



Analysis of the Relationship Between Noise Level and Work Stress Among Textile Workers at PT X

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Abstract. *Technological advances and increasing job demands have made work stress a major concern in modern industrial environments. Noise is one of the physical workplace factors that may contribute to work stress. This study aimed to analyze the relationship between noise exposure and work stress among workers in the spinning department of PT X. A quantitative cross-sectional design was employed, involving 80 workers selected through purposive sampling. Noise levels were measured using a sound level meter, while work stress data were collected through a standardized questionnaire. Data were analyzed using the Chi-Square test. Most respondents were over 35 years old (80%) and female (54%). The highest noise level was recorded in the spinning room (102.17 dBA), while the fiber preparation room had the lowest level (84.07 dBA). Most workers experienced mild work stress (86.25%), whereas 13.75% reported moderate to high stress. The Chi-Square test showed no statistically significant relationship between noise and work stress ($p = 0.074$). However, the Likelihood Ratio test indicated a significant positive trend ($p = 0.021$). These findings suggest that excessive noise exposure may increase work stress and highlight the need for effective noise control, hearing protection, and stress management programs in the workplace.*

Keywords: *Industrial Workers; Noise; Work Stress; Work Environment*

1. INTRODUCTION

Technological advances and increasing job complexity have made work stress one of the major issues in the modern workplace (Haradhan, 2012). Work stress is defined as a harmful physical and emotional response that arises when job demands do not match an individual's capabilities, resources, or needs. This condition not only affects workers' health but also decreases productivity, job satisfaction, and can lead to various behavioral and health problems such as psychological disorders, fatigue, and physical illnesses (Beheshtifar et al., 2011; Poursadeghiyan et al., 2016).

The causes of work stress are diverse, including job characteristics, individual factors, and physical or psychosocial aspects of the work environment (Marchand et al., 2005; Clegg, 2001). One of the physical factors most frequently associated with work stress is noise in the workplace. Noise, defined as unwanted sound, is a significant occupational environmental hazard because it can affect workers' comfort and health both physiologically and psychologically (Leather et al., 2003; Michie, 2002). Long-term exposure to noise has been proven to cause various negative effects, such as hearing impairment (Abbasi et al., 2015a), cardiovascular diseases (Monazzam et al., 2018), sleep disturbances, and communication difficulties (Jeffery et al., 2013; Krogh et

al., 2019). Furthermore, noise contributes to decreased psychological well-being, job satisfaction, and task performance, and can increase error rates and workplace accident risks (Sun et al., 2018; Zhang et al., 2018; Vassie & Richardson, 2017).

The impact of noise on work stress is also influenced by individual factors such as noise sensitivity and perceived disturbance (noise annoyance). Noise sensitivity is an important factor affecting how individuals perceive sound and the level of stress they experience (Babisch et al., 2013). Individuals with high noise sensitivity tend to have stronger emotional responses and greater difficulty adapting to noise exposure (Zhang et al., 2018), making them more susceptible to psychological distress. In addition, although the use of hearing protective devices (HPD) helps protect hearing, their use can cause additional discomfort and indirectly contribute to increased stress. Therefore, understanding the interaction between noise exposure, individual mediating factors, and work stress levels is an important aspect of occupational health management in industrial environments.

Noise is one of the most significant environmental stressors, both in workplaces and residential areas. A study conducted in six European countries reported that the negative health impact of environmental noise ranked second among nine environmental risk factors (Héanninen et al., 2014). Although moderate noise exposure may not necessarily cause hearing damage, it can lead to sleep disturbances, learning difficulties, annoyance, and an increased risk of ischemic heart disease (WHO, 2011; WHO, 2018). Among various non-auditory impacts, annoyance is identified as the second major health effect after sleep disturbance (WHO, 2011). Previous studies have shown a relationship between the level of noise exposure and perceived annoyance, known as the exposure–response relationship (Guski et al., 2017). In this context, individuals who report an annoyance level of ≥ 8 on a 0–10 scale are categorized as “highly annoyed” (ISO, 2003). The exposure–response relationship varies depending on the noise source, such as road traffic, aircraft, or wind turbines (Guski et al., 2017; Janssen et al., 2011). Variations have also been found across countries and regions indicating that contextual and individual factors influence noise perception and stress.

Although many studies have explored the relationship between noise and stress, most focus on general environmental or residential contexts rather than industrial workplaces. Existing research often emphasizes physiological effects or hearing disorders, while the psychosocial responses to occupational noise remain underexplored. This knowledge gap is significant, as industrial workplaces have distinct noise exposure characteristics compared to general environments, in terms of intensity, duration, and types of noise sources. A comprehensive understanding of how occupational noise contributes to psychological stress, perceived disturbance, and worker performance will be highly beneficial in developing occupational health

policies and management strategies. Based on the above, this study aims to analyze the relationship between workplace noise exposure and perceived stress levels among workers. Specifically, it explores the extent to which moderate to high-intensity noise exposure contributes to stress responses and psychological discomfort. The novelty of this study lies in its effort to integrate environmental noise exposure assessment with psychological stress evaluation in the work context, thereby producing empirical evidence on the non-auditory effects of noise on workers' mental well-being and productivity. The findings are expected to serve as a foundation for developing more effective stress management and occupational health programs in industrial settings.

