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Cross-sectional Study of Hypertension in a Neighborhood in Singapore

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Abstract

Introduction: Hypertension is a major risk factor for coronary artery disease, stroke and renal failure. This study aims to estimate the prevalence of hypertension, its awareness, treatment and blood pressure (BP) control in Singapore.

Methods: We performed a cross-sectional, community-based study in Toa Payoh on a random sample of 409 participants aged 40 years and above. We performed three BP measurements; mean of the last two was considered the BP value and calculated prevalence, odds ratios (OR) and 95 percent confidence intervals (CI) where appropriate.

Results: The age-standardized prevalence of hypertension was 53.8 percent (men: 58.0 percent, women: 50.8 percent). Among hypertensive, 72.7 percent were aware of their disease, 62.3 percent were treated and 27.3 percent were previously undiagnosed. Factors positively associated with undiagnosed hypertension: being unmarried/without spouse (OR [95 percent CI]: 2.29 [1.25-4.21]), current smoking (OR [95 percent CI]: 3.56 [1.66-7.63]), employed full-time (OR [95 percent CI]: 2.72 [1.46-5.06]). Factors negatively associated: presence of diabetes (OR [95%CI]: 0.16 [0.05-0.53]), or coronary artery disease (OR [95 percent CI]: 0.09 [0.01-0.69]). Among treated hypertensive, 49.6 percent had poor BP control. Factors associated with poor control: primary school education (OR [95 percent CI]: 3.60 [1.71-7.54]), unemployed/homemaker (OR [95 percent CI]: 2.37 [1.01-5.53]), no physical activity (OR [95 percent CI]: 2.12 [1.06-4.23]) and no recent GP visits (OR [95 percent CI]: 2.51 [1.27-5.01]).

Conclusion: Approximately half of adults aged 40 years and above in Toa Payoh have hypertension. More than one-quarter was previously undiagnosed. Among those on treatment, approximately half had BP's higher than currently recommended levels.

Keywords: Hypertension; Prevalence; Awareness; Treatment; Control; Cross-sectional study; Singapore

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Introduction

The World Health Organization Expert Committee considers hypertension affecting about 20% of the adult population in most countries [1]. The increase in burden of hypertension in economically developed countries is projected at 24% to a total of 413 million in 2025 [2]. Moving into the league of economically developed industrialized nations, Singapore also suffers the expected problems of an aging population and its burden of non-communicable diseases, especially cardiovascular diseases. The elderly aged 65 years and above comprise 8.0% of the population according to the 2004 National Health Survey with the prevalence [3] fluctuating within a margin of 4% in both genders since 1992 and averaging about 25% [4].

Besides gender, socioeconomic status has been found to be a risk factor for hypertension in many countries. In many post-transitional countries, a lower socioeconomic status is associated

with increased prevalence of hypertension [1,5]. Factors involving lifestyle modification have been associated with a reduction in blood pressure (BP) levels and are likely to affect hypertension control [6].

A nationwide Healthy Lifestyle Programme was launched in 1992 to modify the effects of poor lifestyle factors on the status of modifiable non-communicable diseases on Singaporeans and promote a healthy living. It is important to evaluate the current situation of hypertension to monitor the adequacy of current policy strategy and the cost-effectiveness of existing programs [1]. In this study, we aim to assess the prevalence, awareness, treatment, control and their risk factors in a localized but representative sample of Singapore's population.

Methods

Study population and sampling design

We performed a community-based, cross-sectional study in the suburban housing estate of Toa Payoh in central Singapore. The target study sample was 920 individuals who were randomly selected using a 2-stage sampling method. First, we identified a sampling frame of all 3,000 units in our selected study area. We then assigned the units random numbers and the first 920 units were selected. Second, for each selected household unit, out of all the eligible individuals, we randomly selected one individual to participate in our study.

Our sample population included Singapore citizens and Permanent Residents who were at least 40 years of age. We excluded vacant flats, individuals with physical or mental illness that impaired their ability to communicate or respond logically, as well as pregnant and bedridden individuals. In addition, we visited the households which were non-contactable at least twice on different days and time-periods so as to improve our chances of contacting them. Two hundred and eighteen (23.7%) were excluded from our study. The final number of participants in the study was 409 with an overall response rate of 58.1%.

