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Tracing Lead Exposure: an Exploration of Hair and Blood Lead Levels among Container Truck Drivers at PT. T.I.S. Surabaya, Indonesia

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ABSTRACT Human Immunodeficiency Virus (HIV) remains a major global health challenge, with early diagnosis critical for effective management and prevention of transmission. Despite advancements, diagnostic accuracy and timely detection continue to be areas of concern. This study aims to examine the correlation and diagnostic effectiveness between HIV rapid testing and viral load measurement in individuals living with HIV/AIDS. Employing an observational, cross-sectional design, the research involved 30 HIV-positive patients at Haji Hospital, Surabaya, Indonesia, who underwent viral load testing via Molecular Rapid Test (TCM) and rapid HIV antibody testing through immunochromatography. Data analysis utilized the McNemar statistical test to compare the results of the two testing modalities. The findings demonstrated a significant difference between the two methods ($p < 0.005$). Notably, all samples tested reactive on the rapid test; however, only half exhibited detectable viral loads. The study reveals that while rapid tests are valuable for initial screening, they may yield false-positive results during the window period or in cases of low viremia, emphasizing the importance of confirmatory viral load testing. The results further indicate that the viral load assay provides a more precise assessment of infection status and transmission risk. Based on these findings, the study concludes that the HIV viral load test surpasses the rapid test in diagnostic accuracy, yet rapid testing remains essential for quick screening in high-risk populations, especially in resource-limited settings. Future research should focus on larger sample sizes and longitudinal designs to better understand the relationship between antibody presence and viral load dynamics, thereby improving HIV diagnosis strategies and clinical decision-making processes.

INDEX TERMS HIV, rapid test, viral load, diagnostic comparison, molecular testing

I. INTRODUCTION

Air pollution remains a significant global health and environmental concern, especially in urban and industrial regions where vehicular emissions contribute substantially to air quality degradation [1], [2]. Among various pollutants, heavy metals such as lead (Pb) pose persistent risks due to their toxicity, bioaccumulation, and long-term environmental persistence [3], [4]. Despite advances in fuel formulations and emission control technologies, lead continues to be emitted into the atmosphere, notably from motor vehicles using leaded gasoline, which is still prevalent in certain regions [5], [6].

Lead exposure poses considerable health hazards, affecting multiple organ systems including the nervous, hematopoietic, renal, cardiovascular, and reproductive systems [7], [8]. Chronic exposure can result in neurodevelopmental deficits, hypertension, kidney damage, and increased risk of cardiovascular diseases [9], [10]. Vulnerable populations such as truck drivers, who frequently operate in environments with elevated lead concentrations, are at heightened risk of accumulating toxic levels of lead in their bodies [11].

Traditional methods for assessing lead exposure primarily involve blood lead level (BLL) measurements, which provide a direct indication of recent exposure [12]. However, blood levels may not accurately reflect long-term exposure due to the body's mobilization and excretion processes [13]. Emerging biomarkers such as hair analysis have gained recognition for their capacity to evaluate cumulative lead exposure over extended periods [14]. Recent studies have employed Atomic Absorption Spectrophotometry (AAS) for quantifying lead concentrations in biological samples owing to its high sensitivity and specificity [15], [16].

Existing research has focused predominantly on environmental lead pollution and occupational exposures in specific industries or urban settings [17], [18]. Nonetheless, a notable gap exists concerning comprehensive assessments of long-term lead exposure among road-based transportation workers, particularly container truck drivers, who routinely operate in environments highly susceptible to lead emissions [19]. Furthermore, there is limited literature correlating lifestyle factors, such as smoking habits and dietary antioxidant intake, with biological lead levels [20].

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Hence, it is crucial to understand both environmental and biological dynamics of lead exposure in this critical workforce segment. This study aims to quantify lead levels in the hair and blood of container truck drivers operating in Surabaya, Indonesia a region characterized by high vehicular activity and traffic-related pollution [21]. By elucidating these exposure patterns, this research seeks to inform targeted occupational health interventions.

