

# Correlation between Workers' Characteristics and Workplace Noise with Subjective Hearing Disorders in Textile Industry

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## ABSTRACT

**Introduction:** The textile manufacturing industry has a noisy work environment as a result of the weaving machines which have a noise intensity exceeding the threshold value. Noise can cause complaints of hearing disorders. Other factors that influence hearing disorders are age, work period, and the use of ear protection equipment. This study aims to analyze the relationship between age, work period, the use of ear protection equipment, and noise intensity on complaints of subjective hearing disorders in the AJL Weaving Department of Textile Industry. **Method:** This research was a descriptive observational study with a cross sectional approach. Data were obtained by measuring noise intensity and distributing questionnaires to workers. Respondents in this study amounted to 45 people who were the total population of weaving operators and maintenance workers in the AJL Weaving Department of Textile Industry. **Results:** The results of this study indicate that age and work period have a sufficient relationship with complaints of subjective hearing disorders, while the use of ear protection equipment has a weak relationship with complaints of subjective hearing disorders, and noise intensity has a strong relationship with complaints of subjective hearing disorders. **Conclusion:** Individual characteristics only have a weak to moderate relationship with subjective hearing complaints. Meanwhile, exposure to noise intensity has a strong relationship with subjective hearing complaints.

**Keywords:** complaints of hearing disorders, individual characteristics, noise intensity

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## INTRODUCTION

Each industry has different noise levels. The results of previous research showed that of various types of industries in Indonesia, the noise level of machinery industry was the highest of 97 dB, the plastic ore processing industry was 92 dBA; and the convection industry was 65 dBA (Rimantho *et al.*, 2015).

The textile industry in its production uses cotton and rayon yarns. Meanwhile, production machines used include warping machines, slats, palletizing machines, starch making machines, weaving machines, inspection machines, and folding machines. The main sources of noise in this textile industry are weaving and palletizing machines with the highest noise intensity of 98.4 dBA. The type of noise found is wide band noise or persistent, continuous noise without breaks at wide

and high frequencies, which are relatively types of loud noise causing deafness (Sumardiyono *et al.*, 2018). Based on the Minister of Manpower Republic of Indonesia (2018), noise is all unwanted sounds originating from production process equipment and/or work tools at a certain level that can cause hearing disorders.

High levels of occupational noise exposure pose a significant risk to occupational health and safety. Based on data from the World Health Organization, 2021 in 2021, there were more than 5% or 430 million people in the world who experienced hearing disorders. The Australian Government in 2012 stated that 37% of hearing disorders was due to excessive noise. Meanwhile, according to a 2013 report by the UK Commission for Hearing Disorders, an estimated 18,000 people suffered from work-related noise-induced hearing loss (The International Longevity Center-UK, 2014).

Noise can cause hearing loss in textile workers, especially those having an exposure to noise intensity >85 dB for more than 8 hours/day and having working hours of more than 9 years. A worker who is exposed to high intensity noise

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for a long time can suffer from the collapse of the stereocilia and hair cells, causing permanent damage to the hearing function. When the outer hair cells do not work, there is a lot of stimulation or high-frequency sound that will initiate nerve impulses, so that the sensitivity threshold of the inner hair cells will increase and cause hearing loss (Nugraha, Hermawan and Nugrahawati, 2021).

A study conducted by Rachmawati (2015) regarding the relationship between noise intensity and subjective complaints (non-auditory effect) in the Turbine and Generator Boiler Areas found that 53.5% of respondents experienced communication disorders due to noise in the work area, 30.2% respondents experienced physiological disorders, and 37.2% of respondents experienced psychological disorders. Individual characteristics that will influence the occurrence of hearing disorders are age, years of service, and the use of ear protection equipment. This is in line with a study conducted on workers in a textile factory. The result showed that there was a relationship between noise and psychological disorders including discomfort, impaired concentration, emotional disturbances, and sleep disturbances (Darlan and Sugiharto, 2017).

Based on the background of the problem, it can be seen that hearing disorders complaints are experienced by many workers in both the formal and informal sectors. These conditions will cause serious complaints if workers do not receive special attention from the company. Complaints of hearing disorders that do not get special attention will have an impact on the performance and health of workers, which can be detrimental to the company. Therefore, it is necessary to analyze the relationship between noise intensity and individual characteristics with complaints of subjective hearing disorders in the textile industry, especially in the AJL Weaving Department. The general objective of this study is to analyze the relationship between noise intensity and individual characteristics with complaints of subjective hearing disorders in the textile industry, especially in the AJL Weaving Department.

