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The Association between Noise Annoyance and Cognitive Dissonance Reduction, Arousal, and Cognitive Flexibility among Tile Industry Workers

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Abstract

Background: Noise annoyance is recognized as one of the negative effects of noise exposure and the most common mental response to it. This study aimed to examine the impact of noise annoyance on cognitive dissonance, arousal, and cognitive flexibility in tile industry workers.
Materials and Methods: This cross-sectional study was conducted on 104 employees of a tile factory, all of whom were included through a census. The studied population was split into two groups with 53 exposed and 51 non-exposed to noise. Noise measurement was carried out to identify the workers exposed to noise above the standard. To ascertain cognitive flexibility (CFI) as well as arousal and cognitive dissonance reduction (DARQ), two questionnaires were employed. The level of noise annoyance in both groups was assessed using the ISO 15666 method.
Results: The mean score of cognitive flexibility in the non-exposed to noise group (99.27± 12.53) was higher than in the exposed group (85.72 ± 19.89). A significant difference was found between the exposed and non-exposed to noise groups in terms of noise annoyance and cognitive flexibility ($p < 0.05$). Nevertheless, there was no significant difference between the cognitive arousal in the two groups ($p = 0.085$).
Conclusions: According to the results, excessive noise levels negatively affect cognitive behavior among tile industry workers, resulting in heightened noise annoyance and reduced cognitive flexibility. To safeguard employee well-being and productivity, it is essential to implement effective measures, such as reallocating tasks and assigning noise-sensitive workers to lower-exposure areas, to minimize occupational noise exposure.

Keywords: Occupational Noise, Cognitive Flexibility, Cognitive Dissonance, Mental Health, Occupational Stress.

Introduction

Noise exposure poses health and safety risks to workers. There is evidence suggesting that chronic noise exposure causes a wide range of physiological and psychological effects [1]. Noise is defined as any unwanted sound impairing or disturbing human hearing [2]. According to studies, the health outcome from exposure to environmental noise can include hearing impairment, cardiovascular diseases [3], reduced job satisfaction and wellbeing, communication difficulties [4], and sleep disturbance [5]. Adverse noise effects are mediated through individual factors such as noise sensitivity and psychological variables including noise annoyance, varying across individuals. Noise sensitivity is the main predictor of noise disturbance and can influence psychological health dimensions [6].

There are about 130 tile and ceramic factories in Iran, indicating that a large number of workers are employed in these industries. The tile and ceramic industry is one of those industries with multiple hazardous occupational environmental agents with noise being one of them to which workers employed in this industry are exposed [7].

Noise annoyance is known as one of the unhealthy impacts of noise exposure on individual comfort. This factor is one of the most common measurable mental responses [8]. Based on existing evidence, there is an association between noise annoyance and depression as well as anxiety [9]. However, if noise annoyance continues in the workplace, it may not only cause stress but also fatigue in exposed individuals arising from mental fatigue [10]. It is essential to acknowledge that noise-sensitive individuals may be more susceptible to the previously mentioned unfavorable outcomes [11].

Regarding people's exposure to unwanted and hazardous noise in the workplace, statistics reveal that a high percentage of workers worldwide are exposed to noise levels higher than 85 dB, but in Iran, according to a report by the Environment and Occupational Health Center of Ministry of Health, about 2,000,000 reported workers are subjected to noise levels higher than the permissible limit [12]. One of the other effects of noise on humans as an environmental stressor is disturbance in cognitive functions (attention, perception, etc.) which warrants more attention [13]. These factors can cause human error thus increasing the probability of occurrence of irreparable accidents and events [14].

Occupations with specific characteristics such as hard working conditions, stress, or use of physical as well as mental abilities are demanding, and with the persistence of these stresses, they reduce positive psychological characteristics while increasing negative psychological characteristics [15]. Positive psychological characteristics include cognitive flexibility, which diminishes owing to physical and mental stresses. This means the extent of gaining experience and accepting it on the part of the individual in response to internal and external experiences. Indeed, this personality trait determines the type of individual's response to new experiences [16]. Flexible individuals are curious and their life is rich in terms of experience [17]. To be cognitively flexible, an ability is required to connect with the present moment and the distinctive power to differentiate oneself from internal thoughts and experiences [18].

