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ANALYSIS OF TEXTILE INDUSTRY NOISE THROUGH NOISE EXPOSURE, NOISE SENSITIVITY AND NOISE ANNOYANCE OF WORKERS

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Abstract

Noise, the effects of which are revealed later in the occupational health, causes many problems for workers. This paper aims to analyze the results of exposure measurements in a textile factory and to provide a holistic assessment of the noise sensitivity and annoyance. In the case study, noise exposure levels in a textile factory were measured according to ISO 9612:2009. Additionally, a face-to-face structured noise annoyance questionnaire and the Weinstein Noise Sensitivity Scale (WNSS) were applied to workers. The findings were analyzed and evaluated with statistical methods. High levels of noise exposure were measured in the spinning and weaving units of the case study, with levels of 88,5 - 92,3 dBA. Workers identified fibers and powders (67,1%) and noise (58,9%) as crucial parameters affecting indoor comfort levels. A positive and significant relationship was also found between the WNSS Total Score and the noise annoyance levels of the workers (p<0,05). It has been determined that there are high levels of indoor noise in textile factories, which are a representation of working environments. In conclusion, it is necessary to increase noise awareness among workers and to reduce indoor noise level through effective engineering and administrative control precautions.

Keywords: *Noise annoyance, Noise sensitivity, Industrial noise, Occupational noise exposure, Textile factory.*

TEKSTİL ENDÜSTRİSİ GÜRÜLTÜSÜNÜN ÇALIŞANLARIN GÜRÜLTÜ MARUZİYETİ, GÜRÜLTÜ HASSASİYETİ VE GÜRÜLTÜ RAHATSIZLIĞI ÜZERİNDEN ANALİZİ

Öz

İş sağlığında etkileri sonradan ortaya çıkan gürültü, çalışanlar için birçok soruna neden olmaktadır. Bu çalışma, bir tekstil fabrikasında gürültü maruziyet ölçümlerinin sonuçlarını analiz etmeyi ve gürültü duyarlılığı ve rahatsızlığının bütünsel bir değerlendirmesini sağlamayı amaçlamaktadır. Alan çalışmasında, bir tekstil fabrikasındaki gürültü maruziyet seviyeleri ISO 9612:2009 standardına göre ölçülmüştür. Ayrıca, çalışanlara yüz yüze yapılandırılmış bir gürültü rahatsızlığı anketi ve Weinstein Gürültü Hassasiyeti Ölçeği (WNSS) uygulanmıştır. Elde edilen bulgular istatistiksel yöntemlerle analiz edilmiş ve değerlendirilmiştir. Alan çalışmasının eğirme ve dokuma ünitelerinde 88,5-92,3 dBA seviyelerinde yüksek gürültü maruziyet düzeyleri ölçülmüştür. İşçiler elyaf ve tozları (%67,1) ve gürültüyü (%58,9) iç mekân konfor seviyelerini etkileyen önemli parametreler olarak tanımlamıştır. WNSS Toplam Puanı ile çalışanların gürültüden rahatsız olma düzeyleri arasında da pozitif ve anlamlı bir ilişki bulunmuştur (p<0,05). Çalışma ortamlarının bir temsili olan tekstil fabrikalarında yüksek düzeyde iç mekân gürültüsü olduğu tespit edilmiştir. Çalışmanın sonucunda, işçiler arasında gürültü farkındalığının artırılması ve etkili mühendislik ve idari kontrol önlemleri ile iç mekân gürültü seviyelerinin azaltılması gerekliliği ortaya konulmuştur.

Anahtar kelimeler: *Gürültü rahatsızlığı, Gürültü hassasiyeti, Endüstriyel gürültü, Mesleki gürültü maruziyeti, Tekstil fabrikası.*

