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Ten-year Cardiovascular Disease Risk Amongst Workers in a Tertiary Healthcare Institution in Kuala Lumpur

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Abstract

Strategising, which is an effective workplace intervention to curb cardiovascular disease (CVD), requires understanding of the CVD risk related to a specific working population. The Framingham Risk Score (FRS) is widely used in predicting the ten-year CVD risk of various working populations. This study aimed to use FRS to determine the ten-year CVD risk amongst workers in a tertiary healthcare setting and its associated factors. A cross-sectional study was conducted on workers who participated in the special health check programme at the staff clinic of a tertiary healthcare institution in Kuala Lumpur, Malaysia. A set of data sheets was used to retrieve the workers' sociodemographic and CVD risk information. The prevalence of high, moderate and low ten-year CVD risk was 12.8%, 20.0% and 67.2%, respectively. Workers in the high-risk group were older [mean age: 54.81 (standard deviation, 5.72) years], male (44%), smokers (72.7%) and having hyperglycaemia (46.7%) and hypertriglyceridemia [median triglycerides: 1.75 (interquartile range, 1.45) mmol/L]. Diastolic blood pressure (aOR 1.07, 95% CI: 1.01,1.14), hyperglycaemia (aOR 8.80, 95% CI: 1.92,40.36) and hypertriglyceridemia (aOR 4.45, 95% CI: 1.78,11.09) were significantly associated with high ten-year CVD risk. Diastolic blood pressure (aOR 1.08, 95% CI: 1.03,1.13) and hypertriglyceridemia (aOR 2.51, 95% CI: 1.12-5.61) were significantly associated with moderate ten-year CVD risk. The prevalence of high and moderate ten-year CVD risk was relatively high. Amongst the workers in the high-risk group, they were older, male, smokers and with high fasting blood sugar and triglyceride. Understanding the ten-year CVD risk and its associated factors could be used to plan periodic workplace health assessment and monitor to prevent CVD.

Keywords: Framingham, Cardiovascular diseases, Workers, Healthcare

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Introduction

Cardiovascular diseases (CVDs) are the leading global mortality cause with the prevalence of premature deaths from CVDs that ranges from 4% in high-income population (WHO, 2011). Mortality rate related to circulatory disease in Malaysian public hospitals was 21.7% (Ministry of Health, Malaysia, 2018). Framingham Risk Score (FRS) is widely used as a risk assessment tool to predict the ten-year CVD risk in various populations (Cezar-Vaz et al., 2018; Nakhaie et al.,2018; Yadav et al., 2017). Local studies have used FRS to stratify CVD risk amongst the general population (Borhanuddin et al., 2018), rural community (Chia Yook & Pengal, 2009; Zabadi et al., 2011), urban community (Su et al., 2015) and patients attending primary care clinics (Chia et al., 2015).

The working population comprises approximately 65% of young and middle-aged adults in Malaysia (Department of Statistics, Malaysia, 2019). Workplace intervention was recommended to prevent CVD by promoting healthy lifestyles, such as balanced diet, stop smoking and regular physical exercises (Piepoli et al., 2016). Strategising an effective workplace intervention to curb CVD requires an understanding about the CVD risk related to certain working populations (Veronesi et al., 2018). Several local studies were conducted to assess the CVD risk factors amongst various working populations, such as healthcare workers (HCWs) (Helmy Hazmi et al., 2015) and security guards (Moy et al., 2008). However, only the latter research had applied the use of FRS. A score-based formula introduced by D'Agostino et al. (2008) was introduced for an easier adoption in the field for public health use.

The opportunistic serial health checks provided to the workers are potentially useful to detect CVD risk factors in early stages. Workers in a tertiary healthcare setting include HCWs and non-HCWs. These workers play a vital role in delivering care and services to the sick and ailing, either directly or indirectly. Healthcare industry, including tertiary setting, is one of the risky environments to work in (Joseph & Joseph, 2016). Workers in this setting are constantly exposed to a variety of health and safety risk to both communicable and non-communicable disease, including CVD. Furthermore, local information on the ten-year CVD risk by using FRS among workers in this setting is scarce. The objective of this study is to determine the ten-year CVD risk group by using FRS amongst workers in a tertiary healthcare institution and its associated factors.

