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Association between Working Duration and Hemoglobin Levels among Parking Attendants at Gondanglegi Market, Malang Regency

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ABSTRACT

Hemoglobin (Hb) is an essential parameter in oxygen transport and can be affected by occupational and environmental factors, including working duration. Parking attendants at Gondanglegi Market, Malang Regency, are exposed to prolonged working hours, vehicle emissions, and high physical activity, which may contribute to decreased hemoglobin levels. Previous studies have reported that occupational exposure to air pollution and long-term workload may negatively influence hematological status. However, studies focusing on hemoglobin levels among informal sector workers, particularly parking attendants, remain limited. This study aimed to analyze the hemoglobin levels of parking attendants based on their working duration at Gondanglegi Market, Malang Regency. A descriptive quantitative study design was employed using a total sampling technique involving 25 respondents. Blood samples were collected from parking attendants, and hemoglobin levels were measured using a photometer with the Cyanmethemoglobin method at the Bululawang Public Health Center Laboratory. The findings revealed that most respondents with a working duration of less than 10 years had normal hemoglobin levels, whereas respondents with more than 10 years of service tended to have hemoglobin levels below the normal range. These findings indicate that prolonged occupational exposure and longer working duration may contribute to decreased hemoglobin levels among parking attendants.

Keywords: *Hemoglobin Level, Working Duration, Parking Attendants, Occupational Exposure, Informal Workers*

ABSTRAK

Hemoglobin (Hb) merupakan parameter penting dalam transportasi oksigen yang dapat dipengaruhi oleh faktor pekerjaan dan lingkungan, termasuk lama kerja. Petugas parkir di Pasar Gondanglegi Kabupaten Malang bekerja dalam durasi panjang dengan paparan emisi kendaraan dan aktivitas fisik yang tinggi sehingga berpotensi menyebabkan penurunan kadar hemoglobin. Beberapa penelitian sebelumnya melaporkan bahwa paparan polusi udara dan beban kerja jangka panjang dapat memberikan dampak negatif terhadap status hematologi. Namun, penelitian mengenai kadar hemoglobin pada pekerja sektor informal, khususnya petugas parkir, masih terbatas. Penelitian ini bertujuan untuk menganalisis kadar hemoglobin petugas parkir berdasarkan lama kerja di Pasar Gondanglegi Kabupaten Malang. Penelitian menggunakan desain deskriptif kuantitatif dengan teknik total sampling sebanyak 25 responden. Sampel darah diperoleh dari petugas parkir dan pemeriksaan kadar hemoglobin dilakukan menggunakan alat fotometer dengan metode sianmethemoglobin di Laboratorium Puskesmas Bululawang. Hasil penelitian menunjukkan bahwa sebagian besar responden dengan lama kerja kurang dari 10 tahun memiliki kadar hemoglobin normal, sedangkan responden dengan masa kerja lebih dari 10 tahun cenderung memiliki kadar hemoglobin di bawah normal. Temuan ini menunjukkan bahwa paparan kerja jangka panjang dan durasi kerja yang lebih lama berpotensi berkontribusi terhadap penurunan kadar hemoglobin pada petugas parkir.

Kata kunci: Kadar Hemoglobin, Lama Kerja, Petugas Parkir, Paparan Kerja, Pekerja Informal

INTRODUCTION

Hemoglobin (Hb) is a complex protein found in erythrocytes that plays an essential role in transporting oxygen and carbon dioxide throughout the body. Hemoglobin consists of four polypeptide chains and heme groups containing iron atoms, enabling it to bind oxygen in the lungs and distribute it to body tissues. In addition to gas transportation, hemoglobin also functions as a buffer in maintaining blood pH balance. According to the World Health Organization (WHO), normal hemoglobin levels range from 13–18 g/dL in males and 12–16 g/dL in females. Decreased hemoglobin levels may lead to anemia, characterized by fatigue, decreased concentration, and reduced physical and cognitive performance(1).

Hemoglobin levels are influenced by several factors, including age, sex, nutritional status, smoking habits, physical activity, working duration, and occupational environmental exposure (2,3). Workers exposed to air pollution for prolonged periods are at greater risk of hematological disorders due to exposure to carbon monoxide (CO) and other pollutants. Carbon monoxide has a stronger affinity for hemoglobin than oxygen, thereby inhibiting oxygen distribution to body tissues. This condition may contribute to reduced hemoglobin levels and other health problems..

