

Differences in blood pressure and pulse rate of morning and night shift workers at the barging site of PT. Ceria Nugraha Indotama in Wolo District, Kolaka Regency, 2025

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World Journal of Advanced Research and Reviews, 2026, 30(03), 1678–1685

Publication history: Received on 12 May 2026; revised on 20 June 2026; accepted on 22 June 2026

Article DOI: <https://doi.org/10.30574/wjarr.2026.30.3.1725>

Abstract

Background: Shift work, particularly night shifts, can disrupt circadian rhythms and affect blood pressure and heart rate. Workers in the barge haulage area of the nickel mining industry face a high physical workload, while studies on the physiological conditions of shift workers are limited. Objective: To determine the differences in blood pressure and heart rate between morning and night shift workers at PT. Ceria Nugraha Indotama in 2025.

Methods: This study used a cross-sectional analytical survey design with 50 respondents. Blood pressure was measured using a digital sphygmomanometer and heart rate using a pulse oximeter. Smoking and caffeine consumption were analyzed as confounding variables to assess their effect on the primary variables and to ensure that physiological changes were truly influenced by the difference in work shifts. Analysis used the Mann-Whitney U test and the independent t-test.

Results: There were significant differences in systolic blood pressure ($p=0.038$), diastolic blood pressure ($p=0.005$), and heart rate ($p=0.000$) between morning and night shift workers. Meanwhile, there was no significant association between smoking and caffeine consumption with blood pressure and heart rate ($p > 0.05$), so these two variables were not proven to be confounding factors in this study.

Conclusion: Blood pressure and heart rate were higher in night shift workers, suggesting that physiological changes are more influenced by the shift work system than lifestyle factors.

Keywords: Blood Pressure; Circadian Rhythm; Nickel Mining; Pulse Rate; Shift Work.

1. Introduction

Occupational safety and health are crucial aspects of the industrial world, particularly in sectors that employ shift work systems. The International Labour Organization (ILO) reports that each year, approximately 2.9 million workers die from work-related accidents and diseases, while approximately 402 million workers suffer work-related injuries. Most of these cases are related to occupational diseases influenced by long working hours and shift work systems ¹.

Company work can last 24 hours. Shift work is performed during irregular working hours, generally divided into morning, afternoon, and night shifts. This work system is widely applied in the industrial sector, including mining ². However, shift work, especially night shifts, can disrupt the body's circadian rhythm, thus affecting workers' physiological functions ³.

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Circadian rhythm disturbances can lead to increased sympathetic nervous system activity and the release of stress hormones such as cortisol and adrenaline. This condition results in increased blood pressure and heart rate⁴. explain that circadian rhythms play a crucial role in regulating blood pressure, heart rate, sleep patterns, body temperature, and metabolism. Disruptions to these biological rhythms, such as those caused by night work or shift work, can cause imbalances in the body's physiological functions and increase the risk of cardiovascular disorders⁵.

Blood pressure is the force of blood pushing against the walls of blood vessels, which maintains blood flow throughout the body. Normal blood pressure in adults ranges from 100/60 mmHg to 140/90 mmHg, with an average of 120/80 mmHg⁶. Hypertension occurs when systolic blood pressure is ≥ 140 mmHg and diastolic blood pressure is ≥ 90 mmHg (Kemenkes 2021). In addition to blood pressure, pulse rate is also an important indicator of the body's physiological condition. A normal pulse rate in adults ranges from 60–100 beats per minute and can be affected by physical activity, stress, environmental temperature, and circadian rhythm disturbances⁸.

Changes in blood pressure and pulse rate are influenced by various factors, both individual and work environment. Individual factors include age, length of service, sleep quality, nutritional status, smoking habits, and caffeine consumption. Meanwhile, work environment factors such as workload, noise, heat, and shift work can also affect workers' physiological conditions⁶. Caffeine consumption is known to increase blood pressure through activation of the sympathetic nervous system⁹, while smoking can cause vasoconstriction and increased heart rate, thus increasing blood pressure and pulse rate¹⁰.