Materials and methods

A cross sectional study was conducted amongst workers who undergo health checks under a special programme at the staff clinic in at tertiary healthcare institution in Kuala Lumpur, Malaysia. The programme recruited 186 workers from 2013 to 2015, but only 125 workers were included in this study. Sample size was calculated by using a formula by Naing & Rusli (2006), with reference to a previous local study (Moy et al., 2008). The inclusion criteria were all permanent workers in the institution while the exclusion criteria were participants who were pregnant and with incomplete data. Study approval was obtained from the Universiti

Kebangsaan Malaysia Medical Centre (UKMMC) Research Ethic Committee (REC) (project code: FF-2015-253).

A set of data sheet was used to retrieve data from the programme records, medical records, online medical system and online pharmacy record. The data collected consisted of four sections, (1) Section A: sociodemographic characteristics (age, sex, occupation, underlying comorbidity and family history); (ii) Section B: lifestyle (smoking, alcohol consumption and physical activity) (iii) Section C: biophysical measurement [body mass index (BMI), systolic and diastolic blood pressure (SBP and DBP)] and biochemical measurement [fasting blood sugar (FBS), total cholesterol (TCHOL), triglyceride (TG), high-density lipoprotein (HDL) and low-density lipoprotein (LDL)], and (iv) Section D: treatment history (untreated or treated high BP).

For sociodemographic characteristics, occupations were classified into (i) occupational skill level and (ii) job category. Occupational skill level was categorised into (i) first skill level (major group was with elementary occupations), (ii) second skills level (major groups included clerical support workers, service workers and machine-operators), (iii) third skill level (major groups included technicians and associate professionals) and (iv)fourth skill level (major group was with professionals). Job category was divided into (i) academic staff and (ii) support staff. For lifestyle, smokers are defined as they currently or had smoked in the past. Workers who consumed alcohol is defined as alcohol consumption of ≥ 4 or more drinks per day or ≥ 14 drinks per week. Physical activity was recorded according to the frequency of regular physical activity with moderate intensity. For the biophysical measurement, BMI were categorised into obese ($\geq 30 kg/m^2$) and non-obese ($< 30 kg/m^2$) (Ministry of Health, Malaysia, 2004), For the biochemical measurement, FBS was categorised into hyperglycaemia (≥7.0 mmol/L) and normoglycaemia (<7.0mmol/L) (Ministry of Health, Malaysia, 2015).

The FRS was used to assess the general CVD risk which stratifies the workers into a high-, moderate-, or low-risk group and calculates their ten-year risk of developing CVD based on CVD risk factors (D'Agostino et al., 2008). It involves summation of FRS scores derived from each worker's factors and categorising the total FRS scores into ten-year CVD risk: (i) > 20% (high-risk), (ii) 7% -20% (moderate-risk) and (iii) ≤ 6% (low-risk).

Statistical Analyses

All statistical analyses were performed by using the statistical package for social sciences (SPSS Version 20.0). Descriptive statistic which use frequency (*n*) and percentage (%) were used for the categorical data. Mean and standard deviations (SD) were calculated for normally distributed continuous data while median and interquartile range (IQR) was used for non-normally distributed continuous data. Univariable analyses were conducted by using Pearson Chi-square, one-way ANOVA and Kruskal Wallis tests for categorical, normally distributed and non-normally distributed continuous data, respectively. Multivariable analysis i.e. ordinal logistic regression was used to identify factors associated with ten-year CVD risk.

Results

Table 1 shows that the mean age of the workers was 46.73 (8.50) years old with the majority being 45 years old and above (64.8%). More than two-thirds of workers were female (78.4%), had almost equal distribution of workers, which were from second to forth occupational level skill. Most workers were amongst the support staffs (78.4%) and the majority workers have hypertension (19.2%). A small percentage was smokers and consumed alcohol (8.8% and 0.8%, respectively). However, most workers did not engage in physical activity (72%), and either being overweight (29.6%) or obese (56.8%). Up to 12% of workers were with hyperglycaemic condition.

