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ORIGINAL ARTICLE

Outcomes Of Cardiovascular Risk Factors Screening Programme Among Employees Of A Malaysian Public University

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ABSTRACT

Background: The burden on cardiovascular disease in Malaysia is in the increasing trend and this is associated with a number of risk factors.
Aim: This study aims to explore the prevalence of major cardiovascular risk factors among employees of Engineering Campus, Universiti Sains Malaysia.
Design: A cross-sectional study was carried out from 19th February 2009 to 12th March 2009.
Methods and Materials: Data on eight established risk factors were collected.
Statistical Analysis: Descriptive statistic was used to describe the prevalence of risk factors among the study subjects. Multiple logistic regression analysis was used to explore the clustering of risk factors (having two or more risk factors). All data were analyzed using statistical software SPSS package version-16 and a two-tailed p-value < 0.05 was considered to be statistically significant.
Results: A total of 217 (27.7%) respondents participated in the screening exercise. Results from this screening showed that risk factors such as unhealthy diet (92.1%), overweight/obesity (73.3%) and physical inactivity (65.0%) were highly prevalent. The median number of risk factors was 3 (IQR=2). In addition, most of the subjects (n=203, 93.5%) were categorized as being in high risk for future cardiovascular events as according to the definition of National Cholesterol Education Program. Respondents with clustered risk factors were older, had lower intake of fruit and vegetables, less physically active, had a higher body mass index, systolic blood pressure, diastolic blood pressure and fasting blood glucose. Further analysis found that fruit and vegetable intake, physical activity and body mass index formed a good predictive model for prediction of clustered risk factor model with a Nagelkerke R-squared value of 0.529.
Conclusion: There is a high prevalence of cardiovascular risk factors among USM employees and these risk factors tend to cluster. It is therefore recommended that prompt actions should be taken to overcome and modify these risk factors.
Key Words: cardiovascular disease; cluster; prevalence; risk factors

Key Messages:

1. There is a high prevalence of respondents not consuming enough fruits and vegetables (92.1%), overweight (73.3%) and not engaged in physical activity (65.0%).
2. A large percentage (93.5%) of the respondents can be categorized as being in the high risk category by having two or more risk factors.

3. Fruit and vegetable intake, physical activity and body mass index were significantly associated with risk of having clustered risk factors.

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Introduction

During epidemiologic transition, a shift between the main causes of death is seen from infectious disease to non-communicable disease (NCD) [1],[2]. This theory is supported by a growing burden of NCD (described as cardiovascular (CV) disease, cancer, diabetes mellitus and chronic pulmonary disease) over the years. Reports from the 128 hospitals under the Malaysian Ministry of Health found an increasing trend of hospitalizations and death due to CV and circulatory diseases over the past 10 years [3]. Similarly, a study on the total expenditure of prescription drugs in Malaysia for the year 2005 reported that anti-hypertensives drugs, lipid modifying agents and diabetic drugs accounted for 18.5% of all prescribed drugs with a total amount of RM 2.24 billion [4].

A wealth of epidemiological research has demonstrated that a number of risk factors (RF) are associated with significant increased in the risk of developing CV events [5],[6]. Risk factors are defined as any attributes, characteristics and exposure which increases the likelihood of developing a chronic non-communicable disease [7]. A multi-centre case control study, INTERHEART reported that nine RF accounted for over 90% of the risk of first acute myocardial infarction. According to this report, these are smoking, abnormal lipids, hypertension, diabetes mellitus, obesity, unhealthy diet, physical inactivity, excessive alcohol consumption and psychosocial stress [8].

The first step to the prevention of CV disease is to identify those at risk who are eligible for further assessment or likely to benefit from immediate intervention whilst maintaining its cost-effective benefits [9],[10],[11].

Two nationwide population surveys, Malaysia Non-Communicable Disease Survey (MyNCDS) and the Third National Health and Morbidity Survey (NHMS III) were conducted in 2005-2006 to determine the prevalence of non-communicable RF among Malaysians [12],[13]. These two surveys were nationwide surveys involving a mixed population in different environment, thus a local prevalence data on cardiovascular risk factors crucial in identifying RF for targeted programs in an institutional setting like Universiti Sains Malaysia (USM).

Therefore, the objectives of this study were:

a) to explore the prevalence of major cardiovascular risk factors among employees in USM
b) to explore the clustering of cardiovascular risk factors
c) to compare the results with existing national data on prevalence of risk factors

Materials And Methods

Study Design

This was a cross-sectional study to explore the prevalence of cardiovascular risk factors among employees of the USM Engineering campus. There are 783 employees currently working at this campus.

