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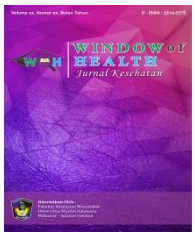

**ARTICLE RESEARCH**

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# Effect of Lead Exposure on AST Enzyme in Individuals Who Smoke

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**ABSTRACT**

Cigarettes are one of the consumer products that are popular with the public. The composition of cigarettes includes tobacco, cloves, and other additives. One of the additives that is often used is lead. Lead can also be carcinogenic, meaning it can cause cancer. Exposure to lead in active smokers can cause various health hazards, especially those related to liver damage. Increased levels of lead in the body of smokers can cause liver cell damage, which can be reflected in increased levels of the enzyme AST (aspartate aminotransferase) in the blood. This study aims to see the effect of this heavy metal on the levels of the Aspartate Aminotransferase Enzyme in Individuals Who Smoke. This research method uses a descriptive introduction with a simple random sampling approach. The subjects of this study consisted of 10 people who were drivers with an average age of 25 years who had been smoking for 5-8 years. Blood lead levels were measured using the APHA method, and AST enzyme levels were measured using the IFCC method. The results showed that there was no relationship between blood lead levels and AST levels in smokers and blood lead levels (significance: 0.066). The average lead level in the blood of active smokers is still below the threshold, which is 34.1437 µg/L (100–250 µg/L). Suggestions for further research are to conduct research to see the relationship between lead levels and Alanine Aminotransferase (ALT) enzyme levels in online motorcycle taxi drivers and cleaners in the city of Palembang.

Keywords : Lead Levels; AST Level; Smokers

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## INTRODUCTION

Indonesia is experiencing a tobacco usage crisis, affecting not only adult males but also youngsters, the elderly, and individuals of all genders. Cigarettes have significantly influenced human life for ages; however, their detrimental effects on health are becoming an increasing worry (1). According to the WHO report from 2020, tobacco use results in over 8 million fatalities annually. Of the deceased, 7 million were active smokers, and 1.2 million were passive smokers (2).

This is unsurprising. A cigarette has around 7,000 chemicals, 250 of which are detrimental to health. Out of 250 dangerous compounds, 70 are recognized as carcinogenic (3). The smoke contains a minimum of 5,000 distinct chemicals, some of which are harmful to the body. The harmful substances in cigarettes may impair cellular integrity. Moreover, the constituents of cigarette smoke are carcinogenic, therefore inducing cancer (4).

Cigarettes contain 250 kinds of hazardous chemicals and 70 recognized carcinogens (5). The ingredients originate from the primary raw material of cigarettes, namely tobacco. An often overlooked issue is the presence of heavy metal in cigarettes, which may significantly endanger public health (6). Despite the health risks associated with smoking, many individuals, particularly addicts, persist in the habit. Lead absorbed by smokers will infiltrate the respiratory system and disseminate throughout the body's tissues and organs. Heavy metals, including cadmium, lead, and mercury, are hazardous agents that may induce several severe disorders and result in prolonged detrimental consequences(7).

Lead metal will adhere to blood and disseminate throughout the body. Over 90% of lead metal breathed by smokers will adhere to red blood cells (8). Lead in cigarettes originates from tobacco leaves, as stated in (9). Elevated blood lead levels may result in developmental abnormalities, metabolic issues, and neurological impairment (10).

The primary absorption pathways for inorganic lead compounds are oral and inhalation, with around 40% absorbed via the respiratory system and about 5-10% via the digestive tract (11). Lead, once entering the circulation, is disseminated to several organs, including the kidneys and liver, subsequently accumulating in the bones and resulting in damage to different organs, including the liver, central and/or peripheral neurological system, heart, immune system, and kidneys(7).

he liver, or liver, is a vital and substantial organ in the human body that contributes to metabolism. Its purpose is to eliminate deleterious elements from both internal and external environments of the body. Nevertheless, the liver is vulnerable to harm from toxic agents. One method to assess the extent of hepatic cellular injury is to evaluate the activity of the enzyme Aspartate Aminotransferase (AST) (12). AST is an enzyme often present in several organs, including the heart, kidneys, muscles, pancreas, and brain. This enzyme is crucial for energy production. AST levels in the bloodstream will increase in cases of significant liver injury, particularly inside the mitochondrial organelles(2).

