



Research Article

Assessment of Physical Factors in the Work Environment as an Effort to Analyze Health Risks of Indonesian Informal Worker

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ABSTRACT

The sandal industry is one of the industries that poses health risks to workers, particularly due to the physical conditions of the work environment and the production process, which serve as potential hazards. One form of control that can be implemented is the measurement of physical factors in the workplaces. Therefore, the purpose of this study was to measure the physical hazard factors, specifically noise and lighting, and to describe the potential health risks faced by workers in a shoe manufacturing company in Surabaya. This research employed an observational analytic design with a cross-sectional approach, involving 25 respondents selected using a total sampling technique. The study was conducted from Juli to August 2024. Data on respondents' characteristics were collected through interviews using a questionnaire, while blood pressure was measured using an Omron digital sphygmomanometer. Blood pressure was assessed before and after work on the same day. Physical factors in the work environment, such as noise, were measured using a sound level meter, and lighting was measured using a lux meter. The results showed that the average noise level range from 80.5-82.4 dBA, which does not exceed the threshold limit value (TLV) of 85 dBA according to the Minister of Manpower Regulation No. 5 of 2018 concerning Occupational Safety and Health in the Work Environment. The average lighting level 107.8 lux, which is below the minimum lighting standard for sewing activities, (500-700 lux), based on the Minister of Health Regulation No. 70 of 2016 concerning Standards and Requirements for Environmental Health in Industrial Workplaces. Health examinations showed an increase in average systolic and diastolic blood pressure among the workers. Further examination is required to determine whether physical factors in the work environment contribute to the observed increase in blood pressure among workers in the sandal and shoe industry.

Keywords: Work environment measurement, Industrial Hygiene, Occupational Health, Informal Sector, Safety

INTRODUCTION

According to Lee J's (2022), further investigations are required to evaluate workplace hazards that may affect the health of workers' informal sector. The limited employment absorption capacity, particularly in the formal sector, forces many individuals to seek or create work



opportunities independently for their livelihood. In Indonesia, 73.98 million people (58.22%) are employed in the informal sector, while 53.09 million people (41.78%) work in the formal sector, according to the Central Statistics Agency (2018). The lack of adequate welfare and safety standards in the industry, which leads to significant losses for workers, highlights the urgent need to assess all ongoing work processes.

Environmental hazards and inadequate occupational safety and health standards are particularly evident in the informal sector. Poor working conditions—such as inadequate buildings, unsatisfactory welfare facilities, and the near absence of occupational health services—negatively affect national economic productivity, public health, and overall community well-being. These conditions result in significant human and material losses and lower the quality of life for informal workers and their families (Idris H, et al., 2015).

One of the informal sector industries at high risk of work-related diseases and occupational accidents due to exposure to workplace hazards is the Shoe Industry. Workers' health may be influenced by both the working environment and production processes, which often involve physical, chemical, biological, ergonomic, and psychosocial hazards. The implementation of occupational health and safety (OHS) programs in the workplace aims to promote a healthy and productive workforce through promotive, preventive, curative, and rehabilitative measures, thereby protecting employees from adverse effects arising from potential workplace hazards..

Physical factors in the work environment are important elements that can affect workers' health and safety. The standard for assessing these physical factors are regulated in the Minister of Manpower Regulation No. 5 of 2018 concerning Occupational Safety and Health in the Work Environment. In the sandal and shoe industry, physical environmental assessments commonly include measurements of noise and lighting levels.. The Mampu Jaya Joint Business Group (KUB) is one of the MSEs in Surabaya engaged in producing hotel shoes and sandals. The business is located in the area formerly known as the Dolly red-light district. Interviews with workers revealed that some experienced eye irritation and had previously been involved in workplace accidents, such as hands injuries caused by sharp objects due to insufficient lighting. Therefore, the purpose of this study is to measure physical hazard factors, namely noise and lighting, and to describe the potential health risks that may arise for workers in the informal sector.

MATERIAL AND METHODS

This research employed an observational analytic design with a cross-sectional approach and was conducted from July to August 2024, involving a total of 25 respondents selected using the total sampling technique. Data on respondents characteristics, including age, gender, work experience, and compliance with the use of personal protective equipment (PPE), were collected through interviews. Blood pressure was measured using an Omron digital sphygmomanometer before starting work and after completing work on the same day. Physical work environment factors—such as noise—were measured using a sound level meter, while, lighting levels were measured using a lux meter.

RESULTS AND DISCUSSION

Overview Characteristics of Workers in the Shoes Industry

This research was conducted in the informal sector MSME engaged in the shoe industry, known as Kelompok Usaha Bersama (KUB) Mampu Jaya, which is situated in the former Dolly localization area at Jalan Kupang Gunung Timur I No. 20-22 Putat Jaya, Sawahan District, Surabaya

City. This industry has been operating since 2014 and employs a total of 25 female workers., The characteristics of the respondents are presented in Table 1:

Table 1. The Characteristics of Respondents in the Shoes Industry

Characteristics of Respondents		n	%
Age	30-35 years old	4	16
	26-40 years old	14	56
	41-45 years old	7	28
Gender	Women	25	100
	Man	0	0
Working Period	1-5 years	8	32
	>5 years	16	68
Compliance to Using PPE	Yes	3	22
	No	22	88
Total		25	100

