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Physical ergonomics analysis of the effect of smoking on sport performance

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Abstract. These day lifestyle become personal identity that many have to choose. Sporty lifestyle that is a positive lifestyle with the purpose of maintaining our health condition with smoking which is a lifestyle that gives adverse effect to the human body due to bad subtances in it. Thus, the researchers looked at the adverse effect of smoking and sport in the form of V02 Max points which is the maximum lung capacity that is affected by the frequency factor of sport exercises, the number of cigarettes per day with smoking duration. The study was conducted using Beep Test method to obtain V02 Max points which will be compared and analyzed to see the influence of both lifestyle directly. The respondents were 18-25 years old man with normal Body Mass Index (BMI). Of the 48 datas that are already divided 50:50 for smokers and non-smokers. The result showed that sport exercise frequency and number of cigarettes per day had significant effect on V02 Max points either independently or combined but for sport exercise frequency and duration of smoking only independently had a significat relationship. Sport exercise frequency has a positive effect to V02 Max Points while smoking has a negative effect for V02 Max points. So Smoking has a negative effect on respiration even though we have been exercising regularly.

1. Introduction

In this day, many people choose lifestyle to define them. Either that good or bad lifestyle, or even many people try to choose both of those good and bad lifestyle at the sametimes. The most common lifestyle that sometimes chosen by the people simultaneously is exercising sport and smoking. As we all know sport is physical or mental activity that have purpose to maintaining people health's condition (Tenenbaum & Eklund, 2007). According to (Poortinga, 2007) Smoking have dangerous substances that dangerous to humans but still many people choose to this activity.

The negative correlation between this 2 lifestyle are exercising sport is good for health of the people but smoking is on the negative way. In the cigarette there is a nicotine that have bad side effect which is fasten nervous system to release chemical substance in our body to contrict the blood vessels. If this happen in lungs vessel (Ateroschlerosis) it will make blood thas pass the lungs will be decreasing so that oxygen exchange in blood at lungs ad also the capacity. This will cause the amount of hemoglobin that

rich with oxygen throughout the body will be stagnating and make body will easily exhausted (Kaufman, 2011). Another side effect of the smoking is narrowing the bronchus that will make decrease of amount oxygen and air that entered the lungs. This will cause decreasing the V02 Max and Human's Endurance (Kaufman, 2011).

When we talk about the basic of sport performance, one of the main attributes that divine the people is endurance, because endurance basically the most fundamental factor to sustain the overall performance (Manna, 2010). V02 Max or maximum Oxygen intake in the lungs is one of the basic assessment to the endurance attributes. If we correlated the negative effect of the smoking to the endurance and V02 max we will see the negative effect that will affect sport performance.

2. Methods

2.1 Comparative Method

The main methods to conducted this study is to see the V02 Max from healthy non-smoking and smoking people. So basically, this research is compare the condition of V02 Max between non-smoker and smoker to see what is the difference and effect of smoking to the V02 Max attributes.

2.2 Beep Test

To achieve the V02 Max the respondend is being tested in method called Beep Test. Beep test itself is the method to get a result of the endurance by running back and forth from 1st point to 2nd point and the test itself commanded by sound "beep" to start the run from each of point (Aandstaad, 2011).

Every run from one point to another point its called run-level that will be marked on this below sheet

Level	Run														
1	1	2	3	4	5	6	7								
2	1	2	3	4	5	6	7	8							
3	1	2	3	4	5	6	7	8							
4	1	2	3	4	5	6	7	8							
5	1	2	3	4	5	6	7	8	9						
6	1	2	3	4	5	6	7	8	9						
7	1	2	3	4	5	6	7	8	9	10					
8	1	2	3	4	5	6	7	8	9	10					
9	1	2	3	4	5	6	7	8	9	10	11				
10	1	2	3	4	5	6	7	8	9	10	11				
11	1	2	3	4	5	6	7	8	9	10	11				
12	1	2	3	4	5	6	7	8	9	10	11	12			
13	1	2	3	4	5	6	7	8	9	10	11	12			
14	1	2	3	4	5	6	7	8	9	10	11	12	13		
15	1	2	3	4	5	6	7	8	9	10	11	12	13		
16	1	2	3	4	5	6	7	8	9	10	11	12	13		
17	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
18	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
19	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
20	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Figure 1. Beep Test Observation Sheet

