Noise Exposure in Workplace and Metabolic Syndrome; Are They Related?

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ABSTRACT

Several studies confirmed the association of diabetes, hypertension, hyperlipidemia, obesity and high body mass index (BMI) on hearing loss among the general population. We think that same with the general population, we might have same association among workers that exposed with noise exposure in their workplaces. Therefore, this study aimed to examine the relationship between metabolic syndrome and noise-induced hearing loss among workers of the Iranian automobile industry.

The present survey was performed on 606 workers of an Iranian automobile product factory. According to Noise exposure measurement, we divided workers into the noise-exposed (≥ 85 dB) and unexposed (<85 dB). We compare demographic data, Anthropometric indices, Systolic and diastolic blood pressure, serum level of glucose and lipid profile between two groups. Metabolic syndrome in study participants was determined according to NCEP ATP III criteria.

Prevalence of metabolic syndrome had a significant association with higher than 85 dB noise exposure. Moreover, logistic regression analysis showed that exposure with higher than 85 dB noise had an independent predictor of metabolic syndrome.

Although there are different and controversial findings on this topic in the literature, we believed that exposure to equal or higher than 85 dB noise in the working population influenced the prevalence of metabolic syndrome.

Keywords: Automobile Factory; Metabolic Syndrome; Noise Exposure; Worker

INTRODUCTION

Metabolic Syndrome (**MS**) is known as the collection of risk factors that ultimately lead to atherosclerotic cardiovascular disease, type 2 diabetes mellitus, and all-cause mortality [1]. There are different epidemiological studies on the worldwide prevalence of MS among several countries with different prevalence rates, for instance, approximately one-fifth of the total American population is known to have MS [2]. According to current knowledge, MS has occurred as a result of chronic low-grade inflammation that is regulated by a combination of genetic and environmental factors. MS cases are accompanied by glucose intolerance, hypertension, visceral adiposity, atherogenic dyslipidemia, and a hypercoagulable state [3].

Several studies confirmed the association of diabetes, hypertension, hyperlipidemia, obesity and high body mass index (BMI) on hearing loss among the general population [4]. We think that same with the general population, we might have same association among workers that exposed with noise exposure in their workplaces. However, according to our literature review, the association between MS itself and noise-induced hearing loss (NIHL) has rarely been investigated among workers. Although theoretically, the role of noise exposure and NIHL in work safety is accepted, limited studies one the literature are paid to this hypothesis and related preventive strategies [5, 6]. Recent studies reported that, although underlying causes of metabolic syndrome is unclear, it is guessed that occupational noise exposure might have association with individual components of metabolic syndrome. Therefore, the aim of this study was to examine the relationship between metabolic syndrome and NIHL prevalence among workers of an Iranian automobile industries.

MATERIALS AND METHODS

Present survey performed at summer of 2017 in one of Iranian industries, which produce automobile segments in Semnan province. Our study sample consisted of all of the industry workers (n=606). Study inclusion criteria were day workers with having at least one year work experience and three positive findings from five diagnostic criteria for metabolic syndrome. Among included workers, those who did not agree with study participants were excluded. In order to assess the individuals' level of noise exposure, a sound assessment method using a sound level meter (440) was adopted by a professional health team located in the HSE unit of the plant and according to their measurements, we divided workers into the two study groups; noise exposed workers with equal or more than 85 dB noise in their workplace and unexposed noise workers with lower than 85 dB noise

in their workplace. Study protocol approved in research ethical committee of Iran University of medical sciences and health services.

We gathered demographic data including age, education, marital status, history of past medical disorders and drug usage via a study checklist. Anthropometric indices including height, weight, body mass index, lumbar ad waist circumference was measured in two study groups with the same devices. Systolic and diastolic blood pressure of study participants measured at the rest sitting position and then one peripheral blood sample was collected for assessment serum level of glucose and lipid profile. Metabolic syndrome in study participants was determined according to NCEP ATP III criteria. In noted criteria, workers with metabolic syndrome must have three or more from five following criteria. [1] Waist circumference higher than 40 inches in men and 35 inches in women. [2] Blood pressure higher than 130/85 mmHg. [3] Serum level of triglycerides higher than 150 mg/dl. [4] High-density lipoprotein (HDL) is lower than 40 mg/dl in females and 50 mg/dl in males. [5] Fasting blood sugar (FBS) higher than 100 mg/dl.

Statistical analysis

Study data entered into the statistical software SPSS ver. 22.0 and analyzed with statistical tests. The mean and standard deviation used for quantitative data, frequency, and percentage for qualitative data. We used the independent student T-test and Chi-square test for comparing quantitative and qualitative variables respectively between the two study groups. All statistical tests considered significant, when under 0.05.