Sampling And Data Collection Procedure

All employees of USM were invited to participate in the screening which was conducted over the period of three weeks between 19th February to 12th March 2009. A mobile screening team consisting of a nurse, medical laboratory technician and an administrative clerk was set up together with the principal researcher. A simplified version of the 'WHO Stepwise approach to surveillance of non-communicable disease risk factors' was developed by the researcher to obtain core data on the established RF that determine the major disease burden. It focuses on eight RF including tobacco use, alcohol consumption, diet, physical activity, obesity/overweight, BP, blood glucose and blood lipids [14].

Measures

Physical and biochemical measurements were collected and measured using validated and standardized instruments. Height and weight were measured in stocking feet or bare feet using a vertical stadiometer and an electronic scale, respectively. Thereafter, body mass index (BMI) was calculated as the ratio of weight in kilogram to standing height squared in meter [15].

Systolic and diastolic BP was measured using a digital BP monitor, Omron SEM1. The same monitor was used throughout the study. Blood sample was drawn after a 10 hour fast from the night before by venipuncture. Analyses of these samples were conducted for fasting blood glucose and total cholesterol level using the RA-50 chemistry analyser.

We defined the RF as an increased risk for future CV events according to the criteria set in the current clinical practice guidelines [15],[16],[17],[18],[19],[20],[21],[22],[23],[24],[25],[26], Table/Fig 1].

(Table/Fig 1) Modifiable Risk Factors And Its Threshold To Be Achieved

Risk Factors	Threshold to be Achieved	References
Raised blood glucose	Fasting blood glucose (FBG) of less than 5.6mmol/L Random blood glucose (RBG) of less than 7.8mmol/L	17, 18, 37
Smoking	Complete smoking cessation	19
Raised blood pressure	<140/90mmHg; <130/80mmHg (diabetics)	20, 21
Excessive alcohol consumption	<14 drinks/week or 4 drinks/occasion for men < 7 drinks/week or 3 drinks/occasion for women	22, 23
Abnormal blood lipid	Total cholesterol (TC) < 6.2mmol/L (1 or less RF) TC < 5.2mmol /L (2 or more RF)	23, 25
Physical inactivity	At least 30 minutes of moderate physical activity, most days of the week is beneficial to health	23, 24
Unhealthy diet	At least 5 servings of fruits and vegetables per day (2 servings of fruits and 3 servings of vegetables)	23, 26
Overweight/ obesity	BMI of less than 23kg/m^2	15, 23

Ethics Approval

This study was approved by the Ethics committee of the School of Pharmaceutical Sciences, Universiti Sains Malaysia-Lam Wah Ee Hospital.

Statistical Analysis

Descriptive statistic was used to describe the prevalence of RF among the study subjects. Distribution of cardiovascular risk factors in study subjects were expressed in mean values [Standard deviation (SD)] and median [Inter-quartile range (IQR)] for continuous variables and proportion for discrete variables respectively. Student's t-test and analysis of variance were used to test for statistical differences in the distribution of RF in terms of sex, age and occupation. For RF whereby the criterions for normality were not met, the corresponding non-parametric tests, Mann-Whitney U and Kruskal-Wallis tests were used. The statistical significance difference in categorical variables between groups was tested with the chi square test or Fisher's exact test, where appropriate.

The responses to the RF were aggregated to create a variable representing individual's total number of RF. The presence of two or more RF in a subject is taken as clustering of RF. Multiple logistic regression analysis was used to explore the clustering of these RF. In this case, clustering of RF was the dependent variable whereas socio-demography information and individual RF were the independent variables. The results were expressed in odds ratio. All data were analyzed using statistical software SPSS

package version-15. A two-tailed p-value < 0.05 was considered statistically significant.

Results

Socio-Demography Characteristics Of Respondents

[Table/Fig 2] showed the baseline characteristics of the respondents. A total of 217 respondents attended the screening sessions held at the 19 schools and departments in the Engineering campus of USM. The median age of the respondents was 35 years (IQR=16) ranging from 22 to 64 years of age. It was noted that more than 90% of the respondents were less than 50 years of age.