## **METHODS**

The subject of this research was the total population comprising workers in the AJL Weaving Department at PT X. There were 45 people in total, consisting of 30 weaving operators and 15 maintenance workers divided into 3 shifts. This research was carried out in the Weaving Area and

Maintenance Area in the AJL Weaving Department of Textile Industry. The research time was in June - July 2021, starting from the initial preparation process for the data collection process.

This research was a descriptive observational study because it observed the subjects without intervention in order to provide an explanation and description of the incident. The research analysis was quantitative data analysis using correlation analysis because this study aimed to analyze the relationship between age, work period, compliance with the use of ear protection equipment, noise intensity and subjective hearing disorders. In regard to the approach of time implementation, this research was cross-sectional because it was carried out once in a certain period of time. This study used interviews and questionnaires to collect data on individual characteristics, namely age, work period and compliance with the use of ear protection equipment. Meanwhile, the noise intensity data was obtained using a sound level meter (SLM) at two points, namely the Weaving Area and the Maintenance Area.

This research consisted of 2 (two) kinds of data analysis, namely univariate and bivariate analysis. Univariate analysis was used to present the frequency distribution of the questionnaire results. Meanwhile, bivariate analysis was carried out using a statistical test, namely the coefficient contingency (C) with the help of SPSS software to find out the relationship strength between the research variables. This research has been tested by the ethics committee of the Faculty of Nursing, Universitas Airlangga with a certificate number 2247-KEPK/2021.

## **RESULTS**

### **Characteristics of Workers in the Weaving Department of Textile Industry**

The characteristics of the workers studied in this study were age, work period, and the use of ear protection equipment. Based on the data obtained from the data collection and processing carried out, the following results were obtained, as shown in Table 1.

Most workers in the AJL Weaving Department were in the >35 year age category with a total of 60%. The youngest age was 27 years, while the oldest age was 41 years. Moreover, most workers were in the work period category of 6-10 years,

accounting for 48.9%. The shortest work period was 4 years, while the longest work period was 14 years. In addition, most of the workers used ear protection, accounting for 57.8%. Meanwhile, 42.2% were non-compliant workers with the use of ear protection.

### Results of the Noise Intensity Measurement in the AJL Weaving Department of Textile Industry at PT X

Noise measurements were carried out using a sound level meter at two points, namely the Weaving Area and the Maintenance Area. Then, the calculation was carried out using the Leq (dBA) formula. The results of the measurements of noise intensity in the AJL Weaving Department of PT X can be seen in Table 2.

Based on the measurements of noise intensity in the AJL Weaving Department, it was known that the noise intensity in the Maintenance Area was below the threshold value of 84.13 dBA. Meanwhile, in the Weaving Area the noise intensity reached 99.30 dBA, which exceeded the threshold value. There were third parties that worked with the company in measuring temperature and relative humidity. Based on the measurements made by a third party

**Table 1.** Characteristics of Workers in the AJL Weaving Department of Textile Industry in 2021

Variable	Total (n)	Percentage (%)
<b>Age</b>		
≤ 35 years old	18	40.0
>35 years old	27	60.0
<b>Work Period</b>		
<6 years	13	28.9
6-10 years	22	48.9
>10 years	10	22.2
<b>Compliance with the use of ear</b>		
Obey	19	42.2
Not Obey	26	57.8

**Table 2.** Results of Noise Intensity Measurements of Workers in the AJL Weaving Department of Textile Industry in 2021

Measuring Point	Noise Intensity (dBA)	Description
Maintenance Area	84.13	< Threshold value
Weaving Area	99.30	> Threshold value

collaborating with the company in Semester I of 2021, the temperature in the AJL Department was in the range of 30-34°C and the humidity was in the range of 6.5-7.5%, measured using a Thermohydrometer. These two values are still within tolerable limits and do not affect sound recording according to SNI 7231:2009 concerning Methods of Measurement of Noise in the Workplace.

### Results of complaints of subjective hearing disorders of workers in the AJL Weaving Department of Textile Industry at PT X

The results of complaints of subjective hearing disorders in the AJL Weaving Department of textile industry at PT X can be seen in Table 3. Based on Table 3, 62.2% of workers experienced complaints of hearing disorders complaints. Meanwhile, the number of workers who had no complaints of subjective hearing disorders was 37.8%. This means that most workers experienced hearing disorder complaints.

The hearing disorders can be explained by the presence of 3 disorders, namely communication disorders, disturbances in carrying out work and impaired perception of hearing disorders. The following is a description of the three disorders.

