Investigation On The Health Status of 11800 Occupational Noise Workers in Xinjiang

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Abstract

Background: To investigate the current status of occupational noise hazards in some Xinjiang enterprises, and to provide a basis for the development of targeted noise prevention measures.

Methods: We used descriptive analysis to investigate a total of 11,800 subjects who underwent occupational health examination in Xinjiang Occupational Disease Prevention Hospital.

Results: The hearing abnormality rate of noise exposure practitioners was 8.03%, which was higher in males than that in females (χ^2=54.507, p <0.05). The abnormal rate of high-frequency hearing threshold in Xinjiang minorities was lower than that of Han nationality (χ^2=11.780, p <0.05), the results of the electrocardiogram were reversed (χ^2=9.128, p <0.05). Differences in abnormal rates of blood pressure (χ^2=149.734, p <0.05), hearing (χ^2=231.203, p <0.05), and physical examination (χ^2=360.609, P <0.05) are statistically significant in different industries. The abnormal rate of blood pressure (χ^2=67.416, p <0.05) and hearing (χ^2=49.535, p <0.05) gradually decreases with the expansion of the enterprise scale.

Conclusion: Male, elderly, mining, small and medium enterprise practitioners should be the key population for noise occupational hazard prevention. It is necessary to standardize occupational health management in enterprises, improve workers' self-protection awareness and the quality of life of employees.

Background

With the advancement of science and the popularization of industrialized production, the occupational health damage of workers caused or induced by productive noise exposure has become a recognized public health problem in the world. More than 600 million workers worldwide have levels of occupational noise exposure above hazardous thresholds [1]. Approximately 16% of adults worldwide lose hearing due to noise at work, and occupational noise deafness account for 16.7% of the total number of occupational patients in China [2]. While the likelihood of workers being exposed to noise is declining in some developed countries with advanced technology, the shift from agriculture to basic industry in developing countries is increasing the likelihood of occupational exposure [3]. Noise exists in all walks of life, occupational noise exposure not only affects the auditory system, but also damages the individual's health to varying degrees. Not only should we address the source of noise exposure, but also focus on protecting vulnerable groups. The purpose of this study is to identify the key groups for prevention and control of occupational noise hazards, and to provide a clue for the development of targeted noise prevention measures.

Methods

Data sources and study participants

This study included 11,800 practitioners who underwent occupational health examinations at Xinjiang Occupational Disease Prevention and Control Hospital from January 1 to December 31, 2019, and whose

occupational hazards were noise. Participating researchers came from 168 companies, and the industry was divided into five categories (National Economy Industry Classification GB / T 4754—2017), three enterprises scale (Statistical Methods for the Classification of Large, Medium, Small and Micro Enterprises 201175). All participants signed informed consent forms and the study was approved by the Medical Ethics Committee of The Third People's Hospital of Xinjiang Uygur Autonomous Region (No.XJSQ20200428-10).

Clinical measurement

The occupational health examination program is conducted in accordance with the Chinese occupational health monitoring regulations (Occupational health monitoring technical specifications GB / Z 188–2014). The physical examination included blood pressure examination, electrocardiogram examination, pure tone hearing threshold test. There are two kinds of final results of occupational health examinations, abnormalities or normalities.

Blood pressure examination(BP)

The examinee rest for at least 10 minutes in a quiet environment. The physical muscles of the subject were relaxed, the palms were extended upwards, the elbows were at the same level as the heart, the cuffs were flat against the skin, and the elasticity was moderate. The lower edge was 1 to 2 cm higher than the elbows. Three measurements were performed at an interval of 5 min, used an electronic sphygmomanometer (12V8117; OMRON; China). The average of the measurement results was used. According to the World Health Organization standard classification, subjects with diastolic pressure > 90 and systolic pressure > 140 were defined as hypertension patients.

Electrocardiogram examination(ECG)

Before the examination, rest in a supine position within 5–10 min. The electrocardiograph uses conventional 12-lead electrocardiograms (ECG-1350; Nihon Kohden; Japan) to measure the electrocardiogram, and is operated by a professionally trained doctor, and the examinee performs the supine measurement. The results were interpreted and the results suggested according to the international standard of ECG. All results were abnormal except for sinus heart rate.