(Table/Fig 2) Socio-Demography Characteristics Of Respondents (N=217)

Characteristics		n	%
Sex	Male	125	57.6
	Female	92	42.4
Age range (years)	≤ 30	73	33.6
	31-40	61	28.1
	41-50	70	32.3
	51-60	12	5.5
	≥ 61	1	0.5
Occupation	Professional	56	25.8
	Supporting	161	74.2

Characteristics And Prevalence Of Cardiovascular Risk Factors

A total of 31 (14.3%) respondents were smokers and all of them were males (24.8% vs 0%, p<0.001). However, none of the respondent consumed alcohol. Assessment of diet included fruit and vegetable intake. Significantly more females consumed adequate servings of vegetable in a day of at least 3 servings a day (24.4% vs 12.0%, p=0.017). Similarly, more men achieved physical activity target (moderate activity for at least 3 days in a week) (46.3% vs 19.8%, p<0.001). On the whole, 35% of the respondents carried out at least 3 days of moderate physical activity.

Almost half (40%) of the respondents were overweight with a BMI of between 23.0 to 27.4 kg/m^2. Furthermore, two of the respondents were classified as obese III with a BMI in excess of 40 kg/m^2 as defined in the Malaysian clinical practice guidelines on the management of obesity [15].

Eight of the respondents were categorized in Stage II hypertension with a BP reading in excess of 160/100 mmHg. A total of 80.1% (n=165) of the population has acceptable BP of less than 140/90 mmHg, but only 35.4% (n=73) of them has optimal BP defined as 120/80 mmHg. Males have significantly higher BP readings with 26.7% males categorized as hypertensive, as opposed to 11.6% of females (p=0.008).

Analyses on fasting blood glucose (FBG) showed that younger age was associated with lower prevalence of raised blood glucose (p=0.013). Among the 44 respondents with abnormal FBG level, 10 of them have FBG level exceeding 7.0 mmol/L and were referred to the clinicians for treatment for diabetes mellitus. However, the respondents' total cholesterol controls were less satisfactory. Less than 50% of the respondents met the target set for total cholesterol [Table/Fig 3] summarized the characteristics and prevalence of the RF.

(Table/Fig 3)Frequency Of Cardiovascular Risk Factors

Risk factors	n (%)
Current smokers (*n*=217)	31 (14.3)
Fruit and vegetable intake < 5 servings/day (*n*=215)	198 (92.1)
Moderate physical activity < 3 days in a week (*n*=214)	139 (65.0)
Body mass index ≥23 kg/m^2 (*n*=210)	154 (73.3)
Blood pressure ≥ 140/90 mmHg (*n*=206)	41 (19.9)
Fasting blood glucose ≥ 5.6 mmol/L (*n*=178)	44 (24.7)
Total cholesterol ≥ 6.2 mmol/L (or 5.2 mmol/L in the presence of 2 or more risk factors) (*n*=178)	92 (51.7)

Burden Of Cardiovascular Risk Factors

The responses to the RF were aggregated to create a variable representing individual's total number of RF. The burden of RF ranged from one to six with a median of 3 (IQR=2). Most of the subjects (n=203, 93.5%) has two or more RF and thus was categorized as being in high risk according to the definition National Cholesterol Education Program (NCEP)[25] [Table/Fig 4]. There was no statistical significant difference between the number of RF and sex, age group or occupation.

(Table/Fig 4) Burden Of Cardiovascular Risk Factors (N=217)

Number of risk factors	Prevalence (%)
1	14 (6.5)
2	42 (19.4)
3	78 (35.9)
4	55 (25.3)
5	22 (10.1)
6	6 (2.8)

Clustering Of Risk Factors

The presence of two or more RF in an individual is taken as clustering of RF. We investigated factors contributing to clustering of RF in our respondents [Table/Fig 5]. Respondents with clustered RF were older (37.2 vs 31.6, p=0.018), low intake of fruits and vegetable (94.0% vs 64.3% not meeting requirement, p=0.012), less physically active (2.1 vs 3.9 days, p=0.001), had a higher BMI (26.2 vs 21.4 kg/m^2, p<0.001), SBP (125.3 vs 115.1 mmHg, p=0.037), DBP (77.4 vs 70.4 mmHg, p=0.027) and FBG (5.4 vs 4.6 mmol/L, p=0.033).

