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PREDICTION MODEL OF CORONARY HEART DISEASE (CHD) SUSPECT, PUBLIC HEALTH-BASED

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ABSTRACT

Aimed: *This study aimed to identify prediction model of CHD suspect public health-based through the analysis of risk factors for CHD. Community-based instrument should be inexpensive, easy to perform, and simpler than any other scores.*

Method: *The method was cross-sectional study by processing data from RISKESDAS 2007. Risk factor analysis was conducted to determine predictor variables in the sample of 162 962 people. Chi square analysis was used to assess the relationship between variables. Further analysis was conducted using logistic regression, however variables were eliminated that required laboratory tests and mutual collinearity.*

Results: *Multivariate analysis found five variables that could be a predictor of for community-based CHD. The minimum number of significant variables to predict CHD was three out of five predictor variables (p <0.05). CHD predictor variables i.e., age> 40 years (OR = 2.08; 95% CI: 1.85 to 2.34), blood pressure of 129.5 / 87.5 mmHg (OR = 1.36; 95% CI: 1 , 21-1.53), abdominal circumference ≥82 cm for women and ≥83 cm for men (OR = 1.34; 95% CI: 1.18 to 1.52), smoking status ≥20 cigarettes / day (OSR = 1.09; 95% CI: 0.94 to 1.26), and sex: male (OR = 0.57; 95% CI: 0.49 to 0.66). The instrument reliability test was taken to CVD Jakarta scores with kappa value = 0, 6.*

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Conclusion: *The prediction model of CHD as a screening tool in the community was made, using the five predictor variables such as: age, sex, smoking status, abdominal circumference and blood pressure. Each variable had a score of 1, so that the total score was 5, and if someone scored ≥3, then he/she would be CHD suspect. This prediction model was named CHD Riskesdas score.*

Keywords: *Suspect CHD, risk factors, prediction model*

INTRODUCTION

Coronary Heart Disease (CHD) was a major cause of death and morbidity throughout the world, particularly in the developed countries such as in Europe and America (McGovern et al., 1996). According to WHO, the incidence of death due to CHD was very high, even reaching 243 048 cases. In 2002, more than 7 million people worldwide died from CHD, and it was expected to increase up to 11 million in 2020 (Ethical digest, 2005). One of the developed countries, Scotland, CHD became the leading cause of death. Similar condition also occured in several countries in Europe, America, and Australia (Hotchkiss et al., 2014). In the United States, it was estimated that every 25 seconds, there was one person who suffered from CHD, and 34% of them ended in death in the same year (Lloyd et al., 2009).

In addition to the vital impact of death, other effects associated with CHD were a decrease in productivity, however it would increase the burden of the state budget. In some countries, an estimated of $ 84 billion in cash would be lost due to CHD, stroke, and diabetes between 2006 and 2015 (Abegunde et al., 2007). Prevention program was actually more efficient. The average cost for preventive program of The Georgia Stroke and Hearth attact was $ 486 per patient per year, while if it was compared with the cost of treatment with no standard care and treatment with standard care reached to $ 534 and $ 624 (Chen et al., 2006).

In Indonesia, the government budget paid through the Community Health Insurance program (Jamkesmas) for services in catastrophic cases such as heart surgery increased rapidly. In 2005, the number of cases reached to 380 cases with the cost more than 3 billion rupiah. This was increased to 9893 cases in 2007 to reach 27 billion budget expense (MoH, 2008). Diseases-related to tobacco was considered to have a large contribution to finance the treatment, i.e., 2.1 trillion rupiah, and one of these diseases was cardiovascular disease (MoH, 2013).

Multi-factorial variables were the cause of CHD, an estimated 90% of people with coronary heart disease (CHD) preceded by at least one of the risk factors such as smoking, diabetes, hypertension, or hypercholesterolemia (Greenland et al., 2003). A very high exposure of these risk factors would give a burden to the

atherosclerosys that eventually led to serious clinical problem i.e., the occurence of CHD. The large number of incidence and deaths due to CHD was caused by the high prevalence of obesity, particularly central obesity. Central obesity was a risk factor, and approximately 53% of Americans experienced the central obesity (Kones et al., 2011).

