

## Health Screening Behaviour among Singaporeans

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### Abstract

**Introduction:** This study assessed the health screening behaviour of Singaporeans and evaluated factors associated with low uptake of screening tests. **Materials and Methods:** Data from the 2010 National Health Survey, which was conducted on Singapore citizens and permanent residents, was used in this analysis. Multivariate Cox regression was used to evaluate the relationship between sociodemographics and health screening behaviour for selected chronic diseases (hypertension, diabetes and hypercholesterolaemia) and cancers (cervical, breast and colorectal). National recommendations for age at which screening should be initiated and appropriate screening interval were used to define appropriate screening behaviour. **Results:** More respondents have had their last chronic disease screening done within the recommended time period compared to cancer screening. A total of 77.8%, 63.4% and 54.9% of the respondents had their last hypertension, diabetes and hypercholesterolaemia done within the recommended time period respectively, while less than 50% of the respondents had their cervical (45.8%), breast (32.9%) and colorectal (20.2%) cancer screenings done within the recommended time period. Respondents with higher household income or more years of education were more likely to have undergone screening within the recommended time period. Indians, who are at higher risk of chronic diseases such as diabetes and hypercholesterolaemia, were also more likely to have been screened. A total of 69.9% and 79.5% of the respondents with previously undiagnosed diabetes and hypertension had reported to have done diabetes and hypertension screenings respectively, within the recommended time period. **Conclusion:** Sociodemographic factors that could be associated with a lower uptake of screening tests include: 1) low household income, 2) low education level, and 3) Malay ethnicity. Health promotion programmes and outreach to these groups can be enhanced to further improve screening uptake.

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**Key words:** Diabetes screening, Hypercholesterolaemia screening, Hypertension screening

### Introduction

Early detection of diseases through health screening, followed by assessment of abnormal screen results and management of chronic conditions, is a key strategy in non-communicable disease control.<sup>1</sup> When used appropriately, this strategy can prevent the development of complications early and significantly increase survival rates, and is critical in limiting escalations in healthcare costs.<sup>2</sup>

Rapidly urbanising Asian countries are experiencing a rising chronic disease burden. Singapore is no exception and this has led to a national government-led emphasis on health promotion and disease prevention initiatives. In the past

decade, the Health Promotion Board (HPB) has implemented several nationwide health screening programmes to screen for chronic diseases (hypertension, hypercholesterolaemia and diabetes mellitus), selected cancers (breast, cervical and colorectal), as well as age-related functional decline. In 2010, a Screening Test Review Committee (STRC) was set up by the Academy of Medicine, Singapore (AMS) to review the screening framework for population health screening, in order to ensure that screening implemented at the national level are clinically effective, cost-effective and tailored to appropriate risk groups and screening intervals.<sup>3</sup> These recommendations were thereafter incorporated into the

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guidelines of national screening programmes and Ministry of Health (MOH) clinical practice guidelines.

While existing screening programmes have been successful in raising public awareness in screening, the participation rates for health screening have varied over time, and cancer screening uptake in particular is low. The last National Health Survey (NHS) conducted in 2010 showed that 39.6% (36.4% in 2004 NHS) of women aged 50 to 69 years had mammography within the last 2 years, and 47.9% (52% in 2004 NHS) of women aged 25 to 69 years had pap smears at least once in the past 3 years.<sup>4,5</sup> Participation in health screening programmes is largely influenced by sociodemography, personal attitudes and beliefs, and varies across population segments.<sup>1</sup> Studies have shown that individuals of lower socioeconomic status are less likely to engage in preventive health behaviours, are associated with higher prevalence of chronic diseases, and have higher levels of risk factors.<sup>6-8</sup>

This paper aims to understand the health screening behaviour amongst Singaporeans. We seek to identify population segments with low uptake of recommended screening, and factors associated with low uptake. Understanding the health screening behaviour of Singaporeans will help local health authorities to better plan screening programmes in order to target under-screened population segments.