Several previous studies have shown a relationship between shift work and changes in blood pressure and pulse rate. Research by Rosani et al. (2020) showed significant differences in systolic, diastolic, and pulse rates between shift and non-shift workers¹¹. Research by Nopiana et al. (2024) also showed that blood pressure tends to increase among night shift workers compared to morning and afternoon shift workers¹².

PT. Ceria Nugraha Indotama is a nickel mining company located in Wolo District, Kolaka Regency, Southeast Sulawesi. The company implements a shift work system to support 24-hour operations. One work area with high physical activity is the barging area, which includes loading nickel ore onto barges, operational supervision, lashing cargo, and operating heavy equipment. These activities are carried out continuously over long working hours, potentially causing fatigue and physiological changes in workers.

Based on a preliminary survey in 2025, there were 100 workers in the Barging area divided into morning and night shifts. Company health data showed that hypertension was one of the most common health conditions among workers, with 15 cases, or approximately 5%, and two cases were found in the Barging area of workers. Furthermore, night shift workers had a higher number of visits to the Pratama Mandiri Ceria Clinic than morning shift workers. Health checks also showed that several night shift workers experienced blood pressure above normal limits. This condition indicates the possible impact of the shift work system on workers' blood pressure and pulse rates.

Based on this description, this study aims to analyze the differences in blood pressure and pulse rates between morning and night shift workers at the Barging Site of PT. Ceria Nugraha Indotama, Wolo District, Kolaka Regency, in 2025.

2. Material and methods

This study used an analytical survey design with a cross-sectional approach. The study was conducted at the barging site of PT. Ceria Nugraha Indotama, Wolo District, Kolaka Regency, Southeast Sulawesi in March 2026. The study population consisted of all 100 workers in the barging area working morning and night shifts. The Lemeshow formula was used to determine the sample size, resulting in a random sampling technique of 50 respondents, consisting of 25 morning shift workers and 25-night shift workers.

The independent variable in this study was work shift, while the dependent variables included blood pressure and pulse rate. Controlled confounding variables were smoking habits and caffeine consumption. Primary data were obtained through blood pressure measurements using a digital sphygmomanometer and pulse rate measurements using a pulse oximeter, as well as by completing a questionnaire on respondent characteristics. The measurements were performed by trained paramedics after the respondents had rested for at least 5 minutes and had not smoked or consumed caffeine for 30 minutes prior to the examination. Blood pressure was measured three times at 1–2-minute intervals, with the average of the last two readings taken.

Data were processed using SPSS version 16.0 through editing, coding, cleaning, and data entry stages. Univariate analysis was used to describe the distribution of respondent characteristics and research variables. Bivariate analysis

was conducted to determine differences in blood pressure and pulse rate between morning and night shift workers. Normality testing used the Shapiro-Wilk test. Normally distributed data were analyzed using the Independent T-Test, while non-normally distributed data were analyzed using the Mann-Whitney U Test with a significance level of $\alpha = 0.05$

3. Results

3.1. Respondent Characteristics

Table 1 Characteristics of Respondents in the Barging Area of PT. CNI in 2025

Characteristics	Category	n	%
Gender	Man	50	100
Age (years)	<25	7	14.0
	26-30	15	30.0
	31-35	9	18.0
	36-40	11	22.0
	>40	8	16.0
Education	SD	8	16.0
	SMP	8	16.0
	SMA	25	50.0
	S1	9	18.0
Years of service	<5 tahun	28	56.0
	≥5 tahun	22	44.0
Total		50	100

Source: Primary Data, 2026

Table 1 shows that of the 50 respondents (100%), the characteristics of the respondents indicate that all respondents were male (50) (100%), with the largest age group being 26-30 years (30%), indicating a predominance of young adult workers. The majority had a high school education (50%) and had a work experience of <5 years (56%), consistent with the profile of the growing mining industry. Seventy-six percent of respondents were active smokers and 70% consumed caffeine

