

Comparison of Total Leukocytes in Conventional Smokers and E-Smokers in Students of the Faculty of Medicine, University of Muhammadiyah North Sumatra

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Abstract: Smoking remains a widespread habit in Indonesia, particularly in Medan, where the prevalence of daily smokers reaches 55.2%, exceeding the national average of 54% in 2016. Despite awareness of the health risks associated with tobacco, many individuals continue smoking and some have shifted to e-cigarettes as an alternative. However, e-cigarettes are also known to have harmful effects on the body, including potential changes in leukocyte count. This study aimed to compare the total leukocyte count between conventional cigarette users and e-cigarette users. It employed an analytical observational approach with a cross-sectional design involving 60 respondents selected through purposive sampling based on inclusion and exclusion criteria. The results showed that most respondents had smoked for 1–5 years. Conventional cigarette users typically smoked 1–5 cigarettes per day, while e-cigarette users consumed 1–2 ml of liquid daily. The Mann-Whitney test produced a significance value of 0.525 (>0.05), indicating no significant difference in the total leukocyte count between conventional and e-cigarette users among medical students at the University of Muhammadiyah North Sumatra.

Keywords: Leukocytes, Conventional Cigarettes, E-Cigarettes

Introduction

Smoking is one of the main risk factors for several chronic diseases that can result in death (Rohmani et al, 2018). Such as hypertension which is often unknown and results in death that can be caused by cigarettes (Septiani, 2022). Smoking is also one of the causes of the increase in Leukocytes in the blood (Ardina & Nada, 2019).

The results of Basic Health Research (Riskesdas) in 2018 stated that the smoking behavior of the Indonesian population aged 15 years and above was 33.8% in 2018. Smokers over the age of 10 years were found to be 24.3% of smokers every day, but 4.6% smoked for a relatively rare period of time. And the proportion of the age group of 10 – 14 years old is 0.7%, 15 – 19 years old is 12.7% and 20 – 24 years old is 27.3% who are active smokers by smoking every day. With a percentage of men of 47.3% and women of 1.2% (Basic Health Research 2018).

Tobacco cigarettes or conventional cigarettes contain toxic ingredients and have an opium effect (Ardina & Nada, 2019). The contents in cigarettes include Tar, Nicotine, Free

Radicals, Lead (Pb), and Carbon Monoxide (CO)(Amalia, 2019). The dangers contained in tobacco cigarettes do not deter cigarette users and stop consuming tobacco cigarettes. Various efforts have been made to reduce tobacco cigarettes. One of the efforts is to replace tobacco cigarettes with e-cigarettes or e-cigarettes (Nursidika et al., 2019).

E-cigarettes are considered safe because they do not contain tar contained in tobacco cigarettes, but they still contain nicotine compounds whose doses are lowered. So many tobacco smokers have switched to using e-cigarettes (Sudradjat, 2019). The nicotine in conventional cigarettes is absorbed through the bloodstream quickly, whereas in e-cigarettes it is slower. Nicotine can have an effect on blood cells. Nicotine can increase the number of white blood cells, a significant increase in neutrophils, lymphocytes, monocytes, eosinophils, and basophils (Nursidika et al, 2019).

Nicotine induces catecholamines and steroid hormones from the adrenal glands. This can trigger an increase in levels of some endogenous hormones such as epinephrine and cortisol, which has an effect on increasing the number of leukocyte cells (Purwaeni, 2020). In addition, the irritating effect of tobacco smoke on the respiratory tract resulting in inflammation can also contribute to an increase in the number of leukocytes (Waleleng et al, 2018). Inflammatory stimulation in the respiratory tract induces an increase in inflammatory markers in the circulation, such as cytokines, which also affects the number of leukocytes (Nursidika et al, 2019).