Later each point run-level will be converted to V02 Max with formula below. The final data that will be analyzed is not the point feedback but the V02 Max.

$$V02\ Max = 15 + (\ 0,3689296 \times RunLevel\ ) + (-0,000349 \times (RunLevel)^2 \tag{1}$$

2.3 Respondent Selection

For this research we must selected certain factors to be attributes of the respondent. The first factor is Exercise frequency (Factor A)with level below :

- Rarely : Exercising less than 3 times per month
- Enough : Exercising less than 1 times per weeks
- Often : Exercising less than 2 times per weeks
- Highly ; Exercising more than 3 times per weeks

Second factors is number of cigarettes taken per day (Factor B) with level below :

- None : no smoking at all
- Less : 1-5 cigarette per day
- Medium : 6-11 cigarette per day
- Much : More than 12 cigarette per day

And the Last one is How long the history time they smoking (Factor C) with level below :

- Do not Smoke
- Smoking for 1-2 years
- Smoking for more than 3 years

3. Result And Discussion

3.1 Data Processing Accuracy of Exercising Frequency and number of cigarettes

The factors for this first research based on the Factor A and Factor B according to above explanantion :
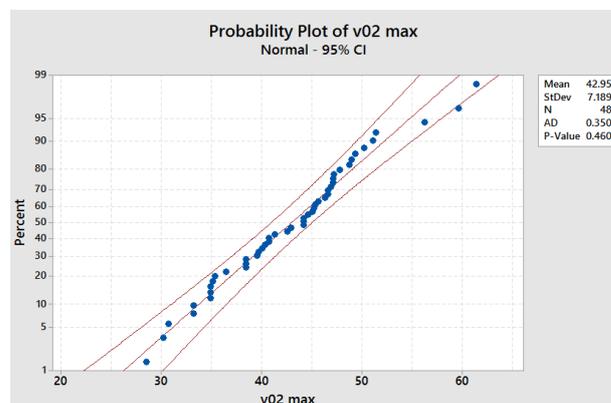
Figure 2. Residual Probability From V02 Max

According to Figure 2 above we can see that the data has been normally distributed this was proven that P-Value from data processing residual of V02 Max is 0.46 which is more than $\alpha = 0.05$. So we can conclude for exercise frequency and number of cigarette per day is showing independent and homogenic data.

According to general theory of statistics which is more data and replication means more good and accurate data we have. Because of limited time, researcher only done this 3 time replication but the data is good enough with maximum difference is 4.

Table 1. The Result of Statistical processing of Factorial Design Analysis for VO2 Max affected by exercise frequency and number of cigarettes

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	17	2191.76	128.927	16.32	0.000
Blocks	2	87.7	43.852	5.55	0.009
Linear	6	1545.98	256.663	32.61	0.000
Exercise Frequency	3	613.13	204.375	25.87	0.000
Number of Cigarette per Day	3	932.85	310.952	39.35	0.000
2-Way Interactions	9	555.08	62.008	7.85	0.000
Exercise Freq*Num. of Cigarette per Day	9	555.08	62.008	7.85	0.000
Error	30	237.04	7.901		
Total	47	2428.8			

We can see from table above that treatment variation from exercise frequency factor and number of cigarette have significant impact to V02 Max with p-value = 0.000 which less than α = 0.05. For Interaction that connected both of factors have significant impact to V02 Max p-value = 0.000 which less than α = 0.05.

