Original Article

Noise Exposure, Noise Sensitivity and Psychological Distress in Workers of a Textile Industry, Iran (2022)

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Article Info

Abstract

Background: Noise pollution is one of the known harmful factors in workplaces. Noise can have different psychological consequences. Noise annoyance (NA) and noise sensitivity (NS) are seen as mediators in the study of noise impacts. The present study was conducted to investigate the association between NA and NS with psychological distress (PD).

Materials and Methods: This cross-sectional study was conducted among 115 textile workers. The sampling method was stratified random sampling. Noise exposure (NE) was determined by a noise dosimeter. NA, NS, and PD were assessed using Noise Annoyance Scale (NAS), Weinstein's Noise Sensitivity Scale (WNSS), and Kessler Psychological Distress Scale, respectively. Data analysis was performed in SPSS-22 software.

Results: The median (interquartile range) of NA was equal to 7 (3). The mean (standard deviation) of NS was equal to 66.33 (15.76). The results showed that there is a positive and significant association between equivalent sound level, and PD (P=0.01, r = 0.23). The results of our study showed that PD had a significant difference in diverse levels of NA (P=0.01) and NS (P<0.001).

Conclusion: In general, the annoyance caused by NA and NS can affect people's PD. Therefore, it is suggested to pay attention to these factors in studying the consequences of noise exposure.

Keywords: Noise, Sensitivity, Mental Health, Psychological Distress, Textile Industry.

Introduction

Noise has emerged as a significant occupational health concern due to the proliferation of robust machinery and the accelerated development of industries. The deleterious impact of noise pollution in both industrial and environmental settings was recognized by researchers as an important issue [1, 2]. Studies showed that about 600 million people worldwide are exposed to occupational noise [3]. It is estimated that roughly 22 million workforces are at risk of being exposed to harmful levels of noise on an annual basis [4].

Noise exposure (NE) has many non-auditory consequences, such as psychological and cognitive effects. Many studies have indicated that NE has a wide range of long-term effects, such as heart disease, decreased job satisfaction, mental health, sleep disorders, and irritability [5]. NE is related to inappropriate behavior and aggression in workers [2]. Furthermore, NE harms the mental health of workers. NE through mental disorders harms the work ability index of workers [6].

When examining the impacts of noise, it is imperative to consider personal characteristics alongside noise characteristics [7]. Noise annoyance (NA) is a negative mental response that can mediate between NE and psychological consequences [8]. The results of studies showed that annoyance caused by NE is associated with physical and mental diseases [9, 10]. NA can lead to sleep disorders, anxiety, and depression [11]. Noise sensitivity (NS) is a property that describes the tolerance of people while NE. NS is a personal and internal characteristic that can determine the level of annoyance of people when exposed to noise [12]. The results of various studies showed that NA can be predicted via NS [13]. Besides, sometimes contradictory results are presented in the study of noise effects. Some researchers explain the cause of these results as individual differences, such as NS or personality traits [14].

As mentioned, noise has various non-auditory effects. NE affects various components of mental health [15, 16]. Psychological distress (PD) refers to a set of symptoms of depression and perceived anxiety in describing psychopathology. Monazzam et al. found that there is a significant association between NE and NA with mental distress [17]. Another study found a significant association between mental disorders, and sleep disturbances in terms of NE and NA in the adult population of Tehran [18].

A review of previous research indicates that the majority of studies in the field of aggravation and noise stress have focused on external environments (traffic, airports, etc.), with industrial noise receiving less attention. The textile industry is one of the most important industries in every country. This industry uses many workers in every country. One of the most important physical harmful factors in the textile industry is noise, which seriously threatens the health of workers. In this industry, noise is caused by high speed of rotation of components of machines [19]. For this reason, paying attention to the noise in the textile industry is very important.

The mental health of workers can affect their personal lives and the productivity of organization. Individuals in the textile industry are exposed to various noise sources that can significantly affect mental health. Thus, a review of studies shows that in examining the mental and cognitive consequences of NE, in addition to the property of noise, it is necessary to pay attention to the

personality and mental traits of people. This study was conducted to investigate the associations among NE, NA, and NS and PD in textile workers.

Materials and Methods

This cross-sectional study was conducted in 2021 in the textile industry. All sections of industry were measured in terms of noise levels. The annual results of this industry were subsequently evaluated. In the end, participants of both genders were chosen from distinct industry wards. The sampling method was stratified random sampling. The sample size was calculated as 115 participants using Cochran's formula with a population size of 165 individuals, and considering the test power of 80% with a confidence level of 95% (Formula 1).

