A Path Analysis: Study of Correlation Between Noise Intensity and Quality of Life of Workers In Textile Industry

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Abstract. Noise intensity is a dangerous stressor in the working environment of the textile industry that can have an impact on the decrease in hearing loss of workers. The decrease in hearing loss will disrupt the workers’ activities in their daily work. Textile industry workers exposed to noise while working every day will potentially be affected by a decrease in hearing loss. Activities that are constantly exposed to noise intensity can also result in a decrease in the quality of workers’ life. This research was conducted to prove the correlation between noise intensity and quality of life through hearing loss using path analysis. Path analysis can explain the correlation between variables indirectly. The research method was used namely analytic survey with the cross-sectional design. The population of the study was workers in 5 textile industries in Central Java Province, Indonesia. The number of subjects was determined based on purposive sampling, each industry was 40 people thus, and the total number was 200 people. The correlation was included independent variables namely noise intensity, work period and age; the mediator variable was a loss of hearing loss, and the dependent variable was quality of life. Path analysis was used as the statistical analysis with Stata 13 software at a significance level of 5%. The research results showed that there was a direct correlation between hearing loss and decreased the quality of life of workers (p = 0.026). The decrease in the quality of workers’ life was also influenced indirectly by noise intensity (p = 0.000) and age (0.012). The working period did not affect the decrease in quality of life (p = 0.210). Increased noise intensity can reduce hearing loss that decreases the quality of life.

1. Introduction

Noise intensity is a dangerous stressor that can cause health problems, including hearing loss(1). Long-term noise intensity can also cause stress (2), hypertension (3), diabetes mellitus (4), and decreased in
quality of life. Noise intensity in the textile industry is interesting to study, especially in developing countries including Indonesia, because there are still many industries that use old models of engines with high noise levels. Declining quality of life due to exposure to noise intensity will affect prosperity. The World Health Organization (WHO) defines quality of life as "individual perceptions of their position in life-based on the cultural context and the value system in which they live and it's related to their goals, hopes, standards, and concerns" (6). The quality of life concept is related to social, environmental, psychological and physical values (7). Kim et al.'s research found a correlation between the daily lives of chronic stroke patients with quality of life, especially dimensions of social mobility and cognition (8). Serra et al. found a correlation between the 6-minutes walking test and quality of life, but there was no correlation between the dimensions of emotional role, mental health, and vitality (9). Hong et al. found that quality of life was significantly reduced in the group of spinal osteoarthritis symptoms (10). In Indonesia, Rahmani and Andean found a correlation between 6WMT activity and quality of life in heart failure outpatients in General Hospital of Dr. Hasan Sadikin Bandung (11).

Previous researches described the quality of life more widely studied in patients and the elderly. We see that research on the quality of workers life that are exposed to hazardous factors from the work environment such as noise intensity has not been conducted. Nada et al. found that in the textile industry produce high noise levels that cause hearing loss for workers, which can disturb the quality of workers life (1). This research was conducted by observing noise intensity as a hazardous risk factor for the labor force that is different from previous researches, and it analyzed using path analysis to find the correlation between noise intensity, hearing loss and quality of life of textile industry workers. This research is useful to be a reference for noise intensity control in the working environment of the textile industry to improve the health status of workers.

2. Material and Methods
   Research Design and Sampling
   Design of the study was a cross-sectional study and sampling technique was used namely proportional purposive sampling. The population was workers in 5 textile industries in Central Java, Indonesia. Inclusion criteria were female gender, minimum work period was 1 year, and the minimum age was 20 years. The number of subjects was determined using the correlative analysis research formula (12). In this study determined Zα (5%) = 1.96, Zβ (10%) = 1.28. The value of r was determined based on the preliminary survey (r = 0.227). Calculations using online software from the Clinical & Translational Science Institute (13), obtained n = 200 people, taken from each company as much as 40 people. Three instruments were used in this study, the first was the demographic characteristics of workers questionnaire, the second was the Short-Form Health Survey (SF-36) to assess the quality of workers' life that had been validated in the general population and various subpopulations(14)(15), and third was pure tone audiometry to measure hearing loss.

Measurement of noise intensity
   Noise measurement used a sound level meter, GM1356 Sanfix type, which results were categorized into categories> 85 dBA and ≤ 85 dBA.