The main purpose of the controlling program through epidemiology and preventive approach was to develop an instrument that could be used to predict the disease. The predictive capacity of CHD risk factors was age group, sex, smoking, high blood pressure, increased LDL, increased level of cholesterol, low HDL, and diabetes mellitus. The model / instrument that could be used was Framingham risk score (Wilson PW et al., 1998). According to Nicolas (2010), atherosclerosis marker and inflammatory markers could be used to predict CHD in adults. (Nicolas, 2010), while Basuni (2009) used gender, age, lipid profile, systolic blood pressure, smoking status, and diabetes from family history as a predictor of CHD. In fact, there were some models / instruments that could used to predict CHD in addition to the Framingham score, such as Reynolds Score (Wilson, 1998), Q-Risk (Anynomous, 2014), a score of PROCAM (Basuni, 2009), and Jakarta CVD score (Kusmana, 2002).

All the instruments were basically based on the experiment in the laboratory, so public health implication was relatively expensive, and it required special skills to conduct laboratory examination. The public health-instrument should be cheap, easy to do and simple. Yet, the accuracy of the instrument differed between populations. Therefore, there should be a new model to predict the risk of CHD to the population in Indonesia. So, this study aimed to find an instrument with a simple-scoring, easy-measurement, inexpensive and did not require laboratory examination. It was in line with the demand of public health, which prevented the occurrence of CHD by using predictive model of suspected CHD- public health based.

With this model, the screening of CHD could be carried out in the community, So, the predictor variables that could be prevented such as central obesity and hypertension, and smoking cessation could be performed optimally in health facility level 1 (PPK1). The goal was to reduce the budget of the State, because the use of health facility at level 2 and 3 (hospital) would be costly. Observing the wide disparity in Indonesia, we hope that we could do a mapping of the risk of CHD by making "the diagnosis region by the province" , and the problematic predictor variable could be followed up.

RESEARCH METHODS

The design was a cross sectional study using data from the Basic Health Research (Riskesdas) in 2007. The population was the sample from the household members i.e., 987 205 people. The sample was the household member who met the inclusion criteria 1) age ≥25 years, 2) not pregnant, 3) had all the data of CHD risk factors with minimum criteria of Jakarta Cardiovascular Disease (CVD) Score, namely: age, sex, physical activity, blood pressure, weight, height, suspected diagnosis of CHD, and smoking history. Based on these criteria, the number of sample that met the requirement was 162 962 people. The independent variable was CHD suspect namely household member with the diagnosis of heart disease by medical-doctor and had complained of chest pain. Dependent variables were risk factors of CHD. Data analysis was univariate, bivariate, and multivariate analyzes. Variables with $p < 0.25$ would be included in the selected variables, and then Multivariate analysis would be conducted.

Analysis backward conditional method was used as a multivariate analysis that would find the variable in the modeling with a value of $p < 0.05$. When there was a change in the value of the odds ratio (OR) that exceeds 10% then it would be put back into modeling and considered as confounding factors. Test of interaction effect would be conducted to identify variable that required laboratory tests and the collinearity variables . The threshold for abdominal circumference and blood pressure by considering the value of OR from 1.5 to 2.0. The threshold for abdominal circumference as a risk-person, if ≥83 cm for men and ≥81 cm for women. Meanwhile, the threshold for the blood pressure was 129.5 / 87.5 mmHg, If the value was greater than the threshold then it would be considered as a risk-person. The variables of age, sex, and smoking status would be categorized risk if the age ≥40 years, male, and if they still smoked one month ago. Reliability test on Jakarta scores of CVD, if the value of kappa ≥0,5, then the score for CHD from Riskesdas could be used as a screening instrument in our society.

RESULTS

Table 1 showed the results of the analysis of risk factors based on the characteristics. The variable characteristics, age group 50-54 years as the most suspected risk factor for CHD. In addition, sex and employment were seen as a protective factor with suspected CHD ($p < 0.05$).

