

Hearing Disorders Caused by Noise Exposure to the Researcher in PLTD (Diesel Power Electricity Generator)

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Abstract: Exposure to noise that exceeds the threshold is mainly on the occupational risk of auditory function, the use of diesel engines and big capacity is the main source of noise from PLTD Telaga. This research is analytic survey with cross sectional study using univariate and bivariate analysis. hearing loss suffered by researcher not because of aging or presbiakusis but actually because of the effect of continuous noise exposure. To solve this noise problem then every officer suggested to use hearing aids. Employees who are in active working lives and in the span of our young age, should pay more attention in its work the use of ear protection than that may need special attention related to other issues arising from the noise sound machine.

Key words: Hearing function, noise, electrical researcher, diesel, electricity generator

INTRODUCTION

Any research that conducted by man has risk factors (Blazsin and Guldenmunt, 2015). One common risk (Bell *et al.*, 2013) and mostly occurred in many workplaces is noise (load noise) (Yankaskas, 2013). Noise is unwanted sound from an activity in certain level or times which can emerge nuisance to the man's health and environmental comfort. Excessive exposure (overexposure) to the noise (Guarnaccia *et al.*, 2015) can create a risk of man's hearing function. This condition can directly decrease their productivity (Cutiva and Burdorf, 2015).

The advance of science and technology has made the industry and mechanism grow and develop in order to realize advanced ad independent industrial society (Soh and Subramanian, 2014). Many engines and sophisticated tools used and produced by industries and manufactures (O'Driscoll and O'Donnell, 2013). Those engines and tools, in one hand are very important to the advanced development (Hatfield *et al.*, 2014); however, in the other side it also brings negative impact to the man's health, especially researcher. Hearing loss risk to the researcher (with noise level of 85 dB (Kryter, 2013a, b; Yankaskas, 2013) and daily exposure for 8 h) is possible to be occurred after working for 5 year, in which 1% researcher will be suffered by a little hearing nuisance, after working for 10 year 3% researcher have possibility on hearing loss risk and after working for 15 year it will increase to be 5%. In the noise level of 90 dB the percentage will be 4, 10 and 14%, respectively and in the noise level of 95 dB the percentage will be 7, 17 and 24%, respectively.

PLTD (Diesel Power Electricity Generator) Telaga PTPLN (Persero) in suluttenggo area, Gorontalo branch is main electricity industry that uses diesel power and owning responsibility and authority over electricity aspect in North Sulawesi Central Sulawesi and Gorontalo

area. That industry has either direct or indirect environmental impact. Its direct impact such as environmental pollution due to industrial waste and residue which can create air and ground water pollution, continuous and impulsive noise which can emerge the diseases. While its indirect impact such as urbanization and the change of social and cultural values. Noise in the workplace and residential area near generator machine is quite serious problem and must be concerned (Sari *et al.*, 2014). It is due to the use of large capacity diesel engines very identical with noise source, thus it can affect workplace and residential area comforts.

MATERIALS AND METHODS

Research design that used was analytical survey research with cross sectional study design. It was conducted by measuring noise exposure in the workplace and by collecting data of hearing function, noise intensity scale, worker age, working period, exposure time and the application ear protector tool. The data then analyzed by the effect of hearing function degradation that suffered by researcher.

Data collection: Data collection technique was conducted integratively (Whittemore and Knafi, 2005) through the steps as follow) primary data source comes from survey and direct interview to the researcher in PLTD Telaga) Data source obtained through data and document review that been available both of acts (Legislations) and government regulations related to the policy of noise threshold for researcher and environmental around.

Data analysis: This research used 2 analysis variables (Malleo *et al.*, 2015) univariate analysis to obtain frequency distribution of independent variable (age,

working period, exposure time, the application of Ear Protector Tool and noise exposure level) and dependent variable (nuisance level of hearing function degradation) and bivariate analysis conducted to test the effect of dependent variable and independent variable by using Exact Fisher test with formulation:

$$P = \frac{(a+b)!(c+d)!(a+c)!(b+d)}{N!a!b!c!d!}$$

RESULTS AND DISCUSSION

PLTD (diesel power electricity generator) Telaga is electricity generator system that uses diesel engine as main generator. This company was established in 1975 and administratively located in paguyaman village, kota tengah district, gorontalo city. It has active machines for 37 units, 28 machines with 5 mw capacity that rented by regional pln (State electricity company) to be operated in North Sulawesi area while the rest 9 active machines operated in Gorontalo city.

Univariate analysis: Analysis of hearing function degradation caused by noise exposure to the researcher was conducted by direct measurement both using audiometer, sound level meter and questionnaire that given directly to all researcher of PLTD (Table 1) for 17 researcher.