**Table 3.** Results of Complaints of Subjective Hearing Disorders, Communication Disorders, Disturbances in Work Execution and Perception of Hearing Disorders on Workers in the AJL Weaving Department of Textile Industry in 2021

Variable	Total (n)	Percentage (%)
<b>Complaints of Subjective Hearing Disorders</b>		
Yes	28	62.2
No	17	37.8
<b>Communication</b>		
Yes	34	75.6
No	11	24.4
<b>Disturbances in Work Execution</b>		
Yes	28	62.2
No	17	37.8
<b>Perception of Hearing Disorders</b>		
Yes	19	42.2
No	26	57.8

### Communication Disorders

Communication disorders felt by workers included having difficulty hearing conversations and not understanding the meaning of what other people are saying. The distribution of the frequency of workers experiencing communication disorders can be seen in Table 3.

Based on Table 3, 75.6% of workers experienced communication disorders. Meanwhile, workers who did not experience communication disorders amounted to 24.4%. This means that most workers experienced communication disorders.

### Disturbances in Work Execution

Disturbances in carrying out work felt by workers were in the form of feeling disturbed when doing activities or carrying out work in noisy places. The distribution of the frequency of workers experiencing problems in carrying out their work can be seen in Table 3.

Based on Table 3, 62.2% of workers experienced problems in carrying out their work. Meanwhile, the number of workers who did not experience any disruption in their work was 37.8%. Thus, it can be concluded that most workers experienced interference in carrying out their work.

### Perception of Hearing Disorders

Perceptions of decreased hearing power felt by workers included complaints in the ears after work, ringing in the ears during leave/holidays from work, and a decrease in hearing in workers. The frequency distribution of workers who experienced a perception of decreased hearing can be seen in Table 3. Based on Table 3, 42.2% of workers experienced hearing disorders. Meanwhile, the number of workers who did not experience hearing disorders was 57.8%. Thus, it could be concluded that the subjective hearing disorders felt by the workers is more related to communication disorders and disturbances in carrying out work. Yet, the stage of the disturbances has not yet reached the level of hearing disorders.

### The Relationship between Workers' Characteristics and Complaints of Subjective Hearing Disorders

The data obtained were analyzed to determine the relationship between workers' characteristics, namely age, work period, and the use of personal protection equipment with the dependent variable, namely complaints of subjective hearing disorders.

The relationship between age and subjective hearing disorders can be seen in Table 4.

Based on Table 4, it can be seen that most of the workers who experienced subjective hearing disorders were workers who were more than 35 years old (81.5%). Meanwhile, workers who were less than 35 years old (33.3%) had less complaints of subjective hearing disorders.

Table 4 also shows that age had a relationship with complaints of subjective hearing disorders, which is evidenced by the Contingency Coefficient value obtained of 0.437, which means that there is a sufficient relationship between the age variable and complaints of subjective hearing disorders. Thus, the older the age, the higher the tendency to experience hearing disorders complaints. Meanwhile, the relationship between work period and complaints of subjective hearing disorders can be seen in table 5.

The results of the analysis show that in the category of work period of less than 6 years, 23.1%

**Table 4.** Relationship between Age and Complaints of Subjective Hearing Disorders in the AJL Weaving Department of Textile Industry in 2021

Age	Complaints of Subjective Hearing Disorders				Total		Contingency Coefficient Value
	Yes		No		N	%	
	n	%	n	%			
≤ 35 years old	6	33.3	12	66.7	18	100.0	0.437
> 35 years old	22	81.5	5	18.5	27	100.0	

**Table 5.** Relationship between Work Period and Subjective Hearing Disorders Compliance in the AJL Weaving Department of Textile Industry in 2021

Work Period	Complaints of Subjective Hearing Disorders				Total		Contingency Coefficient Value
	Yes		No		N	%	
	n	%	n	%			
< 6 years	3	23.1	10	76.9	13	100.0	0.498
6-10 years	15	68.2	7	31.8	22	100.0	
> 10 years	10	100.0	0	0.0	10	100.0	

of workers had complaints of hearing disorders. In the category of work period of 6-10 years those who had complaints of hearing disorders were as many as 68.2%. Meanwhile, in the category of work period of more than 10 years, those who had complaints of hearing disorders were 100%.

Table 5 shows that work period have a relationship with complaints of hearing disorders, as shown by the majority of workers in the 6-10 year work group showed complaints of hearing disorders, accounting for 81.5%, and those who had more than 10 years of work period had complaints of hearing disorders as many as 100%. The Contingency Coefficient value obtained was 0.498, which means that there is a sufficient relationship between the variable of work period and complaints of hearing disorders. The longer the working period, the more susceptible the hearing disorders experienced by workers.

