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Short Communication

Coronary heart disease risk factors among academic workers based on the Jakarta Cardiovascular Score: A cross-sectional study

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Abstract

Change in lifestyle leads to change in disease patterns from infectious diseases and malnutrition to degenerative diseases, such as coronary heart disease (CHD). The increasing prevalence of cardiovascular diseases among Indonesian workers and the general public will not only burden medical care expenses but also reduce work productivity, leading to more work-related injuries and work-related losses. The aim of this study was to determine the risk factors for CHD (age, sex, blood pressure, smoking, diabetes mellitus, body mass index, and weekly physical activity) and the CHD risk level among university workers. A cross-sectional study was conducted at workers at School of Medicine, Universitas Malikussaleh, Lhokseumawe, Indonesia. The risk level of CHD was calculated using Jakarta Cardiovascular Score and predicting model analyzed with multiple logistic regression model. Our data found that 58.2%, 25.5% and 16.3% of the university workers had low-, medium- and high-risk to have CHD. The final model indicted that the risk of heart disease was determined by gender, age, and the presence of hypertension and diabetes mellitus. Being male had odds ratio (OR) 30.84, aged >41 years old had OR 11.52, having hypertension had OR 4.87 and having diabetes mellitus had OR 13.99 for having high risk of CHD compared to female, those younger than 41 years old, having no hypertension and having no diabetes mellitus, respectively. In conclusion, our data suggests that more than 15% the respondents (university employees) have high risk of CHD and being male and older, and having hypertension and diabetes mellitus are associated with risk of CHD. Implantation of the preventive measures is therefore important to be implemented at the universities.

Keywords: CHD, campus-worker, risk factor, risk level, cardiovascular

Introduction

An occupational disease is a health problem caused by the work environment or the work itself. Today, lifestyle changes have caused disease patterns to change, from infectious and nutritionally prone diseases to degenerative diseases, including coronary heart disease (CHD) [1]. Diseases that often affect workers at productive age are divided into two categories: (1) diseases caused by muscles, joints, bones, and limbs; and (2) the diseases caused by an unhealthy lifestyle, for example, heart disease, diabetes mellitus and others [2]. The increasing prevalence of CHD in workers and the public in Indonesia is a burden not only because of the high cost of treatment but also decreased work productivity [3].

According to World Health Organization (WHO), CHD is the leading cause of death globally with an estimated 17.9 million people died in 2016, representing 31% of all global deaths [4]. Of

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these deaths, 85% are caused by heart attacks and strokes. More than three-quarters of deaths from cardiovascular disease occur in low and middle-income countries. Based on Indonesian Basic Health Research data of 2018, the incidence of CHD is increasing from year to year and at least 15 out of 1,000 people or around 2,784,064 individuals in Indonesia suffer from heart disease [5].

According to the WHO, the most important behavioral risk factor for heart disease and stroke are an unhealthy diet, a lack of physical activity, tobacco use, and the harmful use of alcohol[4]. The effects of behavioral risk factors can appear in individuals as increased blood pressure, increased blood glucose, increased blood lipids, and overweight and obesity [6]. Determinants related to CHD are age, gender, smoking, dyslipidemia, hypertension, diabetes mellitus, lack of physical activity, obesity, an unhealthy diet, stress, and excessive alcohol consumption [7]. According to research in 2020, physical activity factors and high body mass index (BMI) are the biggest risk factors that feared to trigger CHD in soldier [8]. A study in 2020 at state that workers with low job control are at increased risk of all-cause and CHD mortality compared to workers with high job control [9] and a study among employees of Dr. Soebardi Jember, Indonesia indicated that 6.3% of employees were at high risk of CHD [10].

University workers have high risk for CHD due to lack of activity and lack of exercise. Many workers have poor knowledge of heart disease risk factors, even though they worked in the university community [11]. The aim of this study was to determine the risk factors for CHD and to estimate the risk level of CHD in the university workers.

Methods

Study design and participants

A cross-sectional study was conducted to calculate risk factors and the risk level of CHD among workers at School of Medicine of Universitas Malikussaleh in Lhokseumawe, Indonesia. The list of staff members listed in the faculty personnel section served as the sample framework and the Epitools was used to calculate the minimal sample size. Sampling was conducted using simple random sampling from the list.

