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FACTORS CAUSING HEARING DISORDERS DUE TO NOISE AT PT X JAKARTA TIMUR BEARING PRODUCTION IN 2020

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Abstract

Hearing disorder is a disease caused by noise in the world and in Indonesia. There are many factors that contribute to hearing loss. This study aims to determine the factors associated with hearing loss in PT X Jakarta Timur Bearing Production workers in 2020. This study uses a Case Control design. The study population was 207 workers consisting of 42 cases and convenience sampling 42 controls. The data collection method was carried out by using a questionnaire for the variable length of service (ordinal), age (ordinal) and the use of APT (ordinal), looking at employee attendance data for the length of exposure variable (ordinal) and looking at Medical Check Up data for 42 respondents with a total sampling technique for case respondents and 42 control respondents for the variable hearing loss (ordinal). This study consisted of independent variables, namely noise intensity, length of exposure, age, years of service, and use of ear protection equipment (APT). The results of the research from the Chi-Square statistical test show that the factors that have a relationship are the length of exposure (p = 0.025) and age p = (0.004) in the PT X Jakarta Timur Bearing Production workers 2020. While the factors that have no relationship are noise intensity (p = 1,000), years of service (p = 0.602), and use of APT (0.169). It is recommended for companies to engineer overtime hours to reduce the length of exposure and carry out training for work-related illnesses, especially hearing loss, as a form of prevention of PAK. Companies can start mapping to relocate workers> 40 years old..

***Keywords**:* Hearing Loss, Noise Intensity, Duration of Exposure

INTRODUCTION

The use of advanced technology is indispensable to meet the needs of human life widely, but without proper control, it can harm humans themselves. By utilizing advanced information technology (IT), manufacturing industries are empowered to merge physical and cyber worlds (Dilger et al., 2021). The use of advanced technology is inevitable, especially in the industrial era marked by mechanization, electrification, modernization and globalization. In this case the use of machines, aircraft, facilities and hazardous materials will continue to increase in accordance with industrialization needs. But on the other hand, technological advances have also caused various adverse effects, namely the emergence of various occupational diseases (Tarwaka, 2008). One of the hazards that are often present

in work locations is noise which causes hearing loss.

Scientifically, noise is defined as the sensation received by the ear as a result of a steady fluctuation in air pressure "superimposing" atmospheric / air pressure. The ear will respond to small fluctuations with great sensitivity. Noise can also be interpreted as a type of vibration / energy that is conduced in air, liquid, solid, invisible, and can enter the ear and cause a sensation on the hearing instrument. Meanwhile, according to regulations in Indonesia, noise is a dangerous sound produced by a company or activity at a certain level and time, which can cause disturbances to human health and environmental comfort. (Kepmen LH No 48. th 1996). Noise causes various problems in life, including Noice Induced Hearing Loses (NIHL). There has been a significant increase in noise in the workplace with industrialization.

The World Health Organization (WHO) in its publication entitled addressing the rising prevalence of healing loss stated that it is estimated that there are 466 million people with hearing loss globally. WHO predicts that if action is not taken immediately, there will be 630 million people living with hearing loss in 2030, this figure is estimated to increase again to 900 million in 2050 (WHO, 2018). Hearing loss is the third most common chronic disability in the United States, the National Institutes of Deafdness and Other Communication Disorder (NIDCD) estimates that about 15% of Americans between the ages of 20-69 experience hearing loss at higher test frequencies, suggesting that hearing loss may be caused by exposure to loud noises (Sahota, 2017). WHO report in 2012, the prevalence of hearing loss in Southeast Asia is 156 million people or 27% of the total population (WHO, 2018).

According to the National Committee for the Management of Hearing Loss and Deafness in 2014, hearing loss due to noise in Indonesia is among the highest in Southeast Asia, which is around 36 million people or 16.8% of the total population (Komnas PGPKT, 2014). The number of hearing loss sufferers in Indonesia is quite high, around 4.6% of the population or 12 million people with a deafness prevalence of 2.6% and is ranked 4th in Southeast Asia after Sri Lanka, Myanmar and India.