Data collection

A standard questionnaire was administered by trained interviewers during the home visit. The interview included questions related to the diagnosis and treatment of hypertension: (1). "Have you ever been told by a doctor that you have high blood pressure?" and (2) "Are you currently taking prescription medication for your high blood pressure?" Information on demographic characteristics including age, gender, ethnicity, marital status, education level, occupation, housing type, and household income were collected. Participants were also asked about smoking, alcohol intake, exercise and their recent health status. A self-reported medical history was obtained relating to co-morbidities such as coronary artery disease, stroke, diabetes and hypercholesterolemia.

Blood pressure measurement and hypertension definition

We performed three blood pressure measurements during the interview, with 5 minute rest intervals as per the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC 7) guidelines [7]. Participants were restricted from alcoholic or caffeinated beverages and smoking for at least 30 minutes prior to measurements, as these may affect blood pressure readings. The mean of the last two measurements were used to define the systolic and diastolic BP level in the current study [8].

High BP was defined as a mean systolic blood pressure (SBP) more than or equal 140 mmHg or a mean diastolic blood pressure (DBP) more than or equal 90 mmHg. Participants were considered hypertensive if they had high BP from examinations, were previously diagnosed by a physician or were currently taking antihypertensive medications. Awareness among hypertensive was defined as a positive answer to the question "Have you ever been told by a doctor that you have high blood pressure?" Treatment of hypertension was defined as current use of antihypertensive medications. Among treated hypertensive, poor BP control was defined as having SBP more than or equal140 mmHg or DBP more than or equal 90 mmHg [7].

Data analysis

All statistical analyses were performed using SAS version 9.1 (SAS Institute, Cary, NC, USA). Means and SD were reported for continuous variables and proportions for categorical variables. In univariate analysis, we examined differences in proportions by chi square test and means by analysis of variance. Age, sex-standardized prevalence rates were calculated by the direct method using the year 2000 Singapore adult population aged more than or equal 40 years as the standard population. The association of undiagnosed hypertension and lack of BP control among treated hypertensive subjects with various factors was examined by calculating odds ratios (OR) and 95% confidence intervals (CI) using logistic regression models after adjusting for age and sex.

Results

Table 1 shows the age-standardized prevalence of hypertension by gender, ethnicity and age in our study population. Out of the 409 participants aged more than or equal to 40 years, 220 (53.8%) were found to be hypertensive. Males had a higher prevalence as compared to women (58.0% vs. 50.8%). Participants more than or equal to 65 years age were more likely to be hypertensive as compared to those below 65. ($p<0.001$).

Table 2 shows the prevalence of awareness, treatment and undiagnosed hypertension among participants with hypertension. 72.7% of hypertensive patients were aware of their disease, 62.3% were on treatment and 27.3% were previously undiagnosed. We found no statistical significance for difference in prevalence of the three domains in relation to gender and ethnicity. However, there was a statistical significance difference in the prevalence of awareness, treatment and undiagnosed hypertension between those more than or equal 65 years age compared to those below.

Table 3 shows different factors proposed to be associated with undiagnosed hypertension among participants with high BP. We found that factors positively associated with undiagnosed hypertension included: being unmarried/without spouse (OR [95%CI]: 2.29 [1.25-4.21]), full-time employment (OR [95%CI]:

2.72 [1.46-5.06]) and current smoking (OR [95% CI]: 3.56 [1.66-7.63]). Negatively associated factors included: presence of diabetes (OR [95%CI]: 0.16 [0.05-0.53]), presence of coronary artery disease (OR [95%CI]: 0.09 [0.01-0.69]), use of cholesterol/lipid lowering medication (OR [95% CI]: 0.03 [0.003-0.18]) and age more than or equal 65 years (OR [95% CI]: 0.50 [0.28-0.92]). Among the 137 treated hypertensive patients we found that 49.6% had poor BP control.

Table 4 shows possible factors associated with poor BP control among treated hypertensive. We found that such participants age more than or equal 65 years (OR [95% CI]: 1.51 [0.75-3.01]), education of below primary school level (OR [95% CI]: 3.60 [1.71-7.54]), unemployment/homemaker (OR [95% CI]: 2.37 [1.01-5.53]), absence of physical activity (OR [95% CI]: 2.12 [1.06-4.23]) and no recent GP visits (OR [95% CI]: 2.51 [1.27-5.01]) were more likely to have poorly controlled hypertension.

Table 1 Prevalence of hypertension among adults more than or equal40 years in Toa Payoh.