Data on respondent characteristics including age, gender, work experience, and compliance with the use of personal protective equipment (PPE) were collected through interview using a questionnaire. Table 1 presents the distribution of worker characteristics at KUB Mampu Jaya, showing that all workers are female. The majority are aged 36-40 years (14 workers or 56%) and 7 people (28%) are over 40 years old. Most workers (16 people or 68%) have more than five years of work experience, and 88% do not use personal protective equipment. The PPE provided includes masks, gloves, thimbles, and glasses, but the workers reported feeling comfortable using only thimbles. The main reason for not using PPE were discomfort and complaints about heat. An evaluation of physical hazards in the work environment (see Table 2) and a health assessment of employees (see Table 3) were also conducted

Tabel 2. Work Environment Results of KUB Mampu Jaya

Indicator for Measuring Physical Factors		Measurement Result
Lighting	1 st point is Pattern Making	96 Lux
	2 nd point is Sewing	100 Lux
	3 rd point is adjustment	103 Lux
	4 th point is Compression, sole installation and sanding	140 Lux
	5 th point is <i>Finishing</i>	100 Lux
Noise	1 st point is Pattern Making	77,5 dbA
	2 nd point is Sewing	80,7 dbA
	3 rd point is adjustment	81,5 dbA
	4 th point is Compression, sole installation and sanding	82,4 dbA
	5 th point is <i>Finishing</i>	80,5 dbA

Information on lighting and noise levels, two physical environmental elements measured at KUB Mampu Jaya, is presented in table 2. The results of light intensity measurement show an average value of 107.8 Lux. According to the Minister of Health Regulation No. 70 of 2016 concerning Industrial Occupational Health, the minimum lighting standard for sewing work is 500-750 lux. This indicates that the lighting level at KUB Mampu Jaya remain below therequired

standard. Noise measurements were conducted from 08:30 to 11:30 and from 13:00 to 16:00, with an average value of 80.52 dBA. This value is still within the noise threshold value (NTV) for an 8-hour workday, as stipulated by Minister of Manpower Regulation No. 5 of 2018. Following the assessment of the work environment, a health examination of the workers was carried out by measuring blood pressure using a digital sphygmomanometer. Measurement were taken twice, before starting work and after 8 hours of working. The detailed results of the workers' blood pressure examination are presented in Table 3.

Tabel 3. Health Examination of Workers Results of KUB Mampu Jaya

Type of Examination	Category	n	%	Mean±SD
Systolic Blood Pressure (mmHg)	Pre-Work			
	≤ 110	12	48	119±8,3
	111-120	8	32	
	>120	5	20	
	Post-Work			
	≤ 110	7	28	128,2±9,7
	111-120	10	40	
	>120	8	32	
Diastolic Blood Pressure (mmHg)	Pre-Work			
	≤ 70	7	28	78,5±8,6
	71-80	9	36	
	80-90	5	20	
	>90	4	16	
	Post Work			
	≤ 70	3	12	86,2±7,2
	71-80	7	28	
	80-90	10	40	
	>90	5	20	
Total		25	100	

The health examination results of KUB Mampu Jaya workers are presented in Table 3. Blood pressure examination were conducted before and after 8 hours of work, focusing on systolic and diastolic value. The average systolic blood pressure before work was 119±8.3 mmHg, which increase to 128.2±9.7 mmHg after eight hours of work. This indicates an increase in systolic blood pressure among the employees of KUB Mampu Jaya. Prior to work, the average diastolic blood pressure was measured at 78.5±8.6 mmHg, however after an 8-hour work shift, the average diastolic blood pressure increased to 86.2±7.2 mmHg. These findings indicate an elevation in both systolic and diastolic blood pressure among the workers who participated in this study.

Beside affecting hearing, noise also has physiological effects, such as increasing blood pressure and heart rate. The brain perceives noise as a potential threat or source of stress, triggering thereleases stress hormones such as epinephrine, norepinephrine, and cortisol (Ticoalu, 2019). Elevated noise exposure can stimulate cortisol production, leading to a stress response that increased muscle contraction. When the contraction of cardiac and smooth muscles increases, it can cause vasoconstriction and an increased heart rate, potentially leading to high blood pressure.

In the industrial sector, worker are often exposed to ototoxic chemicals (trichloroethylene, heavy metals, and asphyxiation) that can causedamage on the inner ear, as per the Centers for

Disease Control (2017). However, the risk can be mitigated through simple precautions to avoid exposure. Reddy et al (2012) stated that hearing impairment is a major global issue, significantly exacerbated by occupational noise. In New Zealand, this condition has a considerable impact on the economy and public health, with an estimated annual cost of USD 53 million, projected to continue rising. The health and safety conditions of workers can also be influenced by physical factors of the work environment (Alfers L., et.al, 2015). In the research activities conducted at KUB Mampu Jaya, the physical characteristics of the work environment were concentrated on illumination hazards and noise hazards.

Exposure to occupational noise significantly influences the increase in blood pressure and heart rate. The arousal of the sympathetic nervous systems influence arteriolar and venous blood vessels, resulting in vasoconstriction (Oktaviana Y, et.al, 2020). Vasoconstriction in the arterioles will elevate total peripheral resistance, hence increasing blood pressure. Meanwhile, vasoconstriction of the veins results in heightened venous return. As cardiac output rises, blood pressure correspondingly increases.

CONCLUSION AND SUGGESTION

The research findings demonstrate that the physical hazard factors in the work environment at KUB Mampu Jaya are still below the threshold value of 85 dBA, as per Permenakertrans No.13 of 2011. Additionally, the lighting measurement results indicate an average value of 107.8 Lux. According to the Minister of Health Regulation No.70 of 2016 concerning Industrial Work Environment Health, the minimum illumination standard for stitching work is 500-750 lux. The results of the occupational health assessment of blood pressure also reveal an average variation between pre-work and post-work measurements.

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CONFLICT OF INTEREST

We Declare no Conflict of interest to this paper.

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