Prevalence of cardiovascular risk factors among healthcare staff in a large healthcare institution in Singapore

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INTRODUCTION This study aimed to determine the prevalence of modifiable cardiovascular risk factors among health workers (HWs) and non-health workers (NHWs) in a large hospital in Singapore.

METHODS A cross-sectional prevalence survey of 3,384 hospital staff was conducted. The study comprised a self-administered questionnaire, body mass index, systolic and diastolic blood pressure measurements, and laboratory analysis of fasting blood samples of total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, triglycerides and plasma glucose. HWs were doctors and nurses, while NHWs were health administrators, facility staff, clerks and administrative personnel.

RESULTS A total of 3,384 out of 3,987 eligible staff (response rate 84.9%) participated in the survey . The majority of the participants were female (81%, n = 2,755), and 64% (n = 2,179) were 20–39 years old. HWs comprised almost two-thirds of the staff employed (61.3%, n = 2076), of whom 87.7% were female, while 72.5% of NHWs were female. Compared to HWs, NHWs had a higher adjusted (age, ethnic group and gender) prevalence of personal history of diabetes mellitus (adjusted prevalence rate ratio [PRR] 1.64, 95% confidence interval [CI] 1.02–2.64), cigarette smoking (adjusted PRR 1.85, 95% CI 1.48–2.32), obesity (adjusted PRR 1.36, 95% CI 1.05–1.75) and elevated systolic pressure (adjusted PRR 1.74, 95% CI 1.31–2.31).

CONCLUSION The prevalence of modifiable cardiovascular risk factors in NHWs is higher than that in HWs. Health promotion programmes should address this captive and neglected audience in healthcare organisations.

Keywords: cardiovascular disease, epidemiology, health personnel, mass screening, risk factors
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INTRODUCTION

In 2006, the World Health Organization (WHO) released its annual report on health entitled 'Working Together for Health'.[1] This report highlighted a number of global issues faced by health systems and health workers (HWs). HWs are persons who provide health services, and include doctors, nurses, therapists, pharmacists, auxiliary nurses and similar staff. Globally, there are about 59.22 million HWs, an estimated 39.47 million of whom are health service providers and 19.75 million are health management and support workers. HWs work long hours and are exposed to many occupational hazards, many of which are not readily appreciated, even by HWs themselves.

In 2004, the health services sector comprised 3,418 establishments and employed a total of 48,823 persons,[2] or about 2% of the labour force in Singapore. Although there were only 22 hospitals then, they employed about 50% of persons, the majority of whom worked in restructured hospitals. Doctors[3] comprised 13%, nurses 40%, pharmacists 2% and dentists 2% of persons employed in the healthcare sector. National Healthcare Group (NHG)[4] and Singapore Health Services (SingHealth)[5] were the providers of health services in the public sector and together employed about 50% of persons in this sector.

The 2004 update of the Global Burden of Disease[6] indicated that cardiovascular disease (CVD) was the leading cause of mortality worldwide, contributing to an estimated 17 million deaths in 2004, of which 21.9% were due to CVD (ischaemic heart disease [IHD] 12.2% and cerebrovascular disease 9.7%). It was projected that IHD and cerebrovascular disease would be among the top four leading causes of mortality by the year 2030. The Disability Adjusted Life Year (DALY) is a measure of burden of disease. It has been projected that by 2030, the top three leading DALYs contributing to total mortality would be HIV/AIDS (10.3%), unipolar depressive disorders (5.3%) and IHD (4.4%). Cerebrovascular disease was projected at sixth place (3.7%). It was estimated that the combined projected contribution to total mortality for IHD and cerebrovascular disease would be 8.1% of total global deaths by 2030.[6]

In Singapore, IHD was the second leading cause of death in 2008, contributing to 20.1% of the total deaths, followed by cerebrovascular disease in fourth place (8.3%), other heart diseases in sixth place (4.0%) and diabetes mellitus (DM) contributing to 2.7% of deaths. Combined deaths due to CVD (including DM) made up about 35.1% of all deaths in Singapore.[7] To our knowledge, there have been no reports on the prevalence of hypertension, DM, obesity, smoking habits and hypercholesterolaemia among hospital workers in Singapore. Thus, a cross-sectional study was conducted in a large local hospital to determine the prevalence of modifiable cardiovascular risk

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factors (hypertension, DM, obesity, smoking habit and hypercholesterolaemia) among HWs and non-health workers (NHWs), and to make appropriate recommendations to reduce the prevalence of these risk factors. NHWs are persons who ensure the optimum functioning of the health system. They do not provide direct health services, and include health administrators, biomedical engineers, facility staff, clerks, human resource workers and others.