2. METHODS

This analytical cross-sectional study investigated the relationship between occupational noise exposure and work stress among workers in the spinning department of PT X, Central Java, Indonesia. The study was conducted from May to July 2025. The study population consisted of 195 production workers exposed to occupational noise hazards. Workers aged 18–55 years, with at least six months of employment and willing to participate by signing informed consent, were eligible for inclusion. Workers who were ill during data collection or had a history of hearing disorders before employment were excluded. Using purposive sampling, 80 respondents meeting the eligibility criteria were recruited.

Noise exposure was measured directly using a calibrated Sound Level Meter (SLM Type II) and recorded in dBA. Measurements were conducted at multiple workstations during active working hours to determine average and maximum noise levels. Work stress was assessed using the validated Workplace Stress Scale (WSS), which was self-administered by respondents. Additional demographic and occupational information, including age, sex, length of service, and use of hearing protection devices, was collected through structured questionnaires and interviews.

Data were analyzed using SPSS version 25. Descriptive statistics were used to summarize respondent characteristics, noise exposure, and work stress levels. The association between noise exposure and work stress was examined using the Chi-square test, with a significance level of $p < 0.05$.

3. RESULT AND DISCUSSION

a. Respondent Characteristics

The characteristics of production department workers based on age and gender can be seen in Table 1 below:

Table 1. Respondent characteristics

Variabel	Total	Persen (%)
Age		
≤ 35	16	20
> 35	64	80
Gender		
Male	37	46
Female	43	54
Total	80	100

Based on Table 1, the majority of respondents were over 35 years old (80%), while 20% were aged 35 years or younger. In terms of gender, female workers accounted for 54% of the respondents, whereas male workers represented 46%.

Age is considered an important factor influencing workers' responses to occupational stress. Older workers generally possess greater work experience and job-related skills; however, prolonged exposure to workplace hazards, including noise, may increase susceptibility to fatigue and stress. Previous research has shown that age affects an individual's ability to adapt to work-related stressors, with younger workers often demonstrating greater adaptability than older workers (Wulandari & Setiawan, 2022).

The study also found a slightly higher proportion of female workers than male workers. Gender differences may influence perceptions of stress and physiological responses to occupational noise. Previous studies have reported that female workers tend to experience higher levels of perceived stress in noisy work environments, which may be associated with differences in psychological and hormonal adaptation mechanisms (Pratiwi et al., 2020). These findings suggest that demographic characteristics should be considered when evaluating the impact of workplace noise on workers' stress levels.

b. Noise

The noise levels in the PT X work environment can be seen in Table 2 below:

Table 2. Noise Measurement Results at PT X

Variable	Location	dBA
Noise		
≤ 85	Fiber Preparation Room	84,07
> 85	Spinning Room	102,17

Based on the results of noise level measurements in the PT X work environment, as shown in Table 2, the highest noise level was found in the spinning room, measuring 102.17 dBA, while the lowest noise level was recorded in the fiber preparation room, at 84.07 dBA.

The measurement results showed that the noise level in the spinning room reached 102.17 dBA, while the fiber preparation room recorded 84.07 dBA. Noise levels exceeding 85 dBA surpass the Threshold Limit Value (TLV) set by the Minister of Manpower and

Transmigration Regulation of the Republic of Indonesia No. PER.13/MEN/X/2011, which is 85 dBA for 8 hours of exposure.

Noise exposure above the TLV can cause both physiological and psychological disturbances in workers, including concentration problems, fatigue, irritability, and increased work stress (Suma'mur, 2018). According to research by Susilowati et al. (2021), exposure to noise above 90 dBA can double the risk of work stress compared to workers exposed to environments with noise below 85 dBA.

c. Work Stres

Work stress in the PT X work environment can be seen in Table 3 below:

Table 3. Work Stres Measurement Results at PT X

Variable	Total	Persen
Work Stres		
Mild	69	86,25
Moderate to high	11	13,75
Total	80	100

Based on Table 3, the majority of respondents were classified as experiencing mild work stress, with 69 workers (86.25%) falling into this category. Meanwhile, 11 workers (13.75%) were categorized as experiencing moderate to high levels of work stress.

The predominance of mild stress levels suggests that most workers were able to adapt to workplace demands and environmental conditions. However, the presence of workers experiencing moderate to high stress indicates that certain occupational factors may still contribute to adverse psychological responses. Work stress occurs when job demands exceed an individual's capacity to cope effectively with workplace pressures (Robbins & Judge, 2019).

