THE EFFECT OF EXERCISE TIME IN THREE DIFFERENT TIME (Morning, afternoon, evening) ON LUNG VITAL CAPACITY REVIEWED FROM METEOROLOGY PARAMETERS

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ABSTRACT

Objectives: Lebak Siliwangi Sports Center or Ganesa Sports Facility (SARAGA) ITB is a miniature of Bandung because it is located in a basin area and it has a tendency to be exposed to air pollution from motor vehicles. Thus it is necessary to do a study of the air pollution effects on health of people who do sports activities at SARAGA ITB.

Methods: The research methodology used is a quantitative descriptive method. The sample of this study is thirty (30) visitors of SARAGA who routinely exercise in the morning, afternoon and evening using purposive sampling. The researcher measure their lung vital capacity before and after exercising with the SP10 ContecTM Spirometer. Meteorological parameters were measured at each exercise time using Laser Egg Origins Smart Air Quality Monitor for PM 2.5, while temperature and humidity were measured using the Weather Station W200.

Results: The results of this study consecutively are, from meteorology parameter is PM2.5, temperature and humidity in terms of exercise time (in the morning, afternoon and evening) is in the morning PM.2.5 (10), the temperature is 28°C, the humidity is 55%; in the afternoon is PM.2.5 (29) with the temperature of 25.1°C, and the humidity is 77%; in the evening is PM.2.5 (94), the temperature is 21.7°C, and the humidity is 89%. While the lung vital capacity on the three exercise time (morning, afternoon and evening) experience a significant momentary decline with p-value < 0.05, with a morning value as much (3.49:3.22), in the afternoon as much (3.48:3.20), and in the evening as much (3.58:3.39).

Conclusions: In conclusion, the peak PM 2.5 air pollution occurs at night, but this does not directly affect the decreased lung vital capacity shortly after doing exercise. However, the factors that need to be considered are temperature/UV index and air humidity because these two factors have a relationship with the decreased lung vital capacity shortly after exercise.

Keywords: PM 2.5, temperature, humidity, lung vital capacity


INTRODUCTION

Bandung as the capital of West Java Province is one of the largest cities in Indonesia. In its development, Bandung city faces various challenges, one of which is air pollution. The biggest source of air pollution in Bandung is from the transportation sector. The highest levels of pollution are generally found in large cities with high population density [2]. Sienfeld and Pandis [10] define air pollution as an atmospheric condition where the substance contained therein has a high enough concentration above its normal ambient limit, so the effect can be measured on humans, animals, plants or existing materials. While according to Cooper & Alley [12], air pollutants are all solids, liquids, or gases present in the atmosphere in concentrations that can cause harmful effects. Sources of air pollution caused by anthropogenic activities include transportation, industry, burning waste and household activities [11]. These problems affect several things, especially on the health of the community, where in the areas with high pollution levels, the level of risk of disease due to air pollution tends to
be higher than other regions [1]. Based on the following data; (1) according to the Bandung city health profile in 2004, out of two-thirds of infants (less than one year old) suffering from upper respiratory infections (ISPA) and (2) based on research conducted by ITB in 2005 on lead levels in the blood of elementary school children (SD) showed that as many as 264 children out of 400 children in 40 elementary schools in the city of Bandung containing lead exceeded the threshold (10 mg / dl) which directly affects to the level of intelligence (IQ) of the school children. While outdoor physical activity has been shown to promote health and wellbeing,[15,16] exercising in environments with high levels of air pollution can increase the risk of health problems ranging from asthma attacks to heart or lung pathologies [17,18]. Long-term exposure to pollution, especially PM 2.5 to humans, is known as an important indicator of chronic lung disease, cardiovascular disease, asthma and lung cancer [3,4,19,20,21], and it is also known that PM 2.5 pollution has a big risk of settling in the alveoli of the lungs and is associated with health risks [5]. The impact of PM 2.5 air pollution is also felt by other regions around Bandung due to the nature of air pollution itself which is able to cross borders. Based on the results of research in areas that represent urban areas and Ciater Station that represents rural areas. The results of air pollution measurements at the five points show that the areas which close to transportation and industrial sources such as Mess LAPAN (Jln. Riau), LAPAN Offices (Jln. Dr. Djundjunan), and Leuwigajah have a tendency of high pollutant concentration values. While in the relatively quiet areas such as Ciater Station (rural) and Dago (settlement) tend to have low levels of pollutant concentration.However, with the ability of pollutants to move far from their source to other regions, this allows areas that should be relatively clean from pollution to become polluted. Lebak Siliwangi sports center or the Ganesha Sports Facility (SARAGA) which is located on Jalan Siliwangi has a tendency of being exposed to air pollution from pollutants in Bandung. This is supported by its location which is in the basin, so it has a tendency to trap exhaust gases produced by pollutant sources in the city and it will increasingly accumulate, as revealed by Zannaria et al [9] that the tendency of increasing emissions and topography conditions of Bandung city which is categorized as not well ventilated, allows a decrease in air quality of the city from year to year. Based on the background and motivation, the writer is interested in examining the tendency of whether there is a direct influence of air pollution in SARAGA on the lung vital capacity of visitors who are exercising in the morning, afternoon, and evening in terms of meteorological parameters, namely PM 2.5, temperature, and humidity at each time their take exercise.