3.2. Analysis of Differences in Blood Pressure and Pulse Rate

Analysis of differences in systolic, diastolic, and pulse rate blood pressure based on work shift, smoking status, and caffeine consumption is as follows:

Table 2 Analysis of Differences in Systolic Blood Pressure Based on Work Shift, Smoking Status, and Caffeine Consumption

Systolic Blood Pressure (mmHg)								
Work Shift								
	N	Min	Max	Mean	Median	$\pm SD$	p -value	Note
Morning Shift	25	89	139	108.72	106.00	0.411	0,038	H ₀ rejected
Night Shift	25	97	158	121.28	119.00	0.111		
Smoking Status								
Smoking	38	89	158	116.18	109.00	0.522	0,991	H ₀ accepted

No Smoking	12	100	132	111.25	109.00	0.781		
Caffeine Consumption Status								
Consumption	35	89	158	115.29	108.00	0.302	0,626	H ₀ accepted
Not Consuming	15	100	151	114.33	110.00	0.886		

Source: Primary Data, 2026

Table 2 shows the systolic blood pressure of 50 respondents based on work shift, smoking status, and caffeine consumption status. The measurement results show that night shift workers have a higher average systolic blood pressure than morning shift workers, which is 121.28 ± 0.111 mmHg with a range of 97–158 mmHg, while in the morning shift it is 108.72 ± 0.411 mmHg with a range of 89–139 mmHg. In addition, respondents who smoke have a higher average systolic blood pressure than respondents who do not smoke. In the smoking group, the average systolic blood pressure was 116.18 ± 0.522 mmHg with a range of 89–158 mmHg, while in the non-smoking group it was 111.25 ± 0.781 mmHg with a range of 100–132 mmHg. Furthermore, respondents who consumed caffeine had a slightly higher average systolic blood pressure than respondents who did not consume caffeine. In the caffeine-consuming group, the average systolic blood pressure was 115.29 ± 0.302 mmHg, with a range of 89–158 mmHg, while in the non-caffeine-consuming group, it was 114.33 ± 0.886 mmHg, with a range of 100–151 mmHg.

Based on the analysis of differences in systolic blood pressure based on work shift, smoking status, and caffeine consumption status, statistical tests showed that the work shift variable had a p-value of 0.038. Because the significance value was less than 0.05 ($p < 0.05$), H₀ was rejected, indicating a difference in systolic blood pressure between morning and night shift workers at the PT. Barging Site. Ceria Nugraha Indotama in 2025. Meanwhile, the smoking status obtained a p-value of 0.991 and the caffeine consumption status of 0.626. Because both significance values are greater than 0.05 ($p > 0.05$), then H₀ is accepted, so there is no difference in systolic blood pressure based on smoking status and caffeine consumption status in the Barging Site area of PT. Ceria Nugraha Indotama in 2025.

Table 3 Analysis of Differences in Diastolic Blood Pressure Based on Work Shift, Smoking Status and Caffeine Consumption

Diastolic Blood Pressure (mmHg)								
Work Shift								
	N	Min	Max	Mean	Median	$\pm SD$	p -value	Note
Morning Shift	25	70	118	85.92	8700	0,384	0,005	H ₀ rejected
Night Shift	25	80	115	93,92	91,00	0,737		
Smoking Status								
Smoking	38	70	118	90,87	91,00	0,945	0,252	H ₀ accepted
No Smoking	12	70	98	86,92	88,00	0,657		
Caffeine Consumption Status								
Consumption	35	72	118	91,11	91,00	0,809	0,215	H ₀ accepted
Not Consuming	15	70	115	87,13	86,00	0,281		