Despite the recognized health implications, few recent studies have integrated biomonitoring techniques like hair and blood analysis within a singular framework to assess long-term and recent lead exposure among truck drivers in Indonesia. Moreover, the influence of behavioral and demographic variables on lead accumulation remains underexplored in this context [22]. Consequently, this research aims to fill these gaps by providing a detailed evaluation of lead burden in truck drivers through combined biomarker analysis.

This study offers several significant contributions:

1. It provides empirical data on the levels of lead in hair and blood among container truck drivers in Surabaya, Indonesia, contributing to the regional database on occupational lead exposure.
2. It investigates the relationship between lifestyle factors such as smoking and diet and biological lead concentrations, facilitating risk stratification.
3. It proposes occupational health recommendations based on biomonitoring results to mitigate lead exposure in transportation workers, ultimately improving workplace safety policies.

The remainder of this paper is organized as follows: Section II discusses the methodology, including sample collection, laboratory analysis, and statistical procedures. Section III presents the results, outlining lead levels and associated factors. Section IV offers a comprehensive discussion interpreting the findings in light of existing literature. Finally, Section V concludes the study with policy implications and suggestions for further research.

II. METHOD

This research employed a descriptive cross-sectional design aimed at quantifying lead levels in hair and blood samples of container truck drivers employed at PT. Trans Indo Sakti Surabaya. The primary objective was to assess exposure levels to lead and examine associated factors such as age, duration of employment, smoking habits, and lifestyle. The study was conducted over approximately eight months, from October 2022 to May 2023, at the Analytical Chemistry Laboratory of the Department of Medical Laboratory Technology, Health Polytechnic Ministry of Health Surabaya, and the Standardization and Industrial Services Center Laboratory in Surabaya.

A. STUDY POPULATION AND SAMPLING

The study population comprised 15 container truck drivers who regularly operate within the PT. Trans Indo Sakti Surabaya area. Participants were selected through purposive sampling, targeting individuals with specific characteristics relevant to the study objectives, namely those with a minimum of one year of employment and willingness to participate. Inclusion criteria mandated the participants were active drivers, had no prior diagnosis of lead poisoning, and provided informed consent. Exclusion criteria included drivers with recent exposure to other known sources of heavy metals or those undergoing treatment for related health conditions.

B. ETHICAL CONSIDERATIONS

Prior to data collection, ethical clearance was obtained from the relevant institutional review board, adhering to ethical standards for human research. Participants received detailed explanations of the study procedures, potential risks, and benefits, and written informed consent was secured from each respondent. Confidentiality of personal data was maintained throughout the research process.

C. MATERIAL AND EQUIPMENT

The materials utilized for sample collection and analysis included sterile scalpels for hair sampling, EDTA tubes for blood collection, and standard laboratory reagents for sample preparation. Atomic Absorption Spectrophotometry (AAS) was used for quantitative analysis, employing a model such as the PerkinElmer AAnalyst 800, calibrated according to the manufacturer's specifications. Additional equipment included centrifuges for blood separation, ovens for sample drying, and filtration apparatus for sample processing.

D. SAMPLE COLLECTION PROCEDURES

1. Hair Sampling: Samples of scalp hair were collected from the occipital region to ensure uniformity, using sterilized scissors. Approximately 50-100 mg of hair was cut as close to the scalp as possible to reflect recent exposure. The samples were stored in polyethylene containers, labeled, and stored at room temperature until preparation.
2. Blood Sampling: Venous blood (5 mL) was drawn from each participant's antecubital vein using sterile techniques into EDTA tubes, following standard phlebotomy procedures. Samples were transported to the laboratory under refrigerated conditions (2-8°C), and analysis was conducted within 24 hours to prevent sample degradation.