Damage to the liver can be caused by various factors, one of which is lifestyle. One lifestyle that has a negative impact on health is smoking (13). According to the 2021 Global Adult Tobacco Survey

(GATS) report released by the Ministry of Health, the number of adult smokers in Indonesia has increased in the last ten years(14). The number of adult smokers increased by 8.8 million people, from 60.3 million in 2011 to 69.1 million in 2021(15). In recent years, studies have increasingly shown a link between smoking and an increased risk of liver disorders. Although cigarette smoke does not directly impact liver cells, toxic compounds absorbed from the alveoli into the blood can reach the liver and cause irreversible damage to liver cells(2). Heavy metal content in cigarettes can cause inflammation in liver tissue, while free radicals in cigarettes can cause oxidative stress in liver cells. Smoking is also a risk factor that can aggravate liver fibrosis in patients with hepatitis C(16).

Recent research has increasingly shown a correlation between smoking and an elevated risk of liver disease. The liver is not immediately impacted by cigarette smoke; nonetheless, hazardous substances taken from the alveoli into the circulation may inflict irreversible damage on liver cells. The elevated heavy metal concentration in cigarettes may induce inflammation of liver tissue, whilst free radicals present in cigarettes can lead to oxidative stress in liver cells. In individuals with hepatitis C, smoking is a risk factor that may exacerbate liver fibrosis.

This research aimed to ascertain the impact of lead in cigarettes on AST enzyme levels in smokers. This encompasses the evaluation of variables like the length of smoking history, the quantity of cigarettes smoked, and the specific kind of cigarette used.

## METHOD

The study used an analytical observational approach using purposive sampling. This study included active smokers with a smoking history exceeding ten years who consented to participate as research subjects. The study included 49 respondents, although only 10 individuals satisfied the requirements and consented to participate as research subjects. The KM 3.5 Palembang Health Laboratory Center conducts examinations of blood lead levels and SGOT (aspartate aminotransferase) enzymes. This research employs statistical data processing techniques and utilizes SPSS 21 (Statistical Product and Service Solutions) as auxiliary software for data analysis. A correlation test was conducted to ascertain the relationship between two variables (parametric statistics) (17). This research complies with the ethical criteria established by Number: 061 / KEPK / UNPRI / VII / 2024.

## RESULTS

This study was conducted at a private college in Palembang, with male subjects. The number of respondents in the study was 10 people who met the criteria. The subjects of this study were active smokers who had smoked for more than 5 years. Based on the table above, the subjects in this study were 10 active smokers with an average age of 25 years, ranging from 24 to 27 years. The type of cigarette most widely consumed is filter cigarettes, and the average number of cigarettes consumed each day is 7 cigarettes.

Table 1. Characteristics of Research Subjects

| Description | Result (N) |
|---|---|
| The quantity of the Subject | 10 |
| Age of Subject | Average: 25 years.<br>Range: 24 to 27 years |
| Type of Cigarette | Filter |
| Duration of Smoking | Average: 6 years<br>Range: 5 – 8 years |
| Daily Quantity of Cigarette Consumption | Average: 7 bars<br>Range: 6 – 12 bars |

The research started with the validation of the methodology and internal quality assurance, followed by the examination of the sample. The objective of doing method verification and Internal Quality Assurance is to guarantee that the used technique produces valid and appropriate outcomes. This research may just provide verification and PMI about the AST test.

Table 2. Method Verification Test Results

| Test | Normal Control AST | High Control AST | Acceptability Limit |
|---|---|---|---|
| Presisi | 5,51% | 5,26% | 7% |
| Akurasi | -2,29% | -3,96% | 6,50% |
| Tea | 8,73% | 6,56% | 20% |

Internal Quality Assurance comprises ongoing monitoring and preventive steps implemented by the laboratory to avert erroneous test findings. The objective of PMI is to mitigate and avert discrepancies and prevent mistakes in the analytical program to ensure accurate examination findings are achieved (18). The results of the Precision, Accuracy, and Tea tests indicate that normal and high control values are within acceptable limits: the precision test is below 7%, the accuracy test is below 6.5%, and the Tea test is below 20%. This research is limited as it can just provide verification and PMI for AST testing, but blood lead level examinations alone offer blood lead level data.

Table 3. Research Data

| Variabel | Mean | Normality Test | SD | Sig. (2-Tailed) | Pearson Correlation |
|---|---|---|---|---|---|
| Lead Levels | 195,307 µg/L | 0,813 | 34,1437 | - | - |
| AST Levels | 1,4184 U/L | 0,129 | 0,14938 | 0,066 | -0,601 |

Table 3. The results of testing the variables of blood lead levels and AST levels showed that the data were normally distributed, namely 0.813 in blood lead levels and 0.129 in AST levels, then continued with the parametric test, namely the Pearson correlation test. These results show that there is no relationship between blood lead levels and AST levels, with a negative correlation direction.

