Original Article

J Res Health Sci, Vol. 8, No.2, 2008, pp. 21-27

A Rapid Method for Estimating of Noise Exposure in Work-places

***Golmohammadi R. PhD, **Atari SQ. Msc, **Arefian S. Bsc, **Golchobian R. Bsc**

**Dept. of Occupational Health, School of Public Health and Center for Health Research, Hamadan University of Medical Sciences, Iran.*

***Dept. of Occupational Health, School of Public Health, Hamadan University of Medical Sciences, Iran*

(Received 2 Sep 2008; Accepted 18 Oct 2008)

Abstract

Background: Noise pollution is one of the important issues of pollutant in workplaces and is almost one of the harmful agents for workers. At present, instrumental based inspections for determining the index levels of noise in workshops is performed. This method is requiring a time consuming and expensive in large scale inspection for workplaces. Classification of workplaces based on noise pollution is one of the necessaries for macro programming view of monitoring and controlling of noise. The Propose of this study was to submit a simply scientifically screening method for inspection of noise pollution in workplaces.

Methods: In this experimental study, the results of instrument based and checklist based of noise investigation was compared. For designing of proposed screening checklist and instrumental measuring based, 30 workplaces with more than 20 workers in Hamadan industrial area (west of Iran) were studied. The suggested screening checklist containing a 3×10 matrix can use for recognition step of noise assessment in a large scale investigations.

Results: Comparison of the results of the noise screening test with the outcome of a noise measurement by sound level meter, gave a sensitivity of 50% and specificity of 85%.

Conclusion: The screening test will be useable, if we only want to estimate the global noise pollution in workplaces.

Keywords: *Noise, Screening, Noise exposure, Workplaces, Iran*

Introduction

Nowadays, however development of industry and technology and using industrial new techniques have apparently presented a comfortable life for human being. But that has followed negative aspects and has caused workers to expose to numerous harmful factors that reckon on inseparable portion of industry and production, they consist threaten the health of workers. Noise pollution is one of the important issues of pollutant in workplaces and is almost one of the harmful agents for workers. At present, instrumental based inspections for determining the index levels of noise in workshops is performed.

Screening is defined as, the presumptive identification of unrecognized agent or defect by the application of tests, questionnaire, examination or other procedures which can be applied rapidly (1). The validity of a test or questionnaire is defined as the ability of the test to distinguish between infected and uninfected people or safe and unsafe conditions (2). To make appropriate recommendation for the development of standards for comprehensive noise screening of workplaces, attention to the efficacy of present system is needed.

Corresponding Author: Dr Rostam Golmohammadi, Fax: +98 811 8255301, E-mail: golmohamadi@umsha.ac.ir

Classification of workplaces based on noise pollution is one of the necessaries for macro programming view of monitoring and controlling of noise. According to the data based statistics in census of industrial workplaces with more than 10 workers, the health ministry of Iran in 1999, about 11002 workplaces had been covered by health delivery system. In theses places and other workplaces that have not covered yet, consideration the condition of harmful agents consist of noise with administration way, needs to the specialist personals, equipments and time that has not the possibility and explanation in the existing circumstances. Therefore, using a simple method base on screening checklist can be helpful to reduce the expense and time in inspection of noise pollution in workplaces.

Screening method is a valid way for early detection of disease and epidemiology studies (3-7), also in other studies screening is a common method for early investigations for separation of study popular (8-12).

The Propose of this study was to submit a simply scientifically screening method for inspection of noise pollution in workplaces. In this study, the results of instrument based and checklist based of noise investigation was compared. The suggested method can be used for recognition step of noise assessment in large scale investigations. This method is a proper way for exploiting and reducing the expenses by separation of workplaces that hasn't the problem of noise pollution.

Materials and Methods

This essay contains investigations result that introduces an innovative method for ridding in inspection of workplaces noise without need to the measurement's system. The study was based on designing a worksheet checklist of any major factor that affected on noise pollution in workplaces (13, 14). In this study 30 workplaces that contained above of 20 workers in Hamadan Province (west of Iran) were studied. In the secondary step of the study, designed checklist containing of 13 items was filled by observation method. In this step, sound pressure level in industries based on instrument on girding method by a calibrated sound level meter (Lutron SL4011) was measured. In the third step, mean of sound pressure levels by results of checklists were compared. Statistical analysis was performed using a best regression between items of checklist. In this step the checklist proportional of measurements was modified. Therefore, final checklist consisted of 10 important items accepted. In this checklist the parameters are inspected that can affect in increasing of noise pollution in a workplace contain follows:

1. The quality of wall sound absorption
2. The quality of ceiling sound absorption
3. The quality of roof sound absorption
4. Mean of noise sources life
5. The quality of maintenance of equipments
6. The rotation and duration of noise produce noise sources
7. The quantity of noise sources
8. Time duration of worker exposure in a shift
9. Clearness of conversation in the distance of one meter
10. The volume of workplaces

For each mentioned items, three characteristics were defined that contained grade coefficients 1, 2 and 3. As well as, regarding to the rate of their effect on noise aggravation, for each item a modified constant was considered. Determining of these constants was based on best multiple regression analysis on SPSS package. Total rank of noise pollution for each workplace was based on sum of the multiplying grade number to constant coefficients. Minimum rank in this method was considered 32, and the maximum 96.

In the final step for comparison of two methods, the sensitivity, specificity, positive predictive value and negative predictive value were calculated. Sensitivity is the ability of the screening test to give a positive finding when the workplace tested truly has the noise pollution, $a/(a+c)$. Specificity is the ability of the test to give a negative finding when the subjects tested are truly free of the noise pollution, $d/(b+d)$. The proportion of positive tests that are truly positive, $a/(a+b)$ is called the predictive value of a positive test. The proportion of negative tests that are truly negative $d/(c+d)$ is called the predictive value of a negative test (6). The general representation of the screening evaluation is shown in Table 1.

Results

Table 2 shows the descriptive analysis comparison between mean sound pressures levels and the rank numbers of screening test in studied workplaces. The statistic analysis showed that a Pearson's regression between two assessment scales was 0.771 and this results was a significant correlation (*P*= 0.0001).

Total rank of noise pollution for each workplace was based on sum of the multiplying grade number to constant coefficients. Minimum rank in this method is considered 32, and the maximum 96. In this suggested screening checklist, the noise pollution boundary of 72.48 (= 72.5) was determined. This criteria was based on the noise pollution level of 85 dB(A) in same measurement results. In this essay, pollutant workplace (positive test) is a ranking of 72.5 or above. Fig. 1 showed the suggested screening checklist. Also Fig. 2 showed the scatter relation between mean SPL values and noise ranking number in study workplaces.

Table 3 shows the general representation of the screening matrix. The calculated values of the noise screening checklist were; sensitivity 50%; specificity, 85%; positive predictive value, 62.5%; and negative predictive value, 73.9%.

Table 1: The general representation of the screening matrix

		Measurement by sound level meter		
		high pollution*	**low pollution**	**Total**
Screening by the noise pollution checklist	Positive**	True positive (a)	False positive (b)	(a+b)
	Negative	False negative (c)	True negative (d)	(c+d)
	Total	(a+c)	(b+d)	(a+b+c+d)

* Mean sound pressure level 85 dB(A) and above

** Rank number 72.5 and above

Table 2: Descriptive analysis of mean sound pressures levels and rank numbers of screening test

	Ranking number in screening checklist	Mean sound level meter dB(A)
Mean	66.33	81.59
Median	66.50	81.80
Mode	66.00	80.23
SD	12.27	8.30
Range	41.00	41.56
Minimum	47.00	54.00
Maximum	88.00	95.56