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1. INTRODUCTION

In the 18th century, with the start of the Industrial Revolution in Europe and America, there were major changes in production methods and technology, and the machine age, symbolizing industrial production, was born. Thanks to machines, manpower was replaced by machine power, thus speeding up production, reducing costs, and increasing product quality. The first mechanization process was seen in the weaving, mining, manufacturing, transportation, and energy sectors; it soon spread to other sectors. With this transformation brought about by the Industrial Revolution, many countries around the world aimed to replace manpower with machine power and thus achieve faster processing times and lower labor costs (Ersoy et al., 2022). With industrialization and mechanization, the need to ensure the occupational health and safety of workers has emerged to improve working environments (Albayrak et al., 2023). Occupational health and safety issues have become an area that is increasingly researched and examined with the increase in working environments and social development (Chen et al., 2020). Various risk factors in the field of occupational health and safety, such as fire and falling from heights, pose a significant danger. However, risk factors that have immediate effects, such as temperature, dust, lighting, and noise, also pose a danger later. It is difficult to identify risk factors that pose a risk later and to observe their effects, and they have uncertainties for the future (Sokas and Sprince, 2008). Exposure to high noise in workplaces causes serious problems that can lead to permanent noise induced hearing loss when observing its effects (Zainal Abidin et al., 2018; Chong et al., 2022). High noise has great effects on physical, physiological, psychological and work performance along with hearing losses (Ege et al., 2003; Mehri et al., 2018).

Exposure to occupational noise has been determined as the second most identified disease in developing countries (WHO, 2009). Occupational noise is an inevitable consequence of mechanization and is a common problem in many industrial environments such as production facilities, factories, industrial areas, vehicles, etc. High noise levels in these environments can pose various health risks to workers (Albayrak et al., 2023). Noise-induced hearing loss (NIHL) is an occupational hazard particularly encountered by textile workers (Osibogun et al., 2000). Textile factories are considered large and intense working areas. Different production processes lead to machine and human interactions (Koradecka, 2010). This makes it difficult to characterize the noise, analyze and interpret it according to its tonal components (Rimskya-Korsakova et al., 2022). Accordingly, the human ear is not equally sensitive to noise. To identify sound, a weighting of A is used depending on the sensitivity of the ear (Ordoñez et al., 2010). Through weighting, noise exposure levels are calculated for workers depending on their working time. Noise exposure levels are presented as an objective acoustics parameter. In the USA, the Occupational Safety and Health Administration, OSHA, states that factory workers should limit their workers' exposure to 90 dBA during an 8-hour period (OSHA, 1974; Onur et al., 1998). In the regulation of different countries, 8-hour noise exposure levels in working environments are limited to 85, 87 and 90 dBA (Yaman et al., 2024).

In occupational health and safety, exposure to high noise in working environments leads to noise annoyance among workers. Noise annoyance is a reaction to existing noise and is related to the noise sensitivity of individuals. Noise annoyance is associated with physical and mental problems of workers (Maschke and Niemann, 2007). Noise annoyance affects individuals' stress, anger, and depression and cause job dissatisfaction (Poursadeghiyan et al., 2016; Bolaji et al., 2018). Along with such psychological effects, noise can have an impact on healthy life, including sleep problems (Park et al., 2022). The detection of noise annoyance is realized by analyzing the noise sensitivity of workers. Noise sensitivity can be defined as a specific individual attitude that can change the intensity of the response to existing noise (Hill, 2012; Di et al., 2022). There are many studies on analyzing noise sensitivities and noise annoyance (Abbasi et al., 2020; Yaman et al., 2023). In the studies, noise sensitivity and noise annoyance are analyzed according to noise exposure. It is necessary to create sustainable and effective working environments by identifying the noise annoyance of workers in working environments and developing solutions.

Factory workers are commonly exposed to elevated noise levels, which can impact both their health and productivity. In line with occupational health and safety standards, workplaces are expected to maintain an acoustic environment that supports human ergonomics and minimizes adverse health effects. This study focuses on assessing noise annoyance levels and understanding the broader impact of noise exposure on workers. In this paper, the research was carried out on a sample of textile factories, which are intensely noisy environments and have great employment opportunities.

2. MATERIALS AND METHODS

2.1. Study Design and Area

The research conducted on the case study take place in Gaziantep, Türkiye. The textile factory taken as the case study area is a large factory covering spinning and weaving units. A total of 146 workers in the factory are exposed to high levels of noise, heat and dust due to the factory process. Analyzing the noise annoyance of workers exposed to high noise levels, depending on their noise sensitivity, is a crucial subjective assessment.