Table 1. Risk factors based on characteristics

Variables	%	OR	95% CI	P
Sex				
Male	0,8	0,61	0,55-0,68	0,000
Female	1,3	1		
Age Group (year)				
25-34	0,4	1		0,000
35-39	0,8	1,83	1,51-2,21	
40-44	1,0	2,29	1,90-2,77	
45-49	1,2	2,84	2,37-3,41	
50-54	1,4	3,23	2,68-3,89	
55-59	1,3	2,99	2,42-3,71	
>60	1,4	3,29	2,73-3,98	
Education				
Risk	0,9	1,09	0,95-1,24	0,25
Not At Risk	0,9	1		
Work				
Risk	0,8	0,73	0,62-0,86	0,000
Not At Risk	1,1	1		

Among other factors that could modified, diabetes mellitus and mental health were the greatest risk factor for CHD. ($p < 0.05$) (Table 2).

Table 2. Risk factors that could be modified

Variable	%	OR	95% CI	P
Consumption of vegetable and fruit				
Risk	0,9	1,01	0,38-2,72	0,81
Not at risk	0,9	1		
Consumption of innards				
Risk				
Not at risk	1,9	2,09	1,59-2,77	0,000
	0,9	1		
Consumption of Fat				
Risk	1,2	1,31	1,23-1,51	0,000
Not at Risk	0,9	1		
Physical activity				
Risk	1,1	1,36	1,22-1,50	0,000
Not at risk	0,8	1		

Smoking status (>20 cigarettes)	0,9	1,34	1,09-1,66	0,007
Risk	0,7	1		
Not at risk				
Drink Alkohol				
Risk	1,2	1.29	0,82-2,03	0,33
Not at risk	0,9	1		
Blood Pressure				
Risk	1,4	1,91	1,72-2,12	0,000
Not at risk	0,8	1		
Diabetes Mellitus				
Risk	11,4	14,89	12,11-18,30	0,000
Not at risk	0,9	1		
Mental Health				
Risk	2,8	4,11	3,68-4,59	0,000
Not at risk	0,7	1		

In Table 3, Multivariate analysis. There was a significant correlation among variables i.e., sex, age, mental and emotional health, the consumption of innards, the consumption of fat, physical activity, abdominal circumference, blood pressure, and diabetes mellitus. Smoking habits showed no significant, however it was included in the multivariate analysis because its value was borderline and OR values exceeding 10%. In addition, smoking was considered as confounding factors.

Table 3. Multivariate analysis of risk factors for CHD Suspect

Variables	B	S.E	OR	95%CI	P
Sex	-.662	.126	.516	0.40-0.66	.000*
Age	.505	.084	1.657	1.41-1.95	.000*
Education	-.212	.105	.809	0.66-0.99	.043
Mental health	1.190	.089	3.286	2.75-3.92	.000*
Consumption of innards	.744	.203	2.104	1.41-3.13	.000*
Activity	.199	.078	1.221	1.05-1.42	.011
Abdominal circumference	.505	.132	1.657	1.28-2.15	.000*
Blood pressure	.381	.085	1.464	1.24-1.73	.000*
Diabetes Mellitus	2.568	.148	13.043	9.76-17.44	.000*
Smoking status (>20 cigarette)	.210	.109	1.233	0.99-1.53	.054
Const.	-5.930	.641	.003		.000

Logistic regression analysis was performed after removing variables using laboratory tests (diabetes), and difficult measurement (mental health), as well as mutual collinear variables (eg. consumption correlated with nutritional status). In Table 4, it could be seen that only a smoking habit which showed no significant result.