Pure tone audiometry examination(PTA)

The examinee is required to avoid noisy environments for up to 12 hours before the test. All subjects underwent pure-tone hearing tests used pure tone audiometer (AD226; Interacoustics; Danish) in rooms with a background noise level of less than 25dB. Both ears were tested using ascending pure tones at frequencies of 0.5, 1, 2, 3, 4, and 6 kHz. The test was repeated at least 3 times to determine the lowest signal strength as the final threshold for each ear. Use average thresholds of 3, 4, 6 kHz to determine high-frequency hearing status. Binaural high-frequency average hearing threshold ≤ 40dB is normal.

Statistical analyses

Continuous data were shown as mean ± standard deviation. Student's t-tests and ANOVA tests were analyzed by using independent-sample, LSD-t tests were used to analyze Pairwise comparison between multiple groups. Qualitative data were analyzed by Pearson $\chi 2$ test. Data were analyzed with IBM SPSS(ver 20). Differences would be considered significant if the P value was < 0.05.

Results

This study included 11800 workers (from 168 companies) with a mean age of 35.0 (range 18 to 66) years. There were 10,626 males, accounting for 90.5%, and 1,190 minority employees, accounting for 10.08% (Table 1).

The abnormal rate of high frequency hearing threshold of male practitioners was higher than that of females ($p < 0.05$), and the working age was slightly longer than that of female practitioners ($p < 0.05$), but the difference was not significant. The abnormal rate of electrocardiogram of Han practitioners is lower than that of other ethnic minorities ($p < 0.05$), but the abnormal rate of high frequency hearing threshold is higher ($p < 0.05$) (Table 2).

Both age and working age had an effect on electrocardiogram, blood pressure, high-frequency hearing threshold, and abnormal rate of physical examination ($p < 0.05$), and age had a greater positive impact on it. Except for the abnormal rate of electrocardiogram ($p > 0.05$), the results of occupational health examination of practitioners of different industries and different enterprise sizes have statistical differences. There were significant differences between the working-age groups in all industries ($p < 0.05$); the comparison between the age distribution groups in all industries (except for the electricity, gas and water production and supply groups and other industry groups) had significant differences ($p < 0.05$) (Table 3).

Comparing the size of enterprises, there were significant differences in working age ($p < 0.05$); the age distribution of practitioners in large enterprises and small and medium enterprises had significant differences ($p < 0.05$) (Table 4).

Table 1
The socio-demographic characteristics of the workers

Variable	n(%)
Gender	
Male	10626(90.05%)
Female	1174(9.95%)
Nationality	
The han nationality	10610(89.92%)
Minorities	1190(10.08)
Industry	
Mining	3005(25.47%)
Manufacturing	6332(53.67%)
EGW*	949(8.04%)
Transportation**	856(7.25%)
Others	658(5.58%)
Enterprise size	
Large-scale	3005(65.51%)
Mid-scale	633(13.80%)
Small-scale	949(20.69%)
*Electricity, gas and water production and supply industries	
**The companies participating in this study are all in the air transport industry	

Table 2
Analysis of occupational health examination results by gender and Nationality

	Gender				**Nationality**			
	Male	Female	t/χ^2	*P*	Han	Minorities	t/χ^2	*P*
AGE(Years,±*s*)	35.25 ± 9.89	35.02 ± 8.47	0.760	0.451	35.27 ± 9.86	34.90 ± 8.84	1.214	0.232
Working age(Years,±*s*)	6.78 ± 7.78	5.47 ± 5.78	5.603	0.003	6.65 ± 7.56	6.74 ± 8.14	0.394	0.701
ECG								
Normal (n)	6731	771	2.475	0.116	6793	709	9.128	0.003
Abnormal (n)	3895	403			3817	481		
PB								
Normal (n)	8765	985	1.474	0.225	8759	991	0.390	0.532
Abnormal (n)	1861	189			1851	199		
PTA								
Normal (n)	9708	1145	54.507	0.001	9728	1125	11.780	0.001
Abnormal (n)	918	29			882	65		
Medical examination results								
Normal (n)	2106	227	0.156	0.693	7089	758	4.666	0.031
Abnormal (n)	8520	947			3521	432		

