

The Relationship between Noise with Stress and Sleep Disturbances among Manufacturing Workers

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ABSTRACT

Objective: Noise can pose various detrimental effects that may put workers at high risk for occupational injuries and detrimental organisational consequences. This study aims to determine the effects of occupational noise exposure levels to psychological stress and sleep disturbance among manufacturing workers in Selangor.

Method: A cross-sectional study was carried out involving 80 manufacturing workers who were exposed to noise levels of above 85dB. The response rate was 80%. Sound level meter (SLM) was used to measure workplace ambient noise level. O'Donnell Personal Stress Inventory was used to measure stress level and Copenhagen Psychosocial Questionnaire (COPSOQ) was used to measure psychosocial factors of stress. While the level of sleep disturbances was measured via Pittsburgh Sleep Quality Index (PSQI).

Result: Thirty respondents (38%) were classified to be stressful and 57 respondents (71.3%) were having poor sleep. Noise was found to be insignificant in predicting stress level and sleep disturbances. Gender and interpersonal relationship significantly associated with stress levels. Work demand, marital status and income were significant in predicting sleep disturbances.

Conclusion: Findings indicated that workers were protected from noise exposure by wearing ear plugs. However, the prevalence of sleep disturbance was high. Therefore intervention strategies to improve sleep quality should focus on those identified significant psychosocial work factors.

Keywords: *Noise, psychosocial work factors, stress, sleep disturbances*

1. Introduction

Noise which corresponds to undesired sound (Chocha-Barrientos et al. 2004) is typically characterized by intensity, frequency, periodicity (continuous or intermittent) and duration of sound. Detrimental effect of high noise level on human health is known for centuries. However, due to the rapid

industrialization, sources of noise are spreading all over the world and noise affects extremely large number of individuals especially in those who works in manufacturing industry.

Many previous findings indicated that noise exposure cause hearing impairment and hearing loss (Mokhtar et al., 2007; Atmaca et al., 2005). Evidence also showed that noise is one of the intrinsic occupational factors that cause negative psychological

effects (Concha-Barrientos et al, 2004; Atmaca et al., 2005) but unfortunately this effect has always been disregarded. The psychological effect which is also known as extra auditory effect can be observed on the performance efficiency of intellectual, attention, and memory tasks which are all contributed to main causes of stress while working in a noise-polluted environment (Nassiri & Fouladi et al., 2012).

According to WHO (2003), stress at work and other psychosocial factors are now major occupational health concerns, joining the traditional problems of employment and exposure to physical, chemical and biological hazards. Workers may suffer from various health complaints, such as depressive symptoms, anxiety, physical symptom and stress, malaise or burn out due to prolonged occupational stress (Cohen, Denise and Gregory, 2007).

There has been a growing belief that the experience of stress at work has undesirable consequences for organisations and the health of their employees. Stress among employees will affect economy through employee sickness, poor productivity, and staff turnover (Ongori and Agolla, 2008).

Noise is also one of the common sources of sleep disturbance which is due to stress (Jansson and Linton, 2006). The effects of noise on sleep can be immediate or secondary to the noise exposure. The first category corresponds to responses occurring simultaneously or immediately after the noise emission, whereas the latter corresponds to effects visible the next day or after a few days. For the immediate effects, it has been shown that acute daytime noise exposure leads to a decrease in sleep quality (Gitanjali and Ananth (2003). For the secondary effects, findings showed that sleeping quality was poor among workers exposed to industrial noise for 1-2 years (Gitanjali and Dhamotharan, 2003). It was found in a previous study that poor sleep quality significantly affects perceived health, sick leave, occupational performance and personal relationships (Doi, Monawa and Tanggo, 2003). Sleep disturbance also put workers at risk of getting occupational injuries due to fatigue and significant reduction of alertness (Salminen, et al. 2010).