A post hoc analysis was conducted to determine if there were significant differences in the health status and cardiovascular risk factors of HWs and NHWs. In the post hoc analysis, a preliminary review of the data suggested that there could be differences in the health status of staff performing clinical duties versus those who do not. At the time the analysis was performed, WHO had published their report on the health status of HWs in 2006, as mentioned earlier. In the report, hospital workers were grouped into HWs and NHWs, where HWs generally had patient contact while NHWs did not.

METHODS

The study population comprised all staff employed as of September 30, 2003 in a large public sector hospital. The study period was October 1 to October 31, 2003. Staff who had tendered their resignation one month prior to the commencement of the survey and those who were members of an external cleaning company contracted for their services were excluded. Ethical approval was sought and obtained for analysis of the aggregate data from this survey.

A cross-sectional prevalence study was conducted, comprising a self-administered questionnaire, measurements of body mass index (BMI), systolic and diastolic blood pressure (BP), and laboratory analysis of fasting blood samples. Invitations were sent out by the human resource department, and announcements were made at departmental and daily nursing meetings. All staff were encouraged to attend the workplace health survey. Mobile sites were set up for a period of time. Items in the questionnaire included participants' past personal, medical and smoking histories. Demographic information was provided by the human resource department. The questions, which were in English only, were previously tested on four staff. During the survey, assistants, most of whom were nurses, translated and explained the questions to staff who were unable to understand English, and assisted in transcribing the answers.

The participants' height (m), weight (kg) and BP were measured. A fasting blood sample was drawn by venepuncture, and the following tests were performed at the hospital's laboratory: blood plasma glucose, total cholesterol, low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol and triglycerides. The measurements and tests conducted conformed with the local clinical practice guidelines for health screening, hypertension, DM, obesity and lipids.[8-12]

Data was analysed using the Statistical Package for the Social Sciences version 13.0 (SPSS Inc, Chicago, IL, USA). Prevalence rate ratio (PRR) was used to compare the presence of categorical factors or variables between NHWs and HWs. Student's *t*-test for independent samples was used for comparison of means for continuous variables. Fisher's exact test was used for categorical variables. In the event that a large number of variables were strongly associated with CVD among participants, a multivariate stepwise Cox logistic regression analysis was performed.

RESULTS

Out of a total of 3,987 eligible staff, 3,384 participated in the survey, yielding a response rate of 84.9%. Analysis of non-respondents showed that their demographic composition was similar to that of the participants. Table I shows the distribution of the general characteristics of HWs and NHWs. Among the respondents, 81.4% (n = 2,755) were female and the majority were aged 20–39 years (64.3%, n = 2,179). HWs comprised almost two-thirds of the staff employed (61.3%, n = 2,076), of whom 87.7% were female compared to 72.5% female among NHWs. Few staff were known to have pre-existing medical conditions such as hypertension, DM, hypercholesterolaemia and CVD (Table I). Table II shows the prevalence of cardiovascular risk factors among NHWs and HWs. Compared to HWs, NHWs had a higher prevalence of all risk factors for CVD (Table II). The prevalence of cardiovascular risk factors in NHWs and HWs was compared after adjusting for age, ethnic group and gender. The results are summarised in Table III. The significant cardiovascular risk factors in NHWs compared with HWs were a personal history of DM (adjusted PRR 1.64, 95% confidence interval [CI] 1.02–2.64), smoking (adjusted PRR 1.85, 95% CI 1.48–2.32), obesity (adjusted PRR 1.36, 95% CI 1.05–1.75) and an elevated systolic pressure (adjusted PRR 1.74, 95% CI 1.31–2.31).

DISCUSSION

A number of well-known studies used to elucidate cardiovascular risk factors have been conducted on HWs, such as the Physicians' Health Study, the Nurses' Health Study and the British Doctors Study.[13-16] On the other hand, few studies have been conducted to determine whether HWs have lower cardiovascular risk than the general population.