Any worker exposed to noise is at risk of hearing loss. The higher the noise intensity, the longer the worker is exposed to the noise, and the higher the risk of hearing loss suffered by the worker due to hearing loss. In the manufacturing and mining industries, 40% of workers are exposed to high levels of noise for more than half of their working hour, compared to 35% in the construction industry (Primadona, 2012). According to a survey conducted in 1987 by the Classification Industrial Standards, the primary metal industry ranks second, accounting for 32.7% of the total number of workers exposed to noise. (National Safety Council, 2012).

Hearing loss due to noise is influenced by various factors, including noise intensity, length of exposure to noise, genetics, years of service, age, use of ototoxic drugs, use of ear protection and exposure to cigarette smoke.

Research at PT Indonesia Power UPB Semarang related to noise intensity, length of work, years of service and age, and the use of personal protective equipment were related to hearing loss due to noise (Septiana & Widowati, 2017). In line with research conducted by Muhammad Rifqi at PT Acryl Textile Mills, it shows that there is a relationship between age, years of service, smoking status and ear protection with hearing loss (Rifqi, 2018). Research using the Case Control method conducted by Wulan Ayu at PT Heinz ABC Indonesia - Daan Mogot shows that there is a relationship between age and hearing loss (Pratiwi, 2019).

PT X Jakarta Timur is a company engaged in manufacturing with a sub-sector of motor parts for bearing producers in Indonesia. In PT X, there is a production process using

semi-automatic machines and humans so that there are potential hazards, one of which is noise. The production location called Ring Production produces noise with an intensity of 90 dB due to the collision of the grinding metal ring with the ring underneath so that the noise with a high enough intensity is continuous. In addition, the danger of noise is present in almost all production areas due to the large number of grinding machines operating non-stop in one location.

Based on the Hazard Identification Risk Assessment Control, the hazards faced by operators in the Bearing Production area are heat and noise. Risk control carried out by the company is in accordance with the risk control hierarchy. However, the results of the hearing test health examination in 2019 showed that 42 employees had hearing problems, including mild conductive hearing loss and mild hearing loss in 207 samples or 21.6%. The noise intensity is very high, that is, in the ringing area the average noise intensity for each channel is 90 dB. Many factors can cause hearing loss in workers, therefore this study aims to determine the factors associated with the incidence of noise due to hearing loss in the bearing production section of PT X Jakarta Timur in 2020.

RESEARCH METHODS

This type of research is quantitative research, namely descriptive analysis through a case control design. Data was collected through questionnaire surveys and additional data, including 2019 physical examination data, company internal measurements and employee attendance data. The population in this study were all employees of the Bearing Production PT. SKF Indonesia in 2019 as many as 207 people. The control group in this study were workers in the Bearing Production section who did not experience hearing loss which was determined using a 1: 1 convenience sampling technique.

The instrument in this study has been tested for validity and reliability test with the results of all questions declared valid and reliable. Furthermore, the normality test was carried out using the Kolmogorov-Smirnov test, variable length of exposure and use of ear protection equipment and obtained a significant value of the length of exposure and use of APT, namely 0.00 <0.05, then it was decided to cut the point using the median. Hearing loss variables at the risk (> 85 dB) and no risk (≤85 dB) cut-off point, the risk category cutoff (≥5 years) and no risk (<5 years) age limit variable, the risk category limit age variable (≥40 years) and not at risk (<40 years).

RESULTS AND DISCUSSION

A. Research Result

1. Unvariate Analysis

The unvariate analysis in this study includes descriptive analysis of hearing loss data, noise intensity, length of exposure, working period, age and use of APT as in the table below.