In Malaysia, a recent study was carried out at 26 selected industries. Findings of this study indicated that the percentage of workers exposed ranged from 13.6% to as high as 68.9% in each industry and 103,673 (39%) from total employment of 267,964 were estimated to be exposed to high risk noise (Tahir

et al., 2014). A reliable data is needed to develop efficient strategies to protect the large number of potentially affected industrial workers from hazardous effects of noise exposure. To provide such a preliminary data in Malaysia, the present study explores on how industrial noise exposure affects psychological stress and sleep disturbances among industrial workers.

2. Materials and Method

This is a cross sectional study which was conducted at an aluminum cans manufacture company in Selangor. The company is addressed as Factory A. This factory was chosen based on a result from a previous walkthrough survey. Findings from the walk-through survey indicated that these workers were likely to be exposed to occupational noise as workers need to repeat their word or shout when they were communicating while standing about 1 meter from each other.

The selection of factories was conducted via purposive sampling by listing all fifteen steel or aluminum factories in three townships; Sri Kembangan, Balakong and Bangi. However, the selection was limited by the approval of the companies. Many companies refused to be involved in this study due to confidentiality reason. In the selected factory, workers who were exposed to high noise exposure level were selected. The noise levels used to select workers were determined through area noise monitoring. Four work units were identified to produce noise levels above the action level.

A random sampling method using simple random sampling was used to choose respondents in these four units. The respondents were chosen based on the list name of workers that had been provided by the selected company. All respondents were equally selected from four work units where the number of respondents for each work unit represent 25% of the total number of respondents. Workers who were professionally diagnosed to have mental illnesses and sleep disorders based on the answers from self-administered questionnaires were excluded.

2.1. Instrumentation

Measurements of environmental noise levels were recorded using a Sound Level Meter (SLM) to develop noise mapping. Noise mapping were constructed at four departments; Aluminum Cutting, Press Moulding, Coating, and Deco. A self-administered questionnaire was used comprising

questions of sociodemographic factors, health status, Pittsburgh Sleep Quality Index (PSQI), Copenhagen Psychosocial Questionnaire (COPSOQ), and O'Donnell Personal Stress Inventory. A pilot study was conducted in which research questionnaires were given to 10% of the manufacturing workers to detect any errors and minimizing any ambiguous terms.

PSQI is a standardized self-related questionnaire which assesses sleep disturbance over a 1-month time interval to determine the symptoms of sleep problems among respondents. It consists of 19 items which are grouped into seven components; subjective sleep quality, sleep latency; sleep duration, habitual sleep efficiency, sleep disturbances, use of hypnotic agent and, daytime dysfunction. Each component is graded from 0 (no difficulty) to 3 (severe difficulty). The PSQI has internal consistency and a reliability coefficient (Cronbach's alpha) of 0.83 for its seven components (Passchier et al., 2001).

A standardized questionnaire, COPSOQ was used to measure occupational psychosocial factors among workers. According to the Fauziah et al. (2000), the validity of Malay version COSPOQ showed high sensitivity and specificity. This questionnaire consists of three main parts which were demand at work, work organization and content and interpersonal relationship and leadership. The score was based on Likert scale of 0=never/hardly ever to 4=always. The total score was based on the average total number.

The O'Donnell Personal Stress Inventory, a standardized questionnaire was selected to determine stress level. It includes eleven main domains including problems with skeletal muscle, gastrointestinal, physical, depression, anxiety, and energy level, sleeping disturbance, lack of attention, diet as well as relationship. The score for each domain is based on Likert scale of 0 until (0= never, 1 = once or twice, 2 = every week, 3 = almost every day). If the score is more or equal 36, the workers are classified in stress condition while if the score is less than 36, workers are classified in no stress condition (Swee et al., 2007). The alpha Cronbach value was 0.937 (Emilia et al., 2007). Data analyses were run by using the "Statistical Package for Social Sciences" (SPSS) Version 21 and Microsoft Office Excel.