Formula 1.

$$n = \frac{\frac{z^2pq}{d^2}}{1 + \frac{1}{N}\left(\frac{z^2pq}{d^2} - 1\right)}$$

The inclusion criteria were consent to participate in the study, exposure to occupational noise for at least one year, and age less than 50 years. The exclusion criteria included any history of head or ear surgery, family history of hearing loss, congenital deafness, and mental health issues, such as family troubles. The objectives and method were explained to the participants. Participation in the study was optional. Therefore, the study protocol was approved (code of ethics: IR.SSU.SPH.REC.1400.074).

To calculate the NE levels, used from dosimeter (model 4428). For obtaining accurate results, the equipment before doing each measurement was calibrated by Bruel & Kjaer 2230. Task-Based measurement (TBM) strategy was used to determine the NE of workers. Therefore, Job information was collected, and all duties were determined [20, 21]. Formula 2 was used to calculate the task-based NE [21].

Formula 2.

$$L_{Aeq-TBM}(dB) = q \times log_{10}\left(\frac{1}{T}\sum_{i=1}^{K} T_i \times 10^{\frac{L_{Aeq}.t_i}{q}}\right)$$

Where,

$L_{Aeq-TBM}$: The task-based noise exposure measurement level
$L_{Aeq}.t_i$: The level-at-task$_i$
T_i: The time-at-task$_i$ for i=1 to k tasks
T: The total time
q: (3 dB) divided by log_{10} of 2.

Kessler Psychological Distress Scale: This questionnaire is widely used to diagnose mental disorders. This questionnaire was developed as a short-term screening scale for PD. The final scale consists of 10 items, each organized in the 5-point Likert scale: 1: Never, 2: Very Low, 3: Sometimes, 4: Most of the time, 5: Always. The final score is the total of all scores. The scores vary between 10 and 50. Kessler et al [22] evaluated the questionnaire's validity and reliability. The validity and reliability of Persian version of this questionnaire were confirmed. Construct validity was studied. Therefore, Cronbach's alpha coefficient was calculated as 0.93 [23]. We found Cronbach's alpha equal to 0.92.

Weinstein's Noise Sensitivity Scale (WNNS): This questionnaire contains 21 questions, each organized on a 6-point scale. A higher score indicates higher NS and vice versa. The scores are classified into three categories with scores below 62 (low sensitivity), those from 62 to 88 (moderate sensitivity), and those above 88 (high sensitivity) [24]. The face validity of Persian version of this questionnaire was confirmed. Thus, Cronbach's alpha of this questionnaire was equal to 0.78. This value indicates that the WNSS has the same reliability and validity for use in field studies [25].

Noise Annoyance Scale: NA of the workers was assessed based on the scale (Figure 1). The validity of this scale was examined in a study and is available in ISO/TS 15666:2003. In this scale, annoyance is divided into five levels: not annoyed, slightly annoyed, rather annoyed, annoyed, and very annoyed. The Persian version of the questionnaire has been proven to be valid and reliable [26].
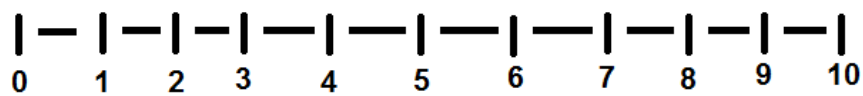

Fig. 1. Noise Annoyance Scale

For descriptive variables were used mean, standard deviation, frequency, and frequency percentage. To perform inferential statistics, Kruskal-Wallis, Mann-Whitney, Spearman correlation, independent sample t-test and one-way ANOVA tests were used. To conduct inferential statistics, the normality of distribution in quantitative variables was assessed using the Kolmogorov-Smirnov test. Median and interquartile range were used to depict departures from the standard range. SPSS-22 was used for data analysis.

Results

The mean (standard deviation) age, and work experience of the participants were 35.33 (7.13) and 9.19 (6.16) years, respectively. Other demographic characteristics are presented in Table 1.