## DISCUSSION

### Laboratory Quality Assurance of AST examination

Quality Assurance of the AST Examination Laboratory technique verification is the process of revalidating a technique by testing and gathering objective information to assess the performance of the established standard, ensuring the laboratory's capability to execute tests yielding trustworthy findings. The objective is to ensure that the methodology used in the assessment aligns with its intended aim to provide accurate and trustworthy results. Method verification is achieved by analyzing the control material, which is assessed ten times, followed by the calculation of precision, accuracy, and TEa values (19). The data acquired originates from the control material used in the preceding month. The findings of this study indicate that the precision and TEa values are within acceptable limits, suggesting that the method's precision and TEa can be utilized for sample analysis. However, the Accuracy value falls below the acceptable threshold, as the total in the AST examination is less than the specified determination. This accuracy value is used to analyze the presence of systematic errors, random errors, or a mix thereof, with the evaluation derived from the analysis of control materials and computed as bias (d%). According to (20) if the precision and TEa results are within the acceptance limits, it can be continued for sample examination.

### Relationship between blood lead level and AST level

The results of the study between blood lead levels and AST levels showed that the data were normally distributed, so it was continued with the parametric test, namely the Pearson Correlation test. The results showed no relationship between blood lead levels and AST levels, with a negative correlation direction. The absence of a relationship between lead levels and AST levels is supported by research conducted by (2), which concluded there was no relationship between lead levels and AST levels. This is because the examination of liver function impairment (AST) was conducted cross-sectionally, while before exposure to lead, blood lead levels were not measured in the sample, so that the causal relationship is not illustrated in this study. Another reason was that blood lead levels were within the normal range.

In this study, lead exposure had a lesser impact on the enzyme Aspartate Transaminase (AST). An aminotransferase enzyme that catalyzes the interconversion of amino acids into alpha-oxo acids through the transfer of amino groups. Elevated transaminase values indicate lead-induced liver cell necrosis and lead hepatocellular injury. The enzyme c-GT, a membrane bound glycoprotein involved in glutathione metabolism and transfer of glutamyl moiety to receptor amino acids, is a sensitive indicator of hepatocellular damage (6).

Heavy metal lead is one of the toxic and poisonous contaminants (21). The entry of lead in human blood is due to long-term exposure to lead. When the amount of lead accumulates in the body, it can be harmful to health. This can occur because motor vehicle exhaust fumes emit lead particles that pollute the air, and smokers, while consuming lead-contaminated food, water, and dust seep into the

body and accumulate (22). Lead can enter the body through inhalation, food contamination, skin contact, and ingestion of lead-contaminated air. Subsequently, lead is absorbed by the body and partially excreted through sweat, urine, and feces. Others will be deposited in hard tissues such as teeth, nails, and hair, as well as soft tissues such as kidneys, liver, spleen, and brain (23). The amount of lead (Pb) shown during the examination is the blood lead (Pb) level.

Exposure to lead (Pb) can be seen from the identification of lead (Pb) in the blood. Blood functions as a transport of food substances along with toxic substances that indirectly enter the body because lead (Pb) exposure enters through the air, about 30-40% will be absorbed into the blood (24).

In this study, with a standard deviation of 34.1437 µg/L, the average blood lead level in this study was 195.307 µg/L. According to Health Ministerial Decree No. 1406 of 2002, normal blood lead levels in humans range from 10-25 g/dL or when converted to 100 -250 µg/L; the results show that lead levels below 10 g/dl do not indicate lead poisoning; levels between 10-14 g/dl are considered the threshold limit, and levels over 14 g/dl require further intervention. When lead levels reach 50 g/dl or more, there are usually no symptoms of acute lead poisoning. If lead use lasts for more than three months, lead poisoning is considered chronic (25).

Although the results of this study showed no relationship between lead levels and AST enzyme levels in smokers, it is hoped that people will continue to maintain their health by reducing or avoiding cigarette consumption. According to (26)Exposure to cigarettes for a long time has the potential to affect the health of the body, such as disrupting the respiratory system and accumulating lead in the body.

## CONCLUSIONS AND RECOMMENDATIONS

Based on the results and discussion of this research, it can be concluded that there is no relationship between blood lead levels and AST levels in smokers, and blood lead levels in research subjects are still within the tolerance threshold. Further research needs to be carried out to see the relationship between lead levels and ALT levels in individuals who have been active smokers for more than 15 years.

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