3. Results

3.1 Socio-demographic data and work characteristics

Eighty workers were selected to participate in this study. The response rate was 100%. Respondents consisted of 86.3% (n=69/80) males and 13.8% (n=11/80) females. The mean age of the workers was 33.03 years. The majority of them (93.8%) were Malays while the remainders were Indians. Majority of the respondents (61.3%) were married while 36.3% were single. Those who completed up to secondary education level represent the majority (65.1%) of the total respondents (Refer to Table 1)

While for working hour, majority (72.6%) of respondents were working more than 10 hours. About 63 respondents had previous working history and 33 respondents agreed that, they were exposed to noise in previous job.

3.2 The level of noise, stress and sleep disturbances.

Thirty respondents (38%) were classified to be stressful and 57 respondents (71.3%) were having poor sleep. The unit of Press Moulding was identified as the noisiest area which the noise reading was 94dB, followed by cutting units (92.40dB (A)), Coating unit (88.86dB (A)) and Decorative unit (87.50dB (A)).

3.3. Psychosocial work factors

Table 2 shows the scores on psychosocial work factors. More scores correspond to high values on the respective dimensions. The highest scores was the item of meaning of work which indicated that they had low level of understanding on the meaning of their work. The second highest scores was the possibilities for development which showed that most respondents perceived that they had low possibilities for their career development. The third was commitment to workplace which means that most respondents had low level of commitment to their workplace.

3.4. The most significant factors predicting stress level

Results from the multiple logistic regression showed that, the socio-demographic (gender) ($\beta=-1.62$) and psychosocial factor (interpersonal) ($\beta=0.09$) were the most significant factor contributed to stress level. See Table 3. Findings indicated that female were more likely to feel stressful than male and workers who had poorer level of interpersonal

relationship were more likely to feel stressful than those who had better interpersonal relationship.

Meanwhile, to predict sleep disturbances, marital status ($\beta = 1.73$), amount of income ($\beta = 1.19$) and work demand ($\beta = -0.25$) were found to be significant. See Table 4. Results indicated that respondents who were single, have higher income and lesser work demand were more likely to have sleep disturbances than those who had lower job demand, being married and had lower income.

Table 1: Socio-demographic factors of respondents (N = 80)

Variables	n (%)
Marital status	
Married	49 (61.3)
Single	29 (36.3)
Widowed	2 (2.5)
Gender	
Male	69 (86.3)
Female	11 (13.8)
Race	
Malay	75 (93.8)
Indian	5 (6.3)
Education	
Primary	1 (1.3)
Secondary	52 (65.1)
Colleges	27 (33.6)

Table 2: Psychosocial work factors among respondents (N = 80)

Variables	Mean	SD
Work demand		
Quantitative demands	3.30	1.470
Tempo & work pace	4.16	1.958
Emotional demands	2.90	1.811
Work content & organisation		
Influence at work	3.75	1.919
Possibilities for development	5.23	1.567
Meaning of work	5.86	1.589
Interpersonal & relationship		
Commitment to workplace	5.03	1.501
Predictability	4.84	1.445
Reward	4.15	1.780
Role clarity	4.91	1.469
Quality of leadership	4.83	1.367
Social support from supervisors	4.14	1.524
Satisfaction with work	1.83	0.569
Work family conflict	3.51	1.518
Trust	4.76	1.305
Justice and respect	4.44	1.713

Table 3: Logistic regression for predicting stress (N = 80)

Variables	B	S.E	Wald	OR	95%CI
Marital status	-1.4	1	2.08	0.24	0.04-10.67
Gender*	-1.6	0.8	4.05	0.2	0.04-0.96
Age level	0.21	0.1	3.49	10.2	0.99-10.54
Noise	0.08	0.1	0.66	10.1	0.89-10.31
Interpersonal*	0.09	0	5.47	10.1	10.01-10.18
Employment (year)	-0	0.1	0.2	0.98	0.87-10.09
Work demand	-0.2	0.1	1.38	0.91	0.77-10.07
Constant	-9.7	9.2	1.11	0	