RESULTS

We included 606 male workers in the statistical analysis and according to that, all of the workers were healthy at the survey time and did not history of past medical disorders or drug usage. The mean of age and work experiences between study workers were 35.26±6.8 (21-65) and 5.14 ± 3.04 (1-17) years respectively. Among study workers, 564 (93.1%) were married and 108 (17.8%) workers had a secondary job. The educational level in half of the workers was diploma (47.5%) and 52 (17.2%) workers were smokers. The mean BMI among workers was 23.18 ± 4.06 (17.35-33.9) kg/m^2. According to that, 222 (73.3%) workers were normal (BMI<25) and 81 (26.7%) workers were overweight. The mean of waist circumference among study workers was 53.83 ± 9.64 (92.26-101.61) centimeters and 316 (52.2%) workers had waist circumference higher than 40 centimeters. The mean of systolic and diastolic blood pressure was 118.79 ± 8.94 and 78.72 ± 6.64 mmHg respectively. Among study workers, 496 (81.8%) and 432 (71.3%) had high systolic and diastolic blood pressure. The mean of fasting blood glucose among workers was 88.05±12.20 (70-132) mg/dl and 314 (84.8%) workers had high blood glucose. The mean serum level of triglyceride among workers was 159.56±73.48 (43-394) mg/dl and 378 (54.1%) workers had a high serum level of triglyceride. The mean serum level of HDL among workers was 50.57 ± 8.72 (30-80) mg/dl and 128 (21.1%) workers had a high serum level of HDL.

Table 1: Frequency distribution of demographic variables among study participants

Study variables	Frequency
Age	35.26 ± 5.14
Married workers	546 (93.1%)
Second Job	108 (17.8%))
Smoker	52 (17.2%)

Comparing study variables between workers with and without noise exposure

The frequency of workers with a low level of HDL among workers of the exposed group was significantly higher than the unexposed group (45.34 vs. 35.06%; P<0.001). The frequency of workers with high systolic blood pressure was significantly higher among workers of the exposed group in comparison with the unexposed group (22.5% vs 13%; P=0.034). The frequency of high diastolic blood pressure was the same between the two study groups (31% vs. 15.6%; P=0.308). Among study workers, the prevalence of workers with fasting blood sugar higher than 100 mg/dl was significantly higher among the exposed group in comparison with the unexposed group (19% vs. 10%; P=0.036). The frequency of serum level of triglyceride higher than 150 mg/dl was significantly higher among workers of the exposed group in comparison with the unexposed group (52% vs. 37%; P=0.01). Prevalence of workers with overweight or obesity (14.5% vs. 8.9%; P=0.412) and high waist circumference (66% vs. 33.3%; P=0.56) had no significant association with exposure with more than 85 db noise.

Comparing study variables between workers with and without metabolic syndrome

According to metabolic syndrome criteria, 40 (23%) workers in exposed and 13 (10.1%) in the unexposed group had metabolic syndrome. prevalence of metabolic syndrome among the study population had a significant association with higher than 85 dB noise exposure (P=0.004). Smoking among workers of exposed and unexposed groups had no significant differences (23% vs. 15%; P=0.067). According to measurements of the occupational health office, 348 (57.4%) workers were exposed to noise with higher than 85 dB (exposed group) and 258 (42.6%) workers were exposed to noise lower than 85 dB (unexposed groups). Mean of age and work experiences matched

between two study groups. Among study workers, 106 (17.5%) workers had metabolic syndrome. The mean of work experience had no significant difference between workers with and without metabolic syndrome (5.54 ±3.84 vs. 5.06 ± 2.89; P=0.29). The mean of age workers with metabolic syndrome was significantly higher compared with other workers (38.64 ±8.39 vs. 34.54 ± 6.23 years; P<0.001). Results of logistic regression analysis showed that exposure with higher than 85 dB noise had an independent predictor of metabolic syndrome.

Table 2: Characteristics of participants with or without noise exposure.