2.2. Materials, Techniques, and Procedures

2.2.1. Acoustics Measurements

Acoustic measurements were conducted in a selected textile factory as part of a case study. These measurements aimed to determine noise exposure levels in accordance with the ISO 9612:2009 standard, based on the duration specified by the relevant regulations. Noise dosimeters (SV 104) were used to measure the levels, with data collected from nine different workers. SV 104 is a noise dosimeter that meets the specifications of IEC 61252 (Europe) and ANSI S1.25-1991 (the United States). The assessment of workers' noise exposure was performed in compliance with the Regulation on the Protection of Workers from Noise-Related Risks, which aligns with the European Parliament and Council Directive 2003/10/EC. Measurements took place during the factory's normal operating conditions, and the workers' noise exposure levels were calculated using the following formula, based on an 8-hour workday.

$$L_{EX,8h,m} = L_{p,A,eq,T_m} + 10\log(\frac{\bar{T}_m}{T_0}) \quad (1)$$

The expression $L_{p,A,eq,Tm}$ in the formula represents the A-weighted equivalent continuous sound pressure level for task m; The expression T_m represents the arithmetic average time of task m; The expression T_0 defines the reference time (8 hours: 28 800 seconds).

2.2.2. Questionnaire for Noise Annoyance Assessment

There are no comprehensive standards established to identify and determine the noise annoyance of workers. However, with reference to the ISO/TS 15666:2021 standard for residential occupants, a four-part noise annoyance questionnaire was developed. The questionnaire included sections on personal and work environment information, the effects of acoustic performance during and after work, and the evaluation of workers' noise awareness. It consisted of structured questions, open-ended questions, checklists, and a 5-point Likert scale. The questionnaire was administered in person, using printed documents, within the workplace. This approach ensured that the factory's operations were not disrupted during the process.

2.2.3. Weinstein Noise Sensitivity Scale, WNSS

Participants show varying responses to ambient noise, with noise sensitivity recognized as a key factor in predicting noise annoyance. As a personality trait, it influences how one perceives and reacts to noise. In 1978, Weinstein developed the Weinstein Noise Sensitivity Scale (WNSS), a unidimensional self-report tool for measuring noise sensitivity. This scale comprises 21 items that assess emotional reactions and attitudes toward general noise and everyday environmental sounds. Noise sensitivity exists on a continuum, ranging from high to low. Participants with high sensitivity tend to react more negatively to noise compared to those with lower sensitivity.

The English and translated versions of the WNSS have demonstrated comparable reliability estimates. Weinstein originally reported acceptable reliability using the Kuder-Richardson formula (*r = 0,83*) (Weinstein, 1978). Other studies have found reliability estimates in the 0,70 (Stansfeld, 1992), but more commonly in the

0,80 (Ekehammer & Dornic, 1990; Zimmer & Ellermeier, 1999). The Turkish version of the WNSS (Tr-WNSS), translated and validated by Keskin Yıldız et al., was used in this study with their permission (Keskin Yıldız et al., 2020). The Tr-WNSS was administered face-to-face in the work environment using printed documents, ensuring the process did not disrupt factory operations.

Tr-WNSS was applied to 146 workers in a textile factory. All workers responded to the scale on a voluntary basis. Through the case study, 131 workers gave complete answers to the WNSS questions (21 questions), and their WNSS total scores were determined. Workers are expected to rate '*agree*' and '*disagree*' with the statements in the relevant items. The division of the WNSS total score into noise-sensitive and non-noise-sensitive was determined as the first 1/3 with the highest score and the first 1/3 with the lowest score, as in Weinstein's study.

2.3. Statistical Analysis

In the final phase of the study, the data collected from various measurements, scales and questionnaires were thoroughly analyzed using SPSS software version 20, with a confidence level set at 95%. The analyses primarily focused on subjective evaluations gathered from the factory workers, as well as objective noise exposure measurements. Before conducting any statistical tests, it was important to check whether the data followed a normal distribution, which is a common assumption in many parametric statistical methods. Given the size of the sample distributions, the assumption of normality was accepted based on the Central Limit Theorem (CLT). According to the CLT, for sufficiently large sample sizes, the distribution of the sample means will tend to approximate a normal distribution, even if the original data are not normally distributed (Correia et al., 2017). This allowed for the use of parametric tests in the analysis. Two main statistical methods were employed to explore the relationships within the data. First, Pearson correlation coefficients were calculated to determine the strength and direction of relationships between continuous research variables. The Pearson correlation method is widely used for analyzing relationships between numerical variables. It provides a correlation coefficient ranging from -1 to 1, where a value of 0 indicates no correlation, 1 represents a total positive correlation, and -1 indicates a total negative correlation (Nettleton, 2014). This coefficient helps to assess both the strength and direction of the relationship between variables, making it a useful tool for understanding associations in data. This analysis helped to identify how closely variables such as noise exposure levels and worker sensitivity were related. Additionally, Analysis of Variance (ANOVA) tests were performed to determine if statistically significant differences existed between multiple groups (Sawyer, 2009). ANOVA was particularly useful for comparing worker groups based on factors such as noise exposure levels, noise sensitivity, and demographic characteristics, including age and years of experience. By applying these tests, the study aimed to uncover meaningful patterns and differences within the dataset, helping to better understand how noise impacts various worker groups and whether specific interventions might be needed for those more affected by noise (Fig. 1).