## Materials and Methods

Data used in this analysis was derived from the NHS 2010 conducted between 17 March 2010 and 13 June 2010. The NHS is a regular 6-yearly nationally representative population-based health survey of Singapore citizens and permanent residents. Its design and rationale have been published in detail elsewhere.<sup>5</sup> The sample selection was divided into 2 phases. A total of 47,500 household addresses were first randomly selected from the National Database on Dwelling (NDD) maintained by the Singapore Department of Statistics (DOS) based on a 2-stage stratified design. The primary selection units (PSUs) were based on geographical zones and the secondary selection units (SSUs) on residential dwelling units. After incorporating ethnicity information, 17,000 addresses were randomly selected for enumeration. All household members aged 18 to 79 years of age were enumerated from contactable households, and this then formed the sampling frame of eligible participants. Disproportionate stratified sampling (stratified by age, gender and ethnicity) was used to select 7695 participants, of whom 183 were subsequently found to be ineligible. An eventual sample of 4337 individuals was obtained, giving a response rate of 57.7%.

Upon enrolment, a standardised questionnaire on

lifestyle practices, demography, health conditions, knowledge, practices, and attitudes towards preventive health programmes and risk factors was administered to all participants by trained interviewers. Following this, participants underwent a health screening examination that included blood pressure measurement, an oral glucose tolerance test (except for diabetics on medication), glycated haemoglobin HbA1c levels, fasting lipids, urine protein measurement, assessment on hearing loss and anthropometric measurements.

For diabetic and hypercholesterolaemia examinations, participants had their blood taken by venipuncture after an overnight fast of at least 10 hours. For non-diabetic subjects and diabetic subjects who were not on medication, a glucose load of 75 g in a 296 mL drink was given before a second blood sample was taken after 2 hours. All blood specimens collected for the survey were sent daily to the Biochemistry Laboratory at the Singapore General Hospital (SGH) for analysis. For blood pressure measurements, participants were rested adequately before their readings were taken by trained survey fieldworkers using standard mercury sphygmomanometer. Informed consent was obtained from all eligible participants before the study was administered. The methodology, protocol and procedures were approved by the HPB Medical Dental Board Ethics Committee.

## Health Screening Practices

Screening behaviours for 6 health conditions were assessed: diabetes, hypertension, hypercholesterolaemia, breast cancer, cervical cancer and colorectal cancer. Answers to the screening questions were only analysed for individuals within age groups that are clinically recommended for the respective screenings. For each selected chronic diseases and cancers, individuals were asked when and where they had last been screened, reasons for their last screen or for not participating in health screening for that condition. The recommended screening guidelines for chronic diseases and selected cancers were defined in accordance to the recommendations of the STRC<sup>3</sup> as follows: diabetes mellitus – fasting glucose for individuals aged  $\geq 40$  years every 3 years; hypercholesterolaemia – fasting lipids for individuals aged  $\geq 40$  years every 3 years; hypertension – blood pressure for individuals aged  $\geq 18$  years at least once every 2 years; cervical cancer – Pap smear for sexually active females aged 25 to 69 years at least once every 3 years; breast cancer – mammography for females aged 50 to 69 years every 2 years; colorectal cancer – faecal occult blood test (FOBT) annually or sigmoidoscopy/colonoscopy once every 10 years for individuals aged  $\geq 50$  years. In the analyses for chronic disease screening, persons who had already been diagnosed with that chronic disease were excluded.

### Statistical Analysis

Statistical analyses were carried out using STATA version 11.0. Weighted Cox proportional hazard regression model was used to estimate the prevalence rate ratios (PRR) and 95% confidence intervals (CI) of sociodemographic factors associated with regular health screening behaviours for chronic diseases (hypertension, diabetes and hypercholesterolaemia) and selected cancers (cervical, breast and colorectal). Follow-up was used as the underlying time variable and all multivariate analyses were adjusted for age, gender, education and monthly household income. Statistical significance was determined at  $P < 0.05$ . Sample weights were calculated at the household enumeration exercise and for survey fieldwork. To adjust for undersampling of Chinese and oversampling of other races and differential response levels, poststratification weights were also computed based on age, gender, ethnic groups, and dwelling type attributes to yield a survey sample similar to the Census 2010 Singapore resident population.