Table 1 Distribution of hearing loss frequency, noise intensity, length of exposure, years of service, age and use of ear protection equipment (APT)

Variable		Total	Percentage
		40	100%
Dependen			
Hearing disorders	Hearing disorders	42	50
	Normal	42	50
Independent			
Noise Intensity	>85 dB	49	58.3
	≤85 dB	35	41.7

Duration of Exposure	≥ 5 Year	65	77.4
	≤5 Year	19	22.6
Years of service	≥ 5 Year	65	77.4
	≤5 Year	19	22.6
Age	≥40 Year	34	40.5
	<40 Year	50	59.5
Use of APT	Use of APT	34	40.5
	obey	50	59.5

Based on table 1, the results of research regarding the frequency distribution of respondents regarding noise intensity in the bearing production section, it can be seen that the highest proportion of 49 drivers (58.3%) were exposed to noise> 85dB, 65 workers (77.4%) were exposed to ≥ 5 hours of exposure, 65 drivers (77.4%)) have a service life of ≥ 5 years, 50 workers (59.5%) aged <40 years and 50 workers (59.5%) obey to use ear protection.

2. Bivariate Analysis

The bivariate analysis in this study was tested by using the chi square test on 5 variables as follows.

Table 2 Statistical Test of Factors Associated with the Incidence of Hearing Loss Due to Noise in the Bearing Production Section of PT X Jakarta Timur in 2020

Variable	Category	Hearing disorders				Total	*P Value*	OR (95%CI)
		Case		Control				
		N	%	N	%	N		
Noise Intensity	>85 dB	25	59.5	24	57.1	49	1,000	1,103 (0,463-2,627)
	≤ 85 dB	17	40,5	18	42,9	35		
Duration of Exposure	≥9 jam	31	73,8	20	47,6	61	0.025	3,100 (1,240-7,751)
	< 9 jam	11	26,2	22	52,4	33		
Years of service	≥5	34	81	31	73,8	65	0.602	1,508 (0,537-4,235)
	<5	8	19	11	26,2	19		
Age	≥40	24	57.1	10	23.8	34	0.004	4,267 (1,672-10,888)
	<40	18	42.9	32	76.2	50		
Use of APT	<12	11	26,2	18	42,9	29	0.169	0,473 (0,189-1,187)
	≥12	31	73.8	24	57.1	55		

Based on table 2, the results of the bivariate analysis show that there is a relationship between the length of exposure and the hearing loss behavior of workers in bearing production with (p-value 0.025 <0.05). Furthermore, there is a relationship between age and hearing loss in bearing production workers (p-value 0.025 <0.05). There is no

relationship between noise intensity and hearing loss of bearing production workers (p-value 1,000> 0.05). There is no relationship between working tenure and hearing loss in bearing production workers (p-value 0.602> 0.05) and there is no relationship between the use of APT and hearing loss in bearing production parts (p-value 0.162> 0.05).

B. Discussion

1. Unvariate Analysis

a. Noise intensity.

The results showed that the highest proportion of noise exposure was at an intensity> 85 dB of 49 people (58.3%). This can happen because the types of machines found in the company are almost all of the same type, namely grinding machines and assembling machines where the average noise measurement results are above 85 dB. The results carried out wulan, (2019) at PT Heinz ABC Indonesia and Mogot, show that the highest proportion is found in workers who are in an area of more than 85 dB at 87.7% because some areas such as the Coji Room have a high noise intensity of 91 dB and on machines. PHE 106 dB. Research conducted by (Mutingah, 2018) shows four (4) of the six (6) sampling points of the noise source are above TLV with a range of 86.2 dB - 90.4 dB.

Noise is all unwanted sound that comes from production process equipment or work tools which at a certain level can cause hearing loss. Scientifically, noise is defined as the sensation received by the ear as a result of a steady fluctuation in air pressure "supersimposing" atmospheric air pressure. The ear will respond to these small fluctuations with great sensitivity (Salami, et al, 2015). Regulation of the Minister of Manpower of the Republic of Indonesia Number 5 of 2018 states that the threshold value of noise intensity for 8 hours of work is 85 dB (Regulation, 2018).

b. Duration of Exposure

Based on the results of the frequency distribution analysis, it is known that the highest proportion of the variable length of exposure is ≥ 9 hours 51 workers (60.7%). This can happen because all employees in the production department must pursue the production output target by working overtime every day so that the length of exposure ≥ 9 hours becomes the highest proportion. This is in line with research conducted by (Asriani Asrun et al, 2012) which shows the same proportion in the case group, namely 35 people for the risk group (> 8 hours) and no risk (<85 hours). However, for the control group, the proportion did not have more risk (49 respondents) than the non-risk group (21 respondents). This is not in line with research conducted by Widowati, 2017 which shows that the highest proportion is in the no-risk group ≤ 85 DB with a total of 79 respondents.