Research by (Junaidin & Kambu, 2020) stated that the increase in the number of leukocytes in active cigarette users is so that researchers are very interested in conducting a study on the comparison of the number of leukocytes in e-cigarette users and conventional cigarettes to see what types of cigarettes have greater side effects. The purpose of this study was to determine the total number of leukocytes with the frequency of smoking and the number of cigarettes smoked in conventional smokers in students of the Faculty of Medicine, University of Muhammadiyah North Sumatra and to find out the total number of leukocytes with the frequency of smoking and the amount of liquid smoked in e-smokers in students of the Faculty of Medicine, University of Muhammadiyah North Sumatra.

Methodology

This research is analytical with a cross sectional approach and non-experimental design, which was conducted on January 18-26, 2024 at the University of Muhammadiyah North Sumatra. Sampling is carried out at the Faculty of Medicine, while sample examination is carried out at the Clinical Pathology Laboratory of the same faculty. The study population was all students of the Faculty of Medicine, and the sample was determined using the Slovin formula with a real level of 0.1, so that a total of 60 respondents were obtained, consisting of 30 users of conventional cigarettes and 30 users of e-cigarettes. The inclusion criteria included students who were healthy, willing to be respondents, and smoked every day for at least one month, while the exclusion criteria included respondents who refused blood draws, took immunosuppressant drugs, or were experiencing infections and allergies.

Tests were performed on 60 blood samples stored in labeled EDTA tubes. The number of leukocytes was analyzed using Mindray's automated hematology analyzer. Before the inspection, the sample is homogenized, then the sample ID is entered into the tool system, and after the process is running, the inspection results are printed automatically. Data analysis was carried out using the SPSS statistical program. Univariate analysis is used to describe the distribution of data in the form of tables and frequencies, while bivariate analysis uses a non-parametric Mann-Whitney test to test the relationship between independent and dependent variables (Scott, 2019). Data from the open-ended questionnaire were tabulated, coded, and categorized based on similarity of meaning before frequency calculations were performed for interpretation of the results.

Result and Discussion

This research was carried out at the Clinical Pathology Laboratory, Faculty of Medicine, University of Muhammadiyah North Sumatra. The population and sample in this study are students of the University of Muhammadiyah North Sumatra who meet the inclusion criteria and are willing to become research respondents. With a total of 60 samples taken, including 30 samples of conventional smokers and 30 blood samples of electric smokers.

Table 1. characteristics of respondents by age

Age	E-cigarettes	Conventional Cigarettes	Frequency	Percentage
18 Years	3	2	5	8.3%
19 Years	4	5	9	15%
20 Years	8	7	15	25%
21 Years	8	8	16	26.7%
22 Years	5	5	10	16.7%
23 Years	1	0	1	1.7%
24 Years	0	2	2	3.3%
25 Years	1	1	2	3.3%
Total	30	30	60	100%

Based on Table 1, information was obtained that based on age, respondents with the age of 18 who smoked as many as 5 people (8.3%) with details of 3 people using e-cigarettes and 2 people using conventional cigarettes. At the age of 19 years old, 9 people (15%) smoked, with details of 4 people using e-cigarettes and 5 people using conventional cigarettes. At the age of 20 years old, 15 people (25%) smoked, with details of 8 people using

e-cigarettes and 7 people using conventional cigarettes. At the age of 21 years old, 16 people (26.7%) smoked, with details of 8 people using e-cigarettes and 8 people using conventional cigarettes. At the age of 22 years who smoked, 10 people (16.7%) with details of 5 people using e-cigarettes and 5 people using conventional cigarettes. At the age of 23 years who smoked 1 person (1.7%) with details of 1 person using e-cigarettes and 0 people using conventional cigarettes. At the age of 24 years who smoked, 2 people (3.3%) with details of 0 people using e-cigarettes and 2 people using conventional cigarettes. At the age of 25 years of age, 2 people (3.3%) smoked, with details of 1 person using e-cigarettes and 1 person using conventional cigarettes.

Table 2. Characteristics of respondents by gender

Gender	E-cigarettes	Conventional Cigarettes	Frequency	Percentage
Man	23	28	51	85%
Woman	7	2	9	15%
Total	30	30	60	100%

Based on Table 2, it can be seen that based on gender, 51 male respondents (85%) smoked, with details of 23 people using e-cigarettes and 28 people using conventional cigarettes. In the female sex who smoked, 9 people (15%) with details of 7 people using e-cigarettes and 2 people using conventional cigarettes.