Variables	Age-standardized prevalence of hypertension, %	No. at risk (hypertension cases)	p-value*
Overall	0.538	409 (220)	
Gender			
Males	0.58	169 (98)	
Females	0.508	240 (122)	0.15
Race/ethnicity (p=0.91)*			
Non-Chinese	0.538	342 (184)	
Chinese	0.537	67 (36)	0.91
Age			
<65 years	0.404	250 (101)	
more than or equal 65 years	74.80%	159 (119)	<0.001

*p-value associated with Chi-Square test for difference between the given categories

Discussion

Prevalence

Our study showed that that prevalence of hypertension is high in Singapore (53.8%) and is similar to a previous study done among community-dwelling elderly (55.5%) [9]. It is also comparable to the National Health Survey 2004, which showed age-specific prevalence of hypertension to be between 21.6% to 56.1% among persons aged 40-69 years [3]. The prevalence of hypertension was also comparable to other countries for our selected age group [10,11].

Awareness

We found that 27.3% of participants were unaware of their hypertensive status. This is comparable to the 28.0% from a previous study done also in Toa Payoh [9] but lower than 38.5% from the NHS 2004. This increased awareness in Toa Payoh could be due to community-based health screening [12] and is comparable to other developed countries [10,13]. However, we did not observe any relationship between gender and undiagnosed hypertension. This is contrary to the other studies in Singapore [3,9] and elsewhere [13,14], which showed a greater prevalence of undiagnosed hypertension among males compared to females. The increased awareness among those aged 65 years old and above is also a consistent finding [14]. This could be due to increased likelihood of co-morbidities within the elderly requiring more frequent medical consultations and closer monitoring of chronic diseases. The higher prevalence of hypertension among the elderly would generally alert doctors to be more vigilant in screening for hypertension among the elderly.

We found marital status to be related to awareness of hypertension-participants without spouses had a greater prevalence of undiagnosed hypertension as compared to those with spouses. Other studies [13,14] support the finding that people who were married were more aware of their hypertension. Marital status could be a surrogate used to assess family infrastructure, which might actually form a bigger aspect of personal healthcare.

Table 2 Awareness, treatment and prevalence of undiagnosed hypertension among participants with hypertension.

Variables	Awareness of hypertension among participants with hypertension (n=220)	Treatment of hypertension among participants with hypertension (n=220)	Undiagnosed hypertension among participants with hypertension (n=220)
Overall	72.70%	62.30%	27.30%
Gender			
Males	72.50%	57.10%	27.50%
Females	73.00%	66.40%	27.00%
p-value*	0.93	15.00%	0.93
Race/ethnicity			
Non-Chinese	77.80%	61.10%	22.20%
Chinese	71.70%	62.50%	28.30%
p-value*	0.46	0.85	0.46
Age			
<65 years	65.40%	52.50%	34.70%
more than or equal65 years	78.90%	70.60%	21.00%
p-value*	0.02	0.006	0.02

*p-value associated with Chi-Square test for difference in awareness, treatment, or control between the given categories

Table 3 Selected factors associated with undiagnosed hypertension among participants with Hypertension.

Risk factors	Number with hypertension (no. of undiagnosed hypertensives)	OR (95% CI) of undiagnosed hypertension
Gender		
Female	122 (33)	1 (Referent)
Male	98 (27)	1.03 (0.57-1.86)
Age		
<65 years	101 (35)	1 (Referent)
more than or equal65 years	119 (25)	0.50 (0.28-0.92)
Marital status		
With spouse	117 (23)	1 (Referent)
Without spouse	103 (37)	2.29 (1.25-4.21)
Working status		
Unemployed/home maker	153 (32)	1 (Referent)
Employed	67 (28)	2.72 (1.46-5.06)
Current smoking		
Absent	187 (43)	1 (Referent)
Present	33 (17)	3.56 (1.66-7.63)
Diabetes		
Absent	177 (57)	1 (Referent)
Present	43 (3)	0.16 (0.05-0.53)

*OR (95% CI): odds ratio (95% confidence interval) calculated from logistic regression model adjusted for age and sex

Table 4 Selected factors associated with lack of blood pressure (BP) control among treated hypertensive subjects.