Working duration and daily working hours are important aspects of occupational health. Working duration refers to the total length of employment in a particular occupation, usually measured in years, while daily working hours refer to the number of hours worked each day. Parking attendants are categorized as informal sector workers who are highly exposed to motor vehicle pollution because they work in open environments with high traffic density. Continuous exposure to air pollution for approximately 8–12 hours per day may increase the risk of health disorders, including decreased hemoglobin levels.

Gondanglegi Market in Malang Regency is one of the economic centers with a high density of motor vehicle activity every day. This condition creates a working environment with considerable exposure to vehicle emissions for parking attendants. In addition, most parking attendants work for long hours with limited rest periods. Previous studies reported a negative relationship between working duration and hemoglobin levels among parking attendants in South Denpasar, where longer working duration was associated with lower hemoglobin levels(4). Another study among gas station workers found that employees with more than three years of service had a greater risk of decreased hemoglobin levels compared to those with shorter working

periods (5). Hal ini menunjukkan bahwa paparan jangka panjang dalam lingkungan kerja yang terpapar polusi udara dapat berdampak negatif pada kesehatan darah pekerja.

Studies concerning hemoglobin levels among informal sector workers remain limited, particularly among parking attendants in traditional market environments. Most previous studies focused on industrial workers or urban populations in general. Therefore, this study offers novelty by specifically examining the relationship between working duration and hemoglobin levels among parking attendants in a traditional market setting with unique occupational exposure characteristics. This study also emphasizes the role of prolonged working hours without adequate rest as a potential risk factor affecting hematological health among informal workers.

Long-term exposure to air pollution, especially carbon monoxide emitted from motor vehicles, may interfere with hemoglobin's oxygen-binding capacity and affect metabolic processes in the body (6). Furthermore, excessive physical workload and prolonged working hours without sufficient rest may influence red blood cell production and physiological balance (7). These conditions indicate that working duration may be an important factor affecting hemoglobin levels among parking attendants at Gondanglegi Market, Malang Regency.

Therefore, this study aimed to analyze hemoglobin levels among parking attendants based on working duration at Gondanglegi Market, Malang Regency. The findings of this study are expected to provide scientific evidence for improving occupational health among informal sector workers, particularly through controlling working duration and minimizing exposure to air pollution in the workplace.

METHODS

This study employed a quantitative descriptive research design aimed at describing hemoglobin (Hb) levels among parking attendants at Gondanglegi Market, Malang Regency, based on working duration. The study population consisted of all parking attendants working at Gondanglegi Market, totaling 25 individuals. Since the population size was relatively small, all participants were included as research samples using a total sampling technique.

The dependent variable in this study was hemoglobin level, while the independent variable was working duration. Data regarding working duration were collected using a structured questionnaire. Hemoglobin examination was conducted using the Cyanmethemoglobin method with a photometer at the Bululawang Public Health Center Laboratory. The questionnaire was designed to collect respondent characteristics, including age, sex, working duration, smoking habits, and the use of personal protective equipment (PPE).

Blood sample examination was performed through standardized pre-analytical, analytical, and post-analytical procedures. Instrument validity testing was conducted to ensure that the questionnaire appropriately measured the variables under study, while reliability testing was evaluated using Cronbach's Alpha to determine data consistency.

The primary data obtained were analyzed using Statistical Package for the Social Sciences (SPSS). Data analysis included descriptive analysis, cross-tabulation, and correlation analysis to identify the relationship between working duration and hemoglobin levels among parking attendants. This study was approved by the Health Research Ethics Committee (KEPK) of Yayasan Ngudia Husada Madura, Universitas Noor Huda Mustofa (UNHM), with ethical clearance number 2673/KEPK/UNIV-NHM/EC/V/2025.

RESULTS

This study involved 25 parking attendants at Gondanglegi Market, Malang Regency, as respondents. Hemoglobin examination was conducted using the Cyanmethemoglobin method with a photometer at the Bululawang Public Health Center Laboratory. The findings demonstrated

variations in hemoglobin levels based on working duration and daily working hours among respondents.

