A Study of the Hand-Arm Vibration Syndrome in Okinawa, a Subtropical Area of Japan

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Abstract: The purpose of this study was to understand the peculiarity of the development of Hand-Arm Vibration Syndrome (HAVS) in a subtropical area of Japan. We analyzed the medical records of 21 subjects reported by the Okinawa Labor Bureau, and tried to determine whether the warm environment has any effect on the severity of HAVS. The mean operating time of vibration tools for all the subjects was over 10,000 hrs. Almost all the subjects from Okinawa had been working only in Okinawa. The presence of Vibration Induced White Fingers (VWF) was markedly smaller in the subjects from Okinawa as compared to those from other prefectures. The results of Cold Water Immersion Tests were similar for all subjects. Ten minutes after the Cold Water Immersion Test, the mean finger skin temperature was about 19°C in all subjects. These findings suggest that not only the operating time of vibration tools but also the warm environment might have an effect on the severity of HAVS. However, the number of subjects in our study was very small. There is the need therefore for further investigations with a larger number of subjects.

Key words: Vibration tools, Vibration syndrome, Subtropical, Okinawa, Birthplace, Workplace

Many studies have indicated the combined effects of vibration and temperature, particularly low temperature, on HAVS1–5). Although Futatsuka et al.6, 7) have reported the results of HAVS in subjects exposed to vibration in the tropical rain forest, insufficient knowledge has so far been obtained on the epidemiological aspects of HAVS in tropical and subtropical areas. With the industrial revolution now progressing in most countries located in the tropical and subtropical areas, there will be more opportunities for exposure to vibrations from use of industrial tools. In order to prevent people from excessive exposure to vibration in these areas, it is important to understand the peculiarities of the development of HAVS in the tropical and subtropical countries. In this study, we tried to determine whether or not the warm environment has any effect on the occurrence of HAVS, Vibration Induced White Fingers (VWF), and the peripheral circulation in the upper extremities of vibration tool operators.

The Okinawa prefecture is in the subtropical area of Japan. All the twenty-one cases reported by the Okinawa Labor Bureau over the years, were the subjects of this study. They were all males and were mainly chainsaw operators and dam constructors. The subjects included those who were born in Okinawa and those who were born in other prefectures of Japan. We obtained their medical records, which contained the results of Finger Skin Temperature, Nail Compression Test, Vibration Perception Threshold, Gripping Power8) and Cold Water Immersion Test of the upper extremities. The patients were required to rest in a room with a room temperature of 23°C for 30 minutes prior to the Cold Water Immersion Test. This was done so as to achieve equilibration at room temperature. The left hand was then immersed in water at a temperature of 10°C for 10 minutes, then the change in finger skin temperature of the II, III or IV finger was measured using an infra-red ray thermistor. Cold Water Immersion Test, which is widely used in Japan, is one of the most sensitive methods used in the diagnosis of HAVS. In this study therefore we chose particularly to analyze the
results of the Cold Water Immersion Tests. The subjects were divided into two groups according to their birthplaces. Group A contained the subjects from Okinawa and group B contained the subjects from other prefectures. Student’s t-test was used to compare their ages, total operating time of vibration tools, presences of VWF and the results of the Cold Water Immersion Tests of the two groups.

The first case of HA VS registered in Okinawa was in 1984. Table 1 shows all HA VS subjects who were registered at the Okinawa Labor Bureau from 1984 to 2000. It also shows the total number of subjects, the mean ages, the total operating time, and the total number of subjects with VWF in each group. The mean age of Group A subjects was significantly higher than that of group B. There was no significant difference in the mean total operating time of vibration tools.

There was only one subject with VWF in Group A. He was a 64 year old worker who had worked with a rock drill and pick hammer from 1971 to 1981 in Okinawa. From 1981 he worked in other prefectures in the temperate zone with the same tools. Sometime during this period he started feeling numbness and stiffness in his fingers. It was then that he first noticed VWF in his hands. However he continued to use the vibration tools until 1994. The total operating time of vibration tool use was about 4356 hours. After hypertension, diabetes and collagen disease were excluded, he was finally diagnosed as having HAVS in 1996.