Table 3. Characteristics of respondents by age of smoking

The Age of Smoking	E-cigarettes	Conventional Cigarettes	Frequency	Percentage
10-19 Years	21	21	42	70%
20-29 Years	9	9	18	30%
Total	30	30	60	100%

Based on Table 3, information was obtained that based on the age of starting smoking, respondents with the age of starting smoking were 42 people (70%) with details of 21 people using e-cigarettes and 21 people using conventional cigarettes. At the age of 20-29 years, 18 people (30%) with details of 9 people using e-cigarettes and 9 people using conventional cigarettes.

Table 4. Characteristics of respondents based on length of time smoking

Long Smoking	E-cigarettes	Conventional Cigarettes	Frequency	Percentage
1-6 Months	11	2	13	21.7%
1-5 Years	18	25	43	71.7%
>10 Years	1	3	4	6.7%
Total	30	30	60	100%

Based on Table 4, information was obtained that based on the length of time they smoked, 13 respondents (21.7%) with details of 11 people using e-cigarettes and 2 people using conventional cigarettes. Respondents with a smoking period of 1-5 years were 43

people (71.7%) with details of 18 people using e-cigarettes and 25 people using conventional cigarettes. And respondents with a smoking period >10 years as many as 4 people (6.7%) with details of 1 person using e-cigarettes and 3 people using conventional cigarettes.

Results of Measurement of Leukocyte Levels in Conventional Cigarette Users Based on Duration of Smoking

Table 5. number of leukocytes in conventional cigarette users based on length of smoking

Long Smoking	Conventional	Median
1-6 Months	2	7350 μ l
1-5 Years	25	7700 μ l
>10 Years	3	8800 μ l
Total	30	7700 μ l

Based on table 5, information was obtained that at 1-6 months of smoking a median value of 7350 μ l was obtained, at a smoking period of 1-5 years a median value of 7700 μ l was obtained, at a smoking period of >10 years a median value of 8800 μ l was obtained. And overall a median value of 7700 μ l was obtained.

Results of Measurement of Leukocyte Levels in E-cigarette Users Based on Duration of Smoking

Table 6. number of leukocytes in e-cigarette users based on the length of smoking

Long Smoking	E-cigarettes	Median
1-6 Months	11	7800 μ l
1-5 Years	18	7600 μ l
>10 Years	1	-
Total	30	7600 μ l

Based on table 6, information was obtained that at the duration of smoking 1-6 months the median value of 7800 μ l was obtained, at the duration of smoking 1-5 years the median value of 7600 μ l was obtained, at the duration of smoking >10 years there was no median value, because there was only 1 person. And overall a median value of 7600 μ l was obtained.

Characteristics Based on a Lot of Conventional Smoking in a Day

Table 7. Respondents' characteristics based on the number of conventional smokers in a day

Number of Cigarettes per day (Sticks)	Frequency (n)	Presentase (%)
>10 Rods	12	40%
6-10 Stems	4	13.3%
1-5 Sticks	14	46.7%
Total	30	100%

Based on Table 7, it is aimed at people who smoke conventional cigarettes in a day with the most 1-5 cigarettes a day, namely 14 people (46.7%).

Characteristics Based on A Lot Of Electric Smoking In A Day

Table 8. Characteristics of respondents based on the amount of e-smoking liquid in a day

Amount of liquid per day (ml)	Frequency (n)	Presentase (%)
1-2 ml	16	53.3%
3-4 ml	13	43.3%
5-6 ml	1	3.3%
Total	30	100%

Based on Table 4.8, it is pointed at the number of people who smoke e-cigarettes in a day with a sample number of 30 that the most respondents consume is 1-2 ml per day with a total of 18 respondents (43.3%).

