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ORIGINAL ARTICLE

Noise Induced Hearing Loss in Begerpang Palm Oil Mill Workers

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ABSTRACT

Aim: The aim of this study is to determine the factors that can affect the occurrence of noise-induced hearing loss (NIHL) and the relationship between the intensity of noise with increased blood pressure on employees who work at Begerpang Palm Oil Mill PT Perusahaan (BPOMPL) Perkebunan London Sumatra Indonesia Tbk.

Materials and methods: This was a cross-sectional study conducted from July to December 2013. The selected employee as the subject was 60 people. They first fill out the questionnaire and then get a clinical examination of ear nose and throat. Respondents were tested for blood pressure before and after working and also checked their hearing using a pure tone audiometer. Chi-square test was used, including the relationship of age, length of working, noise intensity, personal protective equipment to the occurrence of NIHL and the relationship between the intensity of noise with increased blood pressure. It is statistically significant if the p-value is <0.05.

Results: It was found a significant relationship between the working period (p = 0.001), noise intensity (p = 0.008), and the use of personal protective equipment hearing (p = 0.001) with NIHL occurrence. There was also a significant relationship between noise intensity with increasing systolic (p=0.001) and diastolic (p = 0.001) blood pressure.

Conclusion: This study proved a significant correlation between the working period, noise intensity and the use of personal protective equipment of hearing with NIHL occurrence and between noise intensity with increased systolic and diastolic blood pressure.

Clinical significance : NIHL diagnosis is an important step to prevent hearing loss and increased blood pressure in workers.

Keywords: Cross-sectional study, Noise-induced hearing loss, Palm oil factory, Workers.

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INTRODUCTION

Noise-induced hearing loss (NIHL) is a work-related illness common to many industrial workers.[1] Exposure to excessive noise can damage the auditory cells and eventually cause deafness.[2-6] Noise intensity, frequency, duration of exposure per day, length of service, individual susceptibility, age and type of noise are risk factors that affect the degree of hearing loss[7-9] and communication, thus affecting social life. NIHL is sedentary and cannot be cured, therefore prevention is very important.[10] In addition, exposure to noise causes changes in various organs and organ systems.[11] Noise exposure can lead to an increase in blood pressure[5,12] that is a risk factor for cardiovascular disease.[12]

BPOMPL is a London-based plantation and trading company and listed on Indonesian Stock Market 1996, established in 1906 by Harrison & Crossfield Plc is one of the largest and oldest oil palm plantations and producers in Indonesia. In the process of processing palm oil that produces CPO (crude palm oil) and PK (palm kernel), there are four stages: fruit transport to the factory, sterilization process, press process, and verification process. Equipment used in the processing such as heat exchanger, CPO tank, cyclone, packed column, vessel, mixer, filter, pump, valve, boiler, crystallizer tank, refrigerant and filter press cloth. The use of such devices causes noise.[13]

The purpose of this study is to determine the factors that can affect the occurrence of NIHL and the relationship between the intensity of noise with increased blood pressure on employees who work at BPOMPL.

MATERIALS AND METHODS

Study Design and Subjects

This research used a cross-sectional approach. The research was conducted at the BPOMPL from July to December 2013. The research sample was determined by using a single sample formula to estimate the proportion of a population of 60 employees employed in the BPOMPL examined by the researcher. Employees included in the study were aged 20 to 50 years, the period of employment is more than 1 year, did not have head trauma, acoustic trauma, hearing loss, sensorineural, and do not consume ototoxic medications. Clinical examination of ears, nose, and throat was performed by an otolaryngologist. It was

found that all subjects had a normal tympanic membrane. This study has gained approval from the ethics committee on our institution and the informed consent of each research subject.

Subjects first fill out the questionnaire that has been provided and then gets a clinical examination of ear, nose and throat. From the results of the questionnaire and physical examination of ENT, respondents who met the inclusion criteria were tested for blood pressure 15 minutes before working and checked their hearing using a pure tone audiometer. Further 15 minutes after working the respondent's blood pressure was reexamined.

The research variables consist of dependent variables of NIHL occurrence and increased blood pressure; the independent variable is noise intensity, age, working period and the use of personal protective equipment. NIHL is defined as hearing loss or deafness due to the exposure of noise loud enough in a long period, usually caused by noise work environment characterized by "notching" of the audiogram at the high frequencies 3000, 4000, or 6000 Hz with recovery at 8000 Hz.[14] Hearing function is examined using a calibrated pure tone audiometer (Rexton, Type D 67) by using a frequency of 125 to 8000 Hz for air conduction and 250 to 4000 Hz for bone conduction. The threshold is formed by rating the average hearing threshold frequency of 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz. The result of audiometric measurement is taken at the heavier ear side of the NIHL degree. The result of NIHL is classified according to ASHA,[15] ie: slight hearing loss if there is an increase in hearing threshold between 16 to 25 dB, mild if there is an increase in hearing threshold between 26 to 40 dB, moderate if obtained a threshold increase of 41 to 55 dB, moderately severe if obtained a threshold increase between 56 to 70 dB, severe if obtained increase of threshold between 71 to 90 dB, and profound if we get a hearing gain > 90 dB.