Table 2. Result *Model Summary*

S	R-sq	R-sq (Adj)	R-sq (Pred)
2.81093	90.24%	84.71%	75.02%

According to table 2 above shows model summary relationship between exercise frequency and number of cigarette per day and we can see the data accuracy based on R-sq that on he bale which is 90.24% means data accuracy
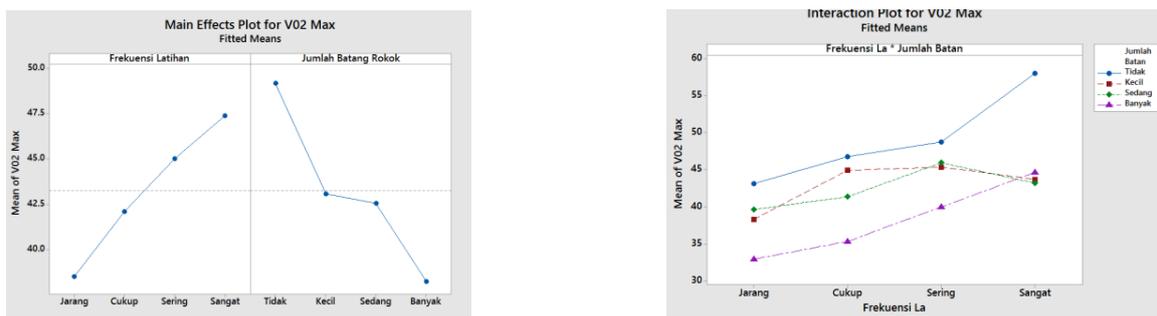

Figure 3. *Main Effect Plot* and *Interaction Plot* for V02 Max

If we see from *Main Effect Plot* and *Interaction Plot* above there is positive correlation from exercise frequency for V02 Max and negative correlation from number of cigarette to V02 Max. Whereas from *interaction plot*, we can see the correlation from both of the factors to V02 Max.

3.2 Data Processing Accuracy of exercise frequency and how long have been smoking.

The factors for second research based on the factor A and C according to explanation above :
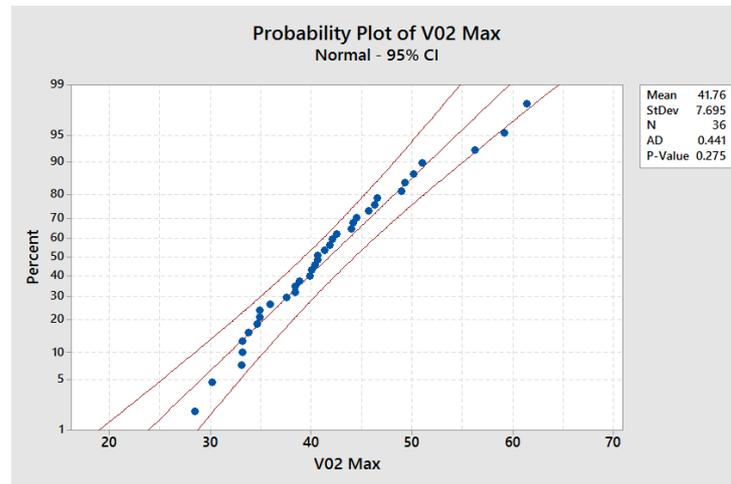
Figure 4. Residual Probability Plot from V02 Max

According to Figure 2 above we can see that the data has been normally distributed this was proven that P-Value from data processing residual of V02 Max is 0.275 which is more than $\alpha = 0.05$. So we can conclude for exercise frequency and number of cigarette per day is showing independent and homogenic data. Based on general thory of statistics, because limited time researcher only done this 3 timer replication with maximum difference 7

Table 3. The Result of Statistical processing of Factorial Design Analysis for VO2 Max affected by exercise frequency and How long have been smoking

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	13	1675.8	128.908	7.15	0.000
Blocks	2	5.7	2.85	0.16	0.855
Linear	5	1426.4	285.279	15.82	0.000
Exercise frequency	3	461.77	153.922	8.54	0.001
How Long Have Been Smoking	2	964.63	482.314	26.75	0.000
2-Way Interactions	6	243.71	40.618	2.25	0.076
Exercise Freq*How Long Smoking	6	243.71	40.618	2.25	0.076
Error	22	396.62	18.028		
Total	35	2072.43			