The known non-modifiable CVD risk factors (CVDRFs) include increasing age, male gender, Indian ethnicity and a family history of premature coronary heart disease (CHD). Beyond the age of 40 years, there is a steep rise in the prevalence of DM, LDL-cholesterol and age-specific prevalence of hypertension in the local population. In the National Health Survey of Singapore 2004, it was found that the prevalence of hypertension was 24.9%, DM 8.2% and high total cholesterol 18.7% in the local adult population.[17] A prevalence survey for CVDRFs in a general hospital in Mexico found that 22% of the staff were hypertensive.[18] Similarly, 26% of hospital staff were reported to be hypertensive in a survey of hospital personnel in a university general hospital in Sao Paulo, Brazil, and almost one-third (29%) of them were non-clinical staff.[19] In the current study involving

Table I. General characteristics of HWs and NHWs.

Characteristic	No. (%)		
	NHWs	HWs	Total
Total no.	1,289 (38.1)	2,076 (61.3)	3,384 (100.0)
Gender			
Male	354 (27.5)	256 (12.3)	610 (18.6)
Female	935 (72.5)	1,820 (87.7)	2,755 (81.4)
Age (yrs)			
< 20	3 (0.2)	13 (0.6)	16 (0.5)
20–29	314 (24.4)	942 (45.4)	1,256 (37.0)
30–39	314 (24.4)	609 (29.3)	923 (27.3)
40–49	379 (29.4)	325 (15.7)	704 (20.8)
50–59	220 (17.1)	147 (7.1)	367 (10.8)
60–69	57 (4.4)	39 (1.9)	96 (2.8)
≥ 70	2 (0.2)	1 (0.0)	3 (0.1)
Ethnicity			
Chinese	526 (40.8)	1,161 (55.9)	1,687 (49.9)
Malay	307 (23.8)	248 (11.9)	555 (16.4)
Indian	291 (22.6)	346 (16.7)	637 (18.8)
Others	165 (12.8)	321 (15.5)	486 (14.3)
Smoking status*			
Smoker	239 (20.0)	140 (7.1)	379 (11.2)
Non-smoker	958 (80.0)	1,820 (92.9)	2,778 (82.0)
Presence of other medical conditions			
Hypertension	139 (10.8)	101 (4.9)	240 (7.1)
Diabetes mellitus	66 (5.1)	28 (1.3)	94 (2.8)
Hypercholesterolaemia	11 (0.9)	11 (0.5)	22 (0.7)
Known cardiovascular diseases	19 (1.5)	7 (0.3)	26 (0.8)

Note: Percentages do not add up due to missing information on staff type (i.e. HWs vs. NHWs).
*Data is missing for some participants.
NHWs: non-health workers; HWs: health workers

3,384 staff from a large healthcare institution, NHWs were found to have a significantly higher prevalence of some CVDRFs, such as DM (PRR 1.64), obesity (PRR 1.36), elevated systolic BP (PRR 1.74) and smoking (PRR 1.85) compared to HWs, even after adjusting for age, ethnic group and gender. This study showed that HWs generally have fewer risk factors for CVDs compared to NHWs, a finding that is similar to the Mexican and Brazilian studies.[18,19] The observed difference may be due to differences in the demographic characteristics of HWs and NHWs, and the population prevalence of hypertension.

The finding that HWs have fewer CVDRFs is not a surprising one, given that HWs are more knowledgeable about the risk factors associated with CVD and its prevention, and have ready and easy access to information on CVDRFs and their management. By virtue of their training, they may also find it easier to comprehend medical jargon and language. As the majority of HWs are nurses and doctors whose jobs require them to be active in doing ward rounds and nursing patients, they are often on the move throughout the day, likely resulting in an increased physical activity level. On the other hand, most NHWs are likely to hold administrative jobs that are predominantly deskbound. They may also not have had previous clinical training and are thus less likely to have easy access to information that would enable them to understand and manage their CVDRFs. It is also likely that they may find it difficult to comprehend medical jargon or technical terms. Another possible reason for the disparity could be attributed to differences in the demographic make-up between the two groups, as discussed earlier. The use of adjusted PRR would, however, control for this.