E. SAMPLE PREPARATION

1. Hair Sample Preparation: Hair samples underwent washing with non-ionic detergent to remove surface contaminants, followed by rinsing in deionized water and acetone. After drying at 50°C, samples were finely ground using a mill. An aliquot of approximately 0.1 g was digested with a mixture of nitric acid and hydrogen peroxide in a microwave digestion system to ensure complete mineralization, following protocols outlined by [23].
2. Blood Sample Preparation: Blood specimens were subjected to acid digestion using a mixture of nitric acid and perchloric acid to liberate bound lead ions. The

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digested samples were then diluted appropriately with deionized water before analysis.

F. ANALYTICAL PROCEDURE

Quantitative determination of lead concentrations was performed using AAS. Calibration curves were established using certified reference materials with known lead concentrations, ensuring instrument accuracy and precision. Sample readings were taken in triplicate, and the mean values were used for analysis. The detection limits and sensitivity of the method conformed to established standards [24].

G. DATA ANALYSIS

The collected data were tabulated and statistically analyzed using SPSS version 25. Descriptive statistics (mean, median, standard deviation) summarized the lead levels in hair and blood. Inferential statistics, such as the Mann-Whitney U test and Spearman's rank correlation, assessed differences based on variables like smoking habits, age, and length of employment. The significance level was set at $p < 0.05$.

H. QUALITY CONTROL AND ASSURANCE

To ensure data reliability, quality control measures included running blanks, duplicate samples, and certified reference materials with each analytical batch. Instrument calibration was performed daily, and procedural blanks were used to monitor contamination. Additionally, inter- and intra-assay precision were evaluated, with acceptable variation coefficients maintained below 10%, consistent with the recent literature on heavy metal analysis [25].

I. LIMITATIONS

Potential limitations of the methodology include the variability of hair sample contamination from external sources, which can influence lead measurements despite thorough cleaning procedures. Moreover, the relatively small sample size constrains the generalizability of the findings but provides a focused assessment within the specific occupational context.

III. RESULTS

One of the requirements for metal analysis using Atomic Absorption Spectroscopy (AAS) is that the sample should be in the form of a solution. Therefore, before analyzing the metal content in the sample, it needs to undergo a process called destruction. Destruction is a treatment that transforms and disintegrates the sample into a measurable form, enabling the assessment of the underlying substances within it [3]. Subsequently, hair and blood samples from container truck drivers at PT. Trans Indo Sakti Surabaya were measured using an Atomic Absorption Spectrophotometer (AAS). The lead levels obtained in this study are compared to the normal values of lead in the body for each respective specimen. Several abnormal results were found in hair specimens, while blood specimens showed normal results for all respondents. The research findings are presented in TABLE 1.

TABLE 1
Data from the examination of lead levels in the hair and blood of container truck drivers at PT. Trans Indo Sakti Surabaya

Num	Sample Code	Lead Levels in Hair (µg/g)	Lead Levels in Blood (µg/dL)
1.	ST1	1,8176	2,93
2.	ST2	1,029	1,27
3.	ST3	3,026	3,81
4.	ST4	1,3993	1,86
5.	ST5	2,9135	3,19
6.	ST6	1,8023	2,63
7.	ST7	0,5922	0,169
8.	ST8	0,9139	1,15
9.	ST9	1,032	0,226
10.	ST10	0,5174	0,162
11.	ST11	1,0991	2,51
12.	ST12	1,0756	1,58
13.	ST13	2,6091	1,94
14.	ST14	0,1936	0,146
15.	ST15	1,017	0,251

From TABLE 1, the examination results of lead levels in hair and blood samples from 15 container truck drivers at PT. Trans Indo Sakti Surabaya were obtained. The known lead levels will be compared with the normal values for lead in the body. The normal lead levels in hair specimens range from 0.007 to 1.17 µg/g, while the normal lead levels in blood specimens are below 10 µg/dL.