Table 4. Multivariate Analysis of Risk Factors of CHD Suspect, with CHD Suspect

Variable	B	S.E	OR	95%CI	P
Sex[1]	-0.558	0.077	0.572	0.492-0.666	0.000
Age[2]	0.734	0.061	2.084	1.851-2.347	0.000
Abdominal Circumference[3]	0.296	0.065	1.345	1.185-1.526	0.000
Blood pressure[4]	0.310	0.060	1.364	1.213-1.533	0.000
Smoking status[5]	0.080	0.077	1.092	0.940-1.268	0.25
Const.	3.305	0.183	27.251		0.000

1 male; 2> 40 years; 3≥ cut-off point (WHO); 4≥ 129.5 / 87.5 mmHg; 5≥ 20 cigarettes

Table 5. Predictor variables of CHD Suspect

Total Score	**Suspect of CHD**		**P**
	N	**%**	
Sex (1)	366	0,7	0,000
Age (2)	255	0,9	
Blood pressure (3)	419	0,9	
Abdominal circumference (4)	213	1,2	
Smoking status (5)	37	1,3	

Analysis on the fifth variable as a predictor of suspected CHD prediction model showed significant result (Table 5).

Table 6. Minimum Predictor Variable of CHD Suspect

Score	**Suspect of CHD**				Total		**P**	**OR**
	Yes		**No**					
	N	**%**	**n**	**%**	**n**	**%**		
4	213	1.3	17.232	98.8	17.445	100	0.000	1.82
3	419	0.9	46.760	99.1	47.179	100	0.000	1.32
2	366	0.7	52.674	99.3	53.040	100	0.88	1.02

Table 6 showed that the number of variables (scores of each variable = 1) of minimum predictor that still had a significant value was the score of ≥3, (OR = 1.32; p = 0.000). The study also conducted reliability test to Jakarta CVD score, with a kappa value = 0.6 (figure 1).

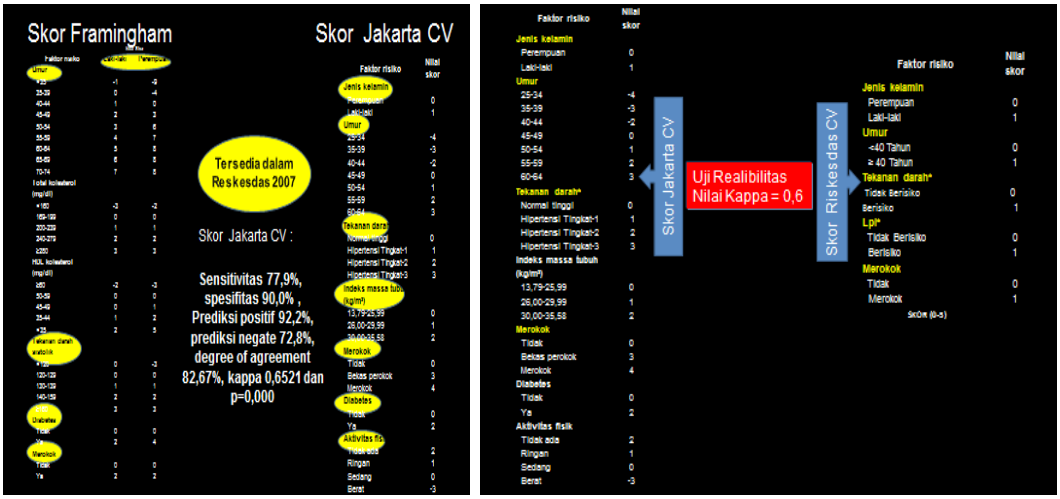

Figure 1: Comparison between Framingham Score, Score Jakarta CV, and the CV Riskesdas Score

DISCUSSION

To socialize the promotive and preventive efforts for public health, there was a need to have a public health-based screening instrument that was inexpensive, easy and simple, to predict CHD in the community. Conducting angiography in the community was certainly not ethically performed. Currently, existing instruments required laboratory tests so that it was difficult to implement because not all people had general health check up. The most important thing was to identify the risk factors that contributed to the incidence of CHD (Dent, 2010).