Meanwhile, the relationship between the use of ear protection equipment and complaints of subjective hearing disorders can be seen in table 6.

The results of the analysis show that in the category of obedient workers using ear protection equipment, 8 (42.1%) out of 19 people had complaints of hearing disorders as Meanwhile, in the category of workers who did not comply with the use of ear protection equipment, 20 (76.8%) out of 26 people had complaints of hearing disorders.

Table 6 shows that the compliance with the use of ear protection equipment has a relationship with complaints of hearing disorders, as shown by the majority of the workers who did not comply with the use of personal protection equipment and showed

complaints of hearing disorders as much as 76.9%. The Contingency Coefficient value obtained was 0.334, which means that there is a weak relationship between the use of ear protection equipment variable and complaints of hearing disorders.

Meanwhile, the relationship of noise intensity with complaints of subjective hearing disorders could be seen in Table 7.

The results of the analysis show that in the category of the work area that had noise intensity below 85 dB, 1 (6.7%) out of 15 people had complaints of subjective hearing disorders. Meanwhile, in the category of work area with noise intensity above 85 dB, 27 (90%) out of 30 people had complaints of subjective hearing disorders.

Table 7 shows that noise intensity has a relationship with complaints of hearing disorders, as shown by the majority of workers in the work area with noise intensity above 85 dB who showed complaints of hearing disorders, as many as 90%. The Contingency Coefficient value obtained was 0.630, which means that there is a strong relationship between the noise intensity variable and complaints of hearing disorders.

## DISCUSSION

### Characteristics of Workers in the AJL Weaving Department of Textile Industry

Workers who became respondents in this study were 30 weaving operators and 15 maintenance workers. This study used a total population of 45 people. The characteristics of the workers studied in

**Table 6.** Correlation between Compliance with the use of Ear Protection Equipment and Complaints of Subjective Hearing Disorders in the AJL Weaving Department of Textile Industry in 2021

Compliance with the Use of Ear Protection Equipment	Complaints of Subjective Hearing Disorders				Total		Contingency Coefficient Value
	Yes		No		N	%	
	n	%	n	%			
Obey	8	42.1	11	57.9	19	100.0	0.334
Not obey	20	76.9	6	23.1	26	100.0	

**Table 7.** Relationship between Noise Intensity and Complaints of Subjective Hearing Disorders in the AJL Weaving Department of Textile Industry in 2021

Noise Intensity	Complaints of Subjective Hearing Disorders				Total		Contingency Coefficient Value
	Yes		No		N	%	
	n	%	n	%			
< 85 dBA	1	6.7	14	93.3	15	100.0	0.630
> 85 dBA	27	90.0	3	10.0	30	100.0	

this study included age, work period and compliance with the use of ear protective equipment. The majority of workers were over 35 years old with more than 6 years of work period. Most of them also did not comply with the use of ear protection equipment.

A previous study showed that there was a relationship between age, work placement, noise intensity, length of exposure and hearing loss (Rahayu *et al.*, 2016). In another study, Hamid, Gafur, and Muttholib (2021) also stated that there was a relationship between workers' age, length of work with and noise intensity with hearing loss.

Previous research in a noisy area of an operations department showed that variables of personal noise dose, work period, hearing protective equipment, history of illness, and hobbies or activities outside of work related to noise significantly affected hearing loss. In contrast, there was no significant effect between the age variable and hearing loss. Thus, it can be concluded that the hearing loss of workers is mostly caused by personal noise dose, work period, the use of hearing protection equipment, history of illness, and hobbies or activities outside of work hours related to noise (Rina, Sukwika, and Abdullah, 2021).

A literature study using articles literature review and research articles in international and national journals in the last 10 years. Declare from several studies that have been carried out, the authors conclude that the risk factors for hearing loss in industrial workers are noise intensity, the use of Personal protective equipment (PPE), work period, and age (Winata, 2022).

The company has provided ear protection devices to workers. However, only some workers comply with the use of ear protection equipment in the workplace. The ear protection devices provided by the company are moldable earplugs and molded earmuffs with 3 flanges. Workers who did not comply with the use of earplugs stated that they forgot to use earplugs while working. Another reason stated by workers is that earplugs are easy to lose. In fact, the use of ear protection is useful to reduce the risk of workers experiencing occupational diseases, especially hearing loss.

### Noise Intensity Measurements

The AJL Weaving Department particularly in the Weaving Section has two work areas, namely the Weaving Area and the Maintenance Area. Researchers did some measurements of noise

intensity using a Sound level meter (SLM) in these two points. The measurement results showed that the two areas had different noise intensities. The maintenance area had a noise intensity less than or below threshold value, which was 84.13 db. Meanwhile, the Weaving Area had a noise intensity of more than or above threshold value, which was 99.30 dB.