Risk factors	Number with lack of BP control (no. of treated hypertensives)	Poor BP control among treated hypertensives*OR (95% CI)
Gender		
Women	81 (42)	1 (Referent)
Men	56 (26)	0.81 (0.41-1.59)
Age		
<65 years	53 (23)	1 (Referent)
more than or equal65 years	84 (45)	1.51 (0.75-3.01)
Education Primary		
Primary school and above	88 (34)	1 (Referent)
Below primary school	49 (34)	3.60 (1.71-7.54)
Working status		
Employed	30 (10)	1 (Referent)
Unemployed/ home maker	107 (58)	2.37 (1.01-5.53)
Physical activity/ exercise		
Yes	79 (33)	1 (Referent)
No	58 (35)	2.12 (1.06-4.23)
Visited GP in last 6 months		
Yes	66 (25)	1 (Referent)
No	71 (43)	2.51 (1.27-5.01)

*OR (95% CI): odds ratio (95% confidence interval) calculated from logistic regression model adjusted for age and sex

Employed participants appeared to have greater undiagnosed hypertension compared to those unemployed or homemakers. This is surprising as it contradicts the expected relationship between those with financial means (employment) and disease awareness. A possible reason could be those who are employed might consider themselves as healthy and have less regular medical checkups. Another possibility could be that they might not have time due to their work for checkups. Despite the greater awareness among subjects who were unemployed or who were homemakers, we found the control of hypertension among these participants being

Poorer [5]. There was increased prevalence of undiagnosed hypertension among current smokers as compared to those not currently smoking [14]. We postulate that smokers were likely to be less health conscious and more reluctant to seek medical care, leaving a greater likelihood for their hypertension to remain undiagnosed.

There were better hypertension awareness and treatment among those who have diabetes, coronary artery disease or those currently on cholesterol-lowering medications. This was found in previous studies [15] and may reflect the fact that these patients may be followed up regularly for their chronic conditions, which would include monitoring and treatment for hypertension.

Treatment and control of hypertension

The treatment of hypertension among those who were aware was high (85.7%). This may be due to the emphasis on aggressive treatment of hypertension within our local clinical practice guidelines [16] especially in older persons, with the use of combination therapy if necessary to maintain a BP<140/90 mmHg. Our study shows that 49.6% of hypertensive currently on treatment suffer poor control of their BP and is similar to NHS 2004 [3].This is also comparable to a recent study conducted in the Netherlands under the Utrecht Health Project, which included a younger age group [17]. This proportion is much better than studies conducted in both China and Turkey [18,19]. The proportion of treated hypertensive with good BP control in our study was also comparable to that found in randomized controlled trials on the use of antihypertensive medications [20].

We found that participants in the older age group was more likely to have uncontrolled hypertension. This may be explained by the concomitant presence of various other co-morbidities in our elderly, leading to increased medical care. Another possibility is that it may be a reflection of the difficulty in prescribing an effective combination of medication to the elderly [21]. Education level and working status suggest a socioeconomic basis for poor control of hypertension possibly in relation to affordability of continuous treatment and compliance [5]. Despite the various healthcare schemes in place to provide subsidized healthcare for the less affluent, socioeconomic status appeared to affect compliance with antihypertensive medications.

Physical activity has been shown to reduce BP independently in many randomized control trials [22,23]. We found that subjects who exercise regularly have better BP control than those who do not. Low physical activity and exercise may be linked to poor lifestyle practices and show an increased odds of poor BP control among treated hypertensive in several studies [24]. These studies suggested that concomitant adherence to lifestyle modification practices with antihypertensive medication increased the proportion of treated hypertensive with good BP control.

Persons on treatment for hypertension who visited a General Practitioner (GP) in the previous 6 months appeared to have better BP control. It was likely that their BP would be checked by these GP visits and followed-up accordingly. Having GP visits would also facilitate any adjustments to dosages and types of antihypertensive medications in improving their BP status [21], underlying the importance of long term follow-up for optimal BP control.

The proportion of participants having good BP control is in agreement with the 'rule of halves' [25] Among hypertensive treated with antihypertensive medication, half would have their BP under control. However, the level of awareness and treatment in our study were better than that construed by the 'rule of halves'. The factors associated with poor BP control in treated hypertensive were consistent with those found in other cross-sectional studies and those with well-controlled BP among those on treatment is relatively high compared to the findings in other studies [26].

Conclusion

Hypertension is a major health problem in Singapore, with awareness, treatment and control of hypertension in Singapore comparable to other countries. Our study shows that various socio-demographic and lifestyle factors have an influence on both awareness and control. While a causal relationship cannot be established, more can be done to alleviate the effects of these risk factors to achieve better hypertension control.

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