Study variables and data collection

The level of risk factor for developing cardiovascular disorders was measured using the Jakarta Cardiovascular Risk Score. The scores are based on seven items: gender, age, blood pressure, smoking, diabetes, BMI, and weekly physical activity [12]. A direct measurement of BMI, blood pressure, and blood sugar levels was made. Blood pressure was measured at morning for all respondents. Respondents were told to not eat or drink for 30 min before taking their blood pressure, emptying the bladder, sitting in a comfortable chair with their back supported for at least 5 min, putting both feet flat on the ground, and keeping their legs uncrossed as recommended [13]. Omron upper arm blood pressure monitor (Omron Healthcare, Illinois, US) was used to measure the blood pressure since it has been tested and validated for clinical accuracy by US he National Opinion Research Center (NORC) [14]. Systolic blood pressure levels between 120 and 139 mm Hg and diastolic between 80 and 89 mm Hg were classified as prehypertension while hypertension was defined as a systolic 140 mm Hg or higher or diastolic level of 90 mm Hg or higher [15]

The random blood sugar was measured using capillary blood glucose test that collected from a fingertip prick. The advantages of this method is only need small blood sample, range of alternate sites capable of testing, short testing time, large display on glucometer and less painful than venipuncture [16]. The blood glucose level was measured using point of care testing (POCT) method using Autocheck GCU 3 in 1 (Gea Medical, Jakarta, Indonesia). Non-fasting blood glucose levels were categorized based on International Diabetes Federation: normal (below 90 mmol/L), prediabetes (between 90 mmol/L and 199 mmol/L), and diabetes (>200 mmol/L) [17]. To calculate the BMI, the height and weight were measured directly and BMI was calculated by dividing the body weight (in kg) by height (in m^2). A BMI of 25.0 or more was classified as overweight as recommended [17]

Through direct interviews are age, gender, physical activity, and smoking habits were evaluated. Physical activity was assessed using Global Physical Activity Questionnaire (GPAQ). The GPAQ assesses the places where physical activity is done (activity at work, travel to and from places, and recreational activities) [18]. Two questions were asked, in the form of "Yes/No", for vigorous- and moderate-intensity activities. Those who responded "No" for both type of activities at the workplace were classified as "sedentary at work". Smoking habit was evaluated using questionnaire consisting three questions about smoking history in the last six months, number of cigarettes and the first smoking age using Brinkman Index. Respondents were classified as smokers and non-smokers of which all those with Brinkman Index <400, 400–799, ≥800 were defined as smoker while former and never smoking in last six month defined as non-smoker as described previously [19].

Jakarta Cardiovascular Score

The Jakarta Cardiovascular Score is a modification of the Framingham Score that has a sensitivity of 77.9%, specificity of 90%, a positive predictive value of 92.2% and a negative predictive value of 72.8% [12]. The Jakarta Cardiovascular Risk Score contains seven items that aim to identify risk factors for cardiovascular disorders (CVD) that participants may experience. The items include gender, age, systolic blood pressure, BMI, smoking behavior, the existence of diabetes mellitus and physical excise. Each possible answer within indictor was given different scores (either negative or positive) and the total score ranges from -7 to 18. The risk of developing a CVD increases with score. A participant was classified into three groups: low risk (scores of -7 to -1), moderate risk (scores of 2 to 4), and high risk (scores of 5 or above) [12]. The detailed of each item and the scoring system have been described previously [12].

Statistical analysis

A logistic regression model was employed to produce a predictive model for a CVD risk factor. Multiple logistic regression was used since it could explain the relationship between one dependent variable (level of risk factor) and two or more predictors [20,21]. A $p<0.05$ was considered significant and all the analyses were conducted using IBM SPSS Statistics 23 (IBM, New York, US). Multiple regression is a statistical technique that can be used to analyze the relationship between a single dependent variable and several independent variables. The objective of multiple regression analysis is to use the independent variables whose values are known to predict the value of the single dependent value. Each predictor value is weighed, the weights denoting their relative contribution to the overall prediction [22].

