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# An Analysis of Vital Pulmonary Capacity, Haemoglobin Levels and Oxygen Saturation in Conventional Electrical Smokers

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## Abstract

Smoking habits will accelerate the decline in vital lung capacity, causing an increase in hemoglobin concentration and a decrease of oxygen saturation levels exposed by carbon monoxide. The purpose of this study was to analyze the relationship and differences pulmonary vital capacity, haemoglobin levels and oxygen saturation in conventional electrical smokers. This study used a quantitative approach with analytic observational research and cross sectional design. The research sample was 88 respondents with a simple random sampling technique. Data analysis used chi-square and mann-whitney test. The results showed that there was a relationship between conventional smoker (p= 0.001) and electric smoker (p= 0.000) with vital lung capacity. There was no relationship between hemoglobin level (0.506) and oxygen saturation (p= 0.308) in conventional smoker status. There is no relationship between hemoglobin levels (p= 1.000) and oxygen saturation (p= 1.000) on electric smoker status. There are differences in oxygen saturation levels in conventional smoker status and electric smoker status (p= 0.044). There are no differences in vital lung capacity (p= 0.651) and hemoglobin levels (p= 0.895) conventional smoker status and electric smokers. Citizens who smoke are expected to stop smoking or reduce the number of cigarettes consumsion.



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## INTRODUCTION

Smoking is known to cause health problems. According to WHO the environment polluted by cigarette smoke is the source of various diseases (Khalisa et al., 2016). The proportion of smokers with the male sex category in 2016 was 6.47%, female was 0.14%. The age group who smoked with a age range of 10-12 years was 0.09%, age 13-15 years was 1.40%, and ages 16-18 years was 9.50%. It was found that smokers on rural areas was higher (3.75%) than urban areas (3.01%) (BPS, 2018). The prevalence of smoking habits at the age of ≥10 years nationally is 8.8% with a prevalence of 17.2% in men and 0.2% in women according to Sirkesnas (2016), whereas according to Riskesdas (2018) the population aged 10-18 years old who smoke as a whole amounted to 9.1%, this means an increase every year.

The results of the Global Youth Tobacco Survey (2014) found that 2.1% teens smoked electric cigarettes for the past 30 days, consisting of 3% men and 1.1% women (Infodatin Kemenkes RI, 2016). Damayanti Research (2016) showed e-cigarette users 54.8% aged 26-35 years, 96.8% were male, 100% had high school and university education, 71% worked as employees, 93.6% had a history of smoking, and 80 , 6% as a means of quitting smoking.

The use of electric cigarettes has increased rapidly throughout the world. Smoking causes cardiovascular and respiratory diseases. Chronic obstructive pulmonary disease is one of the causes of smoking. Respiratory tract obstruction affects lung function parameters (Dey et al., 2015). Smoking habits accelerate the decline in pulmonary physiology, in people with normal pulmonary function and not smoking has decreased of FEV1 20 ml per year, whereas in people who smoke will experience a decrease in FEV1> 50 ml per year (Nisa et al., 2015).

Smoking causes an increase in haemoglobin concentration exposed by carbon monoxide, the average level of haemoglobin increases progressively with the number of cigarettes consumed per day and the duration of exposure to carbon monoxide (Khan et al., 2014). Oxygen levels in the blood are affected by exposure to carbon monoxide which reduces oxygen supply to all body tissues by binding to the haemoglobin protein. In mild smokers, the oxygen saturation level is 98.37%, moderate smokers are 97.86%, acute smokers 96.25%, all respondents are still classified as normal (95-100%) (Septia et al., 2016)

## METHOD

This study uses a quantitative approach with the type of analytic observational research and cross sectional design. The study population was male residents of Srobyong Village, Mlonggo Subdistrict, Jepara District, aged 20-34 years with the category of conventional smokers and electric smokers, the population was 1,070. The sample technique used a simple random sampling method with a sample of 88 people. Data analysis using chi-square and mann-whitney test.

## RESULT AND DISCUSSION

**Table 1.** Univariate Analysis

| Variable | Category | Frequency | Percentage % |
|---|---|---|---|
| Conventional Smokers | Severe | 16 | 30.2 |
| | Moderate | 28 | 52.8 |
| | Mild | 9 | 17.0 |
| Vital Pulmonary Capacity in conventional smokers | Abnormal | 37 | 69.8 |
| | Normal | 16 | 30.2 |
| Hb level in conventional smokers | Abnormal | 24 | 45.3 |
| | Normal | 29 | 54,7 |
| SpO2 level in conventional smokers | Abnormal | 1 | 1.9 |
| | Normal | 52 | 98.1 |
| Electric Smokers | Severe | 28 | 80 |
| | Mild | 7 | 20 |
| Vital Pulmonary Capacity in electric smokers | Abnormal | 26 | 74.3 |
| | Normal | 9 | 25.7 |
| Hb level in Electric smokers | Abnormal | 18 | 51.4 |
| | Normal | 17 | 48.6 |
| SpO2 level in electric smokers | Abnormal | 1 | 2.9 |
| | Normal | 34 | 97.1 |