Table 1. The demographic data of the participants

Indicators	Classification	The exposed group(n=115)	
		N	Percentage
Gender	Men	72	62.6
	Women	43	37.4
Marital status	Single	16	13.9
	Married	99	86.1
Education	Below the level of diploma	43	37.4
	Diploma	53	46.1
	Associate diploma	12	10.4
	BA/BSc. And above	7	6.1
Age (year)	< 30	24	20.9
	31-39	60	52.1
	> 40	31	27
Work experience (year)	< 10	73	63.5
	11-20	39	33.9
	> 21	3	2.6
Shift work	One-shift	23	20
	Shift work	92	80

The median (interquartile range) of NA was 7 (3). At the same time, the median (interquartile range) of the equivalent noise level was 92.80 (13). Because NA did not follow a normal distribution, we analyzed its association with demographic data using Mann-Whitney and Kruskal-Wallis tests. Mann-Whitney test results showed that there was no significant association among noise stimulation and gender, marital status, and shift work. Kruskal-Wallis test results showed that there was a significant association between NA and education level (P=0.04). The mean (standard deviation) of NS was 66.33 (15.76). Moreover, the median (interquartile range) for PD was 20 (12). One-way ANOVA results showed that there was a significant association between education level and sound sensitivity (P<0.001). Additionally, Kruskal-Wallis test results showed that there was a significant association between PD and education level (P<0.001) (Table 2).

Table2. Investigating the association between psychological distress (PD) score and noise sensitivity (NS) of individuals with demographic variables

Demographic Variables		Noise sensitivity			Psychological distress		
		Mean	Standard deviation	P-value*	Median	Interquartile range	P-value*
Education status	Below the level of diploma	62.51	16.13	<0.001	19	11	<0.001
	Diploma	71.30	14.12		23	10	
	Associate diploma	67	10.33		19.50	12	
	BSc. and above	51	19.31		14	6	
Gender	Male	65.44	16.06	0.43	20	13	0.38
	Female	67.81	15.31		22	9	
Marital status	Single	63.64	17.59	0.49	18.50	9	0.14
	Married	66.70	15.54		20	12	
Age	30 years old	63.80	15.27	0.58	20	12	0.38
	30-39 years old	67.73	15.73		20.50	10	
	40 years old and above	65.81	16.91		20	17	
Work experience	Below 10 years	65.86	14.83	0.77	20	11	0.71
	10-20 years	66.74	17.99		21	14	
	Above 20 years	72.33	4.16		20	12	
Shift work	One-shift	63.87	17.96	0.40	18	12	0.26
	Shift work	66.95	15.20		21	12	

* P<0.05

The area containing the maximum sound equivalent level was the flier ward. Additionally, the flyer unit had a substantially higher score for psychological distress than the other wards (P=0.03). The lowest sound equivalent level was related to the administrative ward. The median of equivalent sound level, PD, and NA in different wards are presented in Table 3.

The results of Spearman's correlation test showed that there was a positive and significant association between equivalent sound levels and PD (P=0.01, r=0.23). Table 4 shows the results of comparing PD based on the level of NA and NS.

As shown in Table 4, PD has a significant difference in diverse levels of NA (P=0.01), and NS (P<0.001). No significant association was found between NS, and equivalent noise level, but the Spearman correlation test results showed that there was a significant association between NA and NS (P<0.001, r=0.41).

Table 3. Descriptive of equivalent sound level, psychological distress (PD) and noise annoyance (NA) in different textile wards

Occupational groups (textile wards)	N	Median		
		Equivalent sound level	Psychological distress	Noise annoyance
Ring	19	98.01	20	6
Technical	7	93.50	14	5
Autoconer	13	92.80	20	6
TFO	19	98.30	25	5
Laboratory	3	83.10	11	3
Administrative	6	52	20	5
Warehouse	6	77.45	20.50	10
Flyer	10	98.50	26.50	7
Open-end spinning	11	87.30	18	7
Carding	7	83.60	21	7
Multi-layer weaving	14	85.75	17.50	7

Table 4. Comparison of psychological distress (PD) in different levels of noise annoyance (NA) and noise sensitivity (NS)

Variables	Classification	Psychological distress	
		Median (interquartile range)	P-value *
Noise sensitivity	Low sensitivity	17 (12)	<0.001
	Moderate sensitivity	23 (10)	
	High sensitivity	22.50 (26)	
Noise annoyance	Not annoyed	10 (9)	0.01
	Slightly annoyed	13 (10)	
	Rather annoyed	19 (9)	
	Annoyed	24 (11)	
	Very annoyed	22 (13)	

* P<0.05

Discussion

There are many noise sources in the textile business that might be detrimental to employees' mental health. Our goal was to ascertain how NE, NS, NA, and PD related to textile workers. In our study, the median of NA is equal to 7 which indicated high annoyance in workers. The median equivalent sound level was 92.8 which is higher than permissible limit (85 dbA). The research findings showed that PD scores in occupational groups are different at various sound pressure levels, so the highest PD score was in the Flyer and TFO ward (Table 3). Thus, we found positive and significant associations between equivalent noise levels, NA and sensitivity, and PD.