In Indonesia, we had national data i.e., Basic Health Research (RISKESDAS) in which we processed the data to further identify the greatest risk for CHD. Because the required data related to CHD was available on Riskesdas, then the model was so-called "CHD Riskesdas score". In this study, the result of the analysis on risk factors for CHD suspect, subsequently, was used as a predictor for screening model for CHD. It was found that the most significant variables that had the greatest risk were diabetes mellitus, and emotional mental health.

Yet, these two variables did not meet the criteria for the expected instrument because we needed a laboratory test to determine diabetes mellitus, whereas for emotional mental health would take a long period to determine. We hoped that

the screening tool could be applied in the community i.e, the instrument was simple, and it was easy to do i.e, the community could conduct the measurement without the help of health personnel, and it was cheaper because no laboratory-test. In this study, only five variables were included as predictor used for screening tool. Of the five predictor variables (age, gender, abdominal circumference, blood pressure, and smoking status), further analysis was conducted to determine the minimum number of predictor variables.

The result showed that there were three variables considered as minimum predictor variables for CHD (Table 6). To ensure that this prediction model could be used as a screening tool for CHD in the community, we conducted validation test of CVD Jakarta score with the kappa value = 0.6. Jakarta CVD score was chosen to make a comparison because it had fairly good value on sensitivity, specificity, positive predictive value and negative predictive value and it had fairly high degree of agreement (respectively 77.9%, 90%, 92.2%, 72.8% , and 82.67%) of the Framingham Score.

During the implementation, Jakarta CVD score was quite simple and relatively cheaper when compared to Framingham Score. Framingham score was the gold standard for screening tool for CHD suspect. The variables of age, sex, blood pressure, smoking status, and abdominal circumference were often included in the predictor variables of CHD.

Kusmana (2002) who developed CVD scores Jakarta, used the variables of age, sex, smoking status, blood pressure, body mass index (BMI), diabetes, and physical activity as a predictor variables. Then Basuni (2009), through PROCAM score used the predictor variables i.e., sex, age, HDL cholesterol, LDL cholesterol, triglycerides, systolic blood pressure, smoking status, and the presence of diabetes or not, as well as a family history of CHD.

Framingham score used age, sex, smoking status, blood pressure and total cholesterol, HDL, diabetes mellitus status, smoking status, physical activity as a predictor. This score could predict CHD for ten years to come in a large population. Scoring for screening tool in this study was easily carried out because each predictor variable was only declared by risk (score = 1) and not at risk (score = 0) .Then, it was very easy to calculate the total score, and it could quickly determined whether a person had a risk of CHD or not. People could be trained to measure abdominal circumference and blood pressure by using digital tensimeter. Therefore, people would be able to conduct self assessment including age, sex, and smoking habit. By doing that, people could ask for earlier consultation to the health facility level 1 if they met the criteria of this screening tool.

Additional knowledge was required for the measurement of blood pressure and abdominal circumference in order to perform precise measurements. Overall

the model of Riskesdas CHD score was simpler than Framingham score and Jakarta CVD score.

Several studies had determined the threshold for the normal category of blood pressure and abdominal circumference, but it varied. However, in general the threshold for the systolic blood pressure was different. British Hearth Reginal Study used the threshold with CHD suspect with 131-157 mmHg, while Caerphilly Heart Study determined the normal threshold with 126-150 mmHg. However, the most widely used as a reference for normal threshold was Framminghamm Heart Study i.e (120-140 mmHg). White Hall 2 Study used the smallest-normal threshold value i.e., 112-129 mmHg (Margaret, 2007). In the model of Riskesdas CHD score was 129.5 / 87.5 mmHg. According to WHO, in the journal of Alonso et al. (2008), the threshold for abdominal circumference was ≥ 85 cm for men and ≥ 90 cm for women. In this model, the smallest threshold was ≥ 83 cm for men and ≥ 82cm for women.

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CONCLUSION

Predictive model generated in this study was named Riskesdas CHD Score. The score consisted of five predictor variables (age, sex, smoking status, abdominal circumference, and blood pressure). If it was found that the score was ≥ 3 then the individual was declared CHD suspect, And if ≤ 2 was stated not CHD suspect.

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