Most of conventional smokers are as in moderate category with 28 respondents (52.8%), severe smokers are 16 respondents (30.2%) and mild smokers were 9 respondents (17.0%). The lung vital capacity of conventional smokers with abnormal category is 37 respondents (69.8%), normal category is 16 respondents (30.2%). The conventional smoker's haemoglobin level is abnormal in 24 respondents (45.3%), normal is 29 respondents (54.7%). The oxygen concentration of conventional smokers is in the category of abnormal 1 respondent (1.9%), normal category is 52 respondents (98.1%). (See in Table. 1)

Whereas, the electric smokers was dominated by the severe smoker with 28 respondents (80%), while the mild smokers were 7 respondents (20%). Pulmonary capacity of electric smokers is mostly in the category of abnormal 26 respondents (74.3%), and 9 respondents (25.7%) is normal category. The level of haemoglobin in electric smokers is in the abnormal category of 18 respondents (51.4%), and the normal category is 17 respondents (48.6%). Electric smoker oxygen saturation level is in the category of abnormal is 1 respondent (2.9%), and normal category are 34 respondents (97.1%).

**Table 2.** Bivariate Analysis (*Chi-square Test)*

| Independent Variable | Dependent Variable | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Vital Pulmonary Capacity | | | | | Haemoglobin Levels | | | | | Oxygen Saturation | | | | |
| | Abnormal | | Normal | | p value | Abnormal | | Normal | | p value | Abnormal | | Normal | | p value |
| | f | % | f | % | | f | % | f | % | | f | % | f | % | |
| Conventional Smokers | | | | | 0.001 | | | | | 0.506 | | | | | 0.308 |
| Severe | 15 | 28.3 | 1 | 1.9 | | 9 | 17 | 7 | 13.2 | | 1 | 1.9 | 15 | 28.3 | |
| Moderate | 20 | 37.7 | 8 | 15.1 | | 12 | 22.6 | 16 | 30.2 | | 0 | 0 | 28 | 52.8 | |
| Mild | 2 | 3.8 | 7 | 13.2 | | 3 | 5.7 | 6 | 11.3 | | 0 | 0 | 9 | 17 | |
| Electric Smokers | | | | | 0,000 | | | | | 1.000 | | | | | 1.000 |
| Severe | 25 | 71.4 | 3 | 8.6 | | 14 | 40 | 14 | 40 | | 1 | 2.9 | 27 | 77.1 | |
| Mild | 1 | 2.9 | 6 | 17.1 | | 4 | 11.4 | 3 | 8.6 | | 0 | 0 | 7 | 20 | |

The results of the chi-square test between the status of conventional smokers and vital pulmonary capacity have a relationship with the p value of 0,000 (p <0.05) as seen in Table 2. This study is in accordance with the research of Musniatun et al. (2016) showed that there was a significant relationship between smoking habits and vital lung capacity (p= 0.006).

The impact of smoking causes changes in airway function, research by Pujiani and Siwiendrayanti (2017) states that smoking behaviour is associated with the incidence of upper respiratory tract infection (p= 0,000). Changes that occur in the respiratory tract of mucous cells undergo hypertrophy and the mucus gland undergoes hyperplasia. Narrowing is caused by the build-up of mucus, in the lung tissue an increase in the number of inflammatory cells and damage to the alveoli, consequently the respiratory tract in smokers can affect changes in lung function, this is the cause of chronic pulmonary obstruction including pulmonary emphysema, chronic bronchitis and asthma (Twistiandayani et al., 2014).

Handari et al. (2017) and Dien et al. (2018) have the same conclusion that smoking causes the decrease of pulmonary vital capacity with p value 0.005 (p <0.05), Handari hold this research of the employees of Indonesia Railway in Poncol railway station, meanwhile Dien hold his research in the employees of *PT. Simple Jaya Manado.*

The result of Bivariate analysis between conventional cigarette with Haemoglobin level shows that there is no correlation with p value p= 0.506 (p >0.05). This finding is in accordance with the research of Wibowo et al. (2017) with p value 0.634 . Rangkuti et al. research in (2017) and Muliyadi et al. in (2015) also found the same finding, it had p value 0,373 and 0.360

Haemoglobin level is caused by some factors, such as: age, sex, nutrition intake, activity, the height of the land, and the habit of smoking. Amelia et al. (2016) stated in her research that there is no statistical test that shows the correlation between the habit of smoking and haemoglobin level (p= 0.065*).* Smoking can increase haemoglobin level, carbon monoxide is as the mediator to bind hemoglobin and form carboxymoglobin. The number of cigarettes consumed per day affects the increase in the average hemoglobin level and carboxymoglobin level (Khan et al., 2014).

