

Evaluation of Respiratory and Neurobehavioral Symptoms Due To Exposure with Volatile Organic Compounds among Employees of Petrol Stations in Dezful City: A Cross Sectional Study

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Abstract

Introduction: Exposure to volatile organic compounds can lead to acute and chronic effects, such as respiratory diseases and affect in nervous system. The aim of this study was to evaluation of the respiratory and neurobehavioral symptoms among Dezful petrol stations employees.

Materials and Methods: In this cross-sectional study, 85 workers in 12 petrol stations were participated by using of convenient sampling method in Dezful city, south of Iran in 2016. Then, they fill out the two self - report neurobehavioral and respiratory symptoms questionnaires. Finally, data entered to spss.21 and analyzed by chi-squire and logistic regression tests at significant level of $\alpha = .05$.

Findings: Results showed that the mean age of the workers and working experience were 34.2 ± 8.5 and 6.92 ± 6.9 years, respectively. In assessing the rate of abnormal respiratory symptoms, it was found that approximately in less than 20% of workers all of these symptoms were always present. Also, 16.5% of the workers have stated the presence of cough as always and 57.6% as sometimes. Also, the abnormal feeling of fatigue and difficulty remembering things are among neurobehavioral symptoms expressed by the employees.

Conclusion: the workers have reported the respiratory and neurobehavioral symptoms, therefore, the monitor and measure the exposure levels to examine the inhaled volumes and brain functions are necessary.

Key words: Respiratory and Neurobehavioral Symptoms, Volatile Organic Compounds, Petrol Station Employees, Dezful

INTRODUCTION

Volatile organic compounds (VOCs) are the air pollutants agents and they are in the form of volatile liquids or solids (1). These compounds are belong to gaseous hydrocarbons and evaporate rapidly at 293.15°K and a vapour pressure of 0.01 kpa(2-3). The high evaporation rate results in their rapid release in the air and exposure of people in

the occupational environments (4-5). BTEX (benzene, toluene, ethylbenzene and xylene) compounds, with similar physical and chemical properties, are the most important solvents used in industry and are the main constituent components of gasoline (4, 6). Gasoline is a complex, evaporable and flammable compound and consists of more than 500 saturated and unsaturated hydrocarbons with carbon chain lengths of 3 to 11 carbons. Aromatic compounds such as benzene, xylenes, toluene, ethylene benzene and xylene are the most dangerous element of gasoline (7-8). Individuals who work at the position of loading and discharging gasoline in large volumes including at petrol delivery stations have a high potential for exposure to gasoline due to the inhalation of its vapours, although there is also the possibility of skin exposure and absorption (8-9). The BTEX compounds

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Month of Submission : 03-2017
Month of Peer Review : 04-2017
Month of Acceptance : 05-2017
Month of Publishing : 06-2017

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in the consumed gasoline enter the atmosphere through exhaust, carburetor, vehicles, as well as evaporation of the gasoline at the petroleum products distribution stations. Each of these substances has particular dangers and their harms vary depending on the type of chemical material, the entry point, the duration of contact and their density (10). Exposure to volatile compounds in gasoline causes effects such as skin irritation and sensitization, fatigue, headache, dizziness, loss of balance, as well as effects on liver, kidney and blood (11). In addition to physical damage, people's mental state may also be affected by the contaminants (12). The International Agency for Research on Cancer (IARC) has classified benzene as a definitive and possible carcinogenic for humans. Benzene, as a blood poison, causes different types of leukemia, anaemia, bone marrow damage and other blood diseases (5, 13-14). One of the important impacts of toluene is affecting the central nervous system, which is in the form of fatigue, dizziness, lack of coordination and delayed reaction time and individual's perceptual speed. With high levels of exposure, ethylene benzene in the air can cause the irritation of eyes and digestive system (15). In studies conducted by Maghsoudi (6) and Bahrami (16) with regard to the assessment of the exposure of personnel to volatile organic compounds in a number of oil-related petrochemical industries and fuel distribution stations, it was found that the concentration of these compounds in some cases is higher than the recommended allowed limits. Therefore, the aim of this study was evaluate the respiratory and neurobehavioral symptoms among Dezful petrol stations employees.