The noise intensity in the Maintenance Area is not as high as in the Weaving Area though the two adjacent areas are in the same department, namely AJL Weaving Department. This is because there are no machines which generate constant noise as in the Weaving Area. In the Maintenance Area there is work in the form of repairing spare parts and cleaning spare parts. Spare parts repair uses equipment producing some noise, such as grinders and welding tools. Meanwhile, spare parts cleaning uses tools that have power from a compressor, causing noise. However, the noise generated from these two activities is intermittent and not constant.

In the Weaving Area, there were 120 weaving machines which were on 24 hours a day, 7 days a week. These machines produce noise which is high enough to exceed the threshold value. This is certainly not in accordance with the Regulation of the Minister of Manpower Republik Indonesia (2018), which stated that the maximum noise that workers may be exposed to is 85 dB with 8 working hours per day. In this study, workers have used ear protection equipment in the form of: earplugs made of foam and earplugs made of silicon. These two types of ear protection equipment have noise reduction level of 10 dB. Nevertheless, this has not reduced the noise in the Weaving Area to be under threshold value.

### Hearing Disorders Complaints in the AJL Weaving Department of Textile Industry

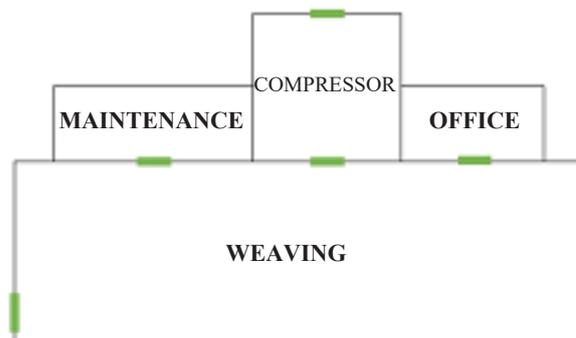


Figure 1. AJL Weaving Department Layout

High levels of noise exposure usually come from occupational noise (such as factories) or recreational noise (such as personal music players). Noise-induced hearing loss is sensory deafness caused by long-term exposure of the auditory system to a noisy environment. Auditory fatigue is an early symptom of noise-induced hearing loss, and hearing can gradually recover after people leave a noisy environment (Ding, Yan, and Liu, 2019).

Noise exposure in workplace for long periods continuously without any control or prevention can cause two types of effects, namely disturbances in the hearing system (auditory effects) and non-hearing disorders (non-auditory effects). Non-auditory effects of noise consist of three aspects, namely physiological disorders, psychological disorders, and communication disorders (Amar, Dina, and Nuryanto, 2019).

Subjective complaints in this study are categorized as non-auditory effects. Subjective complaints are complaints felt by workers when carrying out their work without conducting a medical examination. The complaints are in the form of disturbances in communication, disturbances in carrying out work, and the perception of decreased hearing power. The data obtained to find out complaints of subjective hearing disorders were carried out through interviews and questionnaires.

Based on the results of the interviews, all workers have never had their hearing checked. The company also does not provide health examination or audiometric examination. If workers do not follow up on the complaints they experience, the disturbance will be more severe, and it can even result in more severe effects such as permanent deafness.

Exposure to noise in the workplace can increase the risk of hearing loss in older adults. In addition to audiometric examination, prevention through measurement can reduce noise exposure in the workplace, which potentially contribute to reducing the burden of hearing loss in the future (Gopinath *et al.*, 2021).

### **Relationship between Age and Complaints of Hearing Disorders**

In this study, the age group was categorized as young for those aged 35 years old or less and old for those aged more than 35 years old. Based on the results of the study, it was found that 18 out of 45 workers were in the young age category and 27 out

of 45 workers were in the old age category. Based on the tests that have been carried out, the age group that often experiences complaints of subjective hearing disorders is the old age category aged more than 35 years old.

The result of this research is in line with previous research results that showed a significant relationship between noise, age and the use of ear protective equipment with complaints of hearing loss. Workers exposed to noise above threshold value are known to have 4.512 times higher risk than workers exposed to noise below threshold value after controlling r age variable Dewi and Kusnoputranto, 2021; Rizqi *et al.*, 2017). Also, hearing disorders are experienced by more than 25% of people aged above 60 years old (World Health Organization, 2021). Age and duration of exposure to noise greatly affect the hearing threshold of workers. If the worker has a longer work period, then the risk of experiencing occupational diseases is higher when compared to workers who have a shorter work period (Tarwaka, 2014).