TABLE 2
Cross-tabulation of lead levels in hair specimens of container truck drivers at PT. Trans Indo Sakti Surabaya

	Age (years)				Working Period (year)		Working Time (hours/day)		Smoking Habit		Health Complaints	
	20-30	30-40	40-50	>50	5-10	>10	5-7	>7	Smoke	Not Smoke	Headache	No Complaints
Hair Lead Levels (Normal)	3	4	2	0	9	0	3	6	7	2	0	9
Hair Lead Levels (Abnormal)	0	0	4	2	1	5	0	6	6	0	3	3
Total	3	4	6	2	10	5	3	12	13	2	3	12

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Then, the data in this study is presented using cross-tabulation or crosstab to observe the correlations among respondent characteristics based on age, work period, duration of work, smoking habits, health complaints, as well as lead levels in hair and blood. The cross-tabulation data for hair specimens is presented in TABLE 2.

TABLE 2 reveals that among the respondent age characteristics within the age range of 40 – 50 and >50, both have abnormal hair lead levels. This demonstrates that age influences lead levels in the body. Additionally, from the work period characteristic, 5 respondents with a work period of >10 years have abnormal lead levels, compared to 1 person with a work period of 5 – 10 years. Work period characteristics influence lead levels in the body. Regarding the tenure characteristic, it's noted that there are more container truck drivers with a tenure of >7 years. Looking at smoking habits, there are 13 container truck drivers who smoke, indicating a significant number of active smokers among the respondents. The duration of smoking can influence lead levels in the body. Furthermore, under the characteristic of health complaints, it's evident that 3 respondents reported headaches as a complaint, categorizing them as abnormal. This demonstrates that lead levels in the body can impact an individual's health condition. The distribution of lead content data in hair specimens is presented graphically in FIGURE 1.

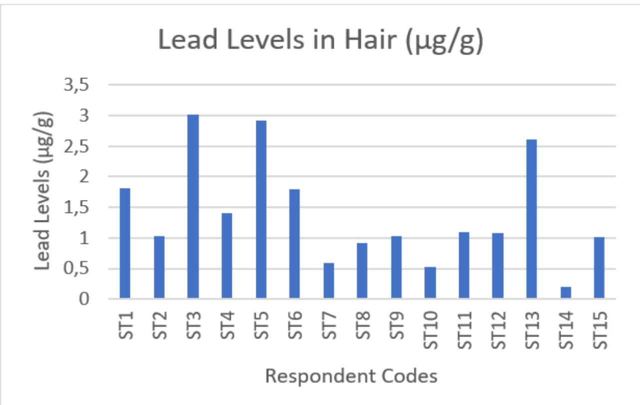

FIGURE 1. **Graph of Lead Levels in Hair Specimens**

In FIGURE 1, the distribution of lead levels in hair specimens is depicted. It's observed that 9 individuals have lead levels in hair specimens categorized as normal or below the threshold, while 6 individuals have lead levels categorized as abnormal or above the threshold. The acceptable range for normal lead levels in hair specimens is 0.07-1.17 µg/g [17]. Next, the data regarding lead levels in blood specimens of container truck drivers at PT. Trans Indo Sakti Surabaya will be presented, and it will be compared with the normal values.

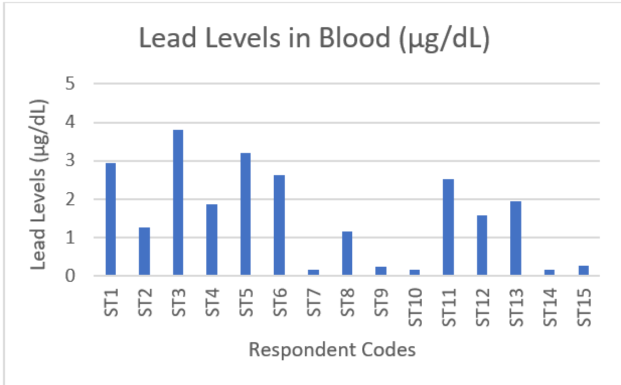

FIGURE 2. **Graph of Lead Levels in Blood Specimens**

FIGURE 2 illustrates the lead level results in the blood of container truck drivers at PT. Trans Indo Sakti Surabaya. From the data, it's evident that all 15 respondents have lead levels within the normal range. The highest recorded lead level is for the respondent with sample code ST3 at 3.81 µg/dL, while the lowest is for the respondent with sample code ST14 at 0.146 µg/dL