Table 3
Analysis of occupational health examination results of workers in different industries

	Mining	Manufacturing	EGW	Transportation	Others	F/χ^2	*P*
AGE(Years,±*s*)	41.97 ± 8.98	31.31 ± 8.07	39.18 ± 9.88*	33.16 ± 8.17	39.17 ± 9.36*	899.372	0.001
Working age(Years,±*s*)	11.85 ± 9.98	4.13 ± 4.45	8.33 ± 8.37	6.45 ± 6.84	5.09 ± 6.47	665.241	0.001
ECG							
Normal (n)	1887	4052	627	523	413	6.269	0.180
Abnormal (n)	1118	2280	322	333	245		
PB							
Normal (n)	2314	5454	736	730	516	149.734	0.001
Abnormal (n)	691	878	213	126	142		
PTA							
Normal (n)	2574	5996	876	805	602	231.203	0.001
Abnormal (n)	431	336	73	51	56		
Medical examination results							
Normal (n)	504	1054	226	356	193	360.609	0.001
Abnormal (n)	2501	5278	723	500	465		
*There was no statistical difference between the groups							

Table 4
Analysis on the results of occupational health examination of workers in different scale enterprises

	large-scale	Mid-scale	Small-scale	F/χ^2	*P*
AGE(Years,±*s*)	33.53 ± 8.98	38.43 ± 10.17*	38.23 ± 11.02*	352.31	0.001
Working age(Years,±*s*)	6.66 ± 7.58	7.17 ± 7.83	4.54 ± 6.68	39.767	0.001
ECG					
Normal (n)	4865	2125	512	2.509	0.285
Abnormal (n)	2806	1173	319		
PB					
Normal (n)	6490	2631	629	67.416	0.001
Abnormal (n)	1181	667	202		
PTA					
Normal (n)	7152	2967	734	49.535	0.001
Abnormal (n)	519	331	97		
Medical examination results					
Normal (n)	1482	650	201	11.213	0.004
Abnormal (n)	6189	2648	630		
*There was no statistical difference between the groups					

Discussion

Earlier studies found that women are significantly more sensitive to hearing at higher frequencies than men, the opposite is true in low-frequency areas. As the age increases, the auditory function of males decays faster. The overall hearing of females is better than that of males, and male occupational hearing loss is always higher than females [4]. The gender difference in this study did not affect the abnormal rates of practitioners' ECG, blood pressure, and physical examination results, and there were differences only in the abnormal rate of binaural hearing threshold (male: 8.64% female: 2.47% total: 8.03%). Therefore, we must focus on the results of occupational health inspections of male practitioners and increase the level of protection for male practitioners. This is consistent with the results of many studies in recent years. In 2015, Lin Daojian's research on the hearing impairment rate (48.1%) of 2473 noise workers in Zhuhai City [5], and Qian Xuequan's research on the hearing impairment rate (28.3%) of 639 noise workers in an oil field in Xinjiang [6]. In comparison, the damage rate in this study was low. Possible reasons are, in recent years, the state and enterprises have improved the equipment, strictly controlled workers 'protection, and the popularity of workers' protection awareness.

Because the surveyed companies are all in the Xinjiang Uygur Autonomous Region that the ethnic minority (mostly Caucasian) population accounts for 60% of Xinjiang's total population compare with other provinces in China, its appearance and living habits are obviously different from those of the Han nationality. Luo Rui analyzed the electrocardiograms of the minority (Kazakhs are the third largest ethnic group in the provincial, the Caucasian ethnic group) and the Hans on physical examination in Xinjiang. They found that the abnormal rate of ECG in Kazakhs is significantly higher than Hans, which is consistent with the results of the high abnormal rate of ethnic minorities in this study [7]. This is closely related to the customs and diet of ethnic minorities. Xinjiang ethnic minorities have a high salt diet, their diets are mainly pasta and meat, and less fresh vegetables and fruits, and lack of trace elements and folic acid. These are high risk factors for heart disease. The results showed that noise exposure was not the main cause of ECG abnormality. The 2013 research results by Themann showed that hearing sensitivity decreased with pigmentation [8], which explained that ethnic minorities normal high-frequency hearing threshold ratio is still higher than that of the Hans, even if the protection of their may be relatively weak due to language problems. So we think ethnic factors are not the main issue.

