THE PREDICTION OF THE INCIDENCE RATE OF CARDIOVASCULAR DISEASE FOR THE EMPLOYEES AND LECTURERS OF YOGYAKARTA STATE UNIVERSITY BASED ON THE POST-EXERCISE RECOVERY HEART RATE

A. Background

Every individual who works for an institution, either government and private institution, is always required to have maximum work productivity. Maximum work productivity will be achieved if a person has an optimal level of health and fitness. On the other hand, due to the advancement of technology that will facilitate every activity of a person, it will encourage a person to be inactive by trying to reduce his/her physical activities which will eventually lead to decreased fitness and even trigger the incidence of diseases. One of the diseases that is closely related to the level of physical activity of a person is cardiovascular disease, such as, heart disease, hypertension, and stroke.

In general, fitness is defined as the ability to perform daily activities efficiently without causing excessive fatigue, so that a person can still enjoy his/her spare time. Giriwijoyo and Sidik (2012: 20-21) said that fitness is a state of physical ability that can adjust the function of the body to certain physical tasks and/or to the environmental condition that must be overcome efficiently, without excessive fatigue, and has been perfectly restored before performing the same tasks in the following day. There are several components of fitness, one of which is cardiovascular fitness or heart and lung fitness that describes the ability of the lungs and heart to meet the oxygen demand for muscles' work for a long time. It can only be achieved by performing regular and programmed exercise.

The more fit a person, the more efficient the work of heart in fulfilling the blood circulation to all tissues and organs of the body. It can be seen by the decreasing frequency of resting heart rate which is close to 60 beats per minute. In contrast, the more unfit a person, the faster the heart rate which will approach to 90 beats per minute. Thus, the heart rate is an indicator of a person's fitness that can be easily observed. When performing any physical activity or exercise, the body will strive to meet the needs of oxygen and energy for muscle contraction by increasing heart rate. This reaction is an acute reaction of the body in an effort to meet the needs for muscle contraction. However, the long-term effects of the regular and programmed

exercise will improve the efficiency of cardiovascular work as the stroke volume increased as a result of the left ventricular hypertrophy.

As with the measurement of body composition and muscle strength, the measurement of cardiac capacity is also important in assessing the performance of a person or overall cardiovascular fitness. There are several heart rate measurements that can be used to monitor a person's health, such as, resting heart rate, maximum heart rate, *reserve heart rate*, and *recovery heart rate*. *Recovery heart rate* (RHR) is a measurement of heart rate after performing aerobic physical exercise. It is well known that RHR is one of the best indicators that can assess both overall and cardiovascular health conditions (Stone, 2011: 1-2).

The fitness of a person can be identified by conducting an objective and standardized fitness test, which is by measuring the status of fitness components that includes the measurements of heart and lung resistance, muscle strength and endurance, flexibility, and body fat percentage. Physical fitness test is a procedure in the form of physical exercises which is aimed at measuring fitness level according to the purpose. The level of physical fitness can be known by physical fitness test and measurement. In the measurement test, there are several principles and procedures which have to be performed. The Rockport method is one of the safest methods of heart and lung fitness measurements for all ages, especially for older people. This method is also safe for groups of people suffer from certain diseases. In addition, the implementation of the Rockport method also does not require for medical examination before performing the fitness test (Adams, 2002: 139).

The heart rate is intrinsically regulated from the heart, both autonomously and extrinsically, as a response to physical and mental activities and is also influenced by the autonomous and hormonal nervous system. The reflect of heart rate regulation is related to the excitatory input from the cardiorespiratory and baroreceptor systems in the blood vessels. The heart rate describes the dynamic balance between the sympathetic and parasympathetic nervous system. The parasympathetic activation inhibits the heart rate by acetylcholine release from efferent fibers of vagus nerve. While the sympathetic activation will trigger the heart rate by releasing either epinephrine in the circulation or norepinephrine in the nervous system, or both. (Robertson, *et.al*, 1979).

The abnormality of autonomic nervous system is closely related to the increased mortality and morbidity of cardiovascular disease in both healthy populations and populations suffering from certain diseases. There are many markers of cardiovascular activity used clinically in identifying patients at high risk for sudden cardiac death. One of the markers is the *exercise stress test* which is used as the diagnostic and prognostic tool that is used extensively in evaluating cardiovascular function. It is known that the exercise response is acutely influenced by the activity of autonomic nervous system, where there is increased sympathetic and decreased parasympathetic activities while performing a physical activity. While after performing an activity, there is a combination of decreased sympathetic activity and parasympathetic reactivation. Thus, Recovery HR after performing the maximum physical activity is one of the simplest parameters that can describe the autonomic activity of the heart and can predict the presence of cardiovascular disorders. (Cole *et al*, 1999: 1351-57 and Jouven *et al*, 2005: 1951-58).