Results of Measurement of Leukocyte Levels in Conventional Cigarette Users Based on Smoking A Lot

Table 9. number of leukocytes in conventional cigarette users based on the number of smokers

A lot of cigarettes are consumed	Conventional	Median
1-5 Sticks	14	7650 μ l
6-10 Stems	4	8250 μ l
>10 Rods	12	7650 μ l
Total	30	7700 μ l

Based on table 9, information was obtained that in many 1-5 cigarettes the median value was 7650 μ l, in many cigarettes 6-10 cigarettes the median value was 8250 μ l, in many cigarettes >10 cigarettes the median value was 7650 μ l. And overall a median value of 7700 μ l was obtained.

Results of Measurement of Leukocyte Levels in E-cigarette Users Based on Heavy Smoking

Table 10. number of leukocytes in e-cigarette users based on the amount of smoking

A lot of cigarettes are consumed	E-cigarettes	Median
1-2 ml	16	7600 μ l
3-4 ml	13	7500 μ l
5-6 ml	1	-
Total	30	7600 μ l

Based on table 10, information was obtained that in many 1-2 ml cigarettes the median value was 7600 μ l, in many 3-4 ml cigarettes the median value was 7500 μ l, in many 5-6 ml cigarettes there was no median value, because only 1 person. And overall a median value of 7600 μ l was obtained.

Uji Mann-Whitney

Table 11. Results of the Mann-Whitney Statistical Test Comparison of Leukocyte Counts in Conventional Cigarette and E-Cigarette Users

Types of Cigarettes	Median	Sig.
Conventional	7700 μ l (4800 μ l - 11300 μ l)	0.525
Electricity	7600 μ l (4600 μ l - 16400 μ L)	

Based on table 4.11, information was obtained that e-cigarettes have a minimum value of 4600 μ l with a maximum value of 16400 μ l and a median value of 7600 μ l. Meanwhile, conventional cigarettes have a minimum value of 4800 μ l with a maximum value of 11300 μ l and a median value of 7700 μ l. In addition, the value of sig. of 0.525, the value > 0.05 thus it can be stated that H_0 is accepted and H_1 is rejected which means that there is no difference in total leukocytes between respondents who smoke using electricity and conventional.

Discussion

In this study, the number of leukocytes was compared with users of conventional cigarettes and e-cigarettes in students of the University of Muhammadiyah North Sumatra. The sample was taken as many as 60 samples, namely 30 Conventional smokers and 30 Electric smokers where respondents were taken in accordance with the inclusion criteria and exclusion criteria, before their blood was taken as proof of their desire to participate in the research, the respondents would be asked to sign a permission form to become a participant. In addition, there is a questionnaire for supporting information or details about the respondents to be given to the respondents. Venous blood was then taken after the questionnaire was completed. Venous blood that has been taken should be checked immediately.

In Table 4, based on the results obtained by the respondents, the frequency of smoking is the most in conventional smokers and e-cigarettes, which is 1-5 years, where in conventional smokers there are 25 people and 18 people for e-cigarettes with a frequency of 43 (71.7%). This research is in line with the (Sirih et al., 2017) A study of 30 chronic smokers with young adulthood and a duration of smoking for 2-5 years stated that there was no difference in the number of leukocytes in people who smoked chronically (Nursidika et al., 2019). There are also several other studies that have obtained different results. Research (Bakhri, 2018) who conducted a case study on 41-year-old active smokers and also found an increase in the number of leukocytes. Based on the length of smoking, it is known that 2 people with leukocytosis smoke > 20 years. These results were also found in the study of Takahashi et al, where active smokers > 20 years showed a significant increase in leukocytes.

In Table 7, based on the results obtained from respondents with the most frequency of smoking in conventional smokers in a day, namely 1-5 cigarettes with a frequency of 14 (46.7%). Meanwhile, in the electric smoker in Table 4.8, the result of the frequency of the

number of people who smoke liquid in a day is 1-2 ml with a frequency of 16 (53.3%). This is due to a sense of dependence, and by smoking they feel calmer.