<table>
<tr><th colspan="9">Screening checklist for estimating of noise exposure</th></tr>
<tr><td colspan="4">Workplace Name:
Number of worker: Main production:</td><td colspan="5">Workplace code:
Date:
Name of screener:</td></tr>
<tr><td>Row</td><td>Effective items</td><td>Trait -A</td><td>3</td><td>Trait -B</td><td>2</td><td>Trait -C</td><td>1</td><td>Constant coefficient</td></tr>
<tr><td>1</td><td>Quality of wall sound absorption</td><td>Hard surface (like cement or tile)</td><td></td><td>Medium hardness(like gypsum)</td><td></td><td>Soft (like wood or fiber board)</td><td></td><td>2</td></tr>
<tr><td>2</td><td>Quality of ceiling sound absorption</td><td>Hard surface (like metal or cement)</td><td></td><td>Medium hardness (like gypsum)</td><td></td><td>Soft (like wood or fiber board)</td><td></td><td>1</td></tr>
<tr><td>3</td><td>Quality of roof sound absorption</td><td>Hard surface (like cement or tile)</td><td></td><td>Medium hardness (like brick)</td><td></td><td>Soft (like wood or fiber board)</td><td></td><td>1</td></tr>
<tr><td>4</td><td>Mean of noise sources life</td><td>More than 10 years</td><td></td><td>5-9 years</td><td></td><td>Less than 5 years</td><td></td><td>1</td></tr>
<tr><td>5</td><td>Quality of maintenance of equipments</td><td>Suitable</td><td></td><td>Little suitable</td><td></td><td>Unsuitable</td><td></td><td>1</td></tr>
<tr><td>6</td><td>Rotation and duration of noise produce noise sources</td><td>All of shift</td><td></td><td>Half of a shift</td><td></td><td>Less than a half shift</td><td></td><td>2</td></tr>
<tr><td>7</td><td>Quantity of noise sources</td><td>More than 10 sources</td><td></td><td>5-9 sources</td><td></td><td>Less than 5 sources</td><td></td><td>2</td></tr>
<tr><td>8</td><td>Time duration of worker exposure in a shift</td><td>More than 8 hours</td><td></td><td>4-7 hours</td><td></td><td>Less than 4 hours</td><td></td><td>1</td></tr>
<tr><td>9</td><td>Clearness of conversation in the distance of one meter</td><td>Isn't heard at all</td><td></td><td>It should be shouted</td><td></td><td>It is heard easily</td><td></td><td>15</td></tr>
<tr><td>10</td><td>Volume of workplaces (m^3)</td><td>Less than 100</td><td></td><td>100-1000</td><td></td><td>More than 1000</td><td></td><td>6</td></tr>
<tr><td colspan="8">Total ranking number (Sum of the multiplying grade number to constant coefficients)</td><td></td></tr>
<tr><td colspan="9">Name of screener: Signature:</td></tr>
</table>

Fig .1: The suggested screening checklist

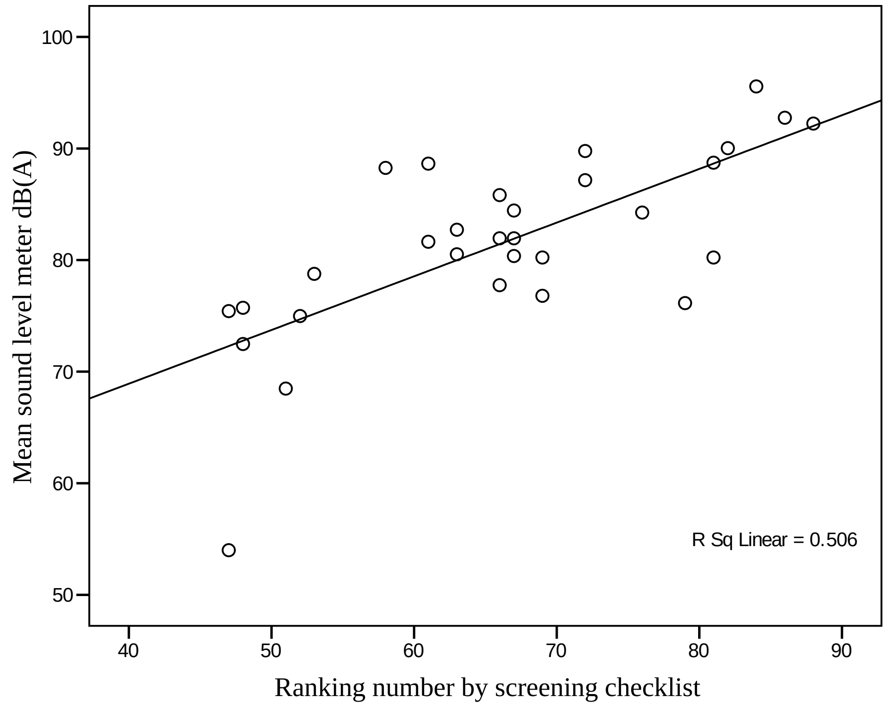

Fig. 2: Relation between mean SPL values and noise ranking number in study workplaces

Table 3: The general representation of the screening matrix

		Measurement by sound level meter		
		High pollution*	**Low pollution**	**Total**
Screening by the noise exposure checklist	Positive**	5	3	8
	Negative	5	17	23
	Total	10	20	30

* Mean sound pressure level 85 dB(A) and above
** Rank number 72.5 and above

Discussion

The Propose of this study was to submit a simply scientifically method for inspection of noise in work places. In this study, the results of instrument based and checklist based of noise investigation was compared.

