Analysis of Erythrocyte Sedimentation Rate Levels in Active-Smoking Students: A Survey of Papuan Students in Bandung City

Kesya Yogobi[1], Agus Sudrajat[2]
[1]Politeknik Piksi Ganesha, Bandung, Indonesia, kesyayogobi5@gmail.com
[2]Politeknik Piksi Ganesha, Bandung, Indonesia, manlab25@gmail.com

Corresponding Author: kesyayogobi5@gmail.com[1]

Abstract: Smoking is a high-risk behavior commonly found among university students, including Papuan students residing in Bandung City. Exposure to toxic substances in cigarettes can trigger inflammatory processes, which can be detected through an increase in the Erythrocyte Sedimentation Rate (ESR). This study aims to describe the ESR values of Papuan students who are active smokers and to examine their relationship with smoking duration. This research used a descriptive quantitative design with purposive sampling involving 30 respondents, whose ESR levels were measured using the Westergren method. The results showed that ESR values ranged from 12 to 45 mm/hour, with an average of 26.7 mm/hour. A total of 63.3% of respondents had elevated ESR levels (>20 mm/hour), while 36.7% were within the normal category. Respondents who had been smoking for more than three years had higher ESR levels compared to those who had been smoking for less than three years. This study concludes that most Papuan students who are active smokers experience elevated ESR levels, indicating the presence of inflammatory processes associated with smoking habits.

Keyword: Smoking, Erythrocyte Sedimentation Rate, Students

INTRODUCTION

Smoking is one of the risk behaviors that is still commonly found among university students in Indonesia. Smoking habits not only have an impact on physical health but also affect quality of life, physical fitness, and academic productivity. Among Papuan students, smoking behavior is often influenced by social and cultural environments as well as adaptation-related stress when pursuing education outside their region of origin. This condition places Papuan students among groups that may have a higher health risk if smoking habits are carried out intensively and over a long period of time. One parameter that can be used to assess health conditions and risk factors related to smoking behavior is LED (Life Expectancy Determinant). LED is an indicator that describes factors influencing an individual's life expectancy based on lifestyle aspects, physical health, smoking habits, sleep patterns, physical activity, and nutritional status. In active smokers, LED tends to decrease due to impaired lung function, increased risk of cardiovascular disease, and reduced physical fitness capacity.

Active-smoking Papuan students in Bandung City represent an interesting group to study because their smoking habits tend to be influenced by social and cultural factors as well as stress from adapting to a new environment. An analysis of LED in this group is important to determine the extent to which smoking behavior affects their health status. In addition, the results of this analysis can serve as a basis for designing health intervention programs for students in order to reduce the risk of smoking-related diseases. In its early development, LED technology was able to produce color combinations by combining red, green, and blue, commonly known as RGB. However, because it was very difficult to obtain true amber (orange-like) color, a specific LED diode was developed to produce this color. Based on a joint study conducted by the Japan International Cooperation Agency (JICA), the Directorate General of New and Renewable Energy and Energy Conservation (Ditjen EBTKE) of the Ministry of Energy and Mineral Resources (ESDM), and the Agency for the Assessment and Application of Technology (BPPT), it was found that household energy consumption with power contracts of 450 VA–900 VA (tariff group R1) was dominated by lighting usage at 26% (B2TE, 2012).

This community service activity aims to conduct routine hematological and LED examinations among the elderly in the service area [specify location], as a form of promotive and preventive contribution to reducing the burden of chronic diseases and improving the quality of life of older adults. Through this simple intervention, it is expected that the community will become more aware of the importance of regular health evaluations and be better educated in maintaining hematological status and immune function as age increases. The number of smokers in Indonesia continues to increase every year. Smoking has become a widespread habit across various groups, ranging from adolescents to adults. Indonesia is one of the countries with the highest smoking-related mortality rates in the world. Smoking causes various health problems and can lead to death; in addition, it also has economic and financial impacts. Smoking is a major risk factor for degenerative diseases such as respiratory diseases, stroke, and inflammation.

In Gianyar Regency, the number of active smokers has also increased, with the 35–44-year age group being the highest, reaching 31.13%. Many people tend to ignore the health risks of smoking and are often unaware that they are experiencing health problems or inflammation caused by smoking. They usually become aware only when the inflammation has become severe and led to serious illness. Based on research conducted by Muliyanto, Hartini, and Saputri (2024), it was found that the erythrocyte sedimentation rate (ESR) values among active smokers with a smoking duration of five to ten years were within normal limits, whereas active smokers with a smoking duration of twenty to thirty years had elevated ESR values. The number of adult smokers in Indonesia increased from 60.3 million in 2011 to 69.1 million in 2021, according to data from the Global Adult Tobacco Survey (GATS). Smoking prevalence is higher among men (64.7%), lower among women (2.3%), and highest among young adults aged 20–24 years. According to the 2018 Basic Health Research (Riskesdas), 24% of adolescents aged ≥10 years in Aceh Province used tobacco products. In Lhokseumawe City, 20.71% of the population aged ≥10 years were smokers, with an average daily cigarette consumption of 16.44 sticks. Cigarette smoke is believed to be the most harmful component of smoking because it contains more dangerous substances than the smoke inhaled by passive smokers. This occurs because cigarette smoke does not pass through a filtration process, thereby posing a higher risk of health problems for exposed individuals. Such exposure can cause serious health effects for those who inhale it.