The results obtained are also in line with research conducted by Tuwongkesong, Akili and Kalesaran (2018), which stated that there was a relationship between age and the threshold value for tourism motorboat drivers at the Kalimas Tourism Pier in Manado City. The measurement results of the study stated that the age group that experienced the most hearing disorders was the age category > 40 years old. There was 46.7% hearing disorders/mild deafness in the right ear and 46.2% in the left ear.

Another study conducted by Raya, Asnifatimah and Ginanjar (2019) on the Pustaka PO bus drivers at the Baranangsiang Terminal, Bogor City stated that there was a significant relationship between age and complaints of hearing disorders. The results of the study stated that the age variable had an Odd Ratio (OR) of 155 times. Older respondents had a 1.55 times greater chance of experiencing hearing disorders complaints at work.

It can be concluded that hearing disorders is caused by various factors, one of which is age. The results of this study indicate that the older a person is, the higher the tendency is for a person to experience complaints of hearing disorders complaints. This can affect worker productivity because workers tend to experience complaints. The company should, therefore, carry out administrative control by providing job rotation or arrangement so that workers over 40 years old are not employed in places with high noise intensity.

### Relationship between Work Period and Complaints of Hearing Disorders

In this study, the working period was categorized into three groups, namely <6 years, 6-10 years, and >10 years. Based on the results of the study, it was found that there were 13 out of 45 workers with <6 years of work period, 22 workers with 6-10 years of work period, and 10 workers with more than 10 years of work period. Based on the tests that have been carried out, all workers in the category of 10 years of service experienced complaints of subjective hearing disorders.

The result of this research is in line with research conducted by Marisdayana, Suhartono and Nurjazuli (2016) which stated that tenure is a risk factor for interference for workers at PT X. The proportion of respondents who worked more than 14 years and suffered from hearing disorders was 66.7%. The results of statistical tests also proved that respondents who worked more than 14 years had a 3.3 times higher risk of suffering from hearing disorders compared to respondents who worked less than 14 years.

According to research conducted by Putri and Martiana (2016) at PT X Sidoarjo, there was a relationship between work period and the hearing threshold of workers as evidenced by the results of the Pearson correlation test with a p-value of 0.036. In the working period of 11-20 years, it was found that the abnormal hearing status of the respondents was 32% in the right ear and 43% in the left ear. Meanwhile, in the range of 5-10 years of work period, there were respondents with abnormal hearing status of 25% in the right ear and 25% in the left ear. This is because workers are continuously exposed to noise, which affects the hearing threshold of workers, which ultimately can cause deafness.

In research conducted on production workers in the manufacturing industry, it was also found that there was a significant relationship between the length of exposure and hearing complaints, evidenced by p value (0.008) < (0.05) (Azzari and Indriani, 2018).

It can be concluded that work period is one of the factors that increase the risk of workers experiencing complaints of hearing disorders. The results of this study indicate that the longer a person's working period, the higher the potential for experiencing complaints of hearing disorders. Therefore, the company should control the work rotation system in order to reduce the risk of hearing disorders. Workers with more than 10 years of work

period should be transferred to a work area where the noise intensity is not so high.

### The Relationship between Compliance with the Use of Ear Protection Equipment and Complaints of Hearing Disorders

In this study, the category of workers using ear protection equipment was divided into being compliant and not being compliant with wearing ear protection equipment. Based on the results of the research, it was found that there were 19 out of 45 workers who complied with the use of ear protection equipment and 26 out of 45 workers who did not. Based on the tests that have been carried out, the majority of workers who experienced complaints of subjective hearing disorders was in the category of non-compliance.

The result of this research is in line with research conducted by Ramadhani, Silaban and Hasan (2017) on ground handling officers at Kualanamu International Airport. The results of the analysis on workers showed that there were 65.6% of workers who suffered from hearing disorders, with 52.8% of them experiencing mild deafness (lowest hearing threshold 26-40 dB) and 47.2% of them experiencing moderate deafness (hearing threshold as low as 41-60 dB). Based on the analysis, respondents who did not use ear protection equipment were at risk for hearing disorders of 11,600 times compared to respondents who used it (OR=11,600; 95% CI=3,121-43,120). This research is also in line with research conducted on metal-making workers in home industry which showed that there was a relationship between the use of ear protection and hearing complaints (Yudhistira *et al.*, 2022).