### Results

More than 70% of eligible respondents had ever been screened for hypertension (3319 or 94.3%), diabetics (1669 or 79.3%) and hypercholesterolaemia (1129 or 71.1%) at least once in their lifetime (Table 1). Of those aged 18 years and above, 77.8% had their last blood pressure measured at least once within the recommended frequency of 2 years. The proportion of respondents aged 40 years and above who had their last screen for diabetes and hypercholesterolaemia in the past 3 years as recommended were 63.4% and 54.9%, respectively.

In comparison to chronic disease screening, the overall participation for cancer screening within the recommended time period was lower. A total of 70.6% and 66.0% of eligible female respondents had undergone Pap smear test and mammography at least once in their lifetime respectively, while only 36.3% of eligible respondents had undergone FOBT or sigmoidoscopy/colonoscopy at least once in their lifetime. Less than half of the women (45.8%) aged 25 to 69 years did their last Pap smear within the past 3 years, and only 3 out of 10 women (32.9%) aged 50 to 69 years had undergone mammography within the past 2 years. Of all respondents (males included) aged 50 to 79 years, only 20.2% were reported to have done FOBT within the past 1 year or sigmoidoscopy/colonoscopy within the past 10 years for colorectal screening.

### Sociodemographic Characteristics Associated with Chronic Disease Screenings

In adjusted analyses, older age groups, Indians, higher educational levels and higher household income (only for hypertension screening) were positively associated with last screening done within the recommended time period for chronic diseases (Table 2). Individuals 60 years and older were more likely to have had their last chronic disease screening done within the recommended guidelines than younger persons (for hypertension, PRR: 1.25, 95% CI, 1.11 to 1.41; for diabetes, PRR: 1.38, 95% CI, 1.20 to 1.58; for hypercholesterolaemia, PRR: 1.24, 95% CI, 1.00 to 1.54). Indians were significantly more likely to have undergone screening for all 3 conditions compared to the Chinese (for hypertension, PRR: 1.08, 95% CI, 1.02

Table 1. Participation in Chronic Disease and Cancer Screenings

	Number of Respondents Eligible for Screening as Recommended*	Those who Had Screened as Recommended		Those who Had Ever Been Screened		Reported to Have Never Been Screened	
	Total	n (%)†		n (%)†		n (%)†	
Blood pressure	3568	2792	(77.8%)	3319	(94.3%)	249	(5.7%)
Fasting blood glucose	2149	1340	(63.4%)	1669	(79.3%)	480	(20.7%)
Fasting blood lipids	1658	905	(54.9%)	1129	(71.1%)	529	(28.9%)
Pap smear	1993	872	(45.8%)	1379	(70.6%)	590	(28.6%)
Mammography	748	204	(32.9%)	449	(66.0%)	293	(33.7%)
Faecal occult blood test/colonoscopy/sigmoidoscopy	1464	228	(20.2%)	413	(36.3%)	1020	(61.9%)

\*Based on recommended screening guidelines for chronic diseases and selected cancers as defined by STRC recommendation for health screening: hypertension – blood pressure for individuals aged  $\geq 18$  years at least once every 2 years; diabetes mellitus – fasting glucose for individuals aged  $\geq 40$  years every 3 years; hypercholesterolaemia – fasting lipids for individuals aged  $\geq 40$  years every 3 years; cervical cancer – Pap smear for sexually active females aged 25 to 69 years at least once every 3 years; breast cancer – mammography for females aged 50 to 69 years every 2 years; colorectal cancer – faecal occult blood test (FOBT) done annually or sigmoidoscopy/colonoscopy once every 10 years for individuals aged  $\geq 50$  years. Includes eligible individuals who have responded “don’t know” or “refused to answer” for the screening questions.

†Weighted percentages.