METHODS

This research was observational study, aiming at explaining the existing phenomena by using numbers to describe the characteristics of an individual or group [6]. It assessed the nature of conditions that appear and aimed at describing the characteristics of things as they are. This research was very important as a preliminary study for other studies and further research. The independent variable in this research was lung vital capacity, while the dependent variables were meteorological parameters (PM 2.5, temperature, and humidity).

Population and research subject : The population chosen in this research was the visitors of SARAGA ITB who consistently exercised in the morning, evening, and night. A number of subjects consisting of 30 visitors SARAGA ITB were divided into three groups based on their training times: morning, afternoon, and evening. Research collection used purposive sampling [7]. The research subjects were the visitors of SARAGA ITB aged 18-19 years old. Ineligible criteria (exclusive criteria) were the visitors of SARAGA ITB aged over 19 years, in a state of illness or injury.

Figure 1: Research Flow
Data Collection

There were two variables in data collection, namely dependent and independent variables. The dependent variable in this research were meteorological parameters (PM 2.5, temperature, and humidity) and the independent variable was lung vital capacity.

The techniques of collecting data were as follows;

1. Taking lung vital capacity using a spirometer was conducted four times. Twice was conducted before doing Cooper Test 2.4 km as pre-test and the last twice was conducted after doing Cooper Test 2.4 km as post-test.
2. Measuring heart rate when performing Cooper Test using Polar H-7 Wireless Heart Rate Monitor was conducted twice both in pre-test and post-test.
3. Meteorological parameters were measured using Weather Underground and Origins, namely PM 2.5, temperature, and humidity.

Equipments and Work Methods

The equipments and work methods used were as follows;

1. Conducting a sampling of research subjects to males who were 17-19 years old.
2. Enacting eligible prospective subjects to be research subjects. Determination of research subjects used screening questionnaires containing questions about individual characteristics such as age, sex, height, weight, disease history, and the number of physical activity carried out in the recent one or two years and that of in one week.
3. Before conducted the research, subjects have to read the approval sheet of informed consent research after obtaining an explanation related to the study
4. Measuring VO2 max using Cooper Test 2.4 km
5. Measuring maximum heart rate and energy expenditure while exercising using Polar H-7 Wireless Heart Rate Monitor
6. Measuring lung vital capacity using Spirometer SP10, Mouthpiece

RESULTS

Anthropometric data of research samples
The sample in this study consisted of thirty (30) visitors of ITB Saraga sports facilities, all research subjects consistently do exercise at ITB twice a week, divided into three groups of training time, in the morning, afternoon and evening according to the subject's habits.

### Table 1: Anthropometry Subject

<table>
<thead>
<tr>
<th>Variables</th>
<th>Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (number of samples)</td>
<td>30</td>
</tr>
<tr>
<td>Age (year)</td>
<td>18.7 ± 0.6</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>167 ± 4.4</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>65 ± 7</td>
</tr>
</tbody>
</table>

### Lung capacity data after exercising at the 3 different time

This research took place at three different time measurements, in the morning, in the afternoon and in the evening. At these 3 times the lung vital capacity was measured before and after exercising (running 2400 meters), then pollution level data (PM 2.5), temperature, and humidity were taken during exercise.