Noise exposure can cause health effects such as Noise Induced Hearing Loss (NIHL) and tinnitus. In addition to the workplace, noise can be obtained from the use of earphones. The results showed that the noise level in the workplace was 88.57 dBA (8 hours Time Weighted Average) which exceeded the Threshold Limit Value of 85 dBA. The prevalence of NIHL and tinnitus at work was 21.6% and 54%, respectively. NIHL was influenced by the use of hearing protection devices and earphones (MLR,  $p < 0.01$ ;  $p < 0.05$ ) and tinnitus was influenced by the use of earphones (MLR,  $p < 0.01$ ) after being controlled by work period. Thus, it can be concluded that the prevalence of NIHL and tinnitus is relatively high, and NIHL is influenced by the use of hearing protection equipment and earphones, while tinnitus

is influenced by the use of earphones (Syah and Keman, 2017).

The use of personal protection equipment is the last control hierarchy, but plays an important role in occupational safety and health. There is a significant relationship between compliance with the use of personal protection equipment and hearing disorders. The results of this study indicate that the more obedient workers are in using ear protection equipment, the lower the risk of workers in experiencing complaints of hearing disorders. The company should, therefore, provide appropriate ear protection for workers, such as earplugs that have a reduced level value that is suitable for the work environment or the addition of earmuffs. Convenience in wearing ear protection also needs to be considered so that workers do not neglect to use it for reasons of being uncomfortable. In addition, companies can carry out socialization regarding the importance of using personal protective equipment so that workers do not neglect to use it and the ways to use PPE properly so as to reduce noise to the maximum.

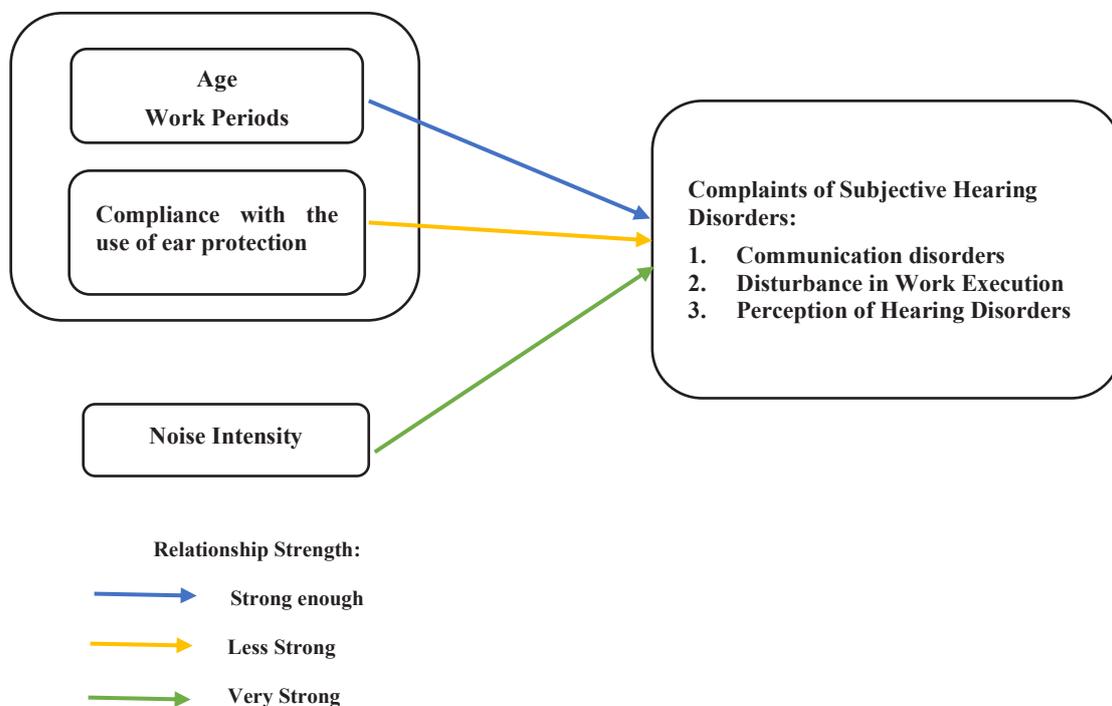
### The Relationship Between Noise Intensity and Complaints of Hearing Disorders

The AJL Weaving Department, especially in the Weaving Section, has two work areas, namely the

Weaving Area and the Maintenance Area. Based on noise measurements in the two areas, it was found that these two areas had different noise intensities. The Maintenance Area had a noise intensity of less than or below the threshold value, which was 84.13 dB. Meanwhile, the Weaving Area had a noise intensity of more than or above threshold value, which was 99.30 db.