Individuals' cognitive systems tend toward stability and constancy, where the existence of cognitive dissonance can cause psychological pressure which in turn can drive the individual towards eliminating cognitive dissonance [19]. Cognitive dissonance can affect decision-making power. Indeed, the interaction of these variables suggests that the decision-making ability of a person affects the occurrence of cognitive dissonance [20]. The existence of cognitive deficits makes a person unable to establish cognitive balance after the occurrence of cognitive dissonance. Thus, the occurrence of cognitive dissonance in the individual alongside some emotional and cognitive disabilities can result in wrong decisions [21].

The results of studies suggest that unwanted noise affects the endocrine system, causing mood disorders and annoyance. Depression, anxiety, irritation, sorrow, hopelessness, and feelings of dissatisfaction are among the most common mental responses to noise annoyance [22]. The issue of noise-induced annoyance is observed in transportation and industries developing owing to long-term exposure to sound [23, 24]. Regarding health and disease, Holmes argues that based on the biopsychosocial model, the simultaneous intervention of biological, psychological, and social factors affects health [25].

Given that limited studies have been conducted on factors affecting psychological and cognitive characteristics such as cognitive dissonance and flexibility in industrial workers in Iran and because of the significance of examining the noise exposure of employees in tile and ceramic industries, this study has explored the impact of noise annoyance caused by workers' exposure to occupational noise on cognitive disorders, including arousal, cognitive dissonance and cognitive flexibility in the tile and ceramic workers.

Materials and Methods

This cross-sectional study was undertaken on 104 workers at a tile factory who were included in the study through a census. The study population was split into two groups: with 53 exposed and 51 non-exposed to noise. Noise exposure levels were measured using a Sound Level Meter (TES-1351) in accordance with the ISO 9612:2009 standard (International Organization for Standardization, 2009). This standard provides a validated engineering method for determining occupational noise exposure, including the calculation of the equivalent continuous noise level (Leq) over an 8-hour working day. Measurements were performed across various units to determine individual noise exposure. Workers from units exposed to sound levels exceeding the permissible limits (≥85 dB) were selected as the exposed group for the study. On the other hand, administrative staff were selected as part of the non-exposed group to noise.

The criteria for inclusion in the study were a minimum of six months' work experience, age under 60 years, no congenital hearing impairment, not taking CNS drugs, and not taking sleeping pills or antidepressants [26]. Along the stages of the study, the participants were assured that the information would be used confidentially and in accordance with research ethics.

Noise Annoyance:

In this study, ISO-15666 standard scale was employed to measure the level of noise annoyance. According to this scale, the test subject specifies the level of mental annoyance caused by the noise of their work environment on an 11-point scale (from 0 to 10) [27]. Choosing grades 6 or higher represents high annoyance. In reviewing the noise annoyance scale, the available parts on the scale include no annoyance (0-2), mild (3-4), medium (5-6), high or annoyed (7-8), and excessive or very annoyed (9-10). The validity and reliability of this scale have been confirmed by Golmohammadi et al. [28].

Assessment of Cognitive Dissonance and Arousal Reduction: Another tool utilized in this study is the standard Cognitive Dissonance and Arousal Reduction Scale (Harmon Jones, DARQ) consisting of 25 items. The validity and reliability of this scale have been reported by Zandi (2010): Cronbach's alpha coefficients of 0.74 and 0.84 for the arousal inconsistency and cognitive dissonance reduction subscales, respectively [29].

The Harmon Jones Cognitive Dissonance and Arousal Reduction Scale includes 25 items and two subscales: 12 items assessing arousal (items 1, 2, 3, 4, 14, 15, 16, 17, 18, 19, 20, 21) and 13 items evaluating cognitive dissonance reduction. This scale is utilized to measure individual differences related to the process of cognitive dissonance reduction. The minimum and maximum total scores range from 25 to 125, respectively. Items are scored on a 5-point Likert scale as follows: (strongly agree = 5, agree = 4, neither agree nor disagree = 3, disagree = 2, strongly disagree = 1).