Table 1. Distribution of Hemoglobin Levels among Parking Attendants at Gondanglegi Market

Hemoglobin Level Category	n	Percentage (%)
Normal	18	72
Abnormal	7	28
Total	25	100

Based on Table 1, most respondents had normal hemoglobin levels, accounting for 18 respondents (72%), while 7 respondents (28%) had abnormal or below-normal hemoglobin levels. These findings indicate that some parking attendants may have a risk of hematological disorders potentially associated with occupational exposure and prolonged working duration.

Table 2. Statistical Distribution of Hemoglobin Levels among Parking Attendants

Parameter	Result
Mean	13.6 g/dL
Standard Deviation	2.011
Minimum Value	10.3 g/dL
Maximum Value	16.9 g/dL
Total Respondents	25

Statistical analysis showed that the mean hemoglobin level among respondents was 13.6 g/dL with a standard deviation of 2.011. The minimum hemoglobin level was 10.3 g/dL, while the maximum value was 16.9 g/dL. These findings indicate variability in hemoglobin levels among parking attendants, which may be influenced by occupational and environmental exposure factors.

Table 3. Cross-tabulation between Hemoglobin Levels and Working Duration among Parking Attendants

Working Duration	Normal n (%)	Abnormal n (%)	Total n (%)
<5 years	3 (12%)	0 (0%)	3 (12%)
5–10 years	15 (60%)	0 (0%)	15 (60%)
>10 years	0 (0%)	7 (28%)	7 (28%)
Total	18 (72%)	7 (28%)	25 (100%)

Table 4. Cross-tabulation between Hemoglobin Levels and Daily Working Duration

Daily Working Duration	Normal n (%)	Abnormal n (%)	Total n (%)
<8 hours	16 (64%)	1 (4%)	17 (68%)
>8 hours	2 (8%)	6 (24%)	8 (32%)
Total	18 (72%)	7 (28%)	25 (100%)

Based on Table 4, most respondents who worked less than 8 hours per day had normal hemoglobin levels, accounting for 16 respondents (64%). Meanwhile, among respondents who worked more than 8 hours per day, the majority had abnormal hemoglobin levels, accounting for 6 respondents (24%). These findings indicate that longer daily working duration may be associated with decreased hemoglobin levels.

Table 5. Cross-tabulation between Hemoglobin Levels and Symptoms of Headache and Fatigue

Symptoms of Headache and Fatigue	Normal n (%)	Abnormal n (%)	Total n (%)
Yes	6 (24%)	2 (8%)	8 (32%)
No	12 (48%)	5 (20%)	17 (68%)
Total	18 (72%)	7 (28%)	25 (100%)

Table 5 demonstrates that 8 respondents (32%) experienced symptoms of headache and fatigue. Among them, 2 respondents (8%) had abnormal hemoglobin levels. Meanwhile, most respondents who did not experience symptoms had normal hemoglobin levels, accounting for 12 respondents (48%).

Table 6. Normality Test Results of Hemoglobin Level Data

Normality Test	Statistic	Sig.
Kolmogorov-Smirnov	0.096	0.200
Shapiro-Wilk	0.953	0.299

The Shapiro-Wilk normality test showed a significance value of 0.299 ($p>0.05$), indicating that the hemoglobin level data were normally distributed. Therefore, further statistical analysis was conducted using the parametric Pearson Correlation test. The Shapiro-Wilk test was selected because the number of respondents was less than 50.

Table 3 shows that all respondents with a working duration of less than 10 years had normal hemoglobin levels. In contrast, all respondents with a working duration of more than 10 years had abnormal hemoglobin levels. These findings suggest that longer employment duration may increase the risk of decreased hemoglobin levels among parking attendants.

Table 7. Correlation Test between Working Duration and Hemoglobin Levels

Variables	Correlation Coefficient (r)	Significance (p)
Working Duration and Hemoglobin Levels	-0.859	0.000

The Pearson Correlation test showed a correlation coefficient value of -0.859 with a significance value of 0.000 ($p<0.01$). These results indicate a very strong and significant negative relationship between working duration and hemoglobin levels. The longer the respondents worked as parking attendants, the lower their hemoglobin levels tended to be.