Blood pressure was examined before and after work. Blood pressure is measured by using an aneroid sphygmomanometer (Riester, Jungingen, Germany) expressed in mmHg units, and was classified according to JNC VII.[16] The noise intensity is based on sound wave measurements using 720 sound level meter (Larson Davis Inc., Provo, USA) and has been calibrated. In this study, the results are categorized as < 85dB and > 85dB. Age is the period that a person possesses after the birth of life is expressed in the number of years until the research is carried out. In this study, the results are categorized as 20 to 35 years and 35 to 50 years. The period of employment is the length of time from the start of the employee working in the process and/or non-process sections until this research is conducted which is expressed in units of years, in this study the results are categorized as < 10 years and >10 years. The use of hearing personal protective equipment is the use of earplugs in employees, in this study the measurement is categorized as use and not use.

Statistics

The results are described using frequency distribution tables including age, education level, marital status, workplace, task type, length of service, noise hearing loss, tinnitus complaints and use of hearing impairment. To know the influence of each dependent variable to independent variable, Chi-square statistical test was used, including the relationship of age, length of working, noise intensity, personal protective equipment to the occurrence of NIHL and the relationship between the intensity of noise with increased blood pressure. It is statistically significant if the p-value is < 0.05.

RESULTS

The selected employee as the subject was 60 people and all male. Characteristics of age, education level, marital status, workplace, task type, and length of service are shown in Table 1.

Distribution of research subject frequency based on noise intensity, audiogram results, tinnitus complaints, and the use of personal protective equipment hearing are shown in Table 2.

Chi-square test results found a significant relationship between the working period, noise intensity, and the use of personal protective equipment hearing with NIHL occurrence (Table 3).

Chi-square test results found a significant relationship between noise intensity with increased systolic blood pressure (Table 4).

Chi-square test results found a significant relationship between noise intensity with increased diastolic blood pressure (Table 5).

DISCUSSION

The results of this study indicate there is a significant relationship between age with NIHL. We believe, however, that this is not presbycusis because the average hearing threshold at frequencies 500, 1000, and 2000 Hz is better than average hearing thresholds at 3000, 4000, and 6000 Hz frequencies accompanied by improvements at frequencies of 8000 Hz. This notching is in contrast to presbycusis.[17] However, in older patients, it is difficult to distinguish the effects of noise with age-related effects without seeing the previous audiogram.

The results of this study indicate there is a significant relationship between the working period with NIHL. Employees with tenure > 10 years will experience NIHL

Table 1: Distribution of respondent characteristics

Variable	*n*	*%*
Age		
≤35 years	20	33.33
>35 years	40	66.67
Average	39	
Level of education		
Elementary school	10	16.67
Junior High school	3	5.00
Senior High school	44	73.33
Diploma/University	3	5.00
Marital status		
Not married	5	8.33
Married	55	91.67
Workplace		
Office	9	15.00
Workshop	21	35.00
Loading ramp	3	5.00
Boiler	3	5.00
Thresing	3	5.00
Waterplant	3	5.00
Kernel	8	13.34
Clarification	2	3.33
Sterilizer	6	10.00
Pressing	2	3.33
Type of task		
Non-process	30	50.00
Process	30	50.00
Years of service		
≤10 years	30	50.00
>10 years	30	50.00
Average	13.67	

Values are presented as number (%).

Table 2: Distribution of research subject frequency based on noise intensity, audiogram results, tinnitus complaints, and the use of personal protective equipment hearing

	Number (n)	*Percentage (%)*
Noise intensity		
≤85 dB	15	25.00
Office (60 dB)		
Waterplant (80 dB)		
Loading ramp (82,4 dB)		
> 85 dB	45	75.00
Workshop (85,1 dB)		
Sterilizer (85,2 dB)		
Clarification (86,8 dB)		
Pressing (87,2 dB)		
Boiler (89 dB)		
Thresing (90 dB)		
Kernel (94,5 dB)		
Audiogram result		
With NIHL	21	35.00
Slight	(0)	
Mild	(8)	
Moderate	(9)	
Moderately severe	(2)	
Severe	(2)	
Profound	(0)	
Without NIHL (-)	39	65.00
Tinnitus complaints		
Tinnitus	11	18.33
No Tinnitus	49	81.67
Use of personal protective equipment of hearing		
Use	36	60.00
Not use	24	40.00