Comparison of the results of the noise screening test with the outcome of a noise measurement by sound level meter, gave a low sensitivity of 50% but a high specificity of 85%. An ideal screening test would be 100% sensitive and 100% specific. In practice this dose not occurs; sensitivity and specificity are usually inversely related (15). Any other studies had similar results for specificity to obtain a reliable test for screening. Sadri and Mahjub gave a low sensitivity of 44.8% but a high sensitivity of 98.9% in Evaluation of the Vision Screening test (E-chart) in School Children (3). Riedar et al. reported 38.9% true positives, 4.4% true negatives, 56.7% false positives and 0% false negatives in the K^2 Asbestos Screening Test (10). Also, Yeagar DE et al. reported a sensitivity of 52.63% and a specificity of 94.90% for Posttraumatic stress disorder (PTSD) Checklist and SPAN in Veterans Affairs primary care settings (16). In this study, the positive predictive value was

62.5% and negative predictive value as 73.9%. According to the results, use of suggested noise screening test to estimate of noise pollution is insensitive and highly specific. When we added 5 true positive to 17 true negative cells to all of 30 studied workplaces in Table 3 we obtained a 76.67% of true answer by the screening method. This finding shows that the screening test will be useable if we only want to estimate the global noise pollution in workplaces. Constant coefficient of Clearness of conversation in the distance of one meter in the row No.9 of suggested checklist showed a noticeable coefficient equal to15, therefore it must need to add any other personal effect variables that affected in this coefficient, such as heart rate of workers, noise annoyance rate, and hearing loss in the future studies.

In conclusion, these results showed that, using proposed screening checklist for noise inspection can be used with a high reliance before of noise measuring without necessity to use the instrument in workplaces. Therefore, this method is a proper rapid method for exploiting and reducing the expenses by separation of workplaces that has not the problem of noise pollution in the occupational health inspection systems.

Acknowledgements

This paper is based on the third and forth author in BSc project which was conducted in Department of Occupational Health, School of Public Health, Hamadan University of Medical Sciences, Iran.

References

1. Last M. *A dictionary of Epidemiology*. Oxford University Press. Oxford, 2001: p. 165.
2. Gordis L. *Epidemiology*. WB, Saunders. New York, 2000: p. 120.
3. Sadri GH, Mahjub H, Evaluation of the Vision Screening in School Children Hamadan Province (the west of Iran). *Journal of Research in Health Sciences*. 2003; **3(2):**13-7.
4. Thomson WD, Evans B. A new approach to vision screening in schools. *Ophthalmic Physiol Opt*. 1999; **19(3):**196-209.
5. Morton RF, Hebel JR, McCarter RJ (1990). *A study guide to Epidemiology and Biostatistics*, Aspen Publication, Maryland. Available from: www.google.com
6. Meinke DK, Dice N. Comparison of audiometric screening criteria for the identification of noise-induced hearing loss in adolescents. *Am J Audiol*. 2007; **16(2):** 190-202.
7. Prasher D, Sułkowski W. The role of otoacoustic emissions in screening and evaluation of noise damage. *Int J Occup Med Environ Health*. 1999; **12(2):** 183-92.
8. Maged H, Waleed E. A GIS-based approach for the screening assessment of noise and vibration impacts from transit projects. *Journal of Environmental Management*. 2007; **84(3):**305-13.
9. Riedar KO, Vernon E R. An Evaluation of the K2 Asbestos Screening Test. *American Ind Hyg Assoc J*. 1986; **47(5):** 245-48.
10. Jacobson JT, Jacobson CA. The effects of noise in transient EOAE newborn hearing screening. *Inter J of Pediatric Otorhinolaryngology*. 1994; **29(3)**:235-48.
11. Stegemann JA, Zhou Q. Screening tests for assessing treatability of inorganic industrial wastes by stabilisation /solidification with cement. *J of Hazardous Materials*. 2009; **161(1):**300-6.
12. Harris Cyril M. *Handbook of Acoustical Measurements and Noise Control*. McGraw-Hill, USA. 1991.
13. Bell LH, Bell DH. *Industrial Noise Control*. Marcel Dekkel, New York, 1994: pp. 133-85.

14. Mausner JS, Kramer S. *Epidemiology-An introductory text*. WB Saunders, USA, 1985: pp. 217-20.
15. Yeager DE, Magruder KM, Knapp RG, Nicholas JS, Frueh BC. Performance characteristics of the posttraumatic stress disorder checklist and SPAN in Veterans Affairs primary care settings. *Gen Hosp Psychiatry*. 2007; **29(4):** 294-301.