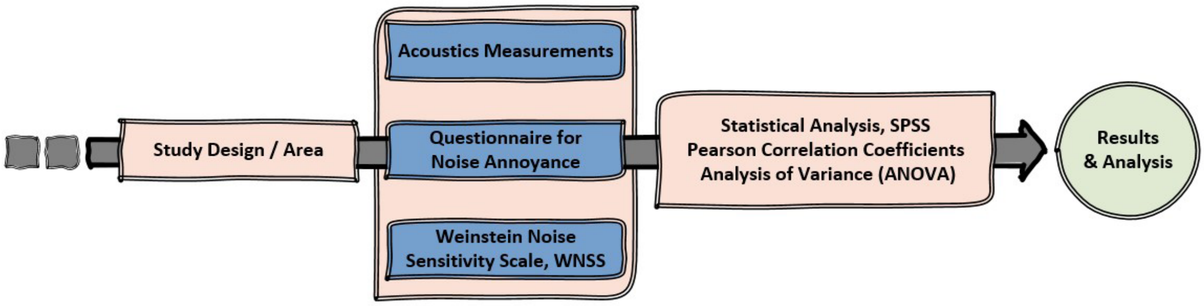

Figure 1: Research methodology and flow chart

3. RESULTS

Acoustic measurements carried out in the case study revealed that workers were exposed to high levels of noise. High levels of noise exposure (88,5-92,3 dBA) create especially in the spinning and weaving units of the factory (Table 1). These values are above the limit values (87 dBA) accepted in Türkiye (Regulation on the Protection of Workers from Noise-Related Risks). The electricity generation section through cogeneration was planned to be independent from the factory. However, it causes an increase in environmental noise from the factory.

Table 1: Noise exposure levels in various parts of the factory

Measure No	Units of the Facility	Sound Exposure Level dBA $L_{EX,8\ hour}$
1	Quality Control	76,2 ± 3,1
2	Folding-Twisting	79,7 ± 3,2
3	Open-End Spinning	88,5 ± 3,0
4	Draw Frame	79,6 ± 3,1
5	Carding	80,0 ± 3,0
6	Pre-treatment	80,2 ± 3,0
7	Weaving - 1	92,3 ± 3,1
8	Weaving - 2	90,3 ± 3,1
9	Cogeneration Electric	101,9 ± 3,2

A questionnaire was applied in the factory, with participation from 146 workers. These workers represented various units within the facility, ensuring a diverse range of perspectives on noise-related issues. While the age, education level, and employment time of the workers are normally distributed (skewness and kurtosis values are between +1,0 – 1,0), the gender of the workers is not normally distributed (Hair et al., 2013). Since the ratio of the number of female workers to the number of male workers in the factory is very low, the gender factor is excluded from the scope of the research.

The age distribution of the workers was 21 (14,4%) between the ages of 18-25, 54 (37%) between the ages of 26-35, 46 (31,5%) between the ages of 36-45, 24 (16,4%) between the ages of 46-55, and 1 (0,7%) between the ages of 56-75. Of the workers, 132 were male (90,4%) and 14 were female (9,6%). The educational level of the workers was determined as 52 primary school (35,6%), 45 secondary school 30,8%), 41 high school 28,1%), and 8 university or college (5,5%). The employment time of the workers were analyzed as less than 1 year for 15 participants (10,3%), 1-5 years for 82 participants (56,2%), 5-10 years for 42 participants (28,8%), 10-20 years for 6 participants (4,1%), more than 20 years for 1 participant (0,7%).

Textile workers defined the most decisive factors for the parameters affecting indoor comfort levels as fibers and powders (67,1%). The next comfort determining parameter was determined to be indoor noise (58,9%). Other parameters affecting comfort levels were found to be at lower values (Fig. 2).