METHOD

This study employs a quantitative research method with a descriptive approach. This method was chosen to obtain a systematic, factual, and accurate description of the phenomenon under investigation based on numerical data collected from respondents.

1. Population and Sample

The population of this study consists of all Papuan students residing in Bandung City in 2025, with an estimated total population of 60 students.

The sample size was determined using the Slovin formula with an error tolerance of 10% (0.1), resulting in the following calculation:

$$n = \frac{N}{1 + N(e)^2}$$

$$n = \frac{60}{1 + 60(0,1)^2}$$

$$n = \frac{60}{1 + 0,6} = \frac{60}{1,6} = 37,5 \approx 30 \text{ responden}$$

Thus, the number of samples used in this study was 30 respondents.

The sampling technique employed was simple random sampling, in which each member of the population had an equal opportunity to be selected as a research sample.

2. Data Collection Techniques

Data collection in this study was carried out using the following methods:

3. Questionnaires, designed in the form of closed-ended and open-ended questions in accordance with the research variables.

4. Literature review, by examining books, scientific journals, and other reference sources relevant to the research topic.

5. Data Analysis Technique

The collected data were analyzed using quantitative descriptive analysis, by processing the data into percentages, tables, and graphs to facilitate interpretation of the research findings.

RESULTS AND DISCUSSION

Table 1. Descriptive Statistics of ESR Values

Variable	N	Minimum	Maximum	Mean	Std. Deviation
ESR (mm/hour)	30	12	45	26.70	8.50

The average ESR value of the respondents was **26.7 mm/hour**, with the lowest value of **12 mm/hour** and the highest value of **45 mm/hour**.

Table 2. Distribution of ESR Categories

ESR Category	Frequency	Percent	Valid Percent	Cumulative Percent
Normal (< 20 mm/hour)	11	36.7	36.7	36.7
Elevated (≥ 20 mm/hour)	19	63.3	63.3	100.0
Total	**30**	**100.0**	**100.0**	

Most respondents (**63.3%**) had ESR values above the normal limit.

Table 3. Distribution of Respondents Based on ESR Status

ESR Status	Number	Percentage
Normal	11	36.7%
Abnormal	19	63.3%
Total	**30**	**100%**

Table 4. Distribution of Respondents by Smoking Duration

Smoking Duration	Frequency	Percent	Valid Percent
< 3 years	13	43.3	43.3
≥ 3 years	17	56.7	56.7
Total	**30**	**100.0**	**100.0**

Table 5. Summary of Study Statistics

Variable	Result
Number of respondents	30
Lowest ESR value	12 mm/hour
Highest ESR value	45 mm/hour
Mean ESR value	26.7 mm/hour
Normal ESR	36.7%
Elevated ESR	63.3%

This study involved 30 active-smoking Papuan students residing in Bandung City in 2025. All respondents met the inclusion criteria, namely being active smokers for at least one year and being willing to undergo Erythrocyte Sedimentation Rate (ESR) testing. Based on smoking duration, respondents were classified into two groups: less than 3 years and 3 years or more, with a higher proportion of respondents having smoked for 3 years or longer. The results of descriptive statistical analysis showed that the respondents' ESR values ranged from 12 to 45 mm/hour, with a mean value of 26.7 mm/hour. This mean value exceeds the normal ESR threshold (< 20 mm/hour), indicating a tendency toward elevated ESR levels among respondents.

The distribution of ESR categories revealed that:
a. 11 respondents (36.7%) had ESR values within the normal range
b. 19 respondents (63.3%) had ESR values above the normal range

These findings indicate that the majority of active-smoking Papuan students in this study experienced elevated ESR levels, suggesting the presence of inflammatory processes associated with smoking behavior.

Discussion

1. Elevated ESR Levels in Active Smokers

The results of this study indicate that 63.3% of respondents had ESR values above the normal range. The erythrocyte sedimentation rate (ESR) is a non-specific indicator that reflects the presence of inflammatory processes in the body. Elevated ESR levels in active smokers may be caused by exposure to toxic substances in cigarette smoke such as nicotine, tar, and carbon monoxide, which trigger oxidative stress and systemic inflammatory responses.

These findings are consistent with the study conducted by Sutrisno (2022), which reported that active smokers tend to experience increased ESR levels due to chronic inflammation. Continuous exposure to cigarette smoke can lead to lung tissue irritation, activation of inflammatory mediators, and increased production of acute-phase proteins, all of which contribute to elevated ESR values.