MATERIALS AND METHODS

The study was a descriptive-analytic research which carried out in summer 2016 in dezful city, south of Iran. The study sample was the labourer's employee in 12 state and private petrol stations located at the Dezful city. Before carrying out the study, the relevant permissions were acquired from officials in charge and the necessary coordination was made with health and safety authorities of the petrol stations. The present study was carried out according to the Declaration of Helsinki and its amendment (17), and all participants completed and signed the informed consent form for enrolment into the study. In addition, in this study, data on work history, smoking, diabetes, anaemia and history of related diseases were collected in the evaluation of respiratory symptoms questionnaire, because the respiratory and neurological parameters are influenced by age and smoking factors and current or previous history of some special diseases such as asthma, tuberculosis, hypertension, diabetes, etc. Upon their arrival sufficient explanations were given to inform

and familiarize workers with the objectives of the study and then the questionnaires were given to them. During the time of attendance and interview with the workers, it was found that the respiratory and neurological test was not taken from any of the individuals at the time of their recruitment. The respiratory symptoms of the workers and employees exposed are completed using the questionnaire of the evaluation of respiratory symptoms according to the recommendations of American Lung Association with some modification. In this questionnaire, questions concerning the individual's respiratory status (chronic cough, wheezing, shortness of breath, sputum excretion, bronchitis, etc.), symptoms in nose and eyes, smoking history, medical and family history of the individual, occupation, work history and previous occupations (especially occupations with risk of respiratory diseases) have been asked. This questionnaire was used to collect relevant data about the prevalence of symptoms in exposed individuals (18).

The data collection tool for finding neurobehavioral disorders in workers was a questionnaire which consisted of 16 questions for measuring the effects of long-term exposure to solvents. This questionnaire has been introduced in the reference books of occupational medicine as a primary and sensitive screening tool for detecting neurobehavioral disorders induced by continuous contact with solvents (19). According to the questionnaire, four or more positive answers in people younger than 28 years of age, and six or more positive answers in people older than 28 years of age, are considered as an indication of neurobehavioral disorder. The purpose of this questionnaire is to find clinical symptoms of toxic encephalopathy in people who are in constant contact with a mixture of solvents. These symptoms include an abnormal feeling of fatigue, burning sensation and pain in some parts of the body, headache, palpitations, excitability, depression, disturbance in reading concentration and comprehension, forgetting, perspiration, difficulty with hand-eye coordination, and change in sexual desires (20). After entering the data on SPSS software version 21, for analyze of the research data, the statistical tests such as independent t-test, Pearson's correlation coefficient, and one-way ANOVA were conducted as considered $\alpha = 0.05$ as significant level.

RESULTS

The mean age and work history of the study sample were 34.2 ± 8.5 and 6.92 ± 6.9 year, respectively. Study of use Opiate materials among participate show that less than 27% of person use of this materials. Table 1 show the

sickness history of fuel stations worker in Dezful city for person selective in order to abnormal respiratory and neurobehavioral symptoms evaluation.

The evaluation of abnormal respiratory symptoms in the three states of always, sometimes and never showed that abnormal respiratory symptoms are always present in less than 20% of individuals. Also, 16.5% of people have expressed cough as always and 57.6% as sometimes (Figure 1). In Table 2, the study subjects can be compared with regard to the frequency of positive responses to each one of the questions in the questionnaire. As the table shows, 47.1% of the individuals expressed abnormal feeling of fatigue, headache at least once a week and a difficulty remembering things, are other neurological symptoms that the employees at petrol stations of the city of Dezful have expressed.

The relationships between the variables of work history and the presence of abnormal respiratory symptoms was assessed by ANOVA test, and the results showed that the significant differences between work history and abnormally respiratory symptoms such as cough, phlegm, wheezing (P-value < 0.05) (Table 3). Also in survey of relationship between work history and neurobehavioral symptoms was found significant relationship (P-value < 0.05). Evolution of relationships between the variables of age with the presence of abnormal neurobehavioral symptoms with age was significant (P-value < 0.05) but relationship between ages with abnormally respiratory symptoms was not significant.

DISCUSSION

The type of occupational disease or health risk caused by work and work environment were directly related to the advancement of technology and the existing economic situation (21). This subject is also valid to some extent with regard to oil and its various derivatives, including gasoline (22-23). Several studies have been conducted on the exposure of workers to BTEX, including benzene, which

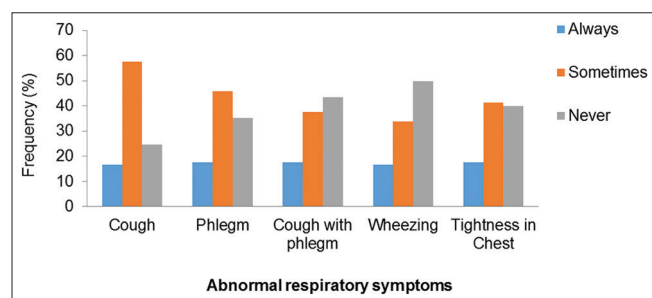


Figure 1: The rate of abnormal respiratory symptoms in study workers

their results indicate an increase in the risk of cancer and some studies have also indicated changes in renal function among the workers of petrol stations (16, 24). The main purpose of occupational health is preventing or properly controlling the contact of people with harmful elements at the work environment and proper contact assessment in designing valuable and useful controlling strategies (25-26). The findings of this study showed that the exposure to volatile solvents from gasoline accompanied with abnormal respiratory symptoms was