Research by Malenica et al. (2017) states that smoking causes a significant increase (p <0.001) in red blood cells, white blood cells (p=

0.040), hemoglobin (p <0.001), hematocrit (p= 0.047) and mean corpuscular hemoglobin (p <0.001) in men compared to female smokers.

Smokers with a degree category mild and moderate-severe have high hemoglobin levels, this is because carbon monoxide has a 200-fold higher affinity for Hb. Research by Mariani & Kartini (2018) concluded that there is a relationship between the degree of smoking and hemoglobin levels with a value of p= 0.047.

The results of the bivariate analysis of conventional cigarettes with oxygen saturation levels showed no relationship with the value of p = 0.308 (p> 0.05). This study is different from the study conducted by Septia et al. (2016) that there is a relationship between smoking and oxygen saturation. It is higher the degree of smoking the lower the level of oxygen saturation in the blood (p <0.005). Sudaryanto's study (2015) found that there was a relationship between the degree of smoking and saturation of oxygen with a value of p= <0.05.

Ozdal et al. (2017) research is also different from this study, that nonsmokers had a higher oxygen saturation than those who did not smoke (p <0.005). The study of Jeon et al. (2014) stated that there was no difference in oxygen saturation between smokers and nonsmokers, oxygen saturation was still within normal limits.

Based on the results of the chi-square test in table 2, there is a relationship between the status of electric smokers with vital pulmonary capacity with a value of p= 0,000 (p <0.05). This research is in accordance with what Warniati et al. (2017) that showed there is a relationship between cigarette consumption and lung function (p= 0.022). Electric cigarrete causes a decrease in FEV1 / FVC compared to nonsmokers (p = 0.01) (Meo et al., 2018).

Electrical cigarettes are initially used as smoking cessation aids by transferring tobacco smokers to e-cigarettes, some of them are actually using it as a way to stop smoking. There are also those who intentionally aimlessly stop (Rahman et al., 2015). Wibowo's (2017) study showed a negative relationship between the perspective of barriers and the possibility of teenage smoking cessation, thus it was statistically significant.

Propylene glycol content in e-cigarettes can reduce lung function, when flight trainees exposed to propylene glycol smoke they experience a decrease in FEV1 / FVC (Zucchet & Schmaltza, 2017). One of them is propylene glycol (PG) which can cause rhinitis, asthma, and allergy symptoms. Exposure to smog in a theater containing PG can cause a decrease in lung function (Hajek et al., 2014). Nurjanah et al. (2014) in employees exposed to cigarette smoke indicate 20% of respondents to experience mild restriction, 2.9% mild obstruction and 2.9% moderate obstruction.

The results of bivariate analysis of e-cigarettes with hemoglobin levels showed no relationship with the value of p= 1,000 (p> 0.05). Research by Malenica et al. (2017) is different from this study, that cigarettes cause an increase in hemoglobin (p <0.001).

Hemoglobin levels are influenced by age, sex, iron adequacy in the body, tea drinking habits, geographical conditions, smoking behavior. Age and sex can affect the normal value of hemoglobin levels, male and female hemoglobin levels are different, women menstruate so blood loss and remove a certain amount of iron needed for hemoglobin formation (Verranika & Rukmana, 2015).

Iron adequacy in the body affects hemoglobin levels because iron is needed for the formation of hemoglobin (Waani et al., 2014). Saptyasih's research (2016) shows that there is a significant relationship between iron intake and hemoglobin level (p= 0,000). Consuming tea and coffee one hour after meals will reduce absorption from iron to 40% for coffee and 85% for tea, because there are polyphenol substances such as tannins contained in tea (Soraya et al., 2014). The geographical condition of the altitude of the sea level is a factor in the normal value of hemoglobin. Decreased air pressure, oxygen partial pressure, body temperature and gravity due to height factors, affect body physiology and can cause hypoxia (Jacobus et al., 2016). Research of Ischorina et al. (2016) in active smokers HbCO levels and hemoglobin levels increased. The results of statistical tests showed there is a significant relationship with a value of p= 0,000. causing an increase in hemoglobin (p <0.001)..