Variables	Noise Exposure		P-value
	No (n=129)	Yes (n=174)	
HDL<50 mg/dl	12 (9.30%)	52 (29.88%)	<0.001
SBP < 135 mmhg	16 (12.40%)	39 (22.41%)	0.03
DBP > 85 mmhg	33 (25.58%)	54 (31.03%)	0.31
FBS>100 mg/dl	13 (10.08%)	33 (18.96%)	0.04
TG > 150 mg/dl	48 (37.21%)	91 (52.29%)	0.01
BMI> 25 kg^2/m	27 (20.93%)	44 (25.29%)	0.41
WC<40 inches	43 (33.33%)	115 (66.09%)	0.56

HDL: high-density lipoprotein; **SBP**: systolic blood pressure; **DBP**: diastolic blood pressure; **FBS**: fasting blood sugar; **TG**: triglyceride; **BMI**: body mass index; **WC**: waist circumference

Table 3. Comparing the frequency of metabolic syndrome among workers with noise exposure

Metabolic syndrome / Noise exposure	Yes		No		Total	
	N	%	N	%	N	%
Yes	40	22.99	134	77.01	174	100
No	13	10.08	116	89.92	129	100
Total	53	17.49	250		303	100
P-value	0.004					
Odds ratio	2.66					

DISCUSSION

The present study was performed to assess the impact of exposure to a high level of noise on the prevalence of metabolic syndrome among workers of an Iranian automobile factory. The findings of our study showed that the prevalence of metabolic syndrome among the study population had a significant association with higher than 85 dB noise exposure. Moreover, logistic regression analysis showed that exposure with higher than 85 dB noise had an independent predictor of metabolic syndrome. Up to our searching on the literature, we found few studies that assessed metabolic syndrome separately among workers in the workplace and most of the studies were performed on the cardiovascular and health properties such as blood pressure, fasting blood sugar, lipid profile and body mass index among workers. For instance, Li *et al.* in their study assessed the relationship between exposure to heat and noise with metabolic syndrome among workers of steel factories and reported that the prevalence of metabolic syndrome was significantly higher among workers who were exposed to noise exposure [7]. Rahma *et al*. assessed the impact of noise exposure on the frequency of high blood pressure and serum lipid levels and reported that serum levels of leptin, systolic and diastolic blood pressure and body mass index were significantly higher among workers with noise exposure [8]. Chen *et al.* evaluated the blood pressure of workers who were exposed to noise and reported that mean of systolic and diastolic blood pressure were significantly higher among workers who were exposed to noise [9].

Some investigators compared the chance of adverse health outcomes such as obesity and cardiovascular disorders among workers that were exposed to a high level of noise. Pyko *et al.* assessed the impact of noise exposure on central obesity indices such as waist circumference and showed that the prevalence of obesity among workers who were exposed to a high level of noise was 1.2 times higher than other workers [10]. Similar to the noted study, Koshinken *et al.* in his study reported that workers with exposing to a high level of noise had 5.2 times higher chance of cardiovascular disorders via the increasing prevalence of high blood pressure, fasting glucose and body mass index among them [11]. Sancini *et al.* in their study on workers found that workers who were exposed to higher than 85 Db noise, experienced a significant increase in their systolic and diastolic blood pressure, orthostatic hypotension occurrence and abnormality findings in their electrocardiograms [12]. And finally, Skogstad *et al.* in their systematic review on the impact of noise exposure and occupational health determinants found a significant association between exposure with a high level of noise and hypertension and mortalities due to cardiovascular disorders [13]. Against our findings and similar studies, Tessier-Sherman *et al.* in his study evaluated the impact of exposure to a high level of noise on blood pressure among workers of steel factories and reported that noise exposure didn't have a significant impact on their blood pressure [14]. Lin *et al.* in their study found that exposure to high levels of noise in the workplace could even decrease the systolic blood pressure of workers [15]. Our study had some limitations; firstly, some of the workers did not present a history of their

drug usage due to fear of losing their work. Secondary, our study was performed on the male workers of a small factory. We think that next studies must be performed on the large industries with different occupational tasks and both male and female workers. Thirdly, we did not assess the dose-response relationship between noise exposure and occurrence of metabolic syndrome and it seems that workers with lower than study threshold (85 Db) might have the chance of metabolic syndrome.

CONCLUSION

Although there are different findings in the study literature, we concluded that exposure to equal or higher than 85 Db noise influenced the prevalence of metabolic syndrome among the working population. Therefore, we must more attention to the screening of metabolic components among working population in annually occupational examination.

ETHICAL ISSUES

Study protocol approved in research ethical committee of Iran University of medical sciences and health services.

CONFLICT OF INTEREST

None

AUTHORS' CONTRIBUTIONS

Elaheh Kabir-Mokamelkhah: data collection and analysis, Mashallah Aghilinejad: study supervision, Afshin Zarafshar: data collection and first drafting the manuscript, Arghvan Basirat: data collection and first drafting the manuscript, Amir Bahrami -Ahmadi: study supervision and finalizing the manuscript text

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