Table 2. Prevalence Rate Ratio (PRR) Estimates for Sociodemographic Characteristics Associated with Chronic Disease Screening Done as Recommended

Sociodemographic Characteristics	Last Blood Pressure Checked as Recommended*		Last Fasting Blood Glucose Checked as Recommended*		Last Fasting Blood Lipids Checked as Recommended*	
	PRR	95% CI	P for Trend	PRR	95% CI	P for Trend
Age (years)						
18–39	Ref	-	-			
40–49	1.06	(0.98–1.14)	Ref		Ref	
50–59	1.16	(1.08–1.26)	1.14	1.05	(0.89–1.24)	
60 and above	1.25	(1.11–1.41)	1.38	1.24	(1.00–1.54)	
Gender						
Male	Ref		Ref		Ref	
Female	1.02	(0.97–1.08)	1.01	1.02	(0.88–1.17)	
Ethnicity						
Chinese	Ref		Ref		Ref	
Malay	1.06	(0.99–1.13)	0.91	0.93	(0.81–1.08)	
Indian	1.08	(1.02–1.13)	1.18	1.16	(1.02–1.31)	
Others	0.99	(0.90–1.08)	1.02	0.91	(0.71–1.17)	
Education			0.001			0.011
PSLE and below	Ref		Ref		Ref	
Secondary	1.01	(0.88–1.16)	1.02	1.03	(0.81–1.32)	
O/N <sup>1</sup> level/NTC 3 certificate or equivalent	1.08	(0.96–1.22)	1.09	1.15	(0.91–1.46)	
A <sup>1</sup> level/NTC 1-2/ Certificate in Office/ Business Skills or its equivalent	1.12	(0.98–1.29)	1.17	1.19	(0.86–1.64)	
Polytechnic/other diplomas and professional qualification	1.17	(1.03–1.34)	1.24	1.24	(0.92–1.68)	
University and above	1.20	(1.06–1.37)	1.23	1.42	(1.08–1.86)	
Household income			0.001			0.350
Below \$2000 per month	Ref		Ref		Ref	
\$2000 – \$3999 per month	1.10	(0.99–1.21)	1.01	1.02	(0.83–1.25)	
\$4000 – \$5999 per month	1.09	(0.98–1.22)	1.05	1.08	(0.85–1.37)	
\$6000 – \$9999 per month	1.10	(0.98–1.24)	1.14	0.99	(0.75–1.31)	
\$10,000 and above	1.25	(1.12–1.39)	1.17	1.19	(0.91–1.56)	

PRR: Prevalence rate ratio

Analyses were adjusted for age, gender, ethnicity, education and monthly household income.

\*Based on recommended screening guidelines for chronic diseases as defined by STRC recommendation for health screening: diabetes mellitus – fasting glucose for individuals aged ≥40 years every 3 years; hypercholesterolaemia – fasting lipids for individuals aged ≥40 years every 3 years; hypertension – blood pressure for individuals aged ≥18 years at least once every 2 years.

to 1.13; for diabetes, PRR: 1.18, 95% CI, 1.08 to 1.29; for hypercholesterolaemia, PRR: 1.16, 95% CI, 1.02 to 1.31). Significant dose-response relationships were observed between higher educational levels and screening done within recommended time period for hypertension, diabetes and hypercholesterolaemia, with individuals with university education and above having a 20%, 23% and 42% increased uptake in screening respectively, compared to those with PSLE and lower education level. However, a dose-response relationship was not as apparent in household income levels.

#### *Sociodemographic Characteristics Associated with Cancer Screenings*

For female cancer screening, younger women and those with higher monthly household income were positively associated with mammography and cervical cancer screening done within recommended guidelines (Table 3). Compared to those between 25 to 39 years old and 50 to 59 years old, those aged 60 and above were less likely to have had Pap smear and mammography done within the recommended time period (for cervical cancer, PRR: 0.44, 95% CI, 0.29 to 0.68; for mammography, PRR: 0.64, 95% CI, 0.43 to 0.95). Household income was positively associated with FOBT/colonoscopy and sigmoidoscopy (*P* for trend: 0.001) done within the recommended time period. Respondents of Malay ethnicity were less likely to have had cancer screening done within the recommended time period, compared to Chinese (for Pap smear, PRR: 0.87, 95% CI, 0.77 to 0.99; for mammography, PRR: 0.88, 95% CI, 0.63 to 1.22; for FOBT/colonoscopy/sigmoidoscopy, PRR 0.33, 95% CI, 0.21 to 0.52).