Values are presented as number (%).

of 9.5 times compared with employees with tenure of <10 years. Decreased hearing function resulting from persistent or intermittent exposure to noise increases most rapidly in the first 10 to 15 years and then decelerates. Continuous exposure to noise during working hours and for many years is more dangerous than not because it does not allow ears to rest.[18]

The results of this study indicate there is a significant relationship between noise intensity with NIHL. Employees working with noise intensity >85 dB will experience NIHL of 6.67 times compared with employees working with noise intensity <85 dB. Continuous noise can damage the cochlear hair cells. The damage begins in the outer hair cells, but if exposure to continuous noise damage can involve inner hair cells.[19-21] The mechanism of NIHL involves the destruction of

Table 3: Relationship between age, work period, noise intensity, and personal protective equipment of hearing usage with occurrence of NIHL

		Hearing loss			
Variable		*With n (%)*	*Without n (%)*	*PR*	*p-value*
Age	>35 years	18 (45.00)	22 (55.00)	3	0,022
	≤35 years	3 (15.00)	17 (85.00)		
Working period	>10 years	19 (63.33)	11 (36.67)	9,5	0,001[a]
	<10 years	2 (6.67)	28 (93.33)		
Noise intensity	> 85 dB	20 (44.44)	25 (55.56)	6,67	0,008[a]
	< 85 dB	1 (6.67)	14 (93.33)		
Use of personal protective equipment of hearing	Use	15 (62.5)	9 (37.5)	3,75	0,001[a]
	Not use	6 (16.7)	30 (83.3)		

Values are presented as number (%). The *p*-value was tested using Chi-square test. PR = Prevalence ratio. [a]$p < 0.05$

Table 4: Relation between noise intensity with increased systolic blood pressure

	Systolic blood pressure increase			
Variable	*With n (%)*	*Without n (%)*	*PR*	*p-value*
Noise intensity >85 dB	36 (80.0)	9 (20,0)	4	0,001[a]
Noise intensity ≤85 dB	3 (20.0)	12 (80,0)		

Values are presented as number (%). The *p*-value was tested using Chi-square test PR = Prevalence ratio [a]*p*<0.05

Table 5: Relation between noise intensity with increased diastolic blood pressure

	Diastolic blood pressure increase			
Variable	*With n (%)*	*Without n (%)*	*PR*	*p-value*
Noisy intensity >85 dB	32 (71.1)	13 (28.9)	12,8	0,001[a]
Noisy intensity ≤85 dB	2 (13.3)	13 (86.7)		

Values are presented as number (%). The p value was tested using Chi-square test PR = Prevalence Ratio. ap < 0.05.

cochlear hair cells due to exposure to noise, especially at high frequencies.[22] Hair cells associated with high-frequency sound are located close to the bottom of the cochlea. The severity of hair cell damage depends on the amount of sound intensity received. The higher the intensity of the sound received then the damage will be heavier and become permanent. Once damaged, the sensory cells cannot repair itself, and no medical procedure can restore it to normal function.[23]

The results of this study also indicate that there is a significant relationship between hearing protective devices with NIHL. Employees who did not use hearing protective devices would experience a NIHL of 3.75 times compared to employees with hearing protective devices. It estimates that employee negligence does not use hearing protective devices although only 30 minutes a day against exposure to noise will lead to 50% NIHL.[24] Although the company has provided hearing ear plugs and ear muffs, there are still many undisciplined workers using them, although they work in locations with noise intensities > 85 dB.

This study showed that noise intensity above 85 dB could cause increased systolic and diastolic blood pressure. Exposure to noise in the long term proved to bring adverse health effects. Acute exposure can cause an increase in blood pressure with the release of stress-inducing hormones such as catecholamines.[11] Noise exposure can cause it through the neuroendocrine system. This exposure triggers an emotional response to the cortical and subcortical structures by affecting concentration, relaxation, and sleep. One meta-analysis study showed a significant association between noise and the occurrence of hypertension.[12] A brief exposure to noisy for 10 minutes alone can lead to a significant increase in blood pressure.[25]

However, this study has the limitation of not doing a hearing screening at the time before the first active worker once carry out its duties, so that there is no preliminary data to be a material comparison with data obtained in this study.

CONCLUSION

This study proved a significant correlation between the working period, noise intensity and the use of personal protective equipment of hearing with NIHL occurrence and between noise intensity with increased systolic and diastolic blood pressure.

CLINICAL SIGNIFICANCE

NIHL diagnosis is an important step to prevent hearing loss and increased blood pressure in workers.

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