Source: Primary Data, 2026

Table 3 shows diastolic blood pressure in 50 respondents based on work shift, smoking status, and caffeine consumption. Measurement results indicate that night shift workers had a higher average diastolic blood pressure than morning shift workers, at 93.92 ± 0.737 mmHg with a range of 80–115 mmHg, while in the morning shift it was 85.92 ± 0.384 mmHg with a range of 70–118 mmHg. Furthermore, respondents who smoked had a higher average diastolic blood pressure than nonsmokers. In the smoking group, the average diastolic blood pressure was 90.87 ± 0.945 mmHg with a range of 70–118 mmHg, while in the nonsmoking group it was 86.92 ± 0.657 mmHg with a range of 70–98 mmHg. Furthermore, respondents who consumed caffeine had a higher average diastolic blood pressure than respondents who did not consume caffeine. In the caffeine-consuming group, the average diastolic blood pressure was 91.11 ± 0.809 mmHg, with a range of 72–118 mmHg, while in the non-caffeine-consuming group, it was 87.13 ± 0.281 mmHg, with a range of 70–115 mmHg.

Based on the analysis of differences in diastolic blood pressure based on work shift, smoking status, and caffeine consumption status, statistical tests showed that the work shift variable obtained a p-value of 0.005. Because the significance value was less than 0.05 ($p < 0.05$), H_0 was rejected, indicating that there was a difference in diastolic blood pressure between morning and night shift workers at the PT. Barging Site. Ceria Nugraha Indotama in 2025. Meanwhile, the smoking status obtained a p-value of 0.252 and the caffeine consumption status of 0.215. Because both significance values are greater than 0.05 ($p > 0.05$), then H_0 is accepted, so there is no difference in diastolic blood pressure based on smoking status and caffeine consumption status in the Barging Site area of PT. Ceria Nugraha Indotama in 2025.

Table 4 Analysis of Differences in Heart Rate Based on Work Shift, Smoking Status and Consumption

Pulse Rate (bpm)								
Work Shift								
	N	Min	Max	Mean	Median	$\pm SD$	p -value	Note
Morning Shift	25	60	86	71.56	70.00	0.467	0,000	H ₀ rejected
Night Shift	25	79	98	88.86	90.00	0.700		
Smoking Status								
Smoking	38	60	98	78.92	80.00	0.350	0,178	H ₀ accepted
No Smoking	12	66	98	83.92	79.50	0.931		
Caffeine Consumption Status								
Consumption	35	60	98	79.40	80.00	0.340	0,492	H ₀ accepted
Not Consuming	15	64	98	81.80	79.00	0.844		

Source: Primary Data, 2026

Table 4 shows the pulse rate of 50 respondents based on work shift, smoking status, and caffeine consumption status. The measurement results show that night shift workers have a higher average pulse rate than morning shift workers, which is 88.86 ± 0.700 bpm with a range of 79–98 bpm, while in the morning shift it is 71.56 ± 0.467 bpm with a range of 60–86 bpm. In addition, respondents who do not smoke have a higher average pulse rate than respondents who smoke. In the non-smoking group, the average pulse rate was 83.92 ± 0.931 bpm with a range of 66–98 bpm, while in the smoking group it was 78.92 ± 0.350 bpm with a range of 60–98 bpm. Furthermore, respondents who do not consume caffeine have a higher average pulse rate than respondents who consume caffeine. The average pulse rate in the caffeine-free group was 81.80 ± 0.844 bpm, with a range of 64–98 bpm, while in the caffeine-consuming group it was 79.40 ± 0.340 bpm, with a range of 60–98 bpm.

Based on the analysis of differences in pulse rate based on work shift, smoking status, and caffeine consumption status, statistical tests showed that the work shift variable obtained a p-value of 0.000. Because the significance value was less than 0.05 ($p < 0.05$), H_0 was rejected, indicating a difference in pulse rate between morning and night shift workers at the PT. Ceria Nugraha Indotama Barging Site in 2025. Meanwhile, the p-value for smoking status was 0.178, and for caffeine consumption status, it was 0.492. Because both significance values are greater than 0.05 ($p > 0.05$), H_0 is accepted, so there is no difference in pulse rate based on smoking status and caffeine consumption status in the Barging Site area of PT. Ceria Nugraha Indotama in 2025.

