to study other aspects, such as morbidity and mortality in the long-term. In addition, we could not quantify the impact of the intervention on improving hypertension management in these low SES communities, given the lack of a control group. However, our aim was not to evaluate the success of such an intervention, but rather to identify groups within these vulnerable communities that may not have been fully served by the intervention. We were also unable to determine the relative contributions of each aspect of the intervention to improvements in hypertension management. Lastly, this study was only limited to 2 geographical sites; extending it to a representative sample of the Singaporean rental flat population was challenging, given that rental flats are scattered across the entire country in socially integrated precincts,²³ posing logistical difficulties.

Conclusion

In this prospective study of hypertension management in low SES communities within an urbanised Asian society, minorities and those of lower SES were more likely to have poorer management of hypertension. While an intensive, access-enhanced outreach intervention did have some success in improving hypertension management, it was less successful in encouraging better cardiovascular risk management amongst newly diagnosed hypertensives. Newly diagnosed hypertensives should be closely followed-up and encouraged to go for screening of their full cardiovascular risk profile. There is further scope for improving the management of hypertension in lower income and lower socioeconomic strata in urbanised societies, particularly in Asia.

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