Measurement of age and work period
   Age and work period are calculated in years using demographic data sheets. The age group is based on an average was 42 years, thus the age group was categorized as age > 42 years and ≤ 42 years. The
average working period was 17 years, thus the working period is grouped into >17 years and ≤ 17 years.

**Measurement of hearing loss**
The level of hearing loss was measured using pure tone Audiometry towards both ears at frequencies of 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz, then the average was calculated (16)(17). Measurements are made before the subject works (06.00-08.00). The average hearing loss of both ears = (monaural in the better ear x 5 + monaural in the worse ear x 1) / 6. The American Speech-Language-Hearing Association (ASHA) provides categories of hearing loss to Normal (-10 to 15 dB), slight (16 to 25 dB), mild (26 to 40 dB), moderate (41 to 55 dB), moderately severe (56 to 70), severe (56 to 90), and profound (91 dB or more). In this study, hearing loss was categorized as having hearing loss (≥ 26 dBA) and normal (<26 dBA) (18).

**Measurement of Quality of Life**
The category of quality of life according to Ware et al, a score of 100 is perfect, a score of 84 to less than 100 is very good, a score of 61 to less than 84 is good, a score of 25 to less than 61 is less good, and a score of 0 to less than 25 is not good. This study categorizes the quality of life as being Good with a score of ≥ 61 and less good with a score of <61 (15).

**Statistical analysis**
The descriptive analysis presents cross tables. Bivariate correlation analysis used Chi-Square test. Path Analysis using the Stata 13 Program analyzed the correlation between noise intensity, hearing loss and quality of life.

**Ethical Clearance**
Before the subjects participated, they have filled out informed consent. Subject information is kept confidential. The Health Research Ethics Commission, Faculty of Medicine, Sebelas Maret University issued an ethical clearance, by letter No. 63 / UN27.6 / KEPK / 2018, protocol number: 01/18/04/059 dated April 24, 2018.

3. **Results**

**Information of Social-demographic Respondents**
All subjects were women, Indonesians, and aged between 25 to 50 years with an average age of 42 years. Body mass index between 18.7 kg / m² to 29.9 kg / m² with a mean of 24.1 kg / m². Subjects did not have a smoking habit (100%) and did not have a drinking alcohol habit (100%).

**Expoise noise intensity**
The highest noise intensity was 104 dBA in the weaving section and the lowest was 64 dBA in the warehouse section. The threshold value standard is 85 dBA exposure in 8 working hours of a workday. The hearing protection device used by the subject was cotton. According to the Occupational Safety and Health Administration (OSHA), United States Department of Labor, cotton is not a good hearing protection device.

**Bivariate statistics description of correlation between variable directly**
The correlation between the variables of noise intensity, age, and work period and hearing loss through bivariate was presented in table 1.
Table 1. Correlation between noise intensity, age, and work period and hearing loss (n = 200).

| Variable          | Hearing loss |       |       |     |      |  \( \chi^2 \) |  \( p \) | OR   | CI95%   |
|-------------------|--------------|-------|-------|-----|------|---------------|--------|-------|---------|
|                   | Deaf         | Normal| Total | n  | %    | n  | %    | N   | %     |
| Noise intensity   |              |       |       |    |      |    |      |     |       |
| > 85 dBA          | 94           | 71,2  | 38    | 28,8| 132  | 11,232 | 0,001 | 2,78 | 1,52 – 5,12 |
| \( \leq 85 \) dBA| 32           | 47,1  | 36    | 52,9| 68   | 100 |      |     |       |
| Age (years)       |              |       |       |    |      |    |      |     |       |
| > 42 years        | 57           | 73,1  | 21    | 26,9| 78   | 5,570  | 0,018 | 2,08 | 1,13 – 3,86 |
| \( \leq 42 \) years| 69         | 56,6  | 53    | 43,4| 122  | 100 |      |     |       |
| Work period (years)|          |       |       |    |      |    |      |     |       |
| > 17 years        | 78           | 71,6  | 31    | 28,4| 109  | 7,530  | 0,006 | 2,25 | 1,25 – 4,05 |
| \( \leq 17 \) years| 48         | 52,7  | 43    | 47,3| 91   | 100 |      |     |       |

The correlation between the variables of hearing loss and quality of life through bivariate was presented in table 2.