Table II. Prevalence of cardiovascular risk factors among NHWs and HWs.

Risk factor	No. (%)	
	NHWs	HWs
Age ≥ 40 yrs	658 (51.0)	512 (24.7)
BMI ≥ 30 kg/m^2	154 (11.9)	130 (6.3)
Systolic BP ≥ 140 mmHg	171 (13.3)	83 (4.0)
Diastolic BP ≥ 90 mmHg	112 (8.7)	93 (4.5)
Total cholesterol ≥ 6.2 mmol/L	222 (17.2)	209 (10.1)
HDL cholesterol < 1.0 mmol/L	44 (3.4)	38 (1.8)
LDL cholesterol ≥ 4.1 mmol/L	144 (11.5)	141 (6.9)
Triglycerides ≥ 2.3 mmol/L	156 (12.1)	127 (6.1)
Blood glucose ≥ 6.1 mmol/L*	107 (8.3)	61 (2.9)

*The current clinical practice guidelines on diabetes mellitus recommends that a diagnosis of diabetes mellitus be made when the fasting plasma glucose (FPG) exceeds 7.0 mmol/L; however, other states of glucose metabolism, such as impaired glucose tolerance and impaired fasting glycaemia where FPG is 6.1–6.9 mmol/L, represent an increased risk for development of diabetes mellitus and cardiovascular disease.
NHWs: non-health workers; HWs: health workers; BMI: body mass index; BP: blood pressure; HDL: high-density lipoprotein; LDL: low-density lipoprotein

History of DM, smoking, obesity and elevated systolic BP are all modifiable risk factors. Thus, it is possible to help NHWs modify their CVDRFs, especially when their work in the hospital makes them a 'captured' workforce and gives them easy access to health facilities. Given these two advantages, health promotion programmes could be easily implemented to target NHWs.

Table III. Crude and adjusted prevalence rate ratio of risk factors between non-health workers and health workers.

Variable	Crude PRR (95% CI)	p-value	Adjusted PRR (95% CI)*	p-value
Known hypertension	2.217 (1.732–2.837)	< 0.001	1.213 (0.917–1.605)	0.176
Known DM	3.796 (2.453–5.874)	< 0.001	1.638 (1.018–2.637)	0.042
Known CVD (CHD/stroke)	4.371 (1.843–10.370)	< 0.001	1.841 (0.732–4.629)	0.194
Smoker	2.795 (2.298–3.400)	< 0.001	1.854 (1.478–2.324)	< 0.001
BMI ≥ 30 kg/m^2	1.908 (1.527–2.384)	< 0.001	1.355 (1.052–1.745)	0.019
Systolic BP ≥ 140 mmHg	3.318 (2.577–4.273)	< 0.001	1.737 (1.306–2.310)	< 0.001
Diastolic BP ≥ 90 mmHg	1.940 (1.487–2.531)	< 0.001	1.146 (0.847–1.549)	0.376
Total cholesterol ≥ 6.2 mmol/L	1.711 (1.436–2.040)	< 0.001	1.019 (0.828–1.254)	0.816
HDL cholesterol < 1.0 mmol/L	1.865 (1.215–2.863)	< 0.001	1.216 (0.760–1.948)	0.415
LDL cholesterol ≥ 4.1 mmol/L	1.673 (1.340–2.087)	< 0.001	0.933 (0.723–1.205)	0.594
Triglycerides ≥ 2.3 mmol/L	1.979 (1.582–2.475)	< 0.001	1.082 (0.836–1.399)	0.550
Blood glucose ≥ 6.1 mmol/L	2.828 (2.081–3.842)	< 0.001	1.218 (0.865–1.715)	0.258

*Adjusted for age, ethnic group and gender.
PRR: prevalence rate ratio; CI: confidence interval; DM:diabetes mellitus; CVD: cardiovascular disease; CHD: coronary heart disease; BMI: body mass index; BP: blood pressure; HDL: high-density lipoprotein; LDL: low-density lipoprotein