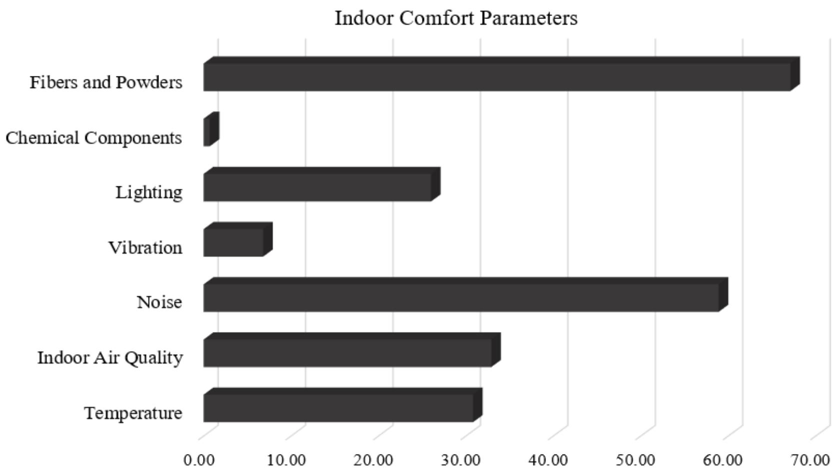

Figure 2: Indoor comfort levels parameters

Textile workers were asked to report their levels of noise sensitivity. Among them, 41,1% (60 workers) indicated low noise sensitivity, while 34,2% (50 workers) reported moderate noise sensitivity. According to the Pearson correlation analysis, a significant positive relationship was found between workers' self-reported noise sensitivity and both their age (*p<0,01*) and employment time (*p<0,05*). In contrast, a significant negative correlation was observed between workers' noise sensitivity and their education level (*p<0,05*). Moreover, the results of the One-Way ANOVA revealed a significant difference in noise sensitivity levels based on the workers' age (*p<0,05*). The average noise sensitivity levels tended to increase as workers' age increased. A significant difference was also found between noise sensitivity levels based on workers' education levels (*p<0,05*). Overall, the findings showed that noise sensitivity increased with age and employment time, suggesting that older and more experienced workers tend to be more sensitive to noise.

In the structured noise annoyance questionnaire applied to factory workers, participants were asked to assess their noise annoyance level. The results showed that 41,1% (60 workers) reported low noise annoyance, while 34,2% (50 workers) indicated moderate noise annoyance. Pearson correlation analysis revealed a significant positive relationship between the workers' self-reported noise annoyance and both their age (*p<0,01*) and employment time (*p<0,01*). Additionally, One-Way ANOVA results demonstrated a significant difference in noise annoyance levels based on the workers' age (*p<0,05*), with mean noise annoyance levels increasing progressively with age. However, no correlation was found between the workers' noise annoyance levels and their educational level. Furthermore, a significant positive correlation was identified between workers' noise sensitivity and noise annoyance (*p<0,01*) (Table 2). This suggests that workers who reported higher noise sensitivity also experienced greater annoyance.

Table 2: Relationship between demographic data, noise annoyance, and noise sensitivity

Variables	n	Avg.	SS	1	2	3	4	5
1. Noise sensitivity	144	2,42	0,89	-	0,26**	-0,18*	0,19*	0,53**
2. Age	146	2,52	0,95	0,26**	-	-	-	0,24**
3. Education level	146	3,03	0,92	-0,18*	-	-	-	-0,15
4. Employment time	146	2,29	0,73	0,19*	-	-	-	0,23**
5. Noise annoyance	144	2,23	0,91	0,53**	0,24**	-0,15	0,23**	-

*p < 0,05; **p < 0,01

72,6% (106 participants) of the factory workers stated that they speak loudly to be heard by their coworkers who are 1 m away. However, 47,7% (51 participants) of the workers who stated that they speak loudly to be heard stated that they do this sometimes, 24,3% (26 participants) often, 15,9% (17 participants) rarely.

In textile factories, the noise source that most disturbs the workers in the interaction of machinery and workers was asked. The evaluations of the workers were made to determine the sources. 67,1% (98 participants) of the factory workers identified other working machines as the most annoying noise source, followed by 57,5% (106 participants) who identified their own working machine as the most annoying noise source (Fig. 3).