Fig. 1 shows the workplace and the mean operating times of each group. The subjects in Group A have worked mainly in Okinawa. The subjects in Group B however have worked mainly in other prefectures. The mean time from when they started to use vibration tools till when they first felt symptoms of discomfort in their hands was 6942 hours in Group A and 5873 hours in Group B. Fig. 2 shows the results of Cold Water Immersion Test. The finger skin temperature of Group A was slightly lower than that of Group B. The difference between the two groups was not statistically significant. Ten minutes after the Cold Water Immersion Test, the mean finger skin temperature of both groups was about 19°C.

In Japan, studies on vibration and its effect on health began in the 1930s. Since then many HAVS cases have been reported. Although a lot of workers have been exposed to vibration through the use of vibration tools in worksites such as coalmines and dam construction, in Okinawa the detailed information on the incidence of HAVS is unknown. Up to date, only 21 HAVS cases have been officially reported. This number is very small compared to that of other prefectures in Japan. The mean operating time in this study was over 3000 hrs from the onset of symptoms of discomfort in their hands till diagnosis of HAVS. One of the reasons for the low reported incidence of HAVS in Okinawa may

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of subjects</th>
<th>Mean age (yr)</th>
<th>Total operating time (× 1000 h)</th>
<th>Number of subjects with VWF</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6</td>
<td>62.5 ± 10.0</td>
<td>11.8 ± 7.4</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>15</td>
<td>51.4 ± 10.0*</td>
<td>11.8 ± 6.9</td>
<td>7</td>
</tr>
</tbody>
</table>

Group A: HAVS subjects whose birthplaces are Okinawa.
Group B: HAVS subjects whose birthplaces are other prefectures.
Each value is expressed as a mean ± SD, *: Significantly different from Group A at p<0.05.

Fig. 1. The operating time of vibration tools in Okinawa and other prefectures of Group A and Group B.
* : Significantly different from Operating time in Okinawa at p<0.05.
be due partly to the fact some of the cases which should have been reported, may have been overlooked because the harmful effect of vibration exposure in workers is not usually given its due consideration by the physicians. This also accounts for the delay in the diagnosis of the disease. Another reason may be that since primary and secondary industries, which use vibration tools, are not well developed in Okinawa, the number of workers who are exposed to vibration are low as compared to mainland of Japan.

In this study, the prevalence of VIWF was also lower in the subjects who were born in Okinawa as compared to those who were born in other prefectures despite the similarity in times of vibration tool operation. Low temperature and vibration exposure time have been recognized as important factors in the reduction of peripheral circulation\(^{10-12}\). Because other prefectures in Japan belong mainly to the temperate zone and have an average temperature in winter much lower than that of Okinawa, the subjects born in these prefectures were exposed to lower temperature when they operated vibration tools in these areas. On the other hand, Okinawa prefecture which is located in the sub-tropic has an annual average temperature of 23\(^\circ\)C and an average winter temperature of 15\(^\circ\)C. The subject with VWF in group A, noticed for the first time that the skin on his finger turned white immediately after he moved to mainland Japan. Furthermore the mean operating time of vibration tool use before symptoms of discomfort was felt was longer in Group A than in Group B. The warm temperature might have prevented the reduction of peripheral circulation in the subjects who were born and worked in Okinawa. This may be the reason why they were less likely to develop HAVS and VWF as compared to those who were born in and worked in other prefectures.

The number of subjects in our study was very small. To determine exactly how warm conditions affect the incidence of HAVS, it is necessary to perform a larger scale investigation.

The result of Cold Water Immersion Test of subjects from Okinawa and those from other prefectures were very similar. It might be useful to refer to the result of other tests. It is necessary also to develop objective methods of diagnosing HAVS.

In this study we obtained information on HAVS subjects from past medical records. The results of all blood tests were however not available. So there is no denying the fact that primary Raynaud’s phenomenon or other atherosclerotic risk factors, such as hyperlipemia, were not ruled out. Furthermore, operating time of vibration tools, one of the most important items, was collected by using recall method so the possibility of recall bias exist. A proper record keeping at the worksites would provide this very important information.

**References**


Influence of local vibration on finger functions of forest workers. Ind Health 35, 337–42.