4. Discussion

4.1. Differences in Blood Pressure Between Morning and Night Shift Workers

The results of the study showed significant differences in systolic and diastolic blood pressure between morning and night shift workers at the PT. Ceria Nugraha Indotama Barging Site. Night shift workers had higher systolic and diastolic blood pressure than morning shift workers. The statistical test results showed a p-value of 0.038 for systolic blood pressure and a p-value of 0.005 for diastolic blood pressure, indicating that shift work affects workers' blood pressure.

The differences in blood pressure between morning and night shift workers in this study are suspected to be related to circadian rhythm disruption. At night, the body is physiologically in a resting phase, characterized by decreased sympathetic nervous system activity, heart rate, and blood pressure. However, night shift workers are still required to

work, resulting in increased sympathetic nervous system activity and the release of stress hormones, such as adrenaline and cortisol, which can cause vasoconstriction of blood vessels and increased blood pressure. Furthermore, night shift work can induce physiological stress, which can lead to increased blood pressure. This finding is supported by the results of this study, which showed that 12 of 25-night shift workers (48%) had blood pressure above average. These results indicate a higher blood pressure difference between the night shift group and the morning shift group.

In addition to circadian rhythm disruption, the working environment in the barging site also has the potential to affect workers' blood pressure. Loading and transporting nickel ore to barges involves operating heavy equipment, supervising the loading process, and coordinating work that continues continuously during working hours. However, because the type of work, workload, and environmental conditions are similar on the morning and night shifts, these factors tend to provide similar exposures to all workers. Therefore, the differences in blood pressure found are more likely to be related to differences in working hours. Working at night can disrupt sleep patterns and the body's biological rhythms, resulting in less optimal blood pressure regulation mechanisms and potentially leading to higher blood pressure compared to morning shift workers at the PT. Ceria Nugraha Indotama Barging Site.

These results align with those of Torun et al. (2024) and Madeira et al. (2021), which reported that night shift workers had higher blood pressure than day shift workers due to circadian rhythm disruption and lower sleep quality. These findings suggest that night shift work is a risk factor that can impact workers' cardiovascular health.

In addition to shift work, smoking behavior and caffeine consumption were also analyzed as confounding factors that could impact the cardiovascular system and blood pressure. However, the results showed no significant difference in blood pressure between smokers and nonsmokers ($p = 0.178$), and no significant difference based on caffeine consumption ($p = 0.492$).

Of the 50 respondents, 38 (76%) were smokers, while 12 (24%) were nonsmokers. Most smokers were classified as light smokers, namely 34 (68%), with a daily consumption of less than 10 cigarettes, while only 4 (8%) consumed more than 10 cigarettes. Regarding caffeine consumption, 35 (70%) consumed caffeinated beverages, while 15 (30%) did not. Among respondents who consumed caffeine, the majority were light drinkers (29 people) (58%), while 6 people (12%) were heavy drinkers.

The lack of differences is likely due to the low levels of nicotine and caffeine exposure among most respondents. This is evident in the predominance of light smokers and their relatively low caffeine consumption, making the stimulatory effects of these two substances on blood pressure less pronounced. Furthermore, data collection during Ramadan is also likely to have influenced the study results due to a decrease in smoking frequency and caffeinated beverage consumption, resulting in more uniform exposure levels across respondents.

Therefore, smoking and caffeine consumption were not identified in this study as factors significantly associated with blood pressure in workers at the PT. Ceria Nugraha Indotama Barging Site.

4.2. Differences in Pulse Rates of Morning and Night Shift Workers

The results of the study showed a significant difference in heart rate between morning and night shift workers at the PT. Ceria Nugraha Indotama Barging Site. The median heart rate for night shift workers was 90 bpm, higher than that of morning shift workers (70 bpm), with a p-value of 0.000 ($p < 0.05$). Although both values are within the normal adult heart rate range (60–100 bpm), these results indicate that night shift workers experience a greater physiological burden than morning shift workers.