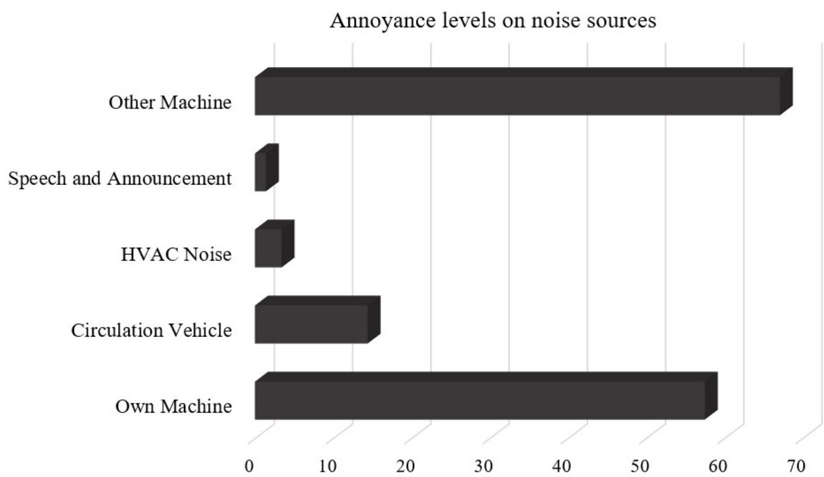

Figure 3: Annoyance levels on noise sources

In the analysis of the noise annoyance questionnaire, which focused on the negative effects of noise as reported by workers, it was found that noise was most commonly associated with headaches, affecting 59,6% of the participants (84 workers). This was the most frequently reported issue among the negative effects of noise. Following headaches, other notable adverse effects included stress, reported by 38,6% of the workers (54 workers), tinnitus, experienced by 33,1% (46 workers), and feelings of nervousness, reported by 28,6% (40 workers) (Fig. 4). These findings highlight the significant impact of noise on the well-being of workers.

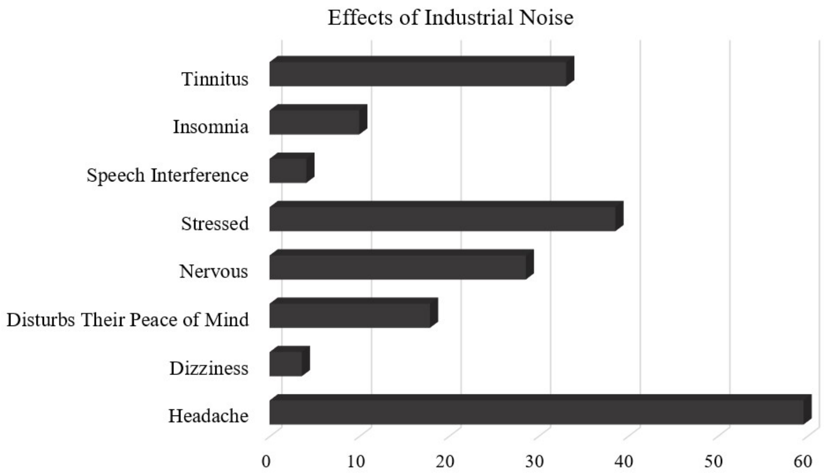

Figure 4: Effects of industrial noise

The usage rates of hearing protective equipment, HPE, were analyzed through questionnaires administered to factory workers. HPE usage rates of the workers are 41,1% (60 participants) constantly, 24,7% (36 participants) never, 19,9% (29 participants) often, 10,3% (15 participants) sometimes, 2,7% (4 participants) rarely responses were received. Workers were asked about the parameters that affect situations where HPE usage rates are not constant. 31,3% of the workers stated that HPE prevents communication. Afterwards, 29,7% indicating the neglecting-forgetting of the equipment respectively. There are 25,4% distributions stating that they do not need it (Fig. 5).