Results

Sociodemographic characteristics and overview of CHD risk category based on Jakarta Cardiovascular Score

A total of 98 respondents, consisting of 60 lecturers and 38 staffs, were included in this study. Most of the respondents were female (61.2%) and aged 40–44 years (31.6%) (**Table 1**). Most of the respondents had normal blood pressure (57.1%) but 19.4% of them had grade 1 hypertension. Most of the respondents had no diabetes mellitus (81%), had sedentary at work (74.5%) and non-smoker (81%) (**Table 1**).

Based on the CHD risk factor level, 58.2%, 25.5% and 16.3% of the respondents had low, medium and high-risk category of CHD, respectively.

Coronary heart disease risk factors

Logistic regression is a statistical model used to estimate the effect of factors when we have categorical response [23]. In this study, gender, age, hypertension, diabetes mellitus, physical activity, smoking behavior are binary response for CHD. For convenience in multivariate analysis, several categories will be combined. Age was categorized as <41 and >41 based on the median age (41). The normal category of hypertension is defined as not hypertension (no), while pre-hypertension and grade 1 hypertension are defined as hypertension (yes). The bivariate logistic regression analysis indicated that gender, age, hypertension, diabetes mellitus, physical activity

and smoking behavior had a $p<0.25$. These variables were included in the multivariate modeling to determine which variables influence most on the risk of CHD (**Table 2**).

Table 1. Characteristics of the respondents and overview of CHD risk factors

Variable	Frequency (n=98)	Percentage (%)
Gender		
Male	38	38.8
Female	60	61.2
Group of age		
25–34	10	10.2
35–39	29	29.6
40–44	31	31.6
45–49	16	16.3
50–54	9	9.2
55–59	2	2.0
60–64	1	1.0
Hypertension		
Normal	56	57.1
Prehypertension	23	23.5
Grade 1 hypertension	19	19.4
Grade 2 hypertension	0	0.0
Grade 3 hypertension	0	0.0
Diabetes mellitus		
No	80	81.6
Yes	18	18.4
Physical activity		
Vigorous-intensity activity	0	0.0
Moderate-intensity activity	25	25.5
Sedentary at work	73	74.5
Smoking behavior		
Non-smoker	78	79.6
Smoker	20	20.4
Coronary heart disease risk category		
Low-risk	57	58.2
Medium-risk	25	25.5
High-risk	16	16.3

Table 2. Initial model of coronary heart disease risk factors

Variable	Coronary heart disease risk				OR	95% Confidence interval		p-value
	Yes		No			min	max	
	n	%	n	%				
Gender					6.04	1.21	30.14	0.001
Male	31	81.6	7	18.4				
Female (*R*)	10	16.7	50	83.3				
Age (year)					56.58	5.46	585.89	0.001
>41	30	65.2	16	21.2				
≤ 41 (*R*)	11	34.8	41	78.8				
Hypertension					4.51	0.98	20.56	
Yes	22	52.4	20	47.6				0.067
No (*R*)	19	33.9	37	66.1				
Diabetes mellitus					22.77	1.90	272.91	0.004
Yes	13	72.2	5	27.8				
No (*R*)	28	35	52	65				
Physical activity					0.74	1.28	4.31	0.46
Moderate-intensity	12	48	13	52				
Sedentary at work (*R*)	29	39.7	44	60.3				
Smoking behavior					0.27	0.18	0.38	0.001
Smoker	20	100	0	0				
Non-smoker (*R*)	21	26.9	57	73.1				

R: Reference group

The multivariate test using the prediction model suggested that gender, age, and having hypertension and diabetes mellitus were risk factors for CHD (all had $p<0.05$). Physical activity

was excluded because the OR showed was protective. Final model showed that men have 30 times the risk of developing CHD than women (**Table 3**).

Table 3. Final model of coronary heart disease risk factors

Variable	Coefficient	Odds ratio	95% Confidence interval		*p*-value
			min	max	
Gender (male)	3.429	30.84	7.37	128.93	<0.001
Age (>41-year-old)	2.445	11.52	2.90	45.78	0.001
Having hypertension	1.585	4.87	1.26	18.87	0.022
Having diabetes mellitus	2.638	13.99	2.25	86.90	0.005
Constanta	-16.020	0.000			<0.001

Discussion

Our study suggested that more than 16 % of the respondents had a high-risk of CHD and being male, being older and having hypertension and diabetes mellitus were the risk factors of CHD. The aging is a physiological process that could cause atherosclerosis and the risk of CHD increases with age. Data of Indonesian Basic Health Research 2013, the highest CHD incidence was reported among those 65–74 years [24].