The most commonly cited reason for not participating in screening for chronic diseases and female cancers for respondents who were of the recommended screening age group was “Not necessary as I am healthy” (25.8% to 49.9%), while another commonly cited reason for non-participation in chronic diseases was “Not suggested by doctors” (22.1% for hypercholesterolaemia to 40.7% for hypertension). For female cancers, the other commonly cited reasons for Pap smear were “Never heard about Pap smear test” (13.3%) and “Painful test” (10.5%) and “No time due to work commitment” (9.4%) for mammography. Only less than 5% have reported that cost was a factor which influenced their decisions to not go for chronic diseases and cancer screenings (data not shown in tables).

#### *Health Screening Practices among Respondents with At Least 1 Previously Diagnosed Chronic Disease*

Respondents with at least 1 known chronic condition (hypertension, diabetes mellitus or hypercholesterolaemia) prior to the survey were more likely to have been screened

for other chronic diseases within the recommended time period compared to healthy respondents without any of the 3 chronic conditions (Table 4). More than 80% of diabetic and hypercholesterolaemia respondents had been screened for the other chronic diseases within the recommended time period. Amongst respondents without known chronic diseases, a higher proportion of them had been screened for hypertension (75.5%) within the recommended time period compared to diabetes (36.7%) and hypercholesterolaemia (34.8%).

#### *Health Screening Practices among Respondents who Had Previously Undiagnosed Chronic Disease Conditions Prior to Survey*

A total of 1171 respondents were found to have hypertension (241), diabetes (281) or hypercholesterolaemia (649) and were previously undiagnosed prior to the survey (data not shown in table). Among these respondents with undiagnosed chronic conditions, a large proportion of undiagnosed diabetics (69.9%) and undiagnosed hypertensives (79.5%) had been screened within the recommended time period for the respective conditions. A total of 40.5% and 74.6% of undiagnosed diabetics and hypertensives respectively, had been screened less than a year ago, while almost half of undiagnosed hypercholesterolemia participants (47.1%) had been screened for high cholesterol within the recommended time period.

#### **Discussion**

More than 66% of eligible respondents have been screened for chronic diseases and cancers, except for colorectal cancer, at least once in their lives. We found that a significant proportion (>50%) of respondents had their last screen for chronic diseases within recommended intervals, compared to breast, cervical and colorectal cancers (the highest was 45.8% for cervical cancer). Colorectal cancer screening uptake in particular was very poor. This study also highlights several demographic factors associated with low screening uptake for selected chronic diseases and cancers within recommended time periods: respondents who were Malay, or from households with lower income, or had lower educational levels were more likely not to go for screening within the recommended time period, and were also more likely to have never undergone any screening in their lives. Indians, who are at higher risk of chronic diseases such as diabetes and hypercholesterolaemia, are more likely to have been screened.

Our findings are consistent with local health utilisation studies by Wee et al<sup>9</sup> and Ng et al,<sup>10</sup> which highlighted poor screening utilisation within the lower income settings, and sociodemographics as an indicator for diabetic screening

Table 3. Prevalence Rate Ratio (PRR) Estimates for Sociodemographic Factors Associated with Cancer Screening Done as Recommended