According to Suma'mur, (2009) extending the working time more than the ability of the length of work is usually not accompanied by efficiency, effectiveness and optimal work productivity, in fact, it is usually seen that the quality and results of work and working for a prolonged period of time arise a tendency to fatigue, health problems. , occupational illness and accidents and dissatisfaction. In Permenaker No. 5 years, 2018 states that the maximum length of exposure for 8 hours of work based on the mean is 85 DB and an increase of 3 dB for each exposure which is down from half the time before.

c. Years of service

From the results of the frequency distribution test, it is found that the highest proportion of workers with a service period of> 5 years is 65 respondents (60.7%). This can happen because 90% of employees at PT X Jakarta Timur are permanent employees who joined since the company was founded in 1988 so that the work period of most employees is more than 5 years. This study is not in line with research conducted by Asrun et al, 2012 that the highest proportion is in the group with a non-risk working period (≤ 5

years) of 69 workers (49.7%) of 140 workers. However, it is in line with research conducted by (Iana, 2019) that the highest proportion of workers at risk is 38 respondents (73.1%) and those who are not at risk are 14 workers (26.9%).

In line with the theory expressed by (Budiono, 2008), tenure is the accumulation of a person's work activities carried out over a long period of time. If these activities are carried out continuously it will cause disturbances in the body. Exercise pressure at any given time causes a decrease in muscle performance, with an indication that the movement is increasingly low. The pressures are about to accumulate every day over a long period of time, causing deterioration of health which is also said to be clinical or chronic fatigue.

d. Age

From the results of the frequency distribution analysis, it was found that the highest proportion was in the non-risk age category as many as 50 respondents (59.5%). This can happen because the age range in the company is between 28 - 55 years (retirement age) where automatically the number of employees who are <40 years old is far more than employees with age ≥ 40 years. This research is in line with research conducted by Amira Primadona, 2012 which states that 15 out of 60 respondents who are more than 40 years old are because the company always opens the acceptance of new workers on condition that they are still young. This is not in line with what was done by Muhammad Rifqi, 2018 at PT Acryl Textile Mills. 2018 shows the proportion of respondents who are at risk (≥ 28 years) are 33 people and those who are not at risk are 26 people (44.1%). According to the theory put forward by Tambunan, (2005) that Presbycusis is assumed to cause an increase in the hearing threshold of 0.5 dB each year, starting from the age of 40 years. Therefore, in calculating the level of disability or compensation, the correction aspect of 0.5 dB is used annually for workers over 40 years of age.

e. Use of APT

From the analysis, the highest distribution was in the adherent group, namely 55 respondents (65.5%). This can happen because employees feel that the use of PPE has become a necessity because the noise that occurs is continuous noise to prevent complaints due to noise such as dizziness, spinning heads and others. This research is in line with research conducted by Rifqi, 2018 that the highest frequency is in the category group using APT with a total of 35 respondents (59.3%). However, it is not in line with the research conducted by Mutingah, 2018 that the largest respondents were in the group not wearing APT, amounting to 36 respondents (70.6%) (Rifqi, 2018).

2. Bivariate Analysis

a. Relationship between Noise Intensity and Hearing Loss.