A significant association was found between education level and PD (Table 2). Increasing the level of education can be associated with a better job position. Job satisfaction and increased control over job can improve mental health [27]. Modarresi et al found no significant association between mental health and education, which is inconsistent with the current findings [28]. A study by Nadri et al found a significant correlation between education and stress [29]. Contradictory findings in this domain might be attributable to variations in the work environment or individual traits. The current study does not establish a correlation between gender and mental disorders. However, some studies confirmed the significant association between gender and cognitive performance, and psychophysiological responses during NE [30]. These discrepancies in results can be in terms of the differences in social, cultural, and economic levels of different communities. No significant associations were found between NA and demographic variables. Monazzam et al. found a positive and significant association between age and NA, which was inconsistent with the current findings [31]. In the study by Fallah et al., no significant association was found between age and stimulation, which is consistent with our findings [32]. The difference in noise frequency, and the studied population can affect the results [33]. A study by Beheshti et al found that noise frequency had a significant impact on NA [34].

NE is associated with mental health factors which can lead to mental disorders. The results of Fallah et al. Studies showed a positive and significant correlation between NE and mental health factors such as stress, anxiety, and depression [35]. A notable disparity was observed in the levels of mental distress between occupational categories and NE in the present study. Yoon discovered, through an examination of numerous occupations in the United States, that occupational NA precipitated psychological disorder symptoms [36]. Various studies showed a positive and significant association between NE and NA. A study by Paiva et al. found that people living in noisy areas had significantly higher levels of noise discomfort [37]. Monazzam et al conducted a study on wind farm workers. Studies showed that exposure to wind turbine noise has a significant impact on NA [31]. The results of Beutel et al. study showed that NA is related to psychological consequences such as anxiety, sleep disorders, and depression [11]. In the study of Dzhambov et al., more NA was associated with poorer mental health and social cohesion [38]. The review of various studies shows that despite the difference in noise sources and the studied population, the negative effect of noise on mental health components was confirmed in the various studies mentioned. The psychological effects of noise can be caused by the stimulation of the hypothalamus and the release of the stress hormone because the release of this hormone can lead to mental disorders [39].

In addition to the noise property, personality traits can interfere with noise effects. NS is an internal characteristic of people that affects people's reactions to noise. The results of studies have shown that NS is related to the psychological effects of noise, which was confirmed in the present study [40]. NS is a robust and consistent predictor of depressive symptoms and PD, according to a number of studies. An investigation was undertaken by Park et al. to examine the impact of NS on physiological and psychological reactions among the general populace of South Korea. The results of their study showed that people with high NS were more likely to have diabetes and hyperlipidemia and were

using psychiatric drugs. The sympathetic nervous system occurs in the people with high NS. Therefore, these people secrete more cortisol and have a weak immune system. In fact, NS acts as a mediator of the disease [41]. As a result of research by Mousavi Kordmiri et al., NE and NS were found to have a significant association with workers' psychological stress, which is consistent with the results of this study [24].

The difference in the results of studies can be caused by the difference in the noise sources and the study population. NS and NA may be affected by the personality traits of individuals. The results of Beheshti et al.'s study showed that there is a significant association between neuroticism and NA [42]. Kharghani Moghadam et al. believe that extroversion and neuroticism have the greatest effect on NS and NA [43].

TBM strategy was used to study NE. Thus, individuals were selected from different wards, such as administrative and warehouses, so that investigations can be done at different levels of sound pressure level (even lower than the permissible limit). Nevertheless, the present study was constrained by certain factors that may have an impact on the findings. Determining alterations in a cross-sectional study is not feasible, as is the case with this investigation. Thus, to measure PD, self-report scales were used, while psychiatric diagnoses can eliminate the limitation of self-report. The present study was conducted in the textile industry and the effect of noise frequency was not investigated. Results may vary due to differences in occupations, noise sources, and working conditions. It is suggested that future studies be conducted by considering variables, such as noise frequency and personality traits such as introversion and extroversion.

Conclusion

The results of this study showed that NA and NS have a significant association with people's mental distress. Therefore, it is recommended to pay attention to personality traits, and other mediators in the evaluation of noise and its effects. This method may also be applied to the selection of individuals for chaotic sections. Furthermore, it is advisable to establish a hearing protection program so as to preserve and enhance the mental well-being of employees.

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