*significant at $p < 0.05$

Table 4: Logistic regression for predicting sleep disturbances

Variables	B	S.E	Wald	OR	95.0% C.I
Work demand*	-0.2	0.1	5.45	0.78	0.63-0.96
Age	0.64	0.6	1.13	1.89	0.58-6.11
Gender	1.52	1	2.54	4.56	0.71-29.47
Employment (year)	-0.1	0.1	0.86	0.95	0.85-1.06
Working hour	0.04	0.2	0.03	1.04	0.69-1.55
Work content	0.09	0.1	1.35	1.09	0.94-1.26
Marital status*	1.73	0.8	4.51	5.63	1.14-27.73
Income*	1.19	0.5	5.96	3.27	1.26-8.47
Education	-0.2	0.5	0.14	0.85	0.35-2.05
Constant	-8.2	4.1	4.1	0	

(N = 80)*significant at $p < 0.05$

4. Discussion

The unit of Press Mould was identified to produce high level of continuous noise exposure. This can be explained by the fact that machine needs more energy powered to compress and mould the raw aluminium into can. There was also a presence of continuous noise from other machine nearby that contributed to higher personal noise reading. Moreover, behind the press mould machine was a concrete wall which poorly absorbed noise vibration thus contributes to higher reading of noise exposure.

For the stress level, the prevalence of stressful workers was 37.5%. This prevalence was considered lower than previous study done among fibreboard workers in Nilai which was 41.7% (Chua et al.,2006). However, this figure was found to be higher than that found among automotive workers (24.2%) in Shah Alam, Selangor (Hassan et al., 2006).

The percentage of total workers in current study who scored global sum of PSQI of more than 5 points (considered to have sleep disturbance) was 71.3% which was much higher than the prevalence found among employees in Finland (22%) (Salminen, et al., 2010) and in Japan (33.1%) (Inoue et al. 2000).

In this study, noise was found to be insignificant in predicting stress and sleep disturbances. These finding were different from those of Mursali et al. (2009). In their findings, there was a significant association between noise condition and stress. Since the respondents in this study were wearing ear plug or other hearing protection devices, they were exposed to low noise intensity every day which probably was the main reason why such association were not significant.

Results from multiple regression for predicting stress levels indicated that female and those who had poorer interpersonal relationship experienced more stress than male and those who had better interpersonal relationship. These results were rather expected. Many of previous findings supported that female tend to be more stressful than male (Kurtz, 2008; Klassen & Chiu, 2010; Kajantie & Phillips (2006). Significant association were also found in many previous studies on the significant relationship between poorer interpersonal relationship and higher stress level (Stoetzer et al., 2009; Takaki et el. 2010).

With regards to sleep disturbances, respondents who had lesser work demand, higher income and single were more like to have poorer disturbances than those who had more work demand, lower income and being married. These results were inconsistent with some of the previous findings (Lallukka, et. al. 2010; Kanazawa et al., 2006; Robert et al., 2000). Results of the current study might be explained by the situation where workers who were married and had high job demand were more likely to experience fatigue which cause them to have more sleep compared to those who had less work demand and being single.

5. Conclusion

The study showed that even though the ambient noise level were hazardous, workers were protected by wearing ear plugs with noise reduction rate (NRR) 24. Therefore, in this study, low level of noise exposure is not significant in predicting both stress and sleep disturbances. Instead, findings indicated that gender and interpersonal relationship were significantly associated with stress and socio-demographic and psychosocial work factors were significant in predicting sleep disturbances instead of noise.

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CONFLICT OF INTEREST

There is no conflict of interest present.

ETHICAL ISSUES

The present study obtained approval from the Committee of Ethics of Faculty of Medicine Ethics Committee for Research involving Human Subjects of and Health Sciences, Universiti Putra Malaysia (JKEUPM).

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