Table 3 shows the result of data processing, we can see from table above, the factor independently have significant impact to V02 Max because both P-value of those factors is less than $\alpha = 0.05$. But when these 2 factors combined, the interaction haven't significant impact because the P-Value is more that $\alpha = 0.05$. So we can say that independently these 2 factors is having significant impact but if Combined they don't have significant impact to V02 Max

Table 4. Model Summary Result

S	R-sq	R-sq (Adj)	R-sq (Pred)
4.24597	80.86%	69.55%	48.75%

According to table 4 above shows model summary relationship between exercise frequency and number of cigarette per day and we can see the data accuracy based on R-sq that on the table which is 80.86% means data accuracy
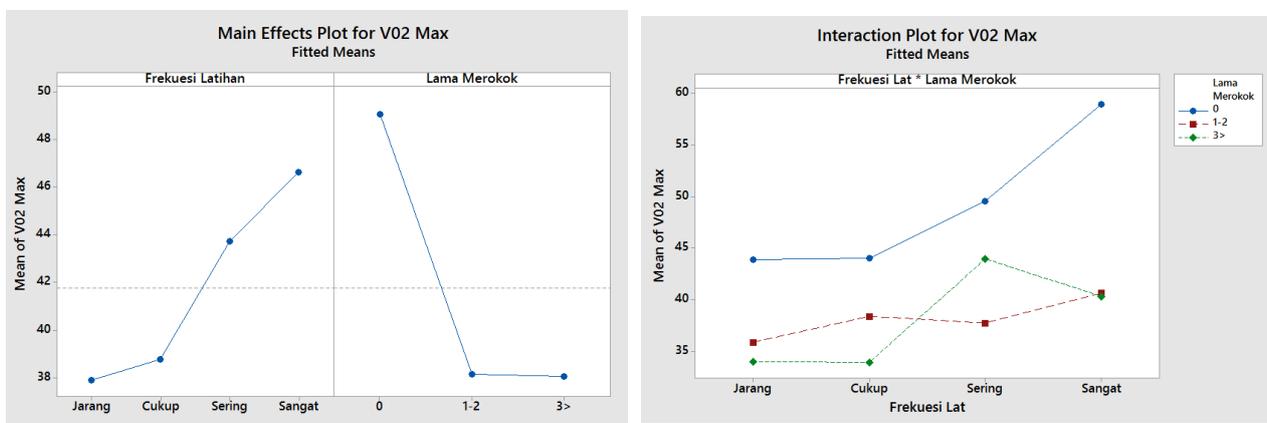
Figure 5. Main Effect Plot dan Interaction Plot untuk V02 Max

If we see from *Main Effect Plot* and *Interaction Plot* above there is positive correlation from exercise frequency for V02 Max and negative correlation from number of cigarette to V02 Max. Whereas from *interaction plotn*, we can see the correlation from both of the factors to V02 Max.

So, the active smoker V02 Max and sport performance has been affected based on the data above which the result is the active smoker is have less V02 Max and Endurance than non-smoker. The reason behind it already explained at the Introduction part.

4. Conclusion

From the research above about effect of smoking to Sport performance that we see from exercise frequency, amount of cigarette and how long have been smoking point of view aims to see the effect of each other that we will be se at V02 Max that indicate the maximum lungs oxygen capacity.

Based on the data processing and analysis, we got the conclusion of this research as follows:

1. For V02 Max with effect of exercise frequency and amount of cigarette per day there is significant impact even for independent or combined of this factors.
2. For V02 Max with effect of exercise frequency and amount of cigarette per day there is significant impact for independently but no when those 2 factors is combined.

3. For Exercise frequency have positif impact for V02 Max where more often exercise more higher of V02 Max but for amount of cigarette and the time used to smoke have negative correlation to V02 Max.

4. Correlation between factors which is exercise frequency and amount of cigarette per day have significant impact compared with exercised frequency and how long have been smoking because amount of time spend to smoking in years unit will more better than smoker that recently start smokig but in higher amount cigarette quantity.

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