Assessment of Cognitive Flexibility: The Cognitive Flexibility Inventory (CFI), designed by Dennis and Vander-Wal in 2010, was applied as the third instrument in this study. This scale consists of 20 items and is employed to assess progress in both clinical and non-clinical settings, as well as to ascertain an individual's progress in developing flexible thinking in cognitive, behavioral, and other mental health therapies. Fazeli et al (2014). reported a Cronbach's alpha coefficient of 0.90 for the full scale in their study [30]. The total score derived from summing all 20 items yields the cognitive flexibility test score. The maximum potential score is 140 while the minimum is 20. Higher scores represent greater cognitive flexibility, while lower scores approaching 20 imply lower cognitive flexibility.

Following the CFI scale, respondents completed a demographic questionnaire covering age, gender, work history, education level, and marital status. They also provided information on use of hearing protection equipment, smoking status, medications taken, medical history, etc. Following data collection, the responses were entered into SPSS version 26 software for statistical analysis and interpretation. The Kolmogorov-Smirnov statistical test was applied to examine the normality of the variables, along with parametric and non-parametric analytical tests such as Kruskal-Wallis and Mann-Whitney U, Pearson correlation, and regression model.

Results

The results of measuring the equivalent noise exposure level in various units selected as exposure groups were as follows: crusher: 86.1 dB, welding: 99.4 dB, chamfer: 85.5 to 99.5 dB, packaging: 86.6 dB, ball mill: 95.4 dB, spray: 89.1 dB. The noise in these units was characterized as continuous and uniform, with high-frequency components, suggesting that workers were exposed to consistent noise levels throughout their shifts.

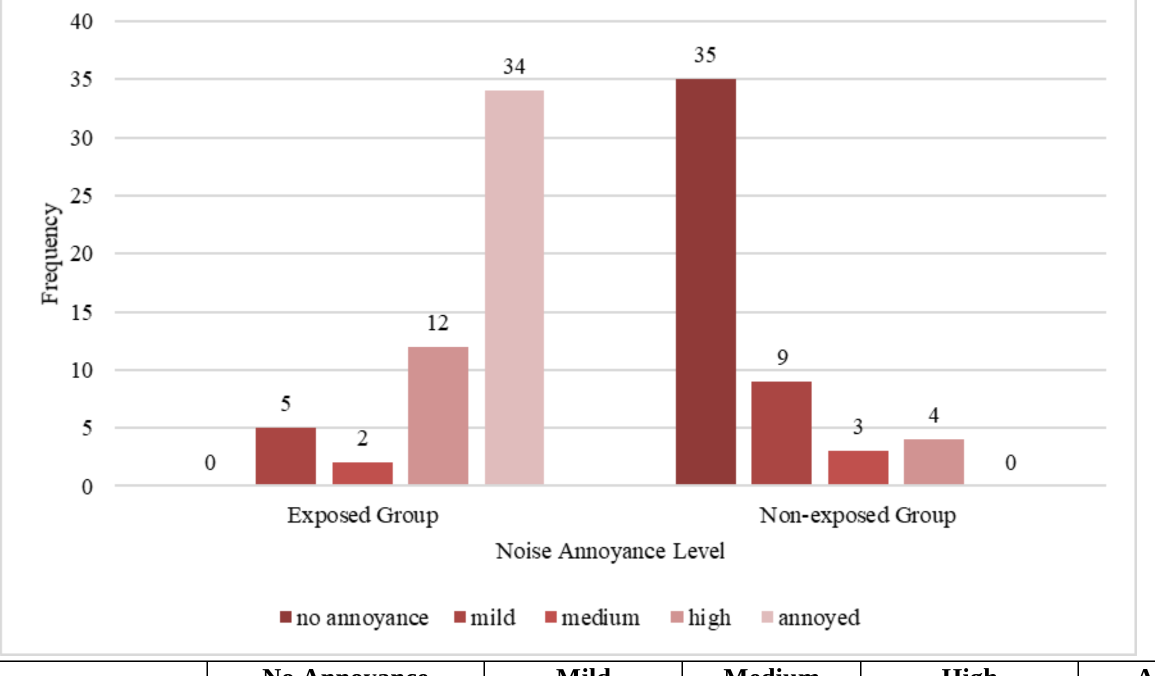
The demographic characteristics of the study samples are reported in Table 1. Among the noise exposed group, 69% of the participants were male, while 39% were female. Also, 47% were aged 30-39 years and 47% had 6-11 years of work experience. Based on the frequency distribution in both exposed and non-exposed groups, the percentage of individuals in the non-exposed group who reported no noise annoyance was 68% (35 people), whereas the exposed group reported no instances of noise annoyance. In the excessive annoyance scale, the frequency of exposure group was equal to 64% (34 people) and it was not observed in the group without noise exposure. The frequency distribution results indicate that 32% of the people in the non-exposure group reported mild to high noise annoyance (scores 3-8), this number in the exposed group includes 34% (Fig. 1).