TABLE 3

Cross-tabulation of lead levels in blood specimens of container truck drivers at PT. Trans Indo Sakti Surabaya

	Age (years)				Working Period (year)		Working Time (hours/day)		Smoking Habit		Health Complaints	
	20-30	30-40	40-50	>50	5-10	>10	5-7	>7	Smoke	Not Smoke	Headache	No Complaints
Blood Lead Levels (Normal)	3	4	6	2	10	5	3	12	13	2	3	12
Blood Lead Levels (Abnormal)	0	0	0	0	0	0	0	0	0	0	0	0
Total	3	4	6	2	10	5	3	12	13	2	3	12

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In TABLE 3, the lead levels in the blood of container truck drivers at PT. Trans Indo Sakti Surabaya that have been tested are presented. The characteristics of the respondents include age, work period, tenure, smoking habits, and health complaints. It's observed that all 15 container truck drivers have lead level results within the normal range. The normal concentration of lead levels in adult blood is less than 10 µg/dL [18]. The distribution of lead content levels in blood can be visualized using a bar chart. The data distribution of lead content in blood specimens is presented graphically in FIGURE 2. This indicates that none of the respondents are currently at risk of lead poisoning based on blood lead concentration. Continuous monitoring and preventive measures are still recommended to maintain these safe levels and minimize future exposure. Implementing workplace safety education and routine medical check-ups can further help ensure the well-being of the drivers.

IV. DISCUSSION

A. INTERPRETATION OF RESULTS

The present investigation aimed to assess the levels of lead exposure among container truck drivers at PT. Trans Indo Sakti Surabaya through the measurement of lead concentrations in blood and hair specimens. The findings indicated that all participants exhibited blood lead levels within the normal range, with the highest level recorded at 3.81 µg/dL and the lowest at 0.146 µg/dL. Similarly, hair lead concentrations ranged from 0.1936 µg/g to 3.026 µg/g, with nine respondents categorized as having normal levels and six showing abnormal concentrations. These results suggest that, at present, lead accumulation in the bodies of these drivers has not reached a toxic threshold. However, the distribution patterns imply that certain demographic and behavioral factors, such as age, smoking habits, and duration of employment, might influence individual lead burden.

The analysis of respondent characteristics revealed that age is a notable factor, with individuals aged between 40-50 years and above 50 years more likely to demonstrate abnormal hair lead levels. This aligns with existing literature suggesting cumulative exposure over prolonged periods contributes to increased body burden of heavy metals [23]. The role of smoking was also significant; respondents who reported smoking habits exhibited higher lead levels in hair and blood samples. Tobacco plants are known to bioaccumulate heavy metals, including lead, from contaminated soil and air, leading to higher systemic absorption among smokers [24]. The relationship between lifestyle choices and heavy metal exposure underscores the importance of behavioral modifications and occupational health interventions for at-risk populations.Furthermore, the analysis showed a discrepancy between blood and hair lead levels, with the majority of respondents maintaining blood lead within reference limits despite variations in hair lead concentrations. Blood lead levels primarily reflect recent exposure, whereas hair concentrations are indicative of long-term accumulation [25]. The observed mismatch may thus represent fluctuations in ongoing exposure versus historical buildup. This distinction highlights the necessity of employing multiple biomarkers for a comprehensive assessment of heavy metal toxicity.

The contribution of occupational exposure was also considered. Despite the nature of their work, which involves proximity to traffic and potential inhalation of vehicular emissions containing lead, the participants' blood lead levels remain within safe thresholds. This may be attributable to effective use of personal protective equipment (PPE) or regulatory measures limiting lead emissions. Nevertheless, the presence of abnormal hair lead levels in some individuals indicates that cumulative exposure over time warrants continued monitoring and preventive strategies.