The result of bivariate analysis in electric smokers with saturation of oxygen level shows there is no relationship with p value 1.000 (p >0.05). This result is different with Palamidas et al. (2017), in his research shows the saturation oxygen decreases with p value <0.001.

The oxygen intake in the body is influenced by environment, exercise, emotion, life-style, and health status. Smoke in ciggarette can cause the decrease of maximum oxigen volume ($VO_2Max$). This is equal with the research of Oktarini and Mukaromah (2015) that investigated the decrease of $VO_2max$ in elderly

Carbonmonoxide decrease the saturartion by declining the abilty of heamoglobin to deliver oxygen because carbonmonoxide has high affinity with red blood cell (250 much than oxygen).

Oxygen saturation must be maintained more than 95%, if it becomes lower it can affect changes in cognitive functions such as thinking and remembering abilities (Jeon et al., 2014). Research on Vakali et al. (2014) also differ from this study, namely there is an increase in heart rate and a decrease in oxygen saturation associated with the use of e-cigarettes containing nicotine.

**Tabel 3.** Bivariate Analysis (Mann-Whitney Test)

| Smoker Category | Vital Pulmonary Capacity | | Hb Level | | SpO2 level | |
|---|---|---|---|---|---|---|
| | Mean rank | p value | Mean rank | p value | Mean rank | p value |
| Conventional | 43.96 | 0.651 | 44.21 | 0.895 | 40.16 | 0.044 |
| Electric | 45.31 | | 44.94 | | 51.07 | |

According to Mann Whitney test results (See in table.3) on conventional smoker status and electric smoker status there was no difference in vital lung capacity with p value = 0.651 (p> 0.05). The average rating of lung vital capacity in conventional smokers was 43.96 lower than that of electric smokers 45.31. This research is in accordance with what Ferrari et al. (2015) did that there is no difference between electric smokers and conventional smokers with FEV1, FVC, FEV1 / FVC, and PEF values.

Decreases in lung capacity include caused by smoking, age, sex, body size, body position, physical exercise, strength of breathing muscles, and pulmonary distensibility and chest wall (Djodjosoewarno et al., 2014).

This study differs from Kumar et al. (2015) that there was a significant difference in lung function decline in the smoker population compared to the non-smoker population. The results of the study by Nisa et al. (2015) also showed that smoking time and the amount of cigarette consumption per day had an effect on the $VEP_1$ / KVP ratio.

The results of the bivariate analysis of the *Mann Whitney* test on the status of conventional smokers with electric smoker status did not show differences in haemoglobin levels with p= 0.895 (p> 0.05). The average haemoglobin level ratings in conventional smokers were 44.21, slightly lower than electric smokers 44.94. Nadia et al. (2015) state that cigarette and *Shisha* smokers have a much higher Hb level, HCT, RBCs, the number of TWBC and MCHC. However, platelet counts were significantly lower in smokers compared with non-smokers.

This study is different from the research of Choi et al. (2018) which showed that conventional single smokers and electrically-conventional double smokers had increased haemoglobin levels with p= 0.0022 in single smokers and p= 0.0012 in double smokers.

Makawekes et al. (2016) study also showed that there were differences in hemoglobin levels between smokers and nonsmokers (p= 0.021), with average smokers 16.263 (mg / dL) and nonsmokers at 15.723 (mg / dL). Based on the type of cigarette, no effect on the hemoglobin level of a person, the study of Mariani & Kartini (2018) states that there is no significant relationship between the types of cigarettes and hemoglobin levels with a value of p= 0.115.

The results of the *Mann-Whitney* bivariate analysis on the status of conventional smokers with electric smoker status differed in oxygen saturation with p value = 0.044 (p <0.05). The average rating of oxygen saturation levels in conventional smokers was 40.16 lower than that of electric smokers 51.07.

Smoking activity can affect the level of oxygen saturation in the blood, the carbon monoxide content in cigarettes is one of the causes of changes in oxygen saturation, nonsmokers have a higher oxygen saturation than those who smoke (p <0.005) (Ozdal et al., (2017). Geographically is also one of the factors causing a decrease in oxygen saturation, there is a significant difference in oxygen saturation between smokers and nonsmokers at high levels (p= 0.010) (Polii et al., 2017).

## CONCLUSION

Based on research and discussion conducted in Srobyong Village, Mlonggo Subdistrict, Jepara Regency, it can be concluded that there is a relationship between conventional and electric smoker status with vital pulmonary capacity, there is no relationship between conventional and electric smoker status with hemoglobin level, there is no relationship between conventional smoker status and electrically with oxygen saturation levels, there are differences in oxygen saturation levels in conventional smoker status and electric smoker status, there is no difference in vital lung capacity and hemoglobin levels in conventional smoker status with electric smoker status.

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