Table 1: Data of respondent related to age, occupation, working period and exposure time in 1 working day

Variables	Amount	
	n	Percentage
Respondent age (years)		
17-19	1	5.9
20-24	3	17.6
25-29	6	35.3
30-34	2	11.8
35-39	2	11.8
≥40	3	17.6
Respondent occupation		
Cleaning service	3	17.6
Electrician	2	11.8
Mechanic	3	17.6
Operator	5	29.4
Supervisor	2	11.8
Security	2	11.8
Working period (years)		
3	1	5.9
4	2	11.8
5	6	35.3
6	4	23.5
13	2	11.8
15	2	11.8
Exposure time (hours)		
5	1	5.9
8	5	29.4
9	8	47.1
10	2	11.8
11	1	5.9
>12	0	0

In the table above, it could be seen that mostly PLTD researcher were in the age range 25-29 year old for 6 researcher (35.3%) and the highest amount of occupation was operator. It showed that the researcher were in their golden age and played very important role in the company. However, if it is seen from their working period, majority researcher have been worked for 5 year, so that it was stated as quite long period and experienced with working duration for 9 h a day. It was appropriate with Act 13 of 2003 on Manpower about working duration for every company. Besides many factors above, univariate analysis also viewed the effect of researcher in protecting themselves by applying ear protector tool. The result of actual observation, from total 17 respondents, it was only 5 respondents who apply ear protector tool (ear plug) while the rest of 12 respondents not apply ear protector properly. Improper application of ear protector tool was also accompanied by noise level (Table 2) at each room in PLTD Telaga.

Every human has hearing threshold for 85 dB (A) (Stone and Moore, 2014). From table above we could see that noise level caused by diesel engine in engine room of PLTD and SEWATAMA I engine room, then the noise level was above the threshold. Thus, the researcher that worked in those locations with long exposure time and without applying ear protector would have very bad effect and could be suffered by hearing function degradation.

To know how much the effect that caused by this engine noise, many operators that became respondent were measured about their hearing nuisance (Table 3) and the result was quite bad because 70.6% suffered by right ear temporal deaf and 64% by left ear temporal deaf. This phenomenon should be concerned by the researcher, especially operator because if it goes continually in long time period then it will cause loss hearing or permanent deaf.

Table 2: Measurement points of machine noise

Measurement points	Noise Level dB (A)	
	Day	Night
Point I (Outside machine area of PLTD)	84	86.1
Point II (Engine room of PLTD)	96.3*	98.6
Point III (Operator room)	77.6	78.2
Point IV (PLTD office)	65.3	66.6
Point V (Logistic room)	80.2	80.5
Point VI (SEWATAMA I engine room)	103.5*	104.2
Point VII (Mosque)	64.2	64.8
Point VIII (security post)	64.8	64.3
Thres hold value = 85 dB (A)		

Table 3: Level of hearing nuisance

Level of hearing nuisance	Right		Left ear	
	n	(%)	n	(%)
Normal (= 25 dB)	5	29.4	6	35.3
Temporal deaf (26-60 dB)	12	70.6	11	64.7
Permanent deaf (61-90 dB)	0	0.0	0	0.0
Amount	17	100.0	17	100.0

Table 4: Bivariate analysis

Variables	Hearing nuisance								p-value
	Right ear temporal deaf		Normal		Left ea temporal deaf		Normal		
	n	(%)	n	(%)	n	(%)	n	(%)	
Age (years old)									
≤40	11	91.7	5	100	10	90.9	6	100.0	Right ear (0.706)
>40	1	8.3	0	0	1	9.1	0	0.0	
Amount	12	100.0	5	100	11	100.0	6	100.0	Left ear (0.647)
Working period (years)									
<5	2	16.7	1	20	2	18.2	1	16.7	Right ear (0.676)
≥5	10	83.3	4	80	9	81.8	5	83.3	
Amount	12	100.0	5	100	11	100.0	6	100.0	Left ear (0.728)
Exposure time (hours)									
≤8	1	8.3	5	100	1	9.1	5	83.5	Right ear (0.010)
>8	11	91.7	0	0	10	90.9	1	16.7	
Amount	12	100.0	5	100	11	100.0	6	100.0	Left ear (0.005)
The application of ear protector tool									
Good	1	8.3	4	80	0	0.0	5	83.3	Right ea (0.001)
Bad	11	91.7	1	20	11	100.0	1	16.7	
Amount	12	100.0	5	100	11	100.0	6	100.0	Right ear (0.010)
Level of noise									
Noisy	9	75.0	0	0	8	72.7	1	16.7	Left ear (0.001)
Not Noisy	3	25.0	5	100	3	27.3	5	83.3	
Amount	12	100.0	5	100	11	100.0	6	100.0	Left ear (0.043)

Bivariate analysis: Test was conducted by examining the effect of all research variables age, working period, exposure time, the application of ear protector tool and level of noise in each room (Table 4).