Based on this research, the intensity of noise in the Maintenance Area was not as high as that in the Weaving Area even though these two areas were close together and were in the same department, namely in the AJL Weaving Department. This is due to the absence of machines that generate constant noise such as those in the Area Weaving. In the Maintenance Area some work is conducted in the form of repairing spare parts and cleaning spare parts. Repairing spare parts uses equipment that causes noise, such as grinders and welding tools. Meanwhile, cleaning spare parts uses tools that have power from the compressor, causing noise. However, the noise generated from these two activities is intermittent and not constant.

In the Weaving Area there were 120 weaving machines or weaving machines that were on 24 hours a day, 7 days a week. These machines generated a quite high noise which exceeded the threshold value. This is certainly not in accordance



**Figure 2.** Relationship Strength between Age, Work Period, Compliance with the Use of Ear Protection Equipment and Noise intensity with Subjective Hearing Disorders in the AJL Weaving Department at PT X

with the Regulation of the Minister of Manpower Republik Indonesia (2018), which states that the maximum noise that workers may be exposed to is 85 dB with 8 working hours per day. Workers in this study have already used ear protection equipment in the form of earplugs made of foam and earplugs made of silicon. Both have a noise reduction level of 10 db. However, this procedure has not reduced the noise levels in the Weaving Area to below the threshold value. Companies, therefore, need to carry out control in the form of routine maintenance and machine maintenance so that machines do not cause more noise. Also, the provision of ear protection equipment such as earplugs or earmuffs that are suitable is highly needed in order to reduce the effects of existing noise. It is advisable to conduct socialization in the form of the use of ear protection equipment, so that workers know how to use ear protection equipment properly, which ultimately will increase the motivation of workers to use it in a disciplined behaviour.

In this study, the noise intensity group was categorized as below threshold value or above threshold value. Based on the data obtained, there were 30 workers in the Weaving Area and 15 workers in the Maintenance Area. Also, based on the tests that have been carried out, workers who mostly experienced complaints of subjective hearing disorders were workers in areas with a noise intensity above the threshold limit value, namely the Weaving Area.

The result of this study is in line with research conducted by Rantung, Lintong and Danes (2015) who conducted study on Game Central Area workers in the Manado Trade Center Area. The results of the analysis with the test showed that there was a significant relationship between noise level and hearing disorders in both left and right ears with  $p = 0.002 < 0.05$ . The results showed that out of 20 respondents, 3 people (15%) had hearing disorders, 2 people (10%) had mild deafness, and 1 person (5%) had moderate deafness.

Another study conducted by Abdullah, Pramono and Ihsani (2017) stated that there was a significant relationship between the degree of noise and the type of deafness in PT Semen Tonasa factory workers. The results showed that out of 82 workers, 28 people (34.1%) experienced sensorineural hearing disorders or Noise Induced Hearing Loss (NIHL), 20 people (24.4%) experienced bone conductive hearing disorders (BCHL), and 4 people (4.9%) had mixed disorders.

Another previous study showed there was a significant relationship between the intensity noise with complaints of hearing loss in workers (Wardani, *et al* , 2020). Risk factors that affect the severity of deafness include noise intensity, frequency, duration of exposure per day, work period, sensitivity of individuals, age and other factors that can cause deafness. Thus, it can be understood that the amount of noise energy exposure received will be proportional to the damage caused. In general, NIHL cannot be cured, but it can be prevented and given rehabilitation (Setyawan, 2021).

On the other hand, several studies on workers showed no relationship between noise intensity and hearing loss (Hanifa, and Tjipto, 2018). A study on iron welding workers in Bandung showed that the results of the statistics using the chi square relationship test showed that there was a non-significant relationship between the intensity noise and hearing loss (Safira, Achmad and Tursina, 2018). This shows that noise intensity is not the only factor that causes hearing loss in workers exposed to noise.

Based on the results of this study, the higher the intensity of noise received by a person, the higher the potential of a person to suffer from health problems, especially the sense of hearing. A work environment that is too noisy can potentially cause workers to experience complaints of hearing disorders and even deafness. The condition of the work environment that has not been controlled optimally causes the relationship between noise intensity and hearing disorders to be more significant.

Machines that have damaged spare parts or have run out of lubrication tend to generate higher noise. Preferably, the company performs control in the form of routine scheduled maintenance and cleaning of machines and work tools. In addition, there should be an application of work rotation, provision of appropriate personal protection equipment, and socialization about the importance of the use of PPE and how to use it properly.

## CONCLUSION

Individual characteristics only have a weak to moderate relationship with subjective hearing complaints. Meanwhile, exposure to noise intensity has a strong relationship with subjective hearing complaints.

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