It is known that there are several types of heart rates that can be used for monitoring the health and fitness levels, such as, resting heart rate, maximal heart rate, *heart rate reserve*, and *recovery heart rate*. There are several ways in measuring the heart rate. Resting heart rate is calculated in the morning when awaken from sleep before performing any activity, expecting that the cardiac output at that time is reserved for basal metabolism without being affected by either physical or mental activity (Stone, 2011:2). Normal heart rate ranges from 60 – 100 beats per minute. The heart rate less than 60 beats per minute is referred to bradycardia and which is more than 100 beats per minute is referred to tachycardia, both of which are the conditions of cardiovascular abnormalities.

The maximum heart rate can be determined by measuring the heart rate immediately after performing a very heavy exercise. However, it is very dangerous to do by someone who does not have a good level of health and should be under the supervision of a doctor. To avoid this risk, there has been many ways that are used recently for measuring the maximum heart rate. There are several calculations to estimate the maximum heart rate by ages, among others, as follows: (Stone, 2011:2)

- 220 - Age (th) for Men, and
- 226 – Age (th) for Women

The *heart rate reserve/HRR* is the difference between the maximum heart rate and resting heart rate, or it can be calculated by using the following formula:

HRR = HR max – HR rest

The greater the number of HRR, the higher the fitness of a person, which also means that the lower the HR rest, the more excellent the fitness of a person. (Stone, 2011:2)

Recovery Heart Rate (RHR) is a measurement of heart rate after performing aerobic exercise. This measurement is performed during the cooling-down period, so that it can monitor changes in heart rate back to normal after performing an exercise. RHR measurement can be performed by measuring the heart rate immediately after performing an exercise and measuring the heart rate two minutes after the exercise. RHR is the difference between the two heart rate calculations (Stone, 2011:2).

It is known that increased heart rate during physical exercise and decreased heart rate after the exercise is a role of the change to the sympathetic and parasympathetic nervous systems. The slow decrease in RHR after performing any physical exercise is associated with higher mortality, cardiac death, and incidence rate of cardiovascular disease associated with ischemic processes (Ghaffari et.al.,2011:47-54). Based on the formulation of the problems above, the objectives of this study are to determine the fitness level of the lecturers and employees of Yogyakarta State University, and to find out the level of risk against the incidence of cardiovascular disease.

RESEARCH METHOD

This study is a *cross-sectional* descriptive study conducted on lecturers and employees of Yogyakarta State University who voluntarily took a fitness test held by the Department of Health Education and Recreation of Yogyakarta State University. The subjects of study were taken by conducting *purposive sampling*. All subjects were given for a Rockport fitness test and measured for their *recovery heart rate* (RHR) after performing a fitness test. The RHR measurement was obtained by subtracting the maximum heart rate after performing a Rockport test with a heart rate two minutes after the completion of Rockport test. The RHR is abnormal if the RHR $\leq$12 beats. From the *recovery heart rate* obtained, the level of risk was then able to determine regarding the incidence of cardiovascular disease. There were also anthropometric measurements conducted in the form of body height, abdominal circumference, and hip circumference measurements. The whole data would be presented descriptive-qualitatively in a percentage.

RESULTS AND DISCUSSION

The characteristics of the subjects of study were lecturers and employees of Yogyakarta State University who voluntarily took a fitness test held by the Department of Health Education and Recreation, which were briefly presented as follows: the subjects consisted of 50 men (79%) and 13 women (21%). The distribution of the subjects of this study by sex was dominated by men. The majority of subjects in this study were in a late-adolescence age of 17-25 years old as many as 46 people (73%), while the characteristics of the subjects based on physical fitness level with a very poor level were 31 people (49%). The data characteristics of the subjects can visually be seen in the following diagram:

Results

The assessment of the prediction of incidence rate of cardiovascular disease in this study was based on the results of measurement of *recovery heart rate* (*RHR*) of the subjects. All subjects were given for a Rockport-method fitness test and measured for their *recovery heart rate* (*RHR*) after performing the fitness test. The RHR measurement was obtained by subtracting the maximum heart rate after performing a Rockport test with a heart rate two minutes after the completion of Rockport test. The *RHR* is abnormal if the *RHR* $\leq$ 12 beats. The results of data analysis can be seen in table 4.2 below:

Table 4.2 The Results of Analysis of the Prediction of Incidence Rate of Cardiovascular Disease

No.	Hydration Status Category	Norm/Interval Category	Frequency	
			f (n)	%
1.	High Risk	$\leq$ 12	37	58,73
2.	Low Risk (Normal)	12	26	41,27
	Total		**63**	**100**

Based on the distribution of frequency above, it can be seen that 37 (58,73%) of 63 employees of Yogyakarta State University, as the subjects of this study, have a high risk of cardiovascular disease, and 26 employees (41,27%) have a low risk of cardiovascular disease. The data shows that the majority of the subjects has a high risk of having cardiovascular disease.

Discussion

Nowadays, the mortality and morbidity rates of cardiovascular disease are increasing. The abnormality of autonomic nervous system is closely related to the increasing mortality and morbidity rates of cardiovascular disease in both healthy populations and populations suffering from certain diseases. There are many markers of cardiovascular activity used clinically in identifying patients at high risk for sudden cardiac death. It is known that the exercise response is acutely influenced by the activity of autonomic nervous system, where there is increased sympathetic and decreased parasympathetic activities while performing a physical activity. While after performing an activity, there is a combination of decreased sympathetic activity and parasympathetic reactivation. Thus, Recovery HR after performing the maximum physical activity is one of the simplest parameters that can describe the autonomic activity of the heart and can predict the presence of cardiovascular disorders. (Cole et al, 1999: 1351-57 and Jouven et al, 2005: 1951-58).

The prediction of incidence rate of cardiovascular disease in this study was accurate as based on the *recovery heart rate* measurement. A previous study showed that the patients with abnormal *RHR* showed the decreased parasympathetic activity after performing maximum exercise and abnormal autonomic function (Gayda et.al, 2012: 6). In addition, Stone (2011:1-2)

stated that RHR is one of the best indicators that can assess both overall and cardiovascular health conditions. The results of data analysis showed that 37 people (58,73%) of the subjects have RHR < 12 which means that the majority of the subjects, which were the employees of Yogyakarta State University, have a high risk of having cardiovascular disease.

The condition of the majority of the subjects who have a high risk of cardiovascular disease can be caused by many factors. One of the factors is the physical activity which has an effect on the fitness level of a person. The fitness level of the subjects showed that the majority of the subjects are in the very poor level which was nearly a half (49%) of the subjects, so that it has an effect on the RHR of the subjects. Stone (2012: 2) stated that the greater the number of HRR, the higher the fitness of a person, which also means that the lower the HR rest, the more excellent the fitness of a person. It can be concluded that the routine physical activity can have an effect on the level of risk of having cardiovascular disease. It is known that increased heart rate during physical exercise and decreased heart rate after the exercise is a role of the change to the sympathetic and parasympathetic nervous systems. The slow decrease in RHR after performing any physical exercise is associated with higher mortality, cardiac death, and incidence rate of cardiovascular disease associated with ischemic processes (Ghaffari et.al.,2011:47-54).

Dimopoulos *et.al*.(2015:1-10) stated that the activity or position after performing a physical activity has an effect on Recovery HR. Recovery HR ≤ 12 beats per minute in the first minute in standing/upright position or ≤ 18 beats per minute in the first minute in laying/supine position or ≤ 22 beats per minute in the first minute in sitting position shows the abnormal condition. There are several evidences which show that the recovery phase after performing a physical activity can be used as the prognostic factor of the presence of cardiovascular disorders.

Conclusions

Based on the results and discussion presented in the previous chapter, there are some conclusions as follows:

1. From a total of 63 subjects of study, 31 subjects (49%) have a very poor fitness level, 20 subjects (32%) have a moderate fitness level, and 2 subjects (3%) have a good fitness level.
2. The results also showed that 37 subjects (58,73%) have a high risk of having cardiovascular disease, and 26 subjects (41,27%) have a low risk of having cardiovascular disease.

Suggestions

Based on the conclusions above, it is suggested for the employees of Yogyakarta State University to improve their physical activities or excercises and to perform exercises measurably and regularly.