Epidemiological and intervention trials have shown that hypertension is a major risk factor for CVD. It was found that compared to HWs, more NHWs had elevated systolic (13.3% vs. 4%) and diastolic (8.7% vs. 4.5%) BPs. Although a diagnosis of hypertension is usually made after a few readings, elevated BP indicates that follow-up is required, and for those with existing hypertension, follow-up is necessary in order to have an estimate of their control. Menotti and Lanti found that "*a single measurement of some coronary risk factors in middle-aged men maintained a regular and almost monotonic relation with the occurrence of CHD deaths during 35 years of follow-up*".[20] BP was one of the risk factors measured in this as well as the current study and thus, a single reading of elevated BP is still significant. After adjustment for age, gender and ethnicity in the current study, we found that systolic BP was significantly higher in NHWs (adjusted PRR 1.74, 95% CI 1.31–2.31), whereas diastolic blood pressure was not significantly different between NHWs and HWs. Mion et al, who observed similar findings when they conducted a prevalence survey of hypertension in a large Brazilian healthcare institution, found that NHWs had an increased prevalence of arterial hypertension compared to HWs.[19] Due to the nature and location of their work, it would be quite easy and convenient for NHWs who were found to have elevated BP to have their BP taken again. If BP is found to be elevated, necessary measures can then be adopted to manage it.

DM is another major risk factor for CVD and confers a risk equivalent to CHD.[21] Only 2.8% of the total staff in the present study were known diabetics; however, 5.1% of NHWs were found to have DM, in contrast to only 1.3% of HWs. Similar to BP, DM can also be managed quite effectively in a hospital setup. Obesity, as defined by a BMI in excess of 30 kg/m^2, carries an elevated risk for CVD (WHO).[22] In this study, more NHWs (11.9%) were obese compared to HWs (6.3%), and this risk factor remained significant after adjusting for age, gender and ethnicity (adjusted PRR 1.36, 95% CI 1.05–1.75). Weight management programmes conducted within the hospital may be more effectively carried out for NHWs who are found to be obese. Given the accessibility of the venue and better supervision, the programme is more likely have a better take-up rate and success.

This study was, however, not without its limitations. Since this was a cross-sectional study, there may have been a recall bias, as not all staff would have been able to remember their past medical illnesses or understand the terms used. Moreover, due to the voluntary nature of participation, reporting bias was present, as not all the questions were answered by the participants, e.g. 6% of the questions were not answered in smoking history, leading to a possible incorrect classification of smoking status. Another limitation pertains to the language of the questionnaire, which was only available in English. Thus, translation of questions by nurses may introduce under-reporting bias if medical terms could not be translated into the individual's language. Moreover, the language used for translation was not recorded. A review of the respondents' highest educational level attained as a proxy measure for proficiency in English suggested that about 10% of respondents, most of whom were NHWs, may have required assistance in completing the questionnaire. In order to minimise this bias, simple terms were used in the questionnaire, such as 'high blood pressure', 'diabetes mellitus', 'stroke', 'heart disease', 'heart attack' or 'heart failure', and 'cancer'. It is likely that translation of these terms into equivalent terms in the respondent's language was available and understood. This bias was likely to have negatively affected the prevalence of self-reported medical conditions, i.e. under-reporting.

In addition, the classification of staff into HWs and NHWs based on the organisation's standard classification may have resulted in wrong classification of jobs. A check through the records prior to analysis, however, did not reveal any inaccuracies, although the job classification may not have accurately reflected the occupational exposures because it was a proxy measure. To minimise biases due to measurement inaccuracies, training

sessions were held for nursing staff assigned to the health screening teams to ensure that measurements of height, weight and BP were conducted in a consistent fashion for accurate results. In cases of high BP, a repeat measurement was taken after the respondent had rested for 30 minutes. Guidance on performance of these measurements and laboratory tests was based on the locally published clinical practice guidelines for health screening.[10] Hence, the laboratory and screening staff were able to ensure that the performance requirements were met, achieving a good response rate of about 85%. Finally, the information in this cross-sectional study was obtained at a point in time and thus, data on trending were not available.

In conclusion, NHWs should not be neglected in a healthcare setting. Current healthy lifestyle messages could be refined so that NHWs as well as HWs are able to understand and internalise these messages. Given that NHWs are captive audience in a healthcare setting, organisations could take the opportunity to develop healthy lifestyle programmes for staff, in particular, NHWs. Screening for CVDRFs on a regular basis, together with programmes, both preventive and curative, developed to take advantage of staff's easy access to healthcare services, will aid in improving the health of NHWs.

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