### Table 2: Decreased Lung Vital Capacity In Terms Of Three Training Time

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>The average score of FVC before running 2.4 km</th>
<th>The average score of FVC after running 2.4 km</th>
<th>Δ%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning (8-9 am)</td>
<td>10</td>
<td>3.49 l</td>
<td>3.22 l *</td>
<td>7.7 %</td>
</tr>
<tr>
<td>Evening (3-4 pm)</td>
<td>10</td>
<td>3.48 l</td>
<td>3.20 l *</td>
<td>8.1 %</td>
</tr>
<tr>
<td>Night (6-7 pm)</td>
<td>10</td>
<td>3.58 l</td>
<td>3.39 l *</td>
<td>5.3 %</td>
</tr>
</tbody>
</table>

*significantly different between before and after (p<0.05), l = liter

In table 2 we can see that there is a decrease in the lung vital capacity after exercising at three different times with a significance value of p <0.05. Each exercise time has different meteorological characteristics, where in the time of morning exercise, it has the lowest PM 2.5 level compared to other times, while at the time of evening exercise, it become the highest exposure to PM 2.5.

### Table 3: The Relationship In Terms Of Training Time

<table>
<thead>
<tr>
<th>Group</th>
<th>Δ % Decrease of FVC</th>
<th>PM (µg/m³)</th>
<th>Temperature (°C)</th>
<th>Humidity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning (8-9 am)</td>
<td>7.7</td>
<td>10 (ns)</td>
<td>28*</td>
<td>55 *</td>
</tr>
<tr>
<td>Evening (3-4 pm)</td>
<td>8.1</td>
<td>29 (ns)</td>
<td>25.1 *</td>
<td>77 *</td>
</tr>
<tr>
<td>Night (6-7 pm)</td>
<td>5.3</td>
<td>94 (ns)</td>
<td>21.7 *</td>
<td>89 *</td>
</tr>
</tbody>
</table>

*significantly related with Δ % (p<0.05), ns (no Significant)

After conducting the correlation test, there is no relationship between the value of decreased lung vital capacity with PM 2.5 pollution levels. While there is a relationship between decreased lung vital capacity with air temperature, where the higher the temperature/UV index, the higher the decreased vital lung capacity shortly after exercising. Likewise, there is a relationship between humidity with the decrease of lung vital capacity, where the lower the humidity in the air, the higher the decrease in lung vital capacity shortly after exercise.

Graph.2 Decreased Lung Vital Capacity
DISCUSSION

Based on the results of this study, the level of pollution (PM 2.5) which is in SARAGA sports facilities is still at a safe threshold according to environmental ministry standards, and does not have a direct effect on the reduction in vital lung capacity while doing sports in Saraga ITB in the 3 time (morning, afternoon and evening). Nevertheless, the factors that need to be considered when doing sports in Saraga ITB are temperature/UV index and humidity, because these two factors are proven to have a relationship with a decrease in vital lung capacity shortly after exercising. However, it is not directly related that temperature is a factor that causes a decrease in vital lung capacity. In a previous study, Jiexiu Zhao in explained that the exercise or aerobic test at hot-dry and hot-humid temperatures affects the aerobic ability, this is in line with the increase in oral and skin temperature when doing physical activity in these circumstances [14]. The decrease in aerobic ability allows the effect of decreasing the vital capacity of the lung shortly after exercise which is temporary. It will return to normal after recovery. Dale R dkk [13], explained that exercise at the moderate PM 2.5 level based on the AQI (air quality index) standard had no effect on the lung vital capacity (fvc) and aerobic ability, and regular aerobic exercise improves overall health and reduces CV risk over the long-term [22]. Based on the results of this study, it can be concluded that the peak of PM2.5 air pollution occurs at night, but it does not directly affect the decrease in lung vital capacity shortly after exercise. Nevertheless, the factors that need to be considered are temperature/UV index and humidity of the air, because these two factors have a relationship with decreased lung vital capacity shortly after training. From the results of this study it is expected that the visitors sport facility can understand and choose the right time to exercise, so that they are able to get the maximum performance.

ACKNOWLEDGMENTS
Thanks to LPPM ITB for funding the research.

REFERENCES