Sociodemographic Characteristics	Last Pap Smear Done as Recommended*			Last Mammography Done as Recommended*			Last FOBT/Colonoscopy/Sigmoidoscopy Done as Recommended*		
	PRR	95% CI	P for Trend	PRR	95% CI	P for Trend	PRR	95% CI	P for Trend
Age (Years)									
25–39	Ref			-			-		
40–49	0.83	(0.72–0.96)		-			-		
50–59	0.70	(0.57–0.86)		Ref			Ref		
60 and above	0.44	(0.29–0.68)		0.64	(0.43–0.95)		1.38	(0.93–2.04)	
Gender									
Male	-			-			Ref		
Female	-			-			0.89	(0.63–1.27)	
Ethnicity									
Chinese	Ref			Ref			Ref		
Malay	0.87	(0.77–0.99)		0.88	(0.63–1.22)		0.33	(0.21–0.52)	
Indian	1.03	(0.94–1.14)		1.05	(0.80–1.38)		0.80	(0.57–1.13)	
Others	1.03	(0.89–1.19)		1.36	(0.78–2.36)		0.72	(0.35–1.46)	
Education			0.521			0.167			0.422
PSLE and below	Ref			Ref			Ref		
Secondary	0.93	(0.70–1.24)		0.98	(0.59–1.64)		1.67	(0.98–2.85)	
O/N <sup>1</sup> level/NTC 3 certificate or equivalent	1.10	(0.86–1.40)		1.38	(0.89–2.13)		1.44	(0.86–2.43)	
A <sup>1</sup> level or NTC 1-2 or Certificate in Office/Business Skills or its equivalent	0.98	(0.72–1.33)		0.84	(0.37–1.90)		1.90	(0.92–3.90)	
Polytechnic/other diplomas & professional qualification	0.97	(0.72–1.30)		1.37	(0.84–2.24)		1.66	(0.76–3.62)	
University & above	0.93	(0.70–1.25)		1.30	(0.78–2.18)		1.49	(0.72–3.11)	
Household income			0.073			0.235			0.001
Below \$2000 per month	Ref			Ref			Ref		
\$2000–\$3999 per month	1.02	(0.84–1.23)		0.99	(0.64–1.53)		2.35	(1.42–3.88)	
\$4000–\$5999 per month	1.08	(0.87–1.33)		1.46	(0.97–2.19)		2.21	(1.19–4.08)	
\$6000–\$9999 per month	1.07	(0.85–1.35)		1.21	(0.71–2.04)		4.00	(2.28–6.99)	
\$10,000 and above	1.24	(0.99–1.55)		1.30	(0.81–2.07)		2.48	(1.19–5.18)	

FOBT: Faecal occult blood test; PRR: Prevalence rate ratio

Analyses were adjusted for age, gender (for colorectal cancer), ethnicity, education and monthly household income.

\*Based on recommended screening guidelines for selected cancers as defined by STRC recommendation: cervical cancer – Pap smear for sexually active females aged 25 to 69 years at least once every 3 years; breast cancer – mammography for females aged 50 to 69 years every 2 years; colorectal cancer – faecal occult blood test (FOBT) done annually or sigmoidoscopy/colonoscopy once every 10 years for individuals aged ≥50 years.

Table 4. Screening Behaviour of Respondents without or At Least 1 Diagnosed Chronic Condition

	Previously Diagnosed Hypertensive n = 761	Previously Diagnosed Diabetic n = 427	Previously Diagnosed Hypercholesterolaemia n = 1006	No Previous Diagnosis of the 3 Conditions n = 2977
	%	%	%	%
Have last blood pressure checked as recommended*		98.2	89.1	75.5
Have last fasting blood glucose checked as recommended*	72.9		76.2	36.7
Have last fasting blood lipids checked as recommended*	59.6	83.9		34.8

\*Based on recommended screening guidelines for chronic diseases as defined by STRC recommendation for health screening: diabetes mellitus – fasting glucose for individuals aged  $\geq 40$  years every 3 years; hypercholesterolaemia – fasting lipids for individuals aged  $\geq 40$  years every 3 years; hypertension – blood pressure for individuals aged  $\geq 18$  years at least once every 2 years.

uptake, as well as with international studies, which have also reported low uptake of screening amongst ethnic minorities and lower socioeconomic groups.<sup>11-13</sup> Low screening uptake has been attributed to common barriers such as out-of-pocket payments, and cultural and personal beliefs (e.g. underestimation of individual risks to cancers).