(Table/Fig 5) Characteristics Of Respondents With And Without Clustered Risk Factors

Characteristics	Clustered risk factors		*p*-value
	≥ 2 risk factors (frequency (%))	< 2 risk factors (frequency (%))	
Age (years) (n=217)*	37.2 (9.2)	31.6 (8.6)	0.018†
Sex (n=217)			0.552‡
Male	118 (58.1%)	7 (50.0%)	
Female	85 (41.9%)	7 (50.0%)	
Occupation (n=217)			0.527§
Professional	54 (26.6%)	2 (14.3%)	
Supporting	149 (73.4%)	12 (85.7%)	
Smoking status (n=217)			0.698§
Current smokers	30 (14.8%)	1 (7.1%)	
Non smokers	173 (85.2%)	13 (92.9%)	
Fruit and vegetable intake/day (n=215)			0.012§
< 5 servings/day	189 (93.6%)	9 (69.2%)	
≥5 servings/day	13 (6.4%)	4 (30.8%)	
Moderate physical activity/week (n=214)			<0.001‡
< 3 days/week	138 (68.3%)	1 (8.3%)	
≥ 3 days/week	64 (31.7%)	11 (91.7%)	
Body mass index (n=210)			<0.001‡
< 23 kg/m^2	45 (22.7%)	11 (91.7%)	
≥ 23 kg/m^2	153 (77.3%)	1 (8.3%)	
Blood pressure (n=206)			0.131§
< 140/90mmHg	152 (78.4%)	13 (100.0%)	
≥ 140/90mmHg	42 (21.6%)	0	
Fasting blood glucose (n=178)			0.123§
< 5.6mmol/L	124 (73.8%)	10 (100.0%)	
≥ 5.6mmol/L	44 (26.2%)	0 (0%)	
Total cholesterol (n=178)			0.051§
< 6.2 or 5.2mmol/L	90 (53.6%)	8 (80.0%)	
≥ 6.2 or 5.2mmol/L	78 (46.4%)	2 (20.0%)	

* mean (standard deviation); † Mann Whitney U test; ‡ Chi Square test; § Fisher-Exact test

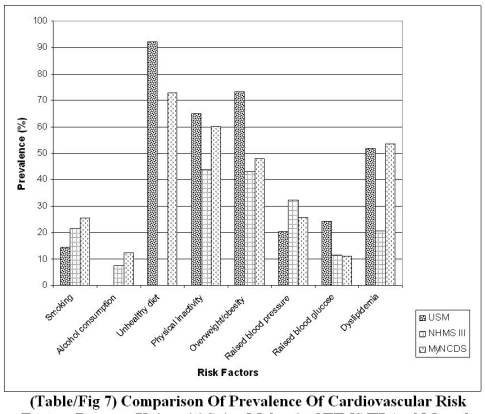
Analysis of multiple logistic regression found that fruit and vegetable intake, physical activity and BMI were significantly associated with risk of having clustered RF. Correlation coefficients between these RF and having clustered RF were found to be -0.215 (p=0.002), -0.226 (p=0.001) and 0.288 (p<0.001) respectively. Further analysis showed that these three RF formed a good predictive model for prediction of clustered RF model with a chi square value of 1.610 and significance value of 0.991. Moreover, the Nagelkerke R-squared of 0.529 further supported these three RF explained more than 50% of the variation of the model. The odds of an individual who lack of fruit and vegetable intake and increasing BMI having clustered RF were 27.9 and 1.8 respectively. The amount of physical activity was negatively associated with clustered RF with an odds ratio of less than 1. It was found that increasing physical activity reduced the odds of having clustered RF by two times. The odds ratios for prediction of clustered RF were summarized in [Table/Fig 6].

(Table/Fig 6) Odds Ratio For Prediction Of Clustered Risk Factors

Risk factors	Odds ratio	*p*-value
Lack of fruit and vegetable intake	27.854	0.001
Moderate physical activity	0.519	0.002
Increased body mass index	1.792	<0.001

Comparison Between Sample Population And National Data

Two large scale national surveys were conducted in 2006, namely the NHMS III and MyNCDS. These surveys aimed at determining the prevalence of RF among Malaysians. A total of 56,710 and 2572 Malaysians from all across the country were included in these surveys respectively. In general, our study population was older than the population enrolled in the NHMS III (36.8 vs 28.6 years). Apart from smoking, alcohol consumption and raised BP, the prevalence of the other RF were higher among our study population [Table/Fig 7].



(Table/Fig 7) Comparison Of Prevalence Of Cardiovascular Risk Factors Between Universiti Sains Malaysia, NHMS III And Myncds Population

Discussions

In view of the increasing trend of the incidence of CV diseases among Malaysians, there is a need for primary prevention strategies to be implemented. This study aimed to report the results of the screening program in order to identify individuals at risk for future CV events. However, although much effort has been put in to maximize the screening rate, only 27.7% of all employees of the campus came forward for the screening. This is probably because of the 'silent' nature of RF and thus are normally perceived as a threat [27].

Results from this study showed that RF such as unhealthy diet, physical inactivity, overweight/obesity and raised total cholesterol were highly prevalent among the USM population. This resembles closely with the results from the MyNCDS survey. This could be due to the similarities in the data collection form used in our study. The data collection form used in this study was adapted from the 'WHO Stepwise approach to chronic disease RF surveillance' instrument [28].