Table 1. Demographic information of the study subjects

Variables		Exposed group	Non-exposed group	P-value
		Frequency (%)	Frequency (%)	
Age (Year)	18-29	13 (27.7)	13 (25.5)	0.484
	30-39	25 (53.2)	24 (47.1)	
	40-49	8 (17)	13 (25.5)	
	50-60	1 (1.2)	1 (2)	
Gender	Female	10 (21.3)	16 (32)	0.236
	Male	37 (78.7)	34 (68)	
Marital status	married	35 (81.4)	33 (64.7)	0.073
	Not married	8 (18.6)	18 (35.3)	

Work experience (Year)	**1-5**	14 (31.1)	18 (35.3)	0.974
	6-11	25 (55.6)	23 (45.1)	
	12-17	4 (8.9)	8 (15.7)	
	18	2 (4.4)	2 (3.9)	
Smoking	**Yes**	1 (1.2)	4 (7.8)	0.201
	No	46 (97.9)	47 (92.2)	
Education	**Under graduated**	18 (38.3)	17 (33.3)	0.014
	Diploma	23 (48.9)	11 (21.6)	
	Degree Associate	3 (6.4)	-	
	Degree Bachelor ' s	3 (6.4)	23 (45.1)	
Mental illness	**Yes**	1 (1.2)	-	0.298
	No	46 (97.9)	51 (100)	
Using hearing protection	**Yes**	21 (44.7)	-	< 0.001
	No	26 (55.3)	51 (100)	

*Kruskal-Wallis and Mann-Whitney U



	No Annoyance	Mild	Medium	High	Annoyed
Exposed group	0 (0%)	5 (9.4%)	2 (3.7%)	12 (22.6%)	34 (64.1%)
Non-exposed group	35 (68.6%)	9 (17.6%)	3 (5.8%)	4 (7.8%)	0 (%)

Fig. 1. Frequency description of noise annoyance scale, in the exposed and non-exposed groups

Initially, the Kolmogorov-Smirnov test was utilized to assess the normality of variable distributions. The Kruskal-Wallis H test examined the relationship between noise annoyance scores and demographic factors including work experience and education level. The Mann-Whitney U test ascertained the association of between noise annoyance scores with other demographic characteristics. The findings revealed that there is a significant difference between noise annoyance and the level of education as well as the use of hearing protection equipment ($p < 0.05$). The Kruskal-Wallis and Mann-Whitney U tests were utilized to explore the relationship between demographic information with cognitive dissonance and cognitive flexibility scores. Gender, marital status, and hearing protection use were only significantly associated with cognitive dissonance scores ($p < 0.05$), but not cognitive flexibility scores.

The mean value of noise annoyance scores in the exposed group was 8.55 while being 2.25 in the non-exposed group. Noise annoyance and cognitive flexibility scores were significantly higher in the exposed group compared to the non-exposed group ($p < 0.05$), but the cognitive dissonance score was not significantly different in the two groups, nor was it statistically different (Table 2).