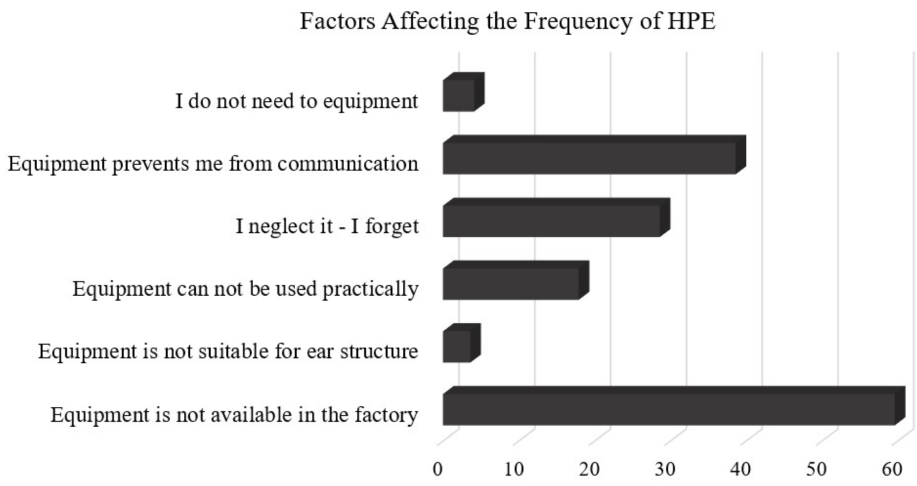

Figure 5: Factors affecting the frequency of HPE

Workers who scored in the middle range on the WNSS were classified as moderately sensitive to noise. The analysis of these workers indicated that the upper cut-off value for the lower sensitivity group was set at 72 points, which included 47 participants. Meanwhile, the lower cut-off value for the upper sensitivity group was established at 77 points, encompassing 45 participants. This categorization facilitates a better understanding of the varying levels of noise sensitivity, allowing for targeted interventions and support for those most affected by noise. In determining the one-third ratios, participants with identical scores were directly assigned to the corresponding group. The mean score for the lower sensitivity group was 68,17 ± 3,08 points, whereas the mean score for the upper sensitivity group was 84,02 ± 8,26 points. Overall, the average score of the 131 workers who completed the scale was 75,44 ± 8,48 points.

A positive and significant correlation was found between the WNSS total score applied to the workers and the workers' description of their noise sensitivity levels in the questionnaire (*p<0,01*). There was also a positive and significant correlation between the WNSS total score and the workers' description of their noise annoyance level in the questionnaire (*p<0,05*). These data show that the questionnaire and the scale (WNSS) are compatible (Table 3).

Table 3: Relationship between WNSS total score, noise sensitivity, and noise annoyance

Variables	n	Avg.	SS	1	2	3
1. WNSS Total Score	144	75,44	8,48	-	0,34**	0,20*
2. Noise sensitivity	144	2,42	0,89	0,34**	-	-
3. Noise annoyance	144	2,23	0,91	0,20*	-	-

*p < 0,05; **p < 0,01

4. DISCUSSION

When the noise levels to which the factory workers are exposed are examined, it has been determined that there are high risks in the weaving and spinning units. Noise exposure levels ($L_{EX,8h}$) were measured at the level of 90-92 dBA in the weaving unit and 88 dB(A) in the spinning unit. Studies conducted in different periods in developing countries support high levels of noise in textile factory (especially in weaving units) (Duran et al., 2020; Ersoy et al., 2022; Shakhatreh et al., 2000; Yaman Turan ve Öney, 2021; Yıldırım et al., 2007). It is observed that hearing loss occurs in workers due to high noise levels. Hearing losses vary according to age, gender, and years of exposure to noise (employment time) (Abraham et al., 2019). Oleru determined that there is a hearing loss in the range of 2-11 dB in textile workers who have been working continuously for more than seven years (Oleru, 1980).

Textile workers stated that the most important factors affecting indoor comfort levels are fibers and powders. Afterwards, workers stated that there were noise levels. Additionally, it has been stated that indoor air quality is low due to fibers and powders. Although fibers and powders are collected by the suction channels, a problem is encountered depending on the processes. Rahman et al. found that textile factories have significantly high levels of indoor environmental pollutants and accordingly textile workers are exposed to oxidative stress to a large extent (Rahman et al., 2020).

In the questionnaire applied to the workers, the workers were asked to rate their noise annoyance and noise sensitivity. It has been determined by statistical analysis that noise annoyance increase depending on the noise sensitivity of the workers. It seems that noise sensitivity interacts with noise annoyance and occur in different ways according to any noise source and affect various psychological and diseases such as hypertension (Baudin et al., 2021; Stansfeld et al., 2021). It has been determined that noise annoyance and noise sensitivity of worker's increase depending on the age and employment time of the workers. It has been determined that as the education level of the workers increases, the noise sensitivity of the workers decreases. This situation can be explained by factors such as good working conditions (positions away from noise) or successful methods of coping with noise.