A report published by Khoo in the year 2000 on the results of health screening program in 10 major centres in Malaysia found similar characteristics in the four RF studied (BP, BMI, total cholesterol and FBG) in terms of the relationships between RF and sociodemography characteristics [29]. Similar prevalence was also reported in previous studies conducted elsewhere [30],[31],[32]. It was also reported that men had a higher prevalence of smoking and raised BP and as well as achieving the minimum requirement for physical activity. This result was consistent with the results in a study conducted in Taiwan [33].

The prevalence of respondents who were classified as pre-hypertensives and those with impaired glucose tolerance were 44.7% (n=92) and 19.1% (n=34) respectively. These respondents would benefit from therapeutic lifestyle changes including modifying their cardiovascular risk factors [18],[21].

This study showed that our respondents have more cardiovascular risk factors than reported elsewhere. It is found that all the respondents have at least one RF, with a median of three RF. This is much higher than the figure reported in a study reported by Coups in 2004, with a mean number of RF of 1.54 [34]. Moreover, none of the respondent in our study population has no RF as compared with 3% reported in the MyNCDS survey [28]. This figure is worrying as most studies reported up to 10% of their subjects have no RF. However, all of these studies, except the MyNCDS only take into account four lifestyle RF, mostly being smoking status, BMI, BP, FBG and blood lipids [30],[31],[35]. The exclusion of fruit and vegetable intake as well as physical activity assessment in the other studies has a huge impact on the burden of RF as the prevalence of these two RF among our study population is especially high. As our sample were mostly white-collared employees of the university, it is not surprising to observe a high prevalence of unhealthy diet and physical inactivity among the employees. In this case, improving the environmental and social support might help in improving and modifying these RF.

Risk factors tend to cluster and have multiplicative effect which means the damage caused by one RF alone is exaggerated in the presence of another RF

[30],[31]. From our study result, more than 90% of our study population has clustered RF, defined as having two or more RF at the same time. Moreover, there was no statistical significant difference between respondents with or without clustered RF in terms of sex or occupation in contrast with reports from previous studies on clustering of RF which found clustering was associated with being female, higher income, urban residence and physical inactivity [31],[36]. Although there are quite a few reports on clustering of RF, it is rather difficult to compare these studies. This is due to the differences in RF being studied, different cut-off point to be considered at higher risk and different analytical technique used for clustering. However, results from the multiple logistic regression analysis provided strong ground for targeting fruit and vegetable intake, physical activity and BMI for a comprehensive management of cardiovascular risk factors in USM population.

Study Limitations

Results reported here are subjected to several limitations. This is a cross-sectional study and hence it is almost impossible to determine the effect of RF in the long- term. The lifestyle RF were self reported by the respondents and the researchers did not use objective measures to verify their answers. This is also subject to recall bias on the part of the respondents. The response rate was quite low and since this is a voluntary screening, most probably only those who is more concerned about their health attended the screening.

Comparisons between this study results and results from NHMS III and MyNCDS were made more complicated due to the lack of uniformity in terms of survey forms used as well as definitions of some of the RF[13],[28]. The difference in cut-off points for RF definitions for FBG and BMI have great impact on the prevalence of RF with more stringent criteria will result in a higher prevalence in a given population.

Conclusions/Recommendations

It can be concluded that our study population has high prevalence for some of the cardiovascular risk factors and these RF tend to cluster and have multiplicative effect on the intermediate and long-term outcome. This result is consistent with results from nationwide epidemiological study.

This study serves to be a preliminary report in identifying individuals at risk for future CV events. This will assist in strategic planning to promote healthy lifestyle targeting all eight RF since they are closely related, among employees of USM especially high risk respondents. If the any of the thresholds for referral to the clinicians was reached, prompt referral will be made so that there is no long term adverse outcome to them.

List Of Abbreviations Used

Blood pressure (BP)
Body mass index (BMI)
Cardiovascular (CV)
Diastolic blood pressure (DBP)
Fasting blood glucose (FBG)
Interquartile range (IQR)
Malaysian Non-Communicable Disease Survey (MyNCDS)
National Cholesterol Education Program (NCEP)
National Health and Morbidity Survey III (NHMS III)
Non-communicable disease (NCD)
Risk factor (RF)
Standard deviation (SD)
Systolic blood pressure (SBP)
Universiti Sains Malaysia (USM)

Conflict Of Interest

The authors declare that there is no conflict of interest.

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