Table 2. Description of noise annoyance, cognitive dissonance and cognitive flexibility in groups

Variables	Exposed group		Non- exposed group		P-value
	Maximum (Minimum)	Mean (SD)	Maximum (Minimum)	Mean (SD)	
Noise annoyance	10 (3)	8.55 (1.97)	8 (0)	2.25 (2.09)	< 0.001
Cognitive dissonance	113 (46)	80.42 (15.73)	93 (41)	73.33 (12.64)	0.085
Cognitive flexibility	120 (23)	85.72 (19.89)	126 (66)	99.27 (12.53)	< 0.001

*Kruskal-Wallis and Mann-Whitney U

Within the noise exposed group, the Pearson correlation found no significant associations between noise annoyance scores and cognitive dissonance as well as cognitive flexibility scores. Among the non-exposed group, neither the Pearson nor Spearman correlations indicated significant relationships based on the results. The Spearman correlation across both groups revealed that noise annoyance had a significant negative correlation with cognitive flexibility scores (correlation coefficient = -0.37, $p < 0.05$). (Table 3).

Table 3. Correlation of noise annoyance score with cognitive dissonance and cognitive flexibility scores

Variables	Exposed group		Non- exposed group	
	r†	P-value	ρ‡	P-value
Noise annoyance	1	-	1	-
Cognitive dissonance	0.148	0.298	0.127	0.199
Cognitive flexibility	-0.015	0.918	-0.379	< 0.001

* The Pearson and Spearman correlation
† Pearson Correlation Coefficient
‡ Spearman Correlation Coefficient

Multiple regression analysis inspected the concomitant impact of demographic characteristics and noise annoyance on cognitive flexibility along with cognitive dissonance. This model indicated that demographics and noise annoyance explained 30% of the variance in cognitive dissonance. Both demographic factors including age, gender, marital status, use of hearing protection and noise annoyance significantly predicted cognitive dissonance, with noise annoyance exerting the strongest positive effect (Table 4). Demographics and noise annoyance also accounted for 47% of the variance in cognitive flexibility. Age, hearing protection use, and noise annoyance significantly predicted cognitive flexibility, with noise annoyance presenting the strongest negative effect (Table 4).

Table 4. Examining the simultaneous effect of demographic information and noise annoyance on cognitive dissonance and cognitive flexibility

Demographic variables	Flexibility cognitive			R² §	Dissonance cognitive			R² §
	B†	SE‡	P-value		B†	SE‡	P-value	
Constant	72.808	37.63	0.057	0.476	64.419	30.952	0.041	0.307
Noise annoyance	-2.188	0.558	<0.001		2.055	0.459	<0.001	
Age	5.649	2.934	0.058		-0.621	2.413	0.798	
Gender	4.226	4.180	0.315		-8.708	3.439	0.013	
Marital status	0.781	4.337	0.858		-8.803	3.567	0.016	
Work experience	-2.360	2.798	0.401		0.448	2.301	0.846	
Smoking	-1.758	7.403	0.813		-3.068	6.089	0.616	
Education	0.010	1.526	0.995		-1.979	1.255	0.119	
Mental illness	21.184	16.147	0.193		8.390	13.281	0.529	
Using hearing protection	-12.385	5.12	0.018		14.182	4.211	0.001	

*Multiple regression analysis
† Regression coefficient
‡ Standard Error
§ Coefficient of Determination

Since the Harmon-Jones indicator comprises arousal and cognitive dissonance reduction subscales, separate statistical analyses indicated a significant relationship ($p = 0.020$) between these dimensions in the questionnaire responses for both the noise exposed and non-exposed groups. (Table 5).

Table 5. The effect of noise annoyance on subscales of the Harmon-Jones cognitive questionnaire

Variables		Mean (SD)	f	t	P-value
Arousal	**Exposed group**	34.64 (10.36)	28.66	5.17	< 0.001
	Non- exposed group	26.21 (5.39)			
Cognitive dissonance reduction	**Exposed group**	45.77 (7.79)	5.59	-0.707	0.02
	Non- exposed group	47.11 (11.32)			

*Kruskal-Wallis and Mann-Whitney U

Discussion

Auditory damage, such as temporary and permanent hearing loss, is a primary concern regarding noise exposure, though other physical and psychological influences of noise exposure should not be ignored. This study aimed to examine the relationship between noise annoyance, cognitive flexibility, arousal, and cognitive dissonance reduction in a tile and ceramic industry in Yazd city, Iran. In this study, two groups were assigned: those with and without noise exposure. Exposure to noise has multiple consequences for humans. Physiological responses resulting from exposure to sound pressure levels include elevated blood pressure or long-term disruption of vital body mechanisms. Noise annoyance is the principal psychological consequence observed in populations exposed to noise pollution. Noise annoyance can arise from interference of noise with daily activities, emotions, thoughts, sleep or rest, and may manifest with negative reactions such as irritation, dissatisfaction, fatigue, and stress-related symptoms [31].

