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3 The profile of heart attack symptoms of cardiovascular patients at XYZ hospital

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Abstract. According to the World Heart Federation research, cardiovascular disease has the highest mortality rate in the world. Heart attacks can come suddenly without showing symptoms. Some symptoms that may appear are like chest pain and short of breath. The study will try to find the profile of attack symptoms of 1076 cardiovascular patients at XYZ Hospital based on age, gender, job, habit, weight-change, ECG, heart noise, breath noise, systolic, diastolic, pulse and sleeping problem. The method using here is the Classification Tree. The study results that the most influence factor to the heart attack symptom is the breath noise. If the breath noise is not normal, 80.5% will have symptom short of breath, for female, 93.6% will have symptom short of breath and for male 69.9% will have symptom short of breath. If the breath noise is normal, 59.3% will have symptom chest of pain. If breath noise is normal, heart voice regular, pulse is not normal, 47.1% will have symptom short of breath. If breath noise is normal, heart noise regular, pulse is normal, 72.3% will have symptom chest pain. If breath noise is normal, heart voice irregular, 47.9% will have symptom short of breath

1. Introduction

According to the World Heart Federation research, cardiovascular disease has the highest mortality rate in the world. The WHO (2017) stated that among the 56.4 million deaths in 2015 due to the top 10 causes, about 54% were attributed to cardiovascular disease. The disease accounted for 15.54% of total mortality in 2017 according to the Agency of Research and Health Development Indonesia. In general cardiovascular disease is a silent killer. Heart attacks can come suddenly without showing symptoms. Some symptoms that may appear are like chest pain (David Railton, 2018) and short of breath but they often come too late.

Sharol Ashma Menezes said that cardiovascular patients have abnormal ECG. Zhongwei Jiang at journal of biomedical engineering said that the cardiac sound measurement and analysis system for in-home use of heart abnormality monitoring heart noise. Anandep Chaudhuri and Jayanthi Thiruvengadam (2006) wrote that cardiac abnormality can be detected using heart sound and breathe noise. Andre-Pascal Kengne and his friends compares the strengths of the associations between different baseline blood pressure variables (systolic blood pressure), diastolic blood pressure and pulse pressure. It can be concluded that abnormal cardiovascular disease patients maybe have abnormal blood pressure and pulse pressure. Naima Covassin, PhD wrote about Sleep Duration and Cardiovascular Disease Risk (2015), so it can be thought that cardiovascular disease patients can have a sleeping problem. Other



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factor that may be indicate cardiovascular disease is a weight change of the patients (William B. Kannel and friends 1967)

The variables above are called health condition of the cardiovascular patients. Other than that, cardiovascular disease is influenced by age, gender, job and smoking habit. These variables are called demographic status of the cardiovascular patients. If the profile of heart attack symptom based on these variables can be found, so the protection of cardiovascular disease can be increased by taking attention of the profile of heart attack symptom. The heart attack symptom consists of chest pain or short of breath.

The study will try to find the profile of the heart attack symptom of cardiovascular disease (chest pain and short of breath) based on health condition of the patient (ECG, heart noise, breath noise, blood pressure, sleeping problem and weight change) and the demographic status of the patients (age, gender, job, smoking habit). The data analyses are made separately between demographic status variables and the joint of health condition variables and demographic status variables. The study uses data 1076 cardiovascular patients at XYZ Hospital in Indonesia and the data analyses are made by using Classification Tree method.

2. Research objectives:

The research objectives in this paper is to determine the heart attack syndrome's profile based on the demographic status variables and health condition variables of the cardiovascular patients at XYZ Hospital.

3. Classification Tree

The method used here is the Classification Tree method. Classification Tree is a nonparametric statistical method that explore the data using categorical tree. The Classification tree method is used to find the variable that most influences the response variable and find the profile of the response variable using the predictor variables. By the data grouping in the tree, the relationship between response variables with one or more predictor variables can be seen. In the classification tree, response variable is a categorical variable. In this study, response variables is the symptom of heart attack including short of breath and chest pain. In the classification tree there is a series of branches and nodes. Branches are part of a classification tree that connects between nodes. The nodes contain classes of response variables consisting of root nodes, parent nodes, child nodes, and terminal nodes.