According to (Nursidika et al., 2019) Conducting a study on the number and type of leukocytes in e-cigarette users with a sample of 30 stated that there was no difference in the number of leukocytes but there was an increase in the type of leukocytes. One of the things that can happen is why leukocyte levels in smokers are still in a normal state because the age of the respondents involved is still in the young adult age category (Faruq, 2018), according to Table 4.1 the age criteria for respondents in the study are ages ranging from 18 years to 25 years which at that age is still included in the young adult age group, because age affects the effects of cigarette exposure physiologically and psychologically, although the number of leukocytes is still relatively normal, but the nicotine content in cigarettes can affect the immune system related to the number and type of leukocytes (Junaidin & Kambu, 2020). There are also other studies that have obtained different results. A study by Aula et al. who conducted a study on active smokers aged 25-35 and 36-45 years who smoked at least 10 cigarettes for 10 years in the city of Erbil showed that it was an increase in the level of the total number of leukocytes. and Research (Al-Temimi, 2017) which found an increase in the number of leukocytes in active smokers with an age range of 30-39 years and increasing at the age of 40-49 years.

The calculation of the number of leukocytes aims to determine the overall level of leukocytes in the blood of smokers, which is useful for establishing diagnosis and can provide an overview of events and infections that occur in the body (Purwaeni, 2020). The increase in the number of leukocytes in the blood of smokers is caused by exposure to cigarette smoke which is a free radical that causes air pollution which can then directly cause oxidative stress in the lungs of cigarette smoke which contains a lot of harmful chemicals (Rohmani et al., 2018). In the results of the hypothesis testing in this study, it was found that there was no difference in the number of leukocytes in users of conventional cigarettes and e-cigarettes.

Based on the results of the data using the Mann-Whitney test in Table 4.11, it shows that the significant value is 0.525, the value > 0.05 which means that there is no difference in the total number of leukocytes between users of conventional cigarettes and e-cigarettes. The level of leukocytes is said to be normal ranging from 4,000-11,000 cells/ μ l.¹⁹ and the median value on the number of leukocytes in this study in accordance with Table 4.11 above shows that the median leukocyte level in conventional smokers is 7,700 μ l and in e-smokers is 7,600 μ l which means that these two types of cigarettes are still in normal leukocyte levels.

There are several factors that can affect the number of leukocytes in each individual, namely: age, gender, nutritional intake, physical activity, history of disease, smoking habits, alcohol consumption, drugs. In addition, the determination of research inclusion criteria also affects the results of the research.

Researchers did not further review some of the factors that can affect leukocyte levels in this study, such as nutritional intake, degree of physical activity and lifestyle. Where this can affect the results of the respondent's leukocyte levels.

In this study, the age of the respondents ranged from 18-25 years old which is still said to be young adulthood, and the respondents in this study were not said to be active smokers because many only consumed 1-5 cigarettes per day in conventional cigarette users and 1-2 ml of liquid per day in e-cigarette users.

In this study, primary data in the form of questionnaires were used to obtain data on cigarette consumption and venous blood tests to see leukocyte levels. The data obtained from the questionnaire also depends on the honesty of the respondents and the respondents' understanding of the questions asked by the researcher.

Conclusion

The results showed that most of the respondents, both conventional and electric smokers, had a smoking period of between 1-5 years, with 25 conventional smokers and 18 electric smokers (71.7%). The median number of leukocytes in conventional smokers was 7,700 μ l, while in electric smokers it was 7,600 μ l. The highest smoking frequency in conventional smokers was 1–5 cigarettes per day (46.7%), while e-cigarette users generally smoked 1–2 ml of liquid per day (53.3%). The median number of leukocytes was not much different, which was 7,650 μ l in conventional smokers and 7,600 μ l in e-smokers. Based on the Mann-Whitney test with a significance value of 0.525 (> 0.05), there was no significant difference between the total number of leukocytes used in conventional and electronic cigarette users. Further research is recommended to examine the relationship between the number of leukocytes in users who use both types of cigarettes at the same time and compare leukocyte levels in chronic smokers.

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