The results of this study indicated that the level of noise annoyance in the exposed group was approximately 3.8 times higher than in the non-exposed group; the mean scores for the exposed and non-exposed groups were 8.55 and 2.25 respectively. A similar study found annoyance levels three times higher in the exposed group compared to the control group, which is really close to the present study findings [32]. Examination of the relationship between noise annoyance score and cognitive dissonance as well as cognitive flexibility scores in the groups revealed a significant inverse correlation between noise annoyance score and cognitive flexibility score (Correlation coefficient -0.37 and p <0.05). The inverse relationship between noise annoyance scores and cognitive flexibility can be explained from different perspectives. For example, a study of automotive workers exposed to chronic noise found a significant association between higher levels of annoyance and diminished cognitive performance, particularly on tasks requiring concentration and flexibility [33]. Noise annoyance is a stress response to environmental noise [34], and repeated noise exposure may heighten the risk of stress hormone [35]. Generally, the effects of noise annoyance deplete cognitive resources, disrupt sleep, and stimulate stress responses. Studies have reported that prolonged exposure to noise is significantly linked to reduced adaptability and performance in tasks that require mental flexibility [36]. Previous studies have indicated that long-term exposure to noise, particularly at levels exceeding occupational exposure limits, is associated with higher noise annoyance and cognitive impairments [37, 38]. The greater noise annoyance and reduced cognitive flexibility in the exposed group highlight the potential influence of excessive noise exposure on workers' psychological and cognitive health.

The study by Fallah Madvari (2020) found that the exposed group experienced higher levels of noise annoyance as compared to the control group. The exposed group had the highest level of noise annoyance, with 60% falling in the excessive noise annoyance range (8 to 10) and 28% in the high annoyance range (6 to 8). Meanwhile, the control group showed the highest level of noise annoyance with 68% reporting no noise annoyance (0 to 2) and 30% reporting mild noise annoyance (2 to 4) [32]. In line with the current study, these results were expected whereby the exposed group had around 64% experiencing excess noise annoyance (8 to 10) whereas the non-exposed group reported 68% not experiencing noise annoyance. In general, the frequency distribution indicated that severe annoyance (scores 9 and 10 on the scale) was absent in the no-exposure group and 68% of the individuals had no annoyance (0 to 2). It is likely that the cause of mild, moderate, and high noise annoyance in the no-exposure group is the more sensitive hearing of these individuals to sudden exposures in the industry. The same possibility exists for the presence of noise annoyance (higher scores 0 to 2) which is associated with no noise annoyance in the exposed group, where repeated exposures to noise are the cause of annoyance.

In a study, people exposed to noise from industrial turbines were studied. The results revealed that these individuals had lower general health, poorer sleep quality, and worse psychological characteristics compared to the control group [39]. Further, in another study investigating the relationship between noise annoyance and personal characteristics, it was found that noise annoyance had a significant relationship with mental disorders [32]. Demographic information in the current study, such as age, gender, marital status, and hearing protection usage, as well as noise annoyance, had a significant influence on the dependent variable of cognitive dissonance. Among these factors, noise annoyance had the greatest positive impact on cognitive dissonance.

The research by Babamiri et al. found that increases in noise pressure levels lead to reductions in auditory components important for various types of attention and work performance. Consequently, exposure to sound as one of the environmental stressors in the workplace, in addition to auditory effects, causes other physiological effects such as elevated blood pressure, cardiovascular disease and sleep disorders which can compromise concentration and accuracy in workers and consequently reduce safety and promote unsafe behaviors. It also results in an increase in the mental workload imposed on the individual from work [40]. Consistent with the results of this study, as observed, exposure to noise had a direct impact on mood and mental functioning such as dissonance in cognitive and flexibility in individuals.