While it is worthwhile to consider making screening free to encourage greater uptake within the lower income community,<sup>14-16</sup> poor regular screening attendance amongst lower income strata may not necessarily be due to screening cost. Other factors influencing the decision not to screen may include fear of having to deal with greater healthcare costs should abnormal results arise, especially for cancer screenings, and having a fatalistic attitude towards personal health. We found that the main reasons cited by respondents who had never undergone screening were “No advice by doctors” and “Not necessary as I am healthy” rather than cost of screening, providing indirect support that poor screening attendance may not be due to the cost of screening alone. More targeted health education campaigns and awareness of financial assistance available in the event that treatment is necessary may alleviate the undue fear. It should be remembered that health screenings may also not be the primary priority of members of lower income strata, and time, convenience and anxiety may present physical barriers for screenings.<sup>17,18</sup> Further studies using qualitative interviews should be considered to provide insights into specific reasons behind non-participation amongst at-risk groups.

Efforts have been made to reduce financial barriers to screening and make screening affordable and accessible in Singapore. A nationwide screening programme, the Integrated Screening Programme (ISP), was introduced in 2008 to encourage Singapore residents aged 40 to 69 years to undergo screening for chronic diseases, colorectal and cervical cancers at ISP-registered general practitioner (GP)

clinics. Under the ISP framework, eligible lower income individuals will only need to pay for the consultation fees. To further improve screening outreach to lower income groups, subsidies are extended to the Community Health Assist Scheme (CHAS) to cover screening-related costs, with valid CHAS cardholders receiving subsidies of up to \$18.50 twice a year to offset consultation fees related to screening.<sup>19</sup> For cancer screening, individuals within the recommended age group for mammograms and colonoscopies can use their own or immediate family member’s Medisave to offset screening cost and minimise cash payment. Subsidies for mammography are also available through the BreastScreen Singapore programme. To enhance accessibility, HPB also collaborates with companies and community groups to bring screening to residents in the community or at their workplace. For instance, initiatives such as Health Screening on Wheels was launched to make screening more convenient for employees at workplaces, by the deployment of mobile screening buses.<sup>20</sup> In 2011, HPB also launched a one-stop screening programme together with a GP network programme at Whampoa Community, which aimed not only to make screening convenient, but to ensure patients with abnormal results receive follow-up treatment and care after screening.<sup>21</sup> More recently, HPB and Breast Cancer Foundation (BCF) have launched a BCF Encouragement for Active Mammograms (BEAM 15) programme in 2013, which provides free mammograms to eligible women above 50 years old from lower income groups.

HPB has also adopted multipronged communication and social marketing strategies for screening campaigns to increase awareness. Integrated marketing campaigns were used for national screening programmes such as BreastScreen Singapore. Approaches include media publicity through print media and infomercials, mailers to women, recruitment and educational activities at

community events and road shows, and engagement of health ambassadors to educate the public on the importance of screening.<sup>22</sup>

In this study, routine check-up was the main reason cited for screenings done within the recommended time period, which suggested the importance of workplace health initiatives and GPs. GPs play a role in influencing people's decision to screen and they can help encourage long-term follow-up patients to go for opportunistic screening. In addition, the presence of a structured and periodic screening schedule in workplace health initiatives and community could also play an important role in bringing more Singaporeans to participate in regular screenings.

To improve screening amongst at-risk groups (people in low socioeconomic strata and the Malay community) within Singapore, health promotion to increase screening uptake may need to be further customised by taking into consideration cultural perspectives and linguistic and socioeconomic diversities.<sup>23</sup> These efforts will need to move beyond health education, and consider economic incentives and the social and built environment, which the HPB has been doing in recent years; the ISP is an example of this broader perspective used in effecting behavioural change. Partnering trusted social institutions such as places of worship and support groups such as Majlis Ugama Islam Singapura (MUIS) may be useful to sustain community outreach and engagement in the Malay community. Similarly, social welfare organisations such as People's Association and the Community Development Councils may be useful when engaging people from lower socioeconomic strata.