Table 1: Characteristics of the Workers in a Tertiary Healthcare Institution (*n*=125)

Factors		Median (IQR)	Mean (SD)	*n* (%)
Age (years)			46.73 (8.50)	
	30-34			10 (8.0)
	35-39			19 (15.2)
	40-44			15 (12.0)
	45-49			34 (27.2)
	50-54			23 (18.4)
	55-59			14 (11.2)
	60-64			9 (7.2)
	65-69			1 (0.8)
Sex				
	Female			98 (78.4)
	Male			27 (21.6)
Occupation skill level				
	First			3 (2.4)
	Second			39 (31.2)
	Third			38 (30.4)
	Fourth			45 (36.0)
Job category				
	Academic staff			27 (21.6)
	Support staff			98 (78.4)
Underlying comorbidity[a] (Yes)				
	Hyperlipidaemia			36 (28.8)
	Heart disease			1 (0.8)
	Type 2 diabetes mellitus			22 (17.6)
	Hypertension			24 (19.2)
Family history[a] (Yes)				
	Hyperlipidaemia			10 (8.0)
	Heart disease			22 (17.6)
	Type 2 diabetes mellitus			68 (54.4)
	Stroke			9 (7.2)

Hypertension			75 (60.0)
Smoking			
Yes			11 (8.8)
No			114 (91.2)
Alcohol			
Yes			1 (0.8)
No			124 (99.2)
Physical activity			
Yes			35 (28.0)
No			90 (72.0)
Blood pressure			
Systolic		125.78 (15.90)	
Diastolic		76.33 (11.02)	
Body mass index (kg/m^2)		29.13 (6.11)	
Underweight			2 (1.6)
Normal			15 (12.0)
Overweight			37 (29.6)
Obese			71 (56.8)
Fasting blood sugar (mmol/L)	5.88 (2.24)		
Hyperglycaemia			15 (12.0)
Normoglycaemia			110 (88.0)
Fasting lipid profile (mmol/L)			
Total cholesterol		5.50 (1.11)	
Triglycerides	1.26 (0.73)		
High-density lipoprotein		1.38 (0.34)	
Low-density lipoprotein	3.50 (1.35)		

Abbreviation: IQR: interquartile range; SD: standard deviation
[a]response to Yes in *n* (%)

The FRS indicated that 12.8% (*n*=16), 20.0% (*n*=25) and 67.2% (*n*=84) of workers were at high, moderate and low ten-year CVD risks, respectively. Table 2 shows that the mean age of workers in the high-risk group was significantly higher as compared to moderate and low risk-risk groups. A total of 44.4% of male, 72.7% of smokers and 46.7% of hyperglycaemic workers were in the high-risk group. The level of TG for workers in the high-risk group was higher than the upper limit of normal value and significantly different as compared to moderate and low-risk groups. Further univariable analysis showed that 12 factors had p value < 0.05 (Table II). All these factors were included in the ordinal logistic regression. The multivariable analysis showed three factors, namely DBP, TG and FBS were significantly associated with ten-year CVD risk, as depicted by Table 3. Workers with an increase of 5 mmHg of DBP had 47 % higher odds for high ten-year CVD risk [(1.08^5= 1.47), (aOR= 1.08, 95% CI: 1.03, 1.13)] and 40.0% higher odds for moderate ten-year CVD risk [(1.07^5= 1.40), (aOR=1.07, 95% CI: 1.00, 1.14)] as compared to low ten-year CVD risk group. Increasing 1 unit of TG put the workers four times more odds for high (aOR=4.45, 95% CI: 1.78, 11.10) and almost three times more odds for moderate (aOR= 2.51, 95% CI: 1.12, 5.61) ten-year CVD risk. Workers with hyperglycaemia had nine times higher odds for high (aOR=8.80, 95% CI: 1.92, 40.36) as compared to normoglycaemic participants.

Table 2: The 10-years CVD risk Distribution of Workers in a Tertiary Healthcare Institution (*n*=125)