Numerous studies have indicated the link between noise annoyance and depression as well as anxiety, in some cases finding that groups experiencing greater noise annoyance exhibited twice the rates of depression and anxiety compared to those without noise annoyance [41]. A five-year longitudinal study in Germany assessed the predictability of anxiety, depression and sleep disorders based on noise annoyance [42]. The findings revealed that comparing noise annoyance at night and day could serve as a predictor of mental health status regarding depression, anxiety and sleep disorders, accounting for the type of noise source.

In Alimohammadi's (2018) study, a linear relationship was observed between the level of noise received by a group of workers in an automobile manufacturing industry and the level of aggression they expressed. Those with higher occupational experience had higher levels of aggression [43]. In the same vein, in the present study, a significant difference was found between education level and noise annoyance, while in contrast to Ali Mohammadi's study, this relationship was not found for occupational experience. In another study, it was stated that workplace noise causes noise annoyance for individuals while also causing occupational stress for them, which can lead to the development of occupational burnout syndrome [44].

The issue of noise and related problems is not limited to industries alone. Mental stress can cause irritability and aggression in individuals. This becomes important when most industries have unauthorized noise levels in core sections employing a large workforce; urban living and the presence of residential houses in busy as well as industrial proximity localities also increase the likelihood of impacting cognitive abilities and individual traits.

The limitations of this research can be noted as the presence of other harmful factors in the workplace and time constraints. While this study measured daily noise exposure levels in accordance with the ISO 9612:2009 standard, it is important to note that individual differences in daily noise exposure such as variations in shift patterns or inconsistent use of hearing protection were not directly evaluated. These factors could contribute to variability in noise annoyance and psychological outcomes among workers. Future studies should consider continuous monitoring of noise exposure over extended periods to better capture the relationship between daily noise exposure patterns and their effects on workers' health as well as cognitive performance. Considering the broad scope of cognitive sciences as well as the many variables in mental health and behavior, it is recommended that more studies be conducted regarding the harmful effects of noise on humans in the cognitive domain and that other relevant tests and questionnaires be utilized for this purpose. Similarly, strategies should be considered to eliminate confounding factors in the study, such as environmental variables.

It is suggested that future studies perform further research to explore long-term interventions and their effectiveness in reducing the cognitive and emotional burdens of occupational noise exposure and evaluating the individual exposure of the study participants.

Conclusion

This study demonstrates that occupational noise exposure exceeding permissible limits adversely affects tile industry workers' hearing health, mental well-being, and cognitive function. Results indicate significant noise annoyance and reduced cognitive flexibility impairing adaptive problem-solving abilities though cognitive dissonance reduction remained relatively unaffected. Beyond physiological harm, chronic noise exposure compromises psychological performance dimensions. Elevated annoyance correlates with anxiety, depression, and attentional deficits, increasing occupational incident risks. Mitigation requires: (1) reassigning noise-sensitive workers to lower-exposure zones, (2) implementing hearing protection programs, and (3) optimizing task rotation protocols. Prioritizing noise control preserves both cognitive health and productivity in high-risk industries.

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Conflict of interest

None declared.

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Ethical Considerations

This study was conducted in accordance with ethical research principles. Confidentiality of participants' information was maintained, and informed consent was obtained prior to participation. Participants were also allowed to withdraw from the study at any stage without any consequences.

Code of Ethics

This research was approved by the industrial diseases research center of Shahid Sadoughi University of Medical Sciences and was approved by the research ethics committee with code IR.SSU.SRH.REC.1400.005.

Authors' Contributions

Rohollah Fallah Madvari: Conceptualization, Supervision, Project administration, Visualization; Moein Nemati: Methodology, Formal analysis, Writing – Original Draft; Ahmad Mehri: Investigation, Data curation; Maryam Zare Bidoki: Resources, Validation; Elham Rahmanzadeh: Data analysis, Investigation. All authors approved the final manuscript and agree to be accountable for all aspects of the work.

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