Table 1: Sickness history of study workers

Sickness	Number
Asthma	3
Pneumonia	2
Tuberculosis	1
Diabetes	1
Anemia	5
High blood pressure	4

Table 2: Comparison of the frequency of positive responses to each question in the questionnaire of neurobehavioral disorders

Questions	workers	
	N	%
1 Do you feel abnormally tired?	40	47.1
2 Do you feel burning sensation and abnormal pain in some parts of the body?	24	28.2
3 Do you have palpitations with no physical activity?	16	18.8
4 Do you get nervous with no cause?	18	21.2
5 Do you get depressed with no cause?	15	17.6
6 Do you often have a hard time to concentrate?	26	30.6
7 Do you forget things easily?	28	32.9
8 Do you sweat with no reason?	16	18.8
9 Do you often find yourself having trouble buttoning and unbuttoning your clothes?	7	8.2
10 When reading a book or newspaper, are you having trouble comprehending the meaning of the content you read?	16	18.8
11 Are you reproached by your family members because of quickly forgetting things?	22	25.9
12 Do you feel pressure on your chest?	25	29.4
13 Do you often have to take notes to remember things?	29	34.1
14 Do you often have to check things you do (locking the door, etc.)?	27	31.8
15 Do you have a headache at least once a week?	30	35.3
16 Have there been any changes in your sexual desires?	15	17.6

Table 3: One-way ANOVA: comparison of mean of respiratory and neurobehavioral symptoms by work history

Variable	Sum of squares	df	F	Sig
abnormally respiratory and neurobehavioral symptoms	3924.88	82	6	<0.05

almost always present in less than 20% of the subjects. By taking into account independent variables such as age, work history, working hours, and drug abuse in relation to abnormal respiratory symptoms, the questionnaire data were collected and were analyzed using ANOVA test, and the results showed that the presence of abnormal respiratory symptoms has a significant relationship only with the variable of age (P -value = 0.032), and this relationship is not significant with other respiratory symptoms such as cough, phlegm, wheezing, etc. With regard to the results, it can be said that the effect of age on abnormal respiratory symptoms is such that with an increase in age their rate increases. As for the frequency of the positive responses to each of the questions of the questionnaire of the neurobehavioral disorders, according to the results, 47.1% of the subjects expressed abnormal feeling of fatigue. Headache at least once a week and difficulty remembering tasks are other neurobehavioral symptoms that the workers employed in petrol stations expressed them. With regard to responses to other questions that were designed for the evaluation of short-term memory, psychosomatic problems, mood disorders, disorder in the hand work (hand-eye) coordination, and change in sexual desire, no statistically significant relationship was determined. The questionnaire used in this study, has been presented as a screening tool for finding disorders occurred due to long-term contact with solvents. So, it was not unexpected and surprising to encounter many false positive cases. According to the recommendations of the designers of this questionnaire, the positive cases should be confirmed by a physician's examination, and then, in case of confirmation by the physician, it should be confirmed by proper clinical examinations, and psychological and neurophysiologic tests, which due to limited facilities, the implementation of these steps was not possible in our study.

It should be noted that the results obtained in this study have been influenced by factors such as the average length of exposure of workers or, in simpler terms, the lower level of exposure of workers to the contaminants of the workplace, as well as the collection of data through the questionnaire, and the honesty of the respondents was unclear to the researcher. Therefore, the need for more studies with larger sample size and longer exposure time is necessary to assess the nature of respiratory disorders caused by these solvents with a higher accuracy in the absence of confounding factors.

ACKNOWLEDGEMENTS

The authors thank the Ilam University of Medical Science for financial support of this research.

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How to cite this article: Yosefimehr A, Jalilian M, Kamalvandi M, Kurd N. Evaluation of Respiratory and Neurobehavioral Symptoms Due To Exposure with Volatile Organic Compounds among Employees of Petrol Stations in Dezful City: A Cross Sectional Study. Int J Sci Stud 2017;5(3):315-319.

Source of Support: Nil, **Conflict of Interest:** None declared.