Table 8. Correlation Test between Daily Working Duration and Hemoglobin Levels

Variables	Correlation Coefficient (r)	Significance (p)
Daily Working Duration and Hemoglobin Levels	-0.718	0.000

The Pearson Correlation analysis revealed a correlation coefficient value of -0.718 with a significance value of 0.000 ($p<0.01$). These findings indicate a strong and significant negative relationship between daily working duration and hemoglobin levels. Longer daily working hours were associated with lower hemoglobin levels among parking attendants.

DISCUSSION

This study was conducted to evaluate hemoglobin (Hb) levels among parking attendants based on working duration at Gondanglegi Market, Malang Regency. The primary objective of this study was to analyze the extent to which length of employment and daily working duration

influence hemoglobin levels among parking attendants who are continuously exposed to air pollution, physical workload, and unfavorable working environments. The study involved 25 male respondents and hemoglobin examination was performed using a photometer with the Cyanmethemoglobin method, which is recognized by the World Health Organization (WHO) as a standard and accurate method for hemoglobin measurement(8).

The results demonstrated that hemoglobin levels among respondents ranged from 10.3 g/dL to 16.9 g/dL, with a mean value of 13.6 g/dL. According to WHO reference standards, normal hemoglobin levels in adult males range from 12.0–18.0 g/dL. In this study, 7 respondents (28%) had hemoglobin levels below the normal threshold, while 18 respondents (72%) had normal hemoglobin levels. No respondents exhibited hemoglobin levels above the normal range. These findings indicate that a considerable proportion of parking attendants may experience hematological disturbances associated with occupational exposure and prolonged work duration.

Cross-tabulation analysis between hemoglobin levels and working duration revealed that all respondents with working duration below 10 years had normal hemoglobin levels. In contrast, all respondents with more than 10 years of employment experienced decreased hemoglobin levels below the normal threshold. These findings indicate that prolonged employment duration as a parking attendant may contribute to reduced hemoglobin levels and increase the risk of anemia. The findings are consistent with previous studies reporting that informal workers with prolonged occupational exposure have a higher risk of hematological disorders due to continuous exposure to environmental pollutants and excessive physical workload (3). Long-term exposure to pollutants, particularly carbon monoxide from vehicle emissions, may lead to the formation of carboxyhemoglobin, which reduces the blood's oxygen-carrying capacity and may eventually contribute to tissue hypoxia and anemia(4,5,9).

In addition to employment duration, daily working hours also showed a substantial relationship with hemoglobin levels. Respondents who worked more than 8 hours per day predominantly exhibited abnormal hemoglobin levels, whereas most respondents working less than 8 hours per day maintained normal hemoglobin levels. This finding suggests that prolonged daily working hours may accelerate physiological fatigue and increase oxidative stress, which can negatively affect erythrocyte metabolism and hemoglobin synthesis. Continuous physical workload without adequate rest may impair the regeneration of red blood cells, particularly when not supported by sufficient nutritional intake(8,10,11).

The demographic characteristics of respondents further supported the interpretation of hemoglobin decline among parking attendants. Most respondents were between 36 and 65 years old, an age range associated with physiological decline in hematopoietic function. Although all respondents were male, who generally have higher hemoglobin levels than females, several respondents still demonstrated low hemoglobin levels, indicating that occupational and environmental factors may exert stronger effects than biological factors alone. Lifestyle factors also played an important role in influencing hemoglobin levels. All respondents were identified as active smokers. Cigarette smoke contains nicotine and carbon monoxide, which bind strongly to hemoglobin and form carboxyhemoglobin. This process substantially reduces oxygen transport capacity and may induce tissue hypoxia. Chronic hypoxia can contribute to fatigue, decreased physical performance, and increased risk of anemia. In addition, none of the respondents reported using personal protective equipment (PPE), particularly masks, during work activities. The absence of PPE use may increase direct exposure to vehicle emissions and airborne pollutants, thereby increasing the risk of respiratory disorders and impaired oxygen transport capacity (12). These findings indicate that unhealthy occupational habits significantly contribute to the vulnerability of parking attendants to hematological disturbances. Nutritional factors also appeared to contribute to the decline in hemoglobin levels. Only one respondent routinely consumed iron supplements, despite the importance of iron intake in hemoglobin synthesis. Iron deficiency over a prolonged period may result in iron deficiency anemia, characterized by decreased concentration, chronic fatigue, reduced productivity, and weakened immune function.