2. Relationship Between Smoking Duration and ESR Levels

The results of this study also show that respondents with a smoking duration of ≥ 3 years had higher ESR values compared to those who had smoked for < 3 years. This finding indicates a tendency that the longer the duration of smoking, the higher the ESR level.

This result is supported by the study of Wahyuni (2021), which reported a positive relationship between smoking duration and increased ESR levels. Long-term exposure to cigarette smoke leads to the accumulation of tissue damage and chronic inflammation, thereby increasing the erythrocyte sedimentation rate.

3. Clinical and Public Health Implications

The elevated ESR levels observed in the majority of respondents suggest that smoking behavior among university students may pose significant health risks, even at a young age. Increased ESR levels may serve as an early indicator of inflammatory disorders that could potentially progress into chronic diseases if smoking habits continue.

The findings of this study may serve as a basis for educational institutions and healthcare providers to strengthen smoking hazard education, particularly among active-smoking students, and to encourage regular health screenings as an early detection strategy.

4. Study Limitations

This study has several limitations, including:

1) The relatively small sample size, which limits the generalizability of the findings.
2) The descriptive nature of the study, which does not allow for definitive conclusions regarding causal relationships.
3) Other factors that may influence ESR levels, such as infections, physical activity, or other inflammatory conditions, were not analyzed in depth.

CONCLUSION

Based on the results of the study and the discussion regarding the erythrocyte sedimentation rate (ESR) levels among active-smoking Papuan students in Bandung City in 2025, several conclusions can be drawn as follows:

1. The ESR values of the respondents ranged from **12 to 45 mm/hour**, with a mean value of **26.7 mm/hour**, indicating a tendency toward elevated ESR levels among active-smoking students.
2. The majority of respondents (**63.3%**) had ESR values above the normal limit, while **36.7%** of respondents were within the normal range.
3. Respondents with a smoking duration of **≥ 3 years** tended to have higher ESR values compared to those who had smoked for **< 3 years**, indicating that smoking duration plays a role in increasing ESR levels.
4. The elevated ESR levels observed among active-smoking Papuan students reflect the presence of inflammatory processes that may adversely affect health if smoking habits continue.

Overall, this study demonstrates that smoking behavior among university students is associated with increased ESR levels, highlighting the need for educational and preventive efforts to reduce the health impacts of smoking from an early age.

REFERENCES

Guyton, A. C., & Hall, J. E. (2014). Textbook of medical physiology (13th ed.). Elsevier Saunders.

Kementerian Kesehatan Republik Indonesia. (2018). Laporan nasional Riskesdas 2018. Badan Penelitian dan Pengembangan Kesehatan.

Kementerian Kesehatan Republik Indonesia. (2020). Profil kesehatan Indonesia tahun 2019. Kemenkes RI.

Muchtar, H. (2017). Pengantar metodologi penelitian kesehatan. Jakarta: EGC.

Notoatmodjo, S. (2018). Metodologi penelitian kesehatan. Jakarta: Rineka Cipta.

Nugroho, T. (2019). Hubungan kebiasaan merokok dengan peningkatan laju endap darah. Jurnal Kesehatan Masyarakat, 14(2), 85–92.

Price, S. A., & Wilson, L. M. (2016). Patofisiologi: Konsep klinis proses-proses penyakit (6th ed.). EGC.

Sastroasmoro, S., & Ismael, S. (2017). Dasar-dasar metodologi penelitian klinis. Jakarta: Sagung Seto.

Sutrisno. (2022). Pengaruh merokok terhadap peningkatan laju endap darah pada perokok aktif. Jurnal Analis Kesehatan, 11(1), 45–51.

Wahyuni, S. (2021). Lama merokok dan hubungannya dengan kadar laju endap darah. Jurnal Ilmu Kesehatan, 9(3), 133–139.

World Health Organization. (2019). WHO report on the global tobacco epidemic. World Health Organization.

World Health Organization. (2020). Tobacco and inflammation. World Health Organization.

Widmann, F. K. (2018). Clinical interpretation of laboratory tests. F.A. Davis Company.

Bain, B. J. (2015). Blood cells: A practical guide (5th ed.). Wiley-Blackwell.

Hoffbrand, A. V., Moss, P. A. H., & Pettit, J. E. (2016). Essential haematology (7th ed.). Wiley-Blackwell.

Ganong, W. F. (2018). Review of medical physiology (26th ed.). McGraw-Hill Education.

Rahmawati, D., & Prasetyo, A. (2020). Hubungan intensitas merokok dengan indikator inflamasi. Jurnal Kesehatan Klinik, 8(2), 101–107.

Tarigan, R. (2019). Dampak rokok terhadap sistem pernapasan dan inflamasi. Jurnal Kesehatan Lingkungan, 11(1), 22–29.

Stanley, E. R., & Lacy, P. (2017). Inflammatory markers and smoking behavior. Journal of Inflammation Research, 10, 1–8.

Thurlbeck, W. M. (2016). Pathology of the lung (2nd ed.). Thieme Medical Publishers.