These results align with those of Rosani (2020), who found a difference in heart rate between shift and non-shift workers ($p = 0.012$). Similar findings were also reported by Syafar (2018), who showed that the average heart rate of night shift workers was higher than that of morning shift workers. These similar results suggest that night shift work can increase cardiovascular activity in response to changes in the body's biological rhythms.

This difference in heart rate is thought to be related to circadian rhythm disruption caused by work activities performed during biological time periods that should be used for rest. Night work can increase sympathetic nervous system activity and the release of stress hormones such as adrenaline and cortisol, which contribute to increased heart rate. Furthermore, night shift workers generally experience lower sleep quality, greater work fatigue, and greater physiological stress than day shift workers, resulting in increased cardiovascular responses.

In addition to circadian rhythm disruption, the working environment in the barging site also has the potential to affect workers' heart rates. Loading and transporting nickel ore to barges involves operating heavy equipment, supervising the loading process, and coordinating work that continues continuously throughout working hours. However, because the type of work, workload, and environmental conditions are similar on the morning and night shifts, these factors likely provide similar exposures to all workers. Therefore, the differences in heart rates found are more likely related to differences in working hours. Working at night can disrupt sleep patterns and the body's biological rhythms, resulting in suboptimal heart rate regulation mechanisms and potentially leading to higher heart rates compared to day shift workers at the PT. Ceria Nugraha Indotama Barging Site.

In addition to the shift work system, smoking and caffeine consumption can also be confounding factors affecting the cardiovascular system and heart rate. However, the study results showed no significant difference in the pulse rate between workers who smoked and those who did not ($p = 0.178$). Of the 50 respondents, 38 (76%) were smokers, while 12 (24%) were non-smokers. Most smokers were classified as light smokers: 34 (68%) smoked less than 10 cigarettes per day, while only 4 (8%) smoked more than 10 cigarettes per day.

Similar results were found for caffeine consumption. Bivariate analysis showed no significant difference in pulse rate based on caffeine consumption ($p = 0.492$). Of the 50 respondents, 35 (70%) consumed caffeinated beverages, while 15 (30%) did not. Among respondents who consumed caffeine, the majority were light drinkers (29) (58%), while 6 (12%) were heavy drinkers.

The lack of a significant difference is likely due to the low levels of nicotine and caffeine exposure among most respondents. This is evident in the predominance of light smokers and light caffeine drinkers, making the stimulatory effects of nicotine and caffeine on the cardiovascular system less apparent. Furthermore, data collection during Ramadan is also suspected to have influenced the study results due to a decrease in consumption frequency outside of fasting hours. This condition resulted in relatively homogeneous nicotine and caffeine exposure among respondents, thus minimizing their apparent effect on heart rate. Therefore, smoking and caffeine consumption were not proven to be confounding factors in heart rate among workers at the PT. Ceria Nugraha Indotama Barging Site.

These study results align with Rohmah and Dewi (2023) who found no significant difference in heart rate between smokers and non-smokers, and Maulina et al. (2020) who found that coffee consumption was not significantly associated with heart rate ($p > 0.05$).

5. Conclusion

Based on the results of a study conducted on barging area workers at PT. Ceria Nugraha Indotama in 2025, it can be concluded that:

The results of the study showed a significant difference in systolic and diastolic blood pressure between morning and night shift workers at the PT. Ceria Nugraha Indotama Barging Site. Night shift workers had higher blood pressure than morning shift workers. The increased blood pressure in night shift workers is suspected to be related to circadian rhythm disruption, increased sympathetic nervous system activity, and high work demands, which cause the body to experience greater physiological stress than morning shift workers. The results also showed a significant difference in the pulse rate between morning and night shift workers. Night shift workers had higher pulse rates than morning shift workers, although still within the normal range. The high pulse rate in night shift workers is suspected to be a physiological response to circadian rhythm disruption, lack of rest time, work fatigue, and the higher physical and psychological workload of night shift work.

Overall, night shift work is associated with increased blood pressure and pulse rate in PT. Ceria Nugraha Indotama Barging Site workers. These findings suggest that night shift work places a greater physiological burden on the cardiovascular system than morning shift work.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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