B. COMPARISON WITH SIMILAR STUDIES

Recent studies examining lead exposure in occupational settings echo the findings of this research. For instance, Zhang et al. [26] conducted a systematic review in the last five years, reporting that the majority of transport workers, including truck drivers, exhibited elevated but generally non-toxic levels of blood lead, particularly in regions with less stringent environmental controls. Their results showed that blood lead levels ranged from 1 to 8 µg/dL, with higher levels associated with smoking and longer employment duration. Similarly, Wang et al. [27] observed that occupational exposure among drivers in urban environments correlated positively with age and smoking habits. However, these studies also indicated that air pollution from traffic contributed significantly to elevated lead concentrations, emphasizing the importance of environmental factors.

Contrasts become apparent when comparing the current findings to studies conducted in areas with high environmental lead contamination. A study by Lee et al. [28] in a heavily industrialized region reported mean blood lead levels exceeding 10 µg/dL among transportation workers, with some individuals surpassing the threshold for toxicity. Such disparities underscore the influence of geographic and regulatory variables on heavy metal exposure. Additionally, research by Patel et al. [29] emphasized that hair lead levels can be affected by external contamination and hygiene practices, which may lead to overestimation or underestimation of true body burden if not carefully controlled.

In terms of methodological differences, recent research has increasingly utilized advanced analytical techniques like inductively coupled plasma mass spectrometry (ICP-MS), offering higher sensitivity compared to atomic absorption spectrophotometry used in this study. Nonetheless, AAS remains a robust, cost-effective method granting reliable results within certain detection limits [30]. The similarity across studies in observing that occupational drivers generally have manageable lead levels points to the effectiveness of current occupational health measures. However, the presence of some abnormal hair lead levels indicates that existing interventions might need reinforcement, especially concerning behavioral risk factors such as smoking.

C. LIMITATIONS AND WEAKNESSES

While this study provides valuable insights into lead exposure among truck drivers, several limitations could influence the interpretation of results. Notably, the sample size was relatively small, comprising only 15 respondents, which limits the statistical power and generalizability of the findings. Larger, multicenter studies are necessary to obtain a more representative picture of occupational exposure across different regions and work environments [31].

The cross-sectional nature of this research captures exposure levels at a single point in time, which may not accurately reflect long-term accumulation or recent fluctuations. Prospective longitudinal studies would be more effective in delineating exposure dynamics and health outcomes associated with chronic lead accumulation [32]. Moreover, external factors such as environmental pollution outside occupational exposure, dietary intake, and hygiene practices were not comprehensively assessed, which could confound the association between occupation and lead levels.

Technical limitations also pertain to the analytical process. The destruction process and sample preparation for atomic absorption spectrophotometry involved some procedural weaknesses, such as incomplete filtration and unstable temperature conditions, which could marginally affect accuracy and precision [33]. The high operational costs and equipment constraints further restrict the feasibility for routine large-scale screening. Also, only male drivers were sampled due to societal norms regarding hair length, potentially neglecting physiological variations relevant to females.

Another critical limitation is the potential for external contamination of hair samples, which can artificially elevate measured lead levels. External deposition from environmental dust or clothing fibers can confound internal lead accumulation estimates if not properly washed or controlled [34]. Future studies should emphasize rigorous sample cleaning protocols and control for external contamination.

Implications of Findings

Despite the limitations, these findings carry important occupational health implications. The predominantly normal lead levels suggest that current safety measures—such as PPE use, regulated environmental emissions, and health surveillance—are effective in maintaining low systemic lead burdens among truck drivers in Surabaya. Nevertheless, the detection of abnormal hair lead levels in a subset of respondents indicates potential areas for intervention. Regular screening, behavioral counseling for smoking cessation, and educational programs emphasizing personal protective measures could further mitigate cumulative exposure.

