

CURRENT STATUS OF HAND-ARM VIBRATION SYNDROME IN CHINA – OCCURRENCE, LAWS, AND MEASURES OF PREVENTION AND CONTROL

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1. INTRODUCTION

China is the most populated country in the world, and is rapidly becoming one of the most industrialized countries as well. Many workers in China are exposed to occupational hazard factors (OHF), and hand arm vibration (HAV) is a continuing OHF for millions of workers. The use of vibrating hand tools may contribute to Reynaud's Syndrome, vibration-induced white finger (VWF), musculoskeletal injuries, neuropathies, cardiovascular effects, psychosocial stress, and mental disorders. Monitoring and detecting hand-arm vibration syndrome (HAVS) is complex, and may require specialized equipment which is not typically available to employers at workplaces, or even at some occupational hygienic institutes. Therefore, many workers exposed to HAV are not identified, monitored, examined, or diagnosed.

Aware of these problems, China now is building systems, using technical and procedural methods, to monitor HAV and related factors, conduct medical surveillance among workers, provide diagnosis and treatment of HAVS, and implement preventative measure.

This paper presents several reports of HAV exposures in China, and then outlines regulations to prevent and control HAVS, as well as the new national prevention and control program for occupational diseases.

2. PREVALENCE OF HAVS AND SOME DIAGNOSTIC REPORTS

Clinical manifestations of multiple sensory neuropathy disorders are expected to occur when a worker is exposed to hand-arm vibration for a long time. These disorders include hand-arm (mainly the elbow and wrist) bone proliferation, joint features of the hand-arm muscles and tendons disorders, and nerve trunk entrapment syndromes. Joint damage, VWF, Dupuytren's contracture and hand-arm muscle atrophy are commonly observed.

2.1 Vibration-Induced White Finger (VWF)

Since 1979, China has carried out VWF investigations of different types of work in various regions in ten provinces and cities in China. These investigations show that VWF has prevalence rates around 10%-60%^[1], but may

be as high as 80% or more for some types of work. In both southern and northern regions of the country, VWF was found in workers but a significant difference in occurrence between regions was observed. Workers averaged 33.8 years old, and averaged of 9.2 years of service. These studies also showed hand swelling, cold hands, and hand sweating were common early clinical symptoms for workers exposed to hand-arm vibration. Episodes of finger blanching happened most frequently before 0900h (where daytime air temperature ranged from 9-22 °C)^[2].

2.2 Joint Damage

Studies were conducted to investigate joint damage in exposed workers. Studies examined changes in x-ray images. For example, Song Hanlin, et al.^[3] examined the changes of hand-bone x-rays for 143 workers who used vibrating hand-held tools. The results showed that 68.5% of workers had x-ray image changes. The extent of damage was related to the vibration exposure duration, and vibration exposure area on the hands and arms. Also, it appeared that the basis of joint pain and activity disorder pathology was articular surface hyperosteoecy, subchondral sclerosis, and joint space narrowing.

2.3 Hand Tendon Contractures

In 1982, Chang Jizeng et al.^[4] investigated a group of polishing and grinding workers. Among them, 41.2% had hand tendon contractures, while the control groups had none. There were significant differences between the two groups ($P < 0.01$). Liu Changting^[5] examined the rivet, shovel mill, and cleaning workers, and found that hand tendon contracture rates were 18.8%, while the control group rate was 2.6%. Again, there were significant differences between the two groups ($P < 0.01$).



Figure 1. Hands of workers exposed to HAVS.

Figure 1 shows the hand tendon contractures of several workers from an ironware plastic company. The workers were not able to straighten their fingers, and they suffered sharp pain [6].

2.4. HAVS Prevalence in Coal Miners

In 2009, there were more than 1.5 million coal miners in China. Most of them worked underground and were exposed to HAV. A research project investigated HAVS, using the mine workers as the exposure group, and workers in other industries and not exposed to vibration as the control group. Results showed there were significant differences between the two groups in prevalence of hydroarthrosis ($\chi^2 = 7.6$, $p < 0.01$), osteoporosis ($\chi^2 = 2.72$, $p < 0.05$), and osteomyelitis ($\chi^2 = 4.39$, $p < 0.05$). Edema and avascular necrosis of the ossa carpi were found only in the exposed group. Hydroarthrosis and edema occurred most in the early stages of vibration exposure. This can be useful in diagnosing HAVS. Changes in the wrist joint also occurred in the early stages of vibration exposure, and could be seen on an MRI.

3. OCCUPATIONAL HEALTH LAWS AND STANDARDS

In October 1985, China published and implemented the national standard (GB4865-85): "*Local Vibration of Occupational Disease Diagnostic Criteria and Principles*". This national standard has played a positive role in promoting work on prevention and control of vibration disease.

In 2001, after enactment of the "*Law on Occupational Disease Prevention and Control of P.R.China*", China released several additional national standards, including "*Diagnostic Criteria of Occupational Hand-Arm Vibration Disease*" (GBZ 7-2002), "*Requirements for Vibration Hazards Reduction of Hand-Held Machines at the Workplace*" (GB/T 17958-2000), and "*Measurement and Evaluation of Vibration Transmissibility of Gloves at the Palm of the Hand*" (GB/T 18703-2002).

Recently, China further enacted "*Occupational Exposure Limits for Hazardous Agents in the Workplace. Part 2: Physical Agents*" (GBZ 2.2-2007), and adjusted the requirements of exposure limits for hand-transmitted vibration. Also issued in 2007 was the latest hand-transmitted vibration measurement standard (GBZ/T 189.9-2007): "*Measurement of Hand-Transmitted Vibration in the Workplace*". When taken together, these regulations and standards provide the basis for conducting hand-arm vibration monitoring, and for the evaluation and control of workplace hazards.

Recently, studies have been conducted to evaluate quantitative methods to assess sensations of vibration, pain,

touch, and temperature. In particular, vibrotactile perception at the fingertips has been studied.

More research is being done on hand numbness, pain, sensory dysfunction, peripheral nerve injury, as well as on vibration perception thresholds and their clinical significance for assessing HAVS. Considerable progress has been made in acquiring experience and developing more consistent views [7].

Even though significant progress is being made in the field of HAV in China, more work needs to be done. There is an opportunity now for further revisions and improvements in China's national occupational hygiene and diagnosis standards, based on current interest and active participation in international standard-setting and research activities.

Therefore, the Chinese *National Prevention and Control Program for Occupational Diseases 2010-2015* has plans to: revise national standards for occupational hygiene to protect the health of workers exposed to HAV; prevent and control factors contributing to HAV; revise national diagnosis standards for early diagnosis of HAVS, based on adverse health effects of workers exposed to HAV; enhance monitoring capacity and warning levels of workplace factors that contribute to HAVS; enhance medical surveillance for workers exposed to HAV; develop occupational health risk assessment, prediction and control methods for management of HAVS; improve tools, equipment, and personal protective equipment through technical innovation and research; strengthen communication of knowledge and information for prevention and control of HAV factors; and improve treatment technologies for HAVS, especially in the use of Chinese traditional medicine.

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