In industrial settings, noise is recognized as an environmental stressor that can affect both physiological and psychological well-being. Continuous exposure to high noise levels may activate the autonomic nervous system and stimulate the release of stress-related hormones, including cortisol, thereby increasing the risk of stress-related symptoms such as fatigue, irritability, and reduced concentration (Wibowo & Indrawan, 2020). Although most workers in this study reported mild stress levels, prolonged exposure to occupational noise may contribute to elevated stress among more vulnerable individuals, emphasizing the importance of effective noise control and workplace stress management programs.

d. The Relationship Between Noise and Work Stress in the PT X Work Environment

Work stress levels in the PT X workplace can be seen in Table 3 below:

Table 4. The relationship between noise and work stress at PT X

Noise	Mild Stress		Moderate to High Stress		Total	Pearson χ^2 (p-value)	Likelihood Ratio (p-value)
	n	%	n	%			
≤ 85 dBA (Non-Noisy)	16	100	0	0	16	0,074	0,021
> 85 dBA (Noisy)	53	82,8	11	17,2	64		
Total	69	100	11	100	80		

Based on Table 4, all workers exposed to noise levels ≤85 dBA experienced mild work stress (100%). In contrast, among workers exposed to noise levels >85 dBA, 17.2% reported moderate-to-high work stress. The Chi-square test showed no statistically significant association between noise exposure and work stress (p = 0.074). However, the Likelihood Ratio test yielded a significant result (p = 0.021), indicating a positive tendency toward an association between noise exposure and work stress.

Descriptively, workers exposed to noise levels above 85 dBA showed a higher proportion of moderate-to-high stress than those exposed to lower noise levels. Although the association was not statistically significant in the Chi-square analysis, these findings suggest that excessive workplace noise may contribute to increased psychological strain among workers.

The present findings are in line with previous studies demonstrating that occupational noise acts as an environmental stressor. Dehaghi et al. (2020) reported that workers exposed to chronic industrial noise exhibited altered salivary cortisol patterns, indicating activation of physiological stress responses. Similarly, Golmohammadi et al. (2019) found that higher occupational noise exposure was associated with increased serum cortisol levels among industrial workers, suggesting elevated stress due to noise exposure. Furthermore, Stansfeld and Matheson (2003) concluded that long-term noise exposure can adversely affect mental health by increasing annoyance, reducing concentration, and triggering psychological stress responses.

The relationship between noise exposure and work stress may be explained through activation of the autonomic nervous system and the hypothalamic-pituitary-adrenal (HPA) axis. Prolonged exposure to excessive noise can increase the secretion of stress hormones, such as cortisol and adrenaline, leading to psychological and physiological responses including tension, fatigue, impaired concentration, and decreased work performance. This

mechanism is supported by Sumardiyono et al. (2020), who found differences in blood cortisol levels among workers exposed to continuous occupational noise, indicating that noise can trigger biological stress responses.

Although the Chi-square test did not show a statistically significant association between noise exposure and work stress ($p = 0.074$), the significant Likelihood Ratio result ($p = 0.021$) and the higher proportion of moderate-to-high stress among workers exposed to noise levels above 85 dBA suggest a tendency toward increased stress with higher noise exposure. The lack of statistical significance may be influenced by individual factors such as age, work experience, duration of employment, coping ability, and adaptation to workplace conditions.

These findings highlight the importance of addressing occupational noise not only as a hearing hazard but also as a potential psychosocial risk factor. Therefore, workplaces should strengthen noise-control measures through engineering controls, regular noise monitoring, consistent use of hearing protection devices, and stress management programs. Implementing these interventions may help reduce the adverse effects of noise exposure while improving worker well-being and productivity.

4. CONCLUSION AND RECOMMENDATIONS

This study shows that most respondents in the spinning department of PT X were over 35 years old (80%) and female (54%), representing a productive age group with relatively long work experience. The highest recorded noise level in the spinning room was 102.17 dBA, exceeding the 85 dBA TLV stipulated in Ministerial Regulation No. PER.13/MEN/X/2011, posing potential physical and psychological health risks to workers.

Most workers experienced mild work stress (86.25%), while 13.75% experienced moderate to high stress, reflecting varying levels of adaptation to the work environment. The Chi-Square test showed no significant relationship between noise and work stress ($p = 0.074$), but the Likelihood Ratio test ($p = 0.021$) indicated a positive trend between the two variables. This suggests that higher workplace noise levels may increase workers' stress levels. Although the relationship was not statistically significant, the trend indicates that noise exposure is a potential risk factor for work stress among textile workers. Therefore, it is essential for companies to implement noise control measures, provide hearing protection devices, and establish work stress management programs to enhance workers' health and well-being.

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