Factors	10-years CVD risk High (*n*=16)	Moderate (*n*=25)	Low (*n*=84)	Test[c]	*p* value
	***n* (%)**	***n* (%)**	***n* (%)**		
Sex				31.64	**<0.001**
Male	12 (44.4)	5 (18.5)	10 (37)		
Female	4 (4.1)	20 (20.4)	74 (75.5)		
Occupational skill				10.65[d]	0.169
First	0 (0)	0 (0)	3 (100)		
Second	3 (7.7)	8 (20.5)	28 (71.8)		
Third	9 (23.7)	4 (10.5)	25 (65.8)		
Fourth	45 (8.9)	13 (28.9)	28 (62.2)		
Job category				0.78	0.676
Academic staff	3 (11.1)	4 (14.8)	20 (74.1)		
Support staff	13 (13.3)	21 (21.4)	64 (65.3)		
Body mass index				6.50	**0.039**
Obese	5 (11.6)	14 (32.6)	24 (73.2)		
Non-obese	11 (13.4)	11 (25)	60 (55.8)		
Underlying comorbidity[a]				21.11	**<0.001**
Yes	12 (21.8)	18 (32.7)	25 (45.5)		
No	4 (5.7)	7 (10)	59 (84.3)		
Family history of disease[b]				2.37	0.306
Yes	13 (14)	21 (22.6)	59 (63.4)		
No	3 (9.4)	4 (12.5)	25 (78.1)		
Smoking				38.87	**<0.001**
Yes	8 (72.7)	1 (9.1)	2 (18.2)		
No	8 (7)	24 (21.1)	82 (71.9)		
Alcohol consumption				6.87	**0.032**
Yes	1 (100)	0 (0)	0 (0)		
No	15 (12.1)	25 (20.2)	84 (67.7)		
Physical activity				1.01	0.604
Yes	5 (14.3)	5 (14.3)	25 (71.4)		
No	11 (12.2)	20 (22.2)	59 (65.6)		
Fasting blood sugar				18.13	**<0.001**
Hyperglycaemia	7 (46.7)	3 (20)	5 (33.3)		
Normoglycaemia	9 (8.2)	22 (20)	79 (71.8)		

	mean (SD)	mean (SD)	mean (SD)	Test[e]	*p* value
Age (years)	54.81 (5.72)	50.80(7.53)	43.98(7.77)	18.64	**<0.001**[g]
Blood pressure (mmHg)					
Systolic	131.50 (13.50)	137.32 (15.00)	121.25 (14.58)	13.19	**<0.001**[g]
Diastolic	80.69 (12.02)	82.48 (11.57)	73.67 (9.71)	8.52	**<0.001**[g]
Fasting lipid profile (mmol/L)					
Total cholesterol	5.90 (1.44)	5.96 (0.91)	5.29 (1.04)	4.88	**0.009**[h]
High-density Lipoprotein	1.16 (0.34)	1.43 (0.37)	1.41 (0.35)	4.05	**0.020**[g]
	Median (IQR)	**Median (IQR)**	**Median (IQR)**	**Test[f]**	***p* value**
Fasting lipid profile (mmol/L)					
Triglycerides	1.75 (1.45)	1.39 (0.60)	1.55 (0.70)	20.11	**<0.001**
Low-density lipoprotein	3.83 (1.76)	3.69 (1.44)	3.44 (1.27)	4.63	0.099

Abbreviation: CVD: cardiovascular disease; IQR: interquartile range; SD: standard deviation
[a]Workers' underlying comorbidity include hyperlipidaemia, heart disease, Type 2 diabetes mellitus or hypertension. [b]Workers' family history including hyperlipidaemia, heart disease Type 2 diabetes mellitus, stroke or hypertension. [c]Pearson χ^2. [d]Fisher Exact test. [e]One-way ANOVA. [f]Kruskal-Wallis Test. [g]significant difference between high-moderate and high-low risk groups. [h]significant difference between moderate-low risk groups.

Table 3. Factors associated with High and Moderate 10-years CVD risk (*n*=125)

Factors	χ^2 (df)	10-years CVD risk High[a]	Moderate[a]	*p* value
		aOR (95% CI)	aOR (95% CI)	
Diastolic blood pressure (mmHg)	13.07 (2)	1.07 (1.01,1.14)	1.08 (1.03,1.13)	0.001
Triglyceride (mmol/L)	12.78 (2)	4.45 (1.78,11.09)	2.51 (1.12-5.61)	0.002
Fasting blood sugar				
Normoglycaemia		1		
Hyperglycaemia	8.10 (2)	8.80 (1.92,40.36)		0.017

Abbreviation: aOR: adjusted odds ratio; CVD: cardiovascular disease
[a]reference group (low CVD risk)

Discussion

CVD risk prediction is crucial in the prevention and management of CVD. The widely used FRS could identify the high-risk group in Malaysian population (Selvarajah et al. 2014). The prevalence of high and moderate ten-year CVD risks amongst the local population is inconclusive, depending on the study population. The prevalence of high and moderate ten-year CVD risks from this current study was almost the same as a previous local study conducted amongst a rural (Zabadi et al., 2011) and an urban community (Su et al., 2015). However, the prevalence of high-risk ten-year CVD risk amongst the worker population was higher (12.8%) as compared to locals (4.8%) (Moy et al., 2008) non-local working populations (Park & Hwang, 2015). This difference could be due to the difference in work sector and these previous studies were conducted amongst male workers only.