Additionally, the study underscores the importance of utilizing multiple biological markers to assess long-term versus recent exposure comprehensively. Hair analysis provides a useful tool for monitoring chronic exposure, while blood testing remains essential for evaluating recent exposure. Policymakers and health authorities should integrate such biomonitoring into occupational health protocols, particularly in settings with high vehicular traffic and potential heavy metal exposure.

The evident influence of behavioral factors like smoking and lifestyle choices on lead levels advocates for targeted health promotion campaigns among transport workers. Moreover, environmental policies aimed at reducing vehicular emissions, including transitioning to cleaner fuels and implementing stricter emission standards, could substantially decrease ambient lead concentrations and protect vulnerable occupational groups.

In conclusion, this study demonstrates that container truck drivers in Surabaya have, on average, low lead burdens, but certain individuals exhibit elevated levels linked to age and smoking habits. Continued monitoring, reinforced safety protocols, and broader environmental measures are recommended to sustain and improve occupational health outcomes related to heavy metal exposure.

V. CONCLUSION

This study aimed to investigate the levels of lead exposure among container truck drivers at PT. Trans Indo Sakti Surabaya through analysis of hair and blood samples using Atomic Absorption Spectrophotometry (AAS). The findings reveal that all respondents exhibited lead concentrations within the normal range, with blood lead levels ranging from 0.146 µg/dL to 3.81 µg/dL, and hair lead levels spanning from 0.1936 µg/g to 3.026 µg/g. Notably, nine individuals had hair lead levels categorized as normal, while six demonstrated abnormal levels, despite all blood lead concentrations remaining within safe thresholds. The data further suggest that age and duration of exposure influence lead accumulation, with older respondents and those working longer hours being more susceptible to elevated lead levels. Smoking habits also emerged as significant factors; respondents with a history of smoking demonstrated higher lead concentrations. The study underscores the importance of preventive measures, such as consistent use of personal protective equipment, healthy lifestyle choices, and dietary interventions rich in antioxidants, which appeared to mitigate lead buildup in some subjects. While the research confirms that typical exposure levels in this occupational group fall within safe limits, it also highlights the potential cumulative effects of lead, especially in older drivers or those with prolonged exposure. Future investigations should consider larger sample sizes, different biomarkers such as urine and fingernail analysis, and include various occupational groups to better understand exposure dynamics. Moreover, longitudinal studies are recommended to assess the long-term health implications of chronic low-level lead exposure among drivers. Overall, the study emphasizes the necessity of ongoing monitoring and targeted interventions to prevent adverse health outcomes resulting from occupational lead exposure, along with expanding research to explore other heavy metals like arsenic, cadmium, and mercury, which may pose additional health risks.

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DATA AVAILABILITY

No datasets were generated or analyzed during the current study.

AUTHOR CONTRIBUTION

All authors contributed significantly to this research. Juliana Christyaningsih and Amiliya Antika Dewi were responsible for conceptualizing the study, designing the methodology, and conducting the data collection. Juliana also oversaw the analytical procedures and laboratory work, ensuring accuracy and reliability of the results. Aiy Puspitasari contributed to data analysis, interpretation of findings, and drafting the manuscript. All authors participated in revising the paper critically and approved the final version for publication, ensuring the integrity and scholarly quality of the research.

DECLARATIONS

ETHICAL APPROVAL

This research was conducted in accordance with ethical standards, with informed consent obtained from all participants prior to sample collection. No conflicts of interest were declared by any of the authors. The study received no specific grant from funding agencies in the public, commercial, or not-for-profit sectors. All data generated or analyzed during this study are included in this publication, and any relevant ethical considerations involving participant confidentiality and data integrity have been strictly adhered to.

CONSENT FOR PUBLICATION PARTICIPANTS.

Consent for publication was given by all participants

COMPETING INTERESTS

The authors declare no competing interests.

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