In this study, the noise exposure practitioners in the mining industry are the oldest, followed by electricity, heat and gas production and supply industry, other industries, and transportation, and finally manufacturing. This is consistent with the detection rate of abnormal blood pressure and high-frequency hearing threshold. The cause of this abnormality is most likely due to the effect of age on the human body. Studies have shown that the effect of age and working age on the human body accelerates age-related hearing loss, while there is a moderate degree of correlation between the accumulation of occupational noise exposure and age and hypertension [9].

The mining and the production and supply of electric heating gas industry have a high incidence of noise exposure and diseases affected by noise, but the occupational noise exposure practitioners in other industries also have high blood pressure and high frequency hearing threshold abnormalities. Although there are fewer occupational noise exposures in some industries, the cumulative exposure time and exposure dose are low, or some industries have no awareness of occupational noise exposure, and due to their inadequate protection, cause their hearing loss and affect their health. Kerns found that 31% of medical and diagnostic laboratory workers are exposed to noise and have substantial hearing impairments, which is higher than the mining and construction industries [10]. No industry can rule out occupational noise exposure. It is necessary to evaluate the exposure of each industry and occupation. It is also necessary to strengthen supervision of "low-risk" industries.

However, this study found that the abnormal rate of blood pressure and high-frequency hearing threshold of exposed workers gradually decreased with the expansion of the size of the enterprise. Many studies are consistent with the results of this paper, compared with large enterprises, small enterprises provide less prevention and education to workers, workers lack safety awareness, and lack comprehensive safety interventions [11, 12]. For small businesses, periodic health checks, and on eliminating or minimizing work environment safety hazards to promote occupational health of Medium and small enterprises.

This study shows that men, mining industries, and small-scale enterprises are vulnerable to noise damage and are also a key group for occupational noise protection. Enterprises in the mining industry should early detection of hearing loss and noise sensitive persons, multilingual training should be carried out in protection knowledge training to ensure that practitioners of ethnic minority noise exposure who are inconvenient in communication can increase their awareness of individual protection and reduce occupational hazards. Small businesses should also quickly establish and improve occupational health surveillance systems to promote sustainable development. This study simply analyzes the health effects of noise exposure on practitioners, and provides a basic basis for occupational health management in the region.

This study may have some limitations. The cross-sectional design may limit causality, which is also the limitation of this article Cohort studies can be carried out later, and occupational exposure assessment using biological monitoring and noise dosimetry can be performed to obtain more accurate results.

Conclusion

This study shows that men, mining industries, and small-scale enterprises are vulnerable to noise damage and are also a key group for occupational noise protection. Enterprises in the mining industry should early detection of hearing loss and noise sensitive persons, multilingual training should be carried out in protection knowledge training to ensure that practitioners of ethnic minority noise exposure who are inconvenient in communication can increase their awareness of individual protection and reduce occupational hazards. Small businesses should also quickly establish and improve occupational health surveillance systems to promote sustainable development. This study simply analyzes the health effects of noise exposure on practitioners, and provides a basic basis for occupational health management in the region.

Abbreviations

BP：Blood pressure examination

ECG：Electrocardiogram examination

PTA：Pure tone audiometry examination

EGW:Electricity, gas and water production and supply industries

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Committee of The Third People's Hospital of Xinjiang Uygur Autonomous Region (XJSQ20200428-10).

Written informed consent was obtained from all subjects.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

We thank all the individuals who participated in the present study. Shi-Yu Zhao, Ping He had the original idea for the study and, with all co-authors carried out the design. Dong-Kui He, Han-Wei Zhang, Ting-Ting Hou, Cheng-Xin Yang, Wen Ding participated in the recruitment of research objects, data collection, analysis and sorting All authors read and approved the final manuscript.

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