This study showed that our workers in the high-risk group had older age. Previous local community studies (Chia Yook & Pengal, 2009; Su et al., 2015; Zabadi et al., 2011) approved these findings but notably, the mean age of local workers was very much lower as compared to these previous studies. The mean age of workers in the high-risk was almost comparable to a study amongst small industrial workers in Korea (Park & Hwang, 2015). These findings supported the suggestion that CVD risk increased with age (Benjamin et al., 2017).

This study showed that almost half of male workers were in the high-risk group. Previous local community studies also showed that the proportion of males in the high-risk group was higher as compared to females, which varied from 35% (Su et al., 2015) to 91.2% (Zabadi et al., 2011). Similar male predominance in the high-risk group was also shown in other non-local studies among workers (Cezar-Vaz et al., 2018; Nakhaie et al., 2018). It is widely perceived that CVD is a man's disease and partly could be explained by the role of sex hormones (Vitale et al., 2010).

This present study indicated that almost three-quarter of smokers and half of hyperglycaemic workers were in the high-risk group. The association of smoking leading to vascular dysfunction and cardiovascular was widely reported (Messner & Bernhard, 2014; Mons et al., 2015). Chronic hyperglycaemia resulting from defective insulin sensitivity and secretion may exert long-lasting negative effects on the cardiovascular system (Paneni et al., 2013). There is substantial evidence from epidemiological and pathophysiological studies that hyperglycaemia is an individual risk factor for CVD (Einarson et al., 2018). A study amongst rural workers in Brazil showed that 63.4% of smokers were in the high-risk group (Cezar-Vaz et al., 2018). However, a study amongst office workers in Iran did not show any different of FRS score and ten-year CVD risk between smokers and non-smokers (Nakhaie et al., 2018). The prevalence of smoking by different industrial and occupation group in the United States of America ranged between approximately 10%-30% and was projected to be greater than its reduction goal by 2020 (Syamlal et al.,2015). The prevalence of diabetes mellitus amongst the general population in Malaysia has doubled to 17.5% in 2015 since 1996 (IPH 2015). Previous study conducted amongst working populations showed the prevalence of diabetes mellitus varies between 7% and 14% (Abou-Gamel et al., 2014; Coetzee et al., 2019; Uehara et al., 2014). In view of the high prevalence of smoking and diabetes mellitus among workers, the smoking cessation initiatives, good glycaemic control and prevention programmes need to be enhanced.

The median level of TG was significantly higher in local high-risk group, which was approved by a study amongst small industry workers in Korea (Park & Hwang, 2015). Several reviews were actively discussing about the role of TG in increased CVD risk (Nordestgaard & Varbo, 2014; Reiner, 2017). A study amongst Spanish working populations indicated that the CVD risk gradually increased from among workers with normal, mild, moderate and severe hypertriglyceridaemia (1.7%, 6.6%, 14% and 37%, respectively) (Valdivielso et al., 2009).

In this study, three factors (DBP, TG and hyperglycaemia) and two factors (DBP and TG) were significantly associated with high and moderate ten-year CVD risks, respectively. Meanwhile, studies study among male workers showed that obesity indices (BMI, waist circumference and waist-hip ratio) were significantly correlated with FRS score (Moy et al., 2008) and another study found seven predictors for the high ten-year CVD risk which include age, occupation, TG, obesity, no physical activity, heavy alcohol consumption and presence of co-morbidity (Park & Hwang, 2015). Despite the differences in the factors associated with high or moderate ten-year CVD risk found in these studies, the findings gave additional information in identifying individuals at increased CVD risks.

There are several limitations in this study. First, the data collected were from workers in tertiary healthcare setting. Therefore, any generalisations of the results to the other working and general populations need to be done cautiously. Second, there is bias information because the data was collected from their medical reports, which may not be updated to workers' well-being. Some of the data were incomplete due to defaulted follow-up or properly documented. Third, patients' lifestyle report such as physical inactivity was obtained from their medical record which may not represent their current lifestyle. This study could include scientific information to the body of knowledge and can serve as a baseline data for future cohort study among these workers.

Conclusion

The prevalence of high and moderate ten-year CVD risk in our working population was relatively high. Amongst the workers in the high-risk group, they were older, male, smokers and with high fasting FBS and TG. Understanding the ten-year CVD risk and its associated factors could be used to plan periodic workplace health assessments and monitoring to prevent CVD.

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