The root node is the initial node that contains all the data to construct a classification tree. The root node will generate branches and other nodes called parent nodes. Next from the parent node will split and generate the new child nodes. In binary classification, each division will generate two child nodes, namely right node and left node. Child nodes that can no longer be split are called terminal nodes.

Here is a general overview of the classification tree:

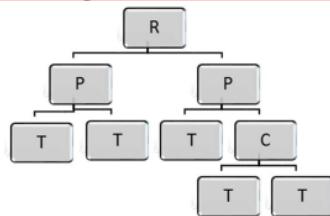


Figure 3.1 General Classification Tree

R is the root node, P is the parent node, C is the child node and T is the terminal node.

The classification tree is formed by binary recursive partitioning algorithm. The purpose of the binary is to divide the data on each parent node into two groups of child nodes that called right node

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and left node based on certain predictor variables. The splitting is done on each node until the terminal node is obtained (recursive).

3.1 Steps for built Tree Classification

Suppose there are N objects to be classified into S class. In this project, $S = 2$, short of breath and chest pain. Suppose that many nodes formed are denoted by t , where $t = 1, 2, \dots, T$.

There are three stages in the process of forming a classification tree:

3.1.1 Selection of Splitting Variable

At this stage the parent division process is done into two groups of child nodes containing all the sample data that are still heterogeneous. The samples were sorted according to the goodness of split criterion (best breaking criterion). Goodness of split criterion is a sorting evaluation by class s at node t which is defined as decreasing of heterogeneity or also called improvement. This criterion will result more homogeneous right and left node of the parent node.

Goodness of split criterion is formed based on impurity measure, denoted $i(t)$. Impurity measure is a measure of the heterogeneity of a class of a particular node in a classification tree. The impurity function used in this research is gini index, which is formulated with $i(t) = \sum_{j \neq i} C(i|j)p_jp_i$, where $p_j = (N_j(t))/(N(t))$. $N_j(t)$ is the number of objects in class j at node t , $N(t)$ is the sum of all objects in node t . Suppose $C(i|j)$ is the weight of misclassification stating the magnitude of the given penalty if the class object j is misclassified in class i at node t . $C(i|j) > 0$, $i \neq j$ and $C(i|i) = 0$, $i = j$.

The smaller the gini index value of a node, the better the process of separating an object into a class j .

3.1.2 Goodness of split criterion

Goodness of split criterion can be formulated as $\Delta i(s, t) = i(t) - p_L i(t_L) - p_R i(t_R)$

$\Delta i(s, t)$ = decrease of class heterogeneity at node t

$i(t)$ = impurity value at node t

p_L = the proportion of the number of objects on the left node

p_R = the proportion of the number of objects on the right node

$i(t_L)$ = impurity value at left n^{th} node

$i(t_R)$ = impurity value at right- t node

s = 1, 2, which denotes the number of classes in the classification tree

t = 1, 2, ..., T , which denotes the number of nodes in the classification tree

The best splitting variable is one that has the greatest $\Delta i(s, t)$ among all other possible divisions because greater $\Delta i(s, t)$ is possible to reduce heterogeneity more significantly.

3.1.3 Terminal Determination

The splitting variable selection process continues until there is no further significant drop in heterogeneity. Generally, there is a minimum limit used in determining terminal nodes. When this condition is met, the process of tree formation stops.

3.2 Label Class Tagging

Class labeling is done based on the most number of rules, that is, the maximum proportion of an object enters into a class s in node t . Mathematically can be written as $p(s_0|t) = \max_s \frac{N_j(t)}{N(t)}$ with $p(s_0|t)$ is the proportion of the number of objects that enter into a class s_0 at node t .