Based on the research results, it was found that there was no relationship between noise intensity and hearing loss. Chi Square test shows p value = 1,000 (p> 0.05), which means that there is no relationship between noise intensity and hearing loss. This can occur due to the limitations of research that uses environmental noise measurements which are measured using a sound level meter as a data source, instead of using individual noise which is measured using a personal noise dosimeter which more accurately measures noise exposure to each individual. It is also proven by statistical results that the average noise intensity is the same between the case and control groups with a number of 85.51 dB for cases and 86.22 dB. Respondents, both cases and controls, were exposed to almost the same noise intensity because the types of machines used were almost the same, namely grinding machines and assembling machines in one line, so that the sound intensity produced was not too far apart.

The results of this study are in accordance with Pratiwi's (2019) research on workers at PT Heinz ABC Indonesia Daan Mogot, showing that there is no significant relationship between noise intensity and hearing loss. Not only that, it also fits the research tried by Rachmawati (2015) which reports that workers who work with great seriousness have the risk of facing obstacles such as communication, physiological and psychological issues. The seriousness of big noise if allowed to cause losses to workers, both auditory constraints and non-auditory constraints.

For Suma 'mur (2009), noise with seriousness that exceeds TLV with long exposure time and continuously can increase the risk of labor facing non-auditory constraints, which can be seen by the presence of physiological constraints, psychological constraints and communication problems.

b. Relationship between length of exposure per day and hearing loss

Chi Square test shows the p-value = 0.025, which means that there is a significant relationship between the length of exposure and noise disturbance. The Odds Ratio calculation shows a number of 3,100 with CI (1,240-7,751), which means that respondents with more than 9 hours of exposure have a 3,100 higher risk of developing hearing loss than respondents with ≤ 9 hours of exposure. Research by Evi Widowati, 2017 at PT. Indonesia Power UBP Semarang, which states that there is a relationship between the length of exposure and hearing loss with a p value of 0.022. Not in line with research conducted by Amira Primadona, 2012 at PT Pertamina Gheothermal Energi, the p value is 1,000 which means there is no significant relationship between length of exposure and hearing loss.

The existing theory states that the effect of worker noise is proportional to the length of noise exposure. The longer the worker is exposed to the noise of eating, the greater the risk of the worker experiencing hearing loss. amira (Suma'mur, 2009). From the results of interviews with production supervisors, it can be seen that the company must reach the daily target, namely a minimum bearing output of 100,000 pcs per day to meet market needs so that the provisions for working overtime or working more than 8 hours are mandatory. Meanwhile, the mapping of workers to work in production lines is based on skills such as hand speed for the packing section and mechanical engineering expertise for employees on machines that are potentially damaged (trouble shooting) such as grinding machines. Overtime arrangements by the company are made to make a weekly schedule so that workers at least one day a week. The recommendation that the researchers shared was one of them by carrying out training on diseases caused by deaf obstacles to increase awareness of deaf obstacles and their dactor aspects. Overtime hours engineering can also be tried to reduce the length of exposure to the exposure / day, either within time or in rotation of the work position.

c. Relationship between Service Period and Hearing Loss

The results showed a p value of 0.602, which means that there is no significant relationship between tenure and hearing loss. This is not in line with research conducted by (Mega Putri, 2017) at PT GMF Aeroasia in 2017 which shows a p value = 0.006, which means that there is a significant relationship between tenure and hearing loss. This can occur because the average length of exposure between the case and control groups differed only slightly, namely 15.01 years and 11.8 years for controls. From the results of field observations, it can be seen that some respondents from the questionnaire results wrote that in the first years of the work contract the respondents were in other locations such as warehouse and production planning. This can be a counfounding variable that affects the test results between years of service and hearing loss. This matter is also in line with research conducted by Rifqi, 2018 at PT Acryl Textile Mills which shows that there is a

meaningful bond between tenure and deaf problems.