Our data also suggested that men had 30 times the risk of developing CHD than women. In men, the risk of CHD increases linearly over time, and the atherosclerotic process is constantly occurring. In contrast, since estrogen has a beneficial effect on the cardiovascular system, women are more protected from atherosclerosis during the fertile period [25]. According to the American Heart Association (AHA) data in 2016, among the 5.1 million cases of heart failure, 52.9% were men and 47.1% were women[26]. Over 60 million women (44%) in the United States are living with some form of heart disease.2 Heart disease is the leading cause of death for women in the United States and can affect women at any age. In 2021, it was responsible for the deaths of 310,661 women [27]. Women are more likely to have heart failure and have higher rates of hospitalization and mortality compared with men [28]. A study in Japan found that male workers may be more susceptible to stress effects than female workers. This is because male workers have high stress levels in daily life, tend to have more job involvement or organizational commitment, and work longer hours than their equivalents [29]. As a result, cardiovascular disease mortality has been increasing among male workers since the late 1990s in Japan [29].

Management of the risk of CHD needs to be placed to reduce the risk. Blood pressure is a modifiable risk factor for CHD and with the right intervention and preventive measures, blood pressure can be controlled and remains normal. Obesity is also a risk factor that puts workers at greater risk of CHD. As compared to non-diabetics, those with type 2 DM carry a higher mortality risk from cardiovascular disease [30]. Hyperglycemia in diabetic individuals causes glycoprotein accumulation on the walls of the coronary blood vessels that destroys the structure and function of the arteries leading to decreased blood flow to the heart muscles [31].

Unhealthy lifestyles such as smoking and lack of physical activity could accelerate atherosclerosis formation. The nicotine in cigarettes causes the production of catecholamines that could induce vasoconstriction of blood vessels, increase heart rate, and increase oxygen use. In addition, cigarette smoke contains carbon monoxide (CO) that could damage blood vessels and CO could bind to hemoglobin leading to hemoglobin carry less oxygen. Due to the lack of oxygen, the body compensates by vasoconstriction and if this continues blood vessels will be damaged then atherosclerosis is the initial stage of CHD [32]. A recent prospective urban-rural epidemiology study measured the effect of modifiable risk factors on cardiovascular diseases across 21 countries and reported that multiple modifiable lifestyle behaviors were associated with a lower risk of cardiovascular mortality [33]. The same study also found that 6.1% of cardiovascular disease can be attributed to poor diet and tobacco use, whereas low physical activity contributed a modest effect (1.5%) to the risk [33]. A recent 4C Study reported that a healthy lifestyle was important for preventing CHD in individuals who already had four or more metabolic risk factors[34]. Although in this study, physical activity and smoking behavior were protective factors against CHD, this could be due to the lack of in-depth questions on smoking

habits and physical activity that were only measured at one time. We recommend in-depth interviews and measurements over a longer period of time.

The are some limitations of the presenting study that need to discussed. This is a cross-sectional study with relatively small sample size and therefore further cohort study design with longer time and larger sample size need to be conducted. Examination of blood pressure and blood sugar levels using rapid checks in this study. The expectation is that the future will include studies using more accurate laboratory tests. However, we assume this study could still prediction for coronary heart disease among workers.

Conclusion

Our data suggests that 25% of the respondents (university employees) have medium-risk of CHD and being male and older and having hypertension and diabetes mellitus are associated with risk of CHD. Therefore, improving health services and counseling about risk factors by providing counseling and direct health promotion are expected to be implemented in the workplace to reduce the incidence of CHD.

Ethics approval

This study was approved by Health Research Ethics Committee Faculty of Medicine University of Muhammadiyah Sumatera Utara (858/KEPK/FKUMSU/2022). All respondent voluntarily signed the informed consent.

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Conflict of interest

All the authors declare that there are no conflicts of interest.

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Underlying data

All data underlying the results can be requested from the corresponding author.

How to cite

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