It has been determined that the most important factor in the effects of noise on workers is headache. Headache was followed by nervousness, tinnitus, and stressed. This indicates that both physiological and psychological negative effects of noise are observed in workers. However, Bolaji et al. stated in their studies that the effects of noise on workers are physiological rather than psychological (Bolaji et al., 2018). Atmaca et al. found that 64% of textile factory workers reported that noise increased their nervousness (Atmaca et al., 2005).

Workers talking loudly to their colleagues at a distance of one meter and identifying other machines and their own machines as sources of high noise indicate that they are directly exposed to high sound pressure levels. In addition, speaking at a high volume to a colleague at a distance of one meter shows that the sound pressure level in the environment is 78-80 dB above (ISO 9921, 2004). It has been determined that the Lombard Effect, defined as a symptom of involuntary voice raising, is intensely observed among workers in factories, which are closed spaces with high levels of noise (Brumm and Zollinger, 2011; Bottalico, 2018;). Workers identified the highest noise sources affecting them as machines. Due to machine and human interaction (direct source and receiver interaction), it reduces the effect of noise control measures to be taken on the transmission path. Noise control measures at the source and noise control measures at the receiver give more effective results.

The frequency of use of hearing protection equipment by workers was evaluated. More than half of the workers said they use hearing protection equipment. Regarding the frequency of use, the reasons are explained that the equipment is not suitable in sufficient numbers in the factory, the equipment prevents communication, is forgotten or neglected. Meinke and Stephenson defined the 5C's that affect hearing protection equipment use cases in their study. 5C's; it is defined as comfort, convenience, cost, communication and climate (Meinke and Stephenson, 2007; Stephenson, 2009). Within the scope of all these parameters, the lack of intrinsic motivation that prevents communication towards workers in the use of hearing protective equipment has been determined in this paper. It is thought that this situation can be solved as a result of hearing protection training and increasing noise awareness among workers.

In the analyzing of the total scores from Weinstein's Noise Sensitivity Scale (WNSS) applied to the workers, the upper cut-off value for the lower sensitivity group was established at 72 points. Meanwhile, the lower cut-off value for the upper sensitivity group was set at 77 points. This analysis helps categorize workers into different sensitivity groups based on their noise sensitivity levels. In their study, Abbasi et al. determined the average of noise sensitivity of textile workers to be 70,3 points (rating 0-5 indicators) (Abbasi et al., 2019). In their study, Abbasi et al. determined the average of noise sensitivity of workers as 72,5 points (weaving) and 73,6 points (spinning) (rating 0-5 indicators) (Abbasi et al., 2020). It was determined that the WNSS total score noise sensitivity obtained in the case study were similar to the studies in the literature.

5. CONCLUSION

As a result of the increase in working environments, occupational health and safety has become an issue that is being researched and examined day by day. Factors such as temperature, dust and lighting, whose effects are felt later in occupational health and safety, constitute important design criteria that need to be examined. Ambient noise is one of the leading design criteria. Analyzing ambient noise brings acoustic measurements and subjective evaluations.

In samples representing various working environments, it was found that indoor noise levels in textile factories were considerably high. This finding raises concerns regarding the overall working conditions and the potential impact on workers' health and well-being. Through the administration of questionnaires and noise sensitivity scales to the workers, it became evident that noise significantly affects indoor comfort conditions within these settings. The analysis revealed a significant and positive correlation between workers' noise sensitivity, as measured by the Weinstein Noise Sensitivity Scale (WNSS), and their reported levels of noise annoyance. This indicates that workers who are more sensitive to noise are also more likely to experience higher levels of annoyance due to the prevalent noise in their work environment. It has been determined that noise annoyances of worker's increase depending on their noise sensitivity and ambient noise, and that there are situations where they work in a noisy environment. It has been observed that physiological and psychological negative effects occur due to noise exposure and noise annoyance. It has been found appropriate to increase the frequency of use of hearing protective equipment in reducing the negative effects of noise. Additionally, it has been deemed necessary to increase noise awareness among workers through hearing training programs and to reduce indoor noise with effective engineering and administrative control precautions. In future studies on health effects related to noise exposure, it is considered important to consider and analyze noise annoyance and noise sensitivity using appropriate statistical models based on mediation analysis and causal inferences.

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