The working period is the length of time or length of time a person works at an institution, office, and so on (Koesindratmono et al, 2011). The theory put forward by Budiono states that the working period is the accumulation of a person's work activities carried out over a long period of time. If these activities are carried out continuously it will cause disturbances in the body. Physical stress over a period of time can cause decreased muscle performance and symptoms of reduced exercise. Stress builds up every day over a long period of time, causing a deterioration in your health, which is known as clinical or chronic fatigue. This occurs because compliant workers will wear an APT or work rotation designed by the foreman to prevent workers from standing on high-powered machines every day.

d. Relationship between Age and Hearing Loss

Bivariate analysis showed that the p value showed a value of 0.004 with an OR value of 4.267 CI (1.672-10,888) where it can be interpreted that there is a significant relationship between age and hearing loss with a possible risk level of 4,267 higher for respondents aged ≥40 than respondents aged < 40 years. This is in line with Putri, 2017 in her research on factors related to PT GMF Aeroasia 2017 hearing loss, the research report shows that p-value = 0.001 which means the relationship between age and hearing loss is very significant. Based on this research, research conducted by Rifqi in 2018 showed that p-value = 0.01 which means there is a relationship between age and hearing loss.

The existing theory states that age is a factor that can cause hearing loss, but this factor is an intrinsic factor which arises from the individual itself because with age, human organs will decrease their function. In line with the theory that the average hearing threshold will continue to increase by 0.5 dB per year starting from the age of 40 due to presbycusis Tambunan.

Mapping done by the EHS Dept. has not included age in environmental monitoring. Monitoring carried out by the EHS department is still limited to indoor measurements by internal companies and outdoor noise measurements by third parties. Interventions such as age-appropriate placement engineering have not been carried out. The suggestion given by the researcher to the company is that the company begins to make a mapping for the relocation of workers aged> 40 years and then placed in work locations with lower exposure than those aged <40 years to minimize presbycusis.

e. The Relationship between Using APT and Hearing Loss

The results of the analysis using Chi Square showed a p value of 0.169, which means that there is no significant relationship between the use of APT and hearing loss. This can occur because the average adherence score between the case and control groups is 12.83 for the case group and 12 for the control group. The results of observations with production operators in the field, there are several things that affect the use of APT such as APT material which for some causes irritation, the type of work that sometimes requires removing the APT such as when looking for pressure pipe leaks based on sound, as well as understanding factors of the importance of using APT on employees itself. The patrols carried out by the EHS department recorded a graph of the use of APT based on the location of the department only, but did not include in detail the names of anyone who was not compliant in using APT. This study is in line with research conducted by Amira Primadona (2012), which states that there is no correlation between the use of APT and hearing loss because the survey data conducted by researchers are homogeneous. Almost all employees are in the obedient category. Not in line with research conducted by (Dini, 2015) at PT Dirgantara Indonesia, it was stated that there was a significant relationship between the use of APT and hearing disorders with p value = 0.55 ($p \leq 0.05$).

The ear protection device (APT) is the last option in the control hierarchy. Since the main area of human noise damage is hearing (inner ear), this control method uses a device that can reduce the noise entering the inner and middle ear. Ear protection equipment can reduce sound intensity by 20 to 30 dB (Kit Et All, 2009).

According to the existing theory, the compliance of workers using APT, the possibility of hearing loss will be smaller. However, this can occur due to various factors, one of which is bias because the questionnaire distributed via google form is perceived differently by respondents with the intent of the researcher. The researcher conducted the survey twice, first through google form and distributed virtually then the researcher went straight to the field while explaining question after question for each worker, so the results obtained were quite different. The second is related to the limitations of this study, that these questions are used to recall the use of Respondent APT in 2019 where data for cases were taken from medical check-up data 2019. Conditions in the field show that respondents on average always use APT unless there is a problem machine hose leaks where ear protection tools must be removed because the ears are functioned to hear the sound of compressed air flow to find leaks.

CONCLUSION

From the results of research and discussion, it can be concluded that most of the workers are exposed to noise> 85 dB of 58.3%, length of exposure ≥9 is 60.7%, working period ≥5 years is 77.4%, worker age ≥ 40 = 34 people, and the use of APT <12 (non-compliant) = 26.2%. There was no significant relationship between noise intensity and hearing loss. There was a significant association between length of exposure and hearing loss. There was no significant relationship between tenure and hearing loss. There is a significant relationship between age and hearing loss. There was no significant relationship between the use of APT and hearing loss.

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