Table 2. Correlation between the variables of hearing loss and quality of life (n = 200).

| Variable          | Quality of Life |       |       |     |      |  \( \chi^2 \) |  \( p \) | OR   | CI95%   |
|-------------------|-----------------|-------|-------|-----|------|---------------|--------|-------|---------|
|                   | Less Good       | Good | Total | n  | %    | n  | %    | N   | %     |
| Hearing loss      |                |      |       |    |      |    |      |     |       |
| Deaf              | 70             | 55,6 | 56    | 44,4| 126  | 4,996 | 0,025 | 1,94 | 1,08 – 3,48 |
| Normal            | 29             | 39,2 | 45    | 60,8| 74   | 100 |      |     |       |

**Path analysis**

The correlation between variables and test results is presented in Figure 1.
The results of the correlation test between variables using Software Stata 13 is presented in table 3.

Table 3. Path Analysis Results of the correlation between Noise intensity, Hearing Loss and Quality of Life (n = 200)

| Dependent Variable | Independent Variable | Cons  | b     | 95%CI      | p    |
|--------------------|----------------------|-------|-------|------------|------|
| **Direct Effect**  |                      | -0.22 |       |            |      |
| Life quality       | Hearing loss         | 0.66  | 0.08 - 1.25 | 0.026 |
| **Indirect Effect**|                      | -1.99 |       |            |      |
| Hearing loss       | Noise intensity      | 1.52  | 0.78 - 2.25 | 0.000 |
| Hearing loss       | Age                  | 1.09  | 0.25 - 1.94 | 0.012 |
| Hearing loss       | Work period          | 0.46  | -0.25 - 1.17 | 0.210 |

Discussion

This study revealed that there was a negative correlation between hearing loss and the quality of life of textile industry workers directly. Noise intensity and age indirectly reduced the quality of life of workers, while the work period did not correlate with quality of life. Thus, the stressors causing the decline in quality of life in textile industry workers were the intensity of noise intensity and age. The impact of noise intensity exposure on health has been previously studied by Afiah et al. who found that the subjects had dissatisfaction with knowledge, attitudes, and practices against the occurrence of
hearing loss due to noise intensity, then appropriate action is needed to identify workers at risk of hearing loss due to noise intensity (19).

Hearing loss has been also studied in the mining industry, which was found that in the processing department (94 dBA), underground mining (102 dBA), and underground workshops (103 dBA) can cause hearing loss was 36.7% of workers; and will increase as workers age (20). In the tile and ceramics industry, the prevalence of hearing loss was 44% (21). In India textile industry, hearing loss occurred in 39% of workers who were exposed to noise intensity exceeding 87.3 dBA for 8-12 hours a day (22). Research in Malaysia found that hearing impairment costs were a very high financing burden, entrepreneurs need extra effort to carry out hearing conservation program in the workplace and the Malaysian government must enforce regulations effectively to reduce noise intensity exposure in the industry (23).

Hearing loss and quality of life have been studied by Carlsson et al., which found severe and very severe patient of hearing loss had higher anxiety and depression than general patients. Patients who had hearing loss were negatively related to the quality of life of patients (24). Hearing loss due to noise intensity ultimately causes a decrease in the quality of life of agricultural workers (25). The results of different studies stated that there was no correlation between hearing loss and quality of life with HIV patients (26).

Our research found that there was a significant negative correlation between age and quality of life of textile industry workers. This study is in line with Campos et al's study who found that adults have a good quality of life if they maintain personal health and do not have depression, whereas in women with poor physical activity tend to have a poor quality of life (p = 0.022) (27). Thus, increasing age, quality of life can also be maintained well by maintaining personal health, do not get depression and doing good physical activity. This is in line with the statement of Netuveli & Blane, who found that the main factor that influences the good quality of life in old age is depression (28).

This study was not found any relationship between the workers' working period and quality of life. There have not been many comparisons with our study, but von Bonsdorff et al's study found that men with long working hours and lack of sleep, his quality of life were not good at terms of physical function, vitality, and general health. Meanwhile, men with long working hours but regular sleep time had a poor quality of life or physical function in old age (29).

4. Conclusion
Noise intensity and age increase hearing loss, and hearing loss reduces the quality of life of textile industry workers, so the entrepreneur needs to carry out the hearing conservation program.

Conflict of Interest
We declare that there was no conflict of interest in this study.

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