It was also observed that individuals with at least 1 known chronic disease were more likely to have screened for other chronic diseases within the recommended time period, compared to healthy individuals. Possible reasons may be due to better health literacy and more concern about personal health amongst patients with pre-existing health conditions. It is more likely however, that this positive result reflects the efforts of primary care doctors (who see the majority of patients with these conditions), ordering appropriate screening tests for other at-risk health conditions for their patients.

For better clinical outcomes, screening has to be coupled with postscreening follow-up and optimal management. The survey found that 69.9% of undiagnosed diabetics were screened within the recommended time period and 41% of these respondents had reported to have done their last diabetic screening less than a year ago. This suggests that diabetes screening might have failed to identify persons with diabetes. There are several possible reasons for this. Large intra-individual variation has been reported for glucose tests. Further, some healthcare providers may have used random glucose testing and capillary testing rather than

the recommended fasting venous glucose tests; random glucose and capillary tests are less accurate<sup>24, 25</sup> and not recommended in the current Clinical Practice Guidelines for diabetes screening.<sup>26</sup> Finally, it is also possible that there may have been a lack of follow-up of patients who had undergone screening and were tested positive. This is especially so for participants of community screening and workplace screening. GP education on appropriate screening tests for diabetes should continue to be provided. To further tighten postscreening follow-up, screening providers in community and workplace health screening events should follow-up closely with individuals who have abnormal results. This can be done by providing reminder phone calls to them 1 month after screening to nudge them to go for follow-ups with GPs, facilitate appointment booking and direct them to appropriate lifestyle interventions. In tandem, a structured referral pathway can be established for individuals with abnormal results to be referred to their GPs for further assessment and management. Screening providers should undertake screening with a call and recall system, by working with HPB and GPs to manage and monitor screening efforts islandwide, under a centralised national screening repository. Not only will this ensure that individuals with abnormal results are better tracked and monitored, eligible individuals due for screening can also be timely reminded by recruitment materials (i.e. invitation letters and education materials) to go for screening.

In this study, individuals without previous diagnosis of chronic disease were twice as likely to be screened for hypertension than diabetes and hypercholesterolaemia. This may be due to the accessibility and convenience of measuring blood pressure whenever individuals go for a GP visit, compared to the testing of diabetes and hypercholesterolaemia, which involves fasting period and blood samples taken for subsequent analyses. This also reflects the need for increased awareness and understanding of hypercholesterolaemia and diabetes in the public and GPs, which is important to improve early detection.<sup>27</sup> GPs should also initiate screening for individuals eligible for screening requirements and where possible, first-degree relatives of patients with these conditions.

The strengths of this study include the use of a large representative sample population, with a reasonable response rate. Health examination and blood tests also allowed us to establish the "true" chronic disease status of participants. There are a few limitations in this study. The study did not establish if the tests undergone by participants were for screening, or if participants were symptomatic, and the tests were performed as part of the diagnostic workup. Further, the study did not establish if respondents were going for regular screening; instead, the time from their last screen done to the NHS interview was calculated as a proxy for screening

within the recommended time period. It is possible that participants who had been screened within the recommended time period were nonetheless not being screened regularly and appropriately. Hence, our estimates of screening prevalence might be an overestimate, and the true prevalence is lower. However, the proportion of respondents who reported that the test was being done as part of a diagnostic workup was low (cervical and breast cancer screenings: 5.1 to 5.7%), except for the case of colorectal cancer (37.5%) and hypertension (15%) screenings.

## Conclusion

While participation rate in regular screening for chronic diseases is high in the Singapore general population, screening for cancer (especially colorectal cancer) is still relatively low. Further, we identified several groups (low socioeconomic status in terms of household income and educational level, and people of Malay ethnicity) where screening within the recommended time period was comparatively low. Health promotion programmes and outreach to these groups should be enhanced. Current efforts to promote appropriate health screening behaviour should be maintained and enhanced. In this regard, GPs play a crucial role, and programmes to support GPs in this important endeavour should be enhanced.

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