Previous studies emphasized that adequate iron intake is crucial for workers with high physical activity, particularly those working outdoors, to prevent anemia and maintain work performance(13,14). Therefore, inadequate nutritional intake may further exacerbate the negative effects of occupational exposure on hemoglobin levels. Clinical manifestations associated with decreased hemoglobin levels were also identified in this study. Symptoms such as headache and fatigue were reported by several respondents. Reduced hemoglobin levels may decrease oxygen supply to the brain and body tissues, resulting in hypoxia-related symptoms, including headaches, generalized weakness, and fatigue. These findings suggest that low hemoglobin levels not only represent laboratory abnormalities but also have direct implications for workers' physical health and occupational productivity. The Pearson correlation analysis demonstrated a very strong negative correlation between working duration and hemoglobin levels ($r = -0.859$; $p = 0.000$). Similarly, daily working duration showed a strong negative correlation with hemoglobin levels ($r = -0.718$; $p = 0.000$). These findings indicate that longer employment duration and longer daily working hours are significantly associated with lower hemoglobin levels among parking attendants. Prolonged physical workload may increase metabolic demands, physiological stress, and erythrocyte turnover, thereby affecting red blood cell production and hemoglobin synthesis(8,10).

The negative correlations identified in this study suggest that occupational exposure time plays a critical role in the decline of hemoglobin levels among parking attendants. This mechanism is likely associated with chronic exposure to carbon monoxide, insufficient rest periods, inadequate nutritional intake, and continuous work in polluted open-air environments. Furthermore, the combination of smoking habits, absence of PPE use, and increasing age may aggravate the reduction in hemoglobin levels and elevate the risk of anemia and tissue hypoxia. The working conditions of parking attendants at Gondanglegi Market illustrate that informal sector workers are highly vulnerable to occupational hematological disorders. Therefore, occupational health interventions should become a priority for this population(15). Several preventive measures may be implemented, including regulation of working hours, provision of adequate rest areas, distribution of personal protective equipment such as masks, health education programs, and routine iron supplementation. In addition, periodic health examinations are necessary to monitor workers' health conditions and prevent long-term complications associated with occupational exposure(16).

Overall, this study provides significant scientific evidence regarding the impact of prolonged occupational exposure on hemoglobin levels among informal sector workers, particularly parking attendants in traditional market environments. The findings demonstrate that working duration and daily working hours are strongly associated with decreased hemoglobin levels, which may be further aggravated by unhealthy lifestyle factors and lack of occupational protection. These findings may serve as a basis for developing occupational health policies aimed at improving the welfare and health protection of informal workers.

CONCLUSION

Based on the findings of this study, it can be concluded that working duration and daily working hours are significantly associated with hemoglobin levels among parking attendants at Gondanglegi Market, Malang Regency. Respondents with a working duration of less than 10 years generally had normal hemoglobin levels, whereas respondents with more than 10 years of employment tended to experience decreased hemoglobin levels below the normal range. In addition, parking attendants who worked more than 8 hours per day were more likely to have abnormal hemoglobin levels compared to those with shorter daily working durations.

Pearson correlation analysis demonstrated a very strong negative correlation between working duration and hemoglobin levels ($r = -0.859$; $p = 0.000$), as well as a strong negative correlation between daily working duration and hemoglobin levels ($r = -0.718$; $p = 0.000$). These

findings indicate that prolonged occupational exposure, excessive workload, air pollution exposure, smoking habits, lack of personal protective equipment use, and inadequate nutritional intake may contribute to decreased hemoglobin levels among parking attendants.

This study highlights the importance of occupational health protection among informal sector workers, particularly parking attendants working in environments with high exposure to vehicle emissions. Therefore, preventive strategies such as regulating working hours, providing adequate rest periods, encouraging the use of personal protective equipment, and improving nutritional awareness are necessary to reduce the risk of hematological disorders. Future studies are recommended to include larger sample sizes, additional occupational and lifestyle variables, and broader research locations to obtain more comprehensive and representative findings regarding occupational factors affecting hemoglobin levels among informal workers.

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