Distribution of hearing nuisance to the researcher with age range ≤40 year old showed that 11 researcher suffered by temporal right ear deaf and 10 researcher by temporal left ear deaf while for respondents with age range >40 year old showed that 1 worker suffered by temporal right ear deaf and 1 worker by temporal left ear deaf. Score that obtained in this research showed that between age and hearing nuisance caused by noise had no significant effect. It was supported by (Wayne and Johnsrude, 2015) in the research conducted to determine the relationship between age, hearing loss and a decline in the power of human movement that showed hearing degradation caused by aging factor known as presbycusis which is occasionally and very individual in the age range 60>65 year old.

Besides that test that conducted in working period for every worker showed that 2 respondents with working period <5 year suffered by temporal right ear deaf and the same amount for temporal left ear deaf category. Moreover, 10 respondents with working period ≥5 year suffered by temporal right ear deaf and 9 respondents by temporal left ear deaf. It should be much concerned by all researcher because the longer working period will cause the higher risk of hearing nuisance.

Every researcher has the same working hour as with company rule which is 8 h. It is in line with Regulation of Manpower and Transmigration Minister No.51/Men/1999 which established noise threshold and daily exposure time

for 85 dB and working hour as 8 h a day. However, in PLTD Telaga, many researcher with working h>8 when it was conducted by test, 11 respondents suffered by hearing nuisance of right ear and 10 respondents by left ear. In addition, the effect was less affected to the researcher with working h≤8 where it was only 1 respondent that suffered by hearing nuisance of left ear. It was in line with the research result that conducted by (Noweir and Zyton, 2013) to test the long exposure, noise levels and limit the hearing to the Karawan working as an aircraft maintenance technician that working period related with continuous noise exposure time. The longer period for someone stays in noisy area, the higher risk obtained for hearing nuisance. This effect was exacerbated by researcher that not apply ear protector properly, for example, researcher that only apply 20% ear protector tool which means they are careless to their ear health.

Noise from diesel engine in this company occurred day and night, there were 2 points in the day and 3 points in the night that had level of noise above threshold of man's hearing. From many points that had level of noise above threshold value >85 dB were points for noise source because those were center point of electricity generator process. In the measurement of noise level that been conducted in this research, there was the difference between day and night measurement. It was due to operating system of generator engine, in which night operating (peak load) related with larger electricity needs than day operating (normal load). Thus, in night operating, machine operated at greater scale to produce larger power of electricity (peak load). There were 9 researcher who research in the noisy place that suffered

by hearing function degradation. It was also affected by researcher that not apply ear protector tool properly, even they listened to the music with high volume as noise competitor until they slept.

One of hearing nuisance causes for man is age factor. However, in this research, it showed that age factor was not factor of hearing nuisance, but it was caused by noise exposure in the workplace with level of noise above established threshold score. It was in line with the result that obtained by Liu *et al.* (2015) to test the effect that can be caused by the noise of diesel engines to human hearing which stated that there was no significant relationship between age and hearing nuisance of sensory neural type with p-value 0.262. In this research, age was limited for 40 year old to see that hearing nuisance that suffered by researcher was not from aging or presbycusis factor rather it was caused by continuous noise exposure.

Working period of the researcher was not determinant factor to the hearing degradation because hearing degradation was not affected by working period. It means that there was no effect of hearing degradation that caused by working period. It was interesting if we see research result that conducted by Basner *et al.* (2014) the noise caused by the machine at the hospital can disturb the patient's sleep and cause daytime sleepiness, affect the outcome of patients and hospital staff performance. To anticipate hearing problem, then every worker suggested applying ear protector tool.

As one regional company which is main supplier of electricity needs in Gorontalo area and around, the company should give much concern on the noise from diesel engine because that noise was very disturbing for the hearing of worker and people around PLTD. According to the explanation of Lavandier *et al.* (2016) to measure the impact of aircraft noise for residential communities around airports it showed that those who acquire the largest effect of engine noise sound comes from an industry were the researcher and people around so that it needed appropriate regulation for company to solve problem with the level of noise caused by diesel engine.

CONCLUSION

The researcher in PLTD Telaga mostly in active working period and productive age where they should give concern about risk factors around them such as noise exposure. Related to the noise exposure, the researcher should apply ear protector tool to decrease the risk caused by noise from engine diesel in PLTD Telaga in

which many points of area had level of noise above threshold value of human hearing. Indeed, it would have a risk for hearing function degradation such as temporal deaf that suffered by the researcher.

For the company, it is expected to give more concern on occupational health and safety aspect and more improving on the actions to minimize the risk of hearing function degradation both administratively and technically. Besides that it needs special concern related to the other problem caused by engine noise, particularly impact that acquired by people around PLTD Telaga PT. PLN (Persero), Gorontalo branch.

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