4. Findings

4.1 The profile of the heart attack symptom of cardiovascular disease based on the demographic status

From the figure 4.1 below, the result are:

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- The variable that most influences the heart attack symptom of cardiovascular disease is gender. For male 50.5% will have symptom chest pain but for female 69.8% will have heart attack symptom short of breath.
- For male with age more than 70 years old or smaller than 30 years old, 58.1% will have heart attack symptom short of breath
- For male with age 50-70 years old, not working, 49.4% will have the heart attack symptom chest pain
- For male with age 50-70 years old, working, smoking, 48.8% will have heart attack symptom short of breath
- For male with age 50-70 years old, working, not smoking, 50% will have heart attack symptom chest pain

The Classification Tree for demographic status is described in Figure 4.1 below:

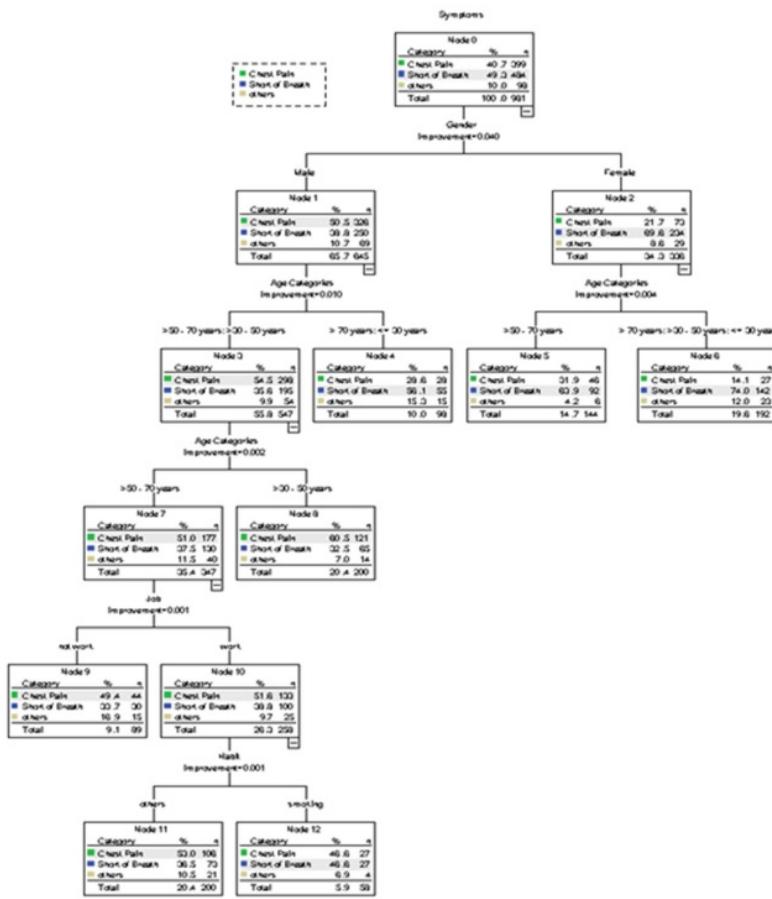


Figure 4.1 Tree Diagram Demographic Status

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4.2 The profile of the cardiovascular symptom based on health condition and demographic status
The Classification Tree can be found in the Diagram Tree on Figure 4.2 below:

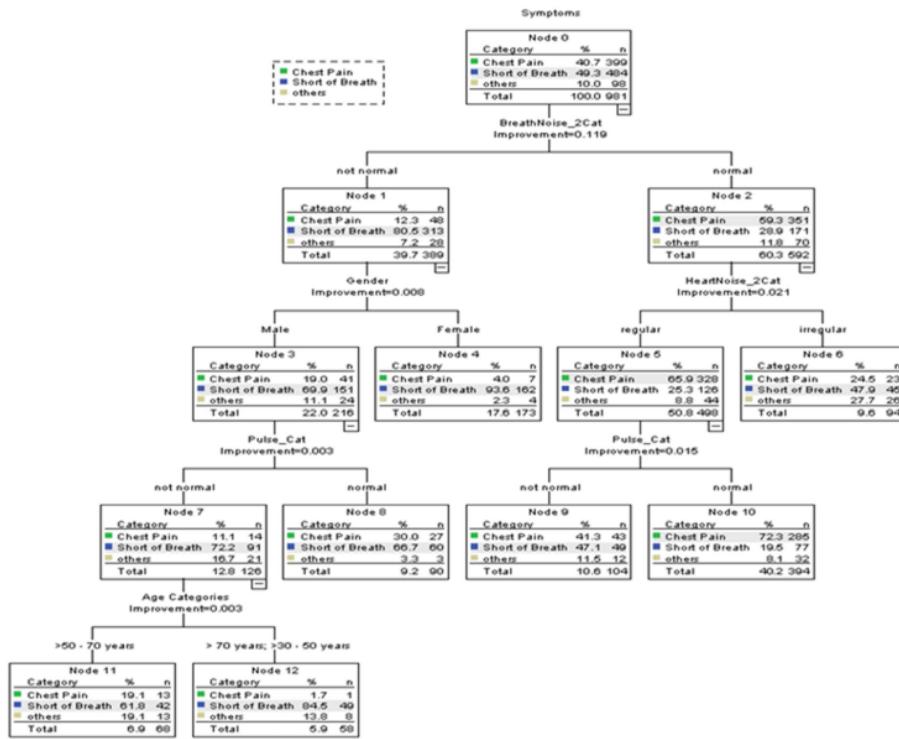


Figure 4.2 Tree Diagram for Health Condition and Demographic Status

From the Tree diagram Figure 4.2 above, the results are:

- The variables that most influences the heart attack symptom of cardiovascular disease is the breath noise. If the breath noise is not normal, 80.5% will have heart attack symptom of short of breath. If the breath noise is normal, 59.3% will have heart attack symptom of chest of pain.
- If the breath noise is not normal, for female, 93.6% will have heart attack symptom short of breath. For male 69.9% will have of the heart attack symptom of cardiovascular disease short of breath.
- If breath noise is normal, heart voice regular, pulse is nor normal, 47.1% will have heart attack symptom short of breath
- If breath noise is normal, heart noise regular, pulse is normal, 72.3% will have heart attack symptom chest pain.
- If breath noise is normal, heart voice irregular, 47.9% will have heart attack symptom short of breath.

1**5. Discussion**

From the results above, people who do not check their health condition must be careful with their demographic status. Female must be aware with short of breath. It can be a sign of the appearance of heart attack. In general, male with age >70 years old or <30 years old must be aware when they feel short of breath. Male who are 50-70 years old, working and smoking must also be aware with short of breath. Male must be aware with chest pain especially for men with age 50-70 years old, working and not smoking. If the sign of the profile appeared, the patients must be careful and check their health condition.

When people check their health condition and combine the result with their demographic status they must be careful with breath noise especially when their breath noise is not normal. If the breath noise is not normal, they must careful when they feel short of breath though they have regular heart noise. When they have regular heart noise, not normal pulse they must also be aware with the appearance of short of breath. When their pulse is still normal, they must be aware with the appearance of chest pain.

6. Conclusion

The conclusions of this study that describe the profile of heart attack symptom of cardiovascular disease are:

1. From demographic status, the variable that most influences the heart attack symptom of cardiovascular disease is gender. Male will have symptom chest pain but female will have symptom short of breath. Other variables that influence heart attack symptom is age, working or not and smoking habit. For male with age more than 70 years old or smaller than 30 years old will have symptom short of breath. For male with age 50-70 years old, not working will have symptom chest pain. For male with age 50-70 years old, working, smoking will have symptom short of breath. For male with age 50-70 years old, working, not smoking will have symptom chest pain
2. From demographic status and health condition of the cardiovascular disease patients, the variable that most influences the heart attack symptom is the breath-noise. If the breath noise is not normal the patients will have symptom short of breath. If the breath noise is normal the patients will have symptom chest of pain. Other variables that influence the heart attack symptom are gender, heart voice and pulse. If the breath noise is not normal, for female will have symptom short of breath. For male will have symptom short of breath. If breath noise is normal, heart voice regular, pulse is nor normal, the patients will have symptom short of breath. If breath noise is normal, heart noise regular, pulse is normal, the patients will have symptom chest pain. If breath noise is normal, heart voice irregular, the patients will have symptom short of breath.
3. Before short breath appear people must take care with their breath noise, heart noise pulse, their working and their habit to smoke. Before chest pain appear every person must take care with their breath noise, pulse, age and their working.

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