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VIBRATION EXPOSURE AND PREVENTION IN JAPAN

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ABSTRACT

Working conditions of vibration exposure have generally improved, but many difficult problems must be solved such as (1) hygienic improvements in a variety of vibrating tools; (2) improving working conditions, for example, by limiting the time of operation in spite of economic difficulties such as those faced by those who work on a piece rate basis; (3) gathering more complete information about the risk population because of the large number of self-employed in informal employment sectors; and (4) finding work places after rehabilitation for patients, particularly in mountainous rural areas or in small scale industries. Historical observation of vibration and preventive measures in Japanese national forests was presented on the basis of the results of a retrospective cohort study in Kyushu, Japan. Prevalence rate of VWF remarkably changed from 58.4% in the groups that began to operate chain saws in 1960 to only a few cases in the groups who started the operation after 1971. When we compare the relationships between the results of long term cohort study and the consequences of preventive measures of vibration syndrome, the most important factor is the decrease of vibration exposure (improvement in chain saws plus the time restriction system). The comprehensive prevention system used in Japanese national forests consists of the following: (1) Health care system; (2) Work regulation system; (3) System for improving mechanized tools; (4) Warming system to protect against cold conditions; and (5) Education and training system.

Key Words: Vibration syndrome, Epidemiology, Vibration exposure, Prevention

INTRODUCTION

We began our cooperative investigation into vibration problems in the late 1960's by studying workers in Japanese national forests and then in the mining and stone quarry industries. Our research and efforts resulted in the development of a comprehensive system for prevention of vibration syndrome in the Japanese national forest industry which employs more than 30,000 workers.[1)] It has become a good model of prevention for other industries in Japan. At present, working conditions have generally been improving year by year, however, many difficulties have been encountered: (1) improving vibrating tools; (2) improving working conditions, for instance, by limiting the time of operation inspite of economic difficulties such as those faced by those who work on a piece rate basis; (3) gathering more complete information about the risk population because of the large number of self-employed or informal employment sectors; and (4) finding work places after rehabilitation for patients, particularly in mountainous rural areas or in small industries.

GENERAL CONDITION OF VIBRATION PROBLEMS IN THE WORK PLACE OF JAPAN

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Table 1. Historical changes of verified patients with vibration syndrome by industry

year	Manufacturing	Mining	Construction	Agriculture & Forestry	Miscellaneous	Total
1964	1	2	1	1	-	5
1965	8	8	12	10	-	38
1966	6	11	3	28	1	49
1967	4	1	4	14	-	23
1968	4	5	4	5	-	18
1969	6	1	6	32	-	45
1970	9	2	2	51		64
1971	3	1	1	35	-	40
1972	5	2	7	43	-	57
1973	11	3	3	152	1	170
1974	28	11	6	228	7	280
1975	11	16	9	271		307
1976	44	44	10	329	3	430
1977	101	60	76	592	11	840
1978	68	108	79	354	11	620
1979	58	79	66	224	5	432
1980	46	52	52	123	21	294
1981	21	33	38	86	1	179
1982	20	34	36	80	3	173
1983	27	7	51	46	-	131
1984	10	16	32	52	5	115
1985	11	7	18	38	4	78
1986	13	1	14	26	-	54
1987	8	18	15	18	-	59
1988	11	10	15	13	1	50
1989	13	2	6	17	1	39
1990	6	3	5	8	1	23
1991	3	2	9	9	-	23
Total	556	539	580	2885	78	4636

Table 2. Subject Industries & Tools with High Risk for Vibration Syndrome

(1) Forestry & Wood Industries · · · · · · Chain Saws, Bush Cutters

(2) Construction · · · · · · · · · · · · · · Rock Drills, Pick Hammers, Concrete Breakers
Concrete Vibrators, Tie Tampers, Chipping Hammers

(3) Quarrying Industries · · · · · · · · · · Rock Drills, Chipping Hammers

(4) Mining · · · · · · · · · · · · · · · · · Rock Drills, Pick Hammers

(5) Manufacturing · · · · · · · · · · · · · Air Grinders & Air Cutters, Impact Wrenchs, Sand Rammers etc.

Ceramic, Stone & Clay
Iron & Steel
Non-ferrous metal
Fabricated metal
Ordinary Machinery
Electric Machinery & Equipment
Transport Equipment

* Other vibrating tools designated by Government.
Riveting Hammers, Hand Hammers, Baby Hammers, Scaling Hammers.
Peeling Machines, Pedestal Grinders.

(Japanese Government)

Table 1 shows the historical changes of verified patients by industry in Japan.[2] The number of patients reached a peak of 840 cases in the late 1970's, then decreased gradually to the point where only 20 or so patients have been verified in recent years. Among 4,636 cases in total from 1964 to 1991, 62.6% of the verified patients were mainly chain saw operators in the forestry sector. Around 12% were in the manufacturing, mining and construction industries.

It is not clear how many workers operate vibrating tools all over the country.

Table 2 shows a list of subject industries and tools with high risk for vibration as published by the Japanese Government. The number of vibrating tool operators is estimated to be over 1,300,000: 880,000 workers in manufacturing, 260,000 in construction, 150,000 in forestry and less than 10,000 in mining.[3] Out of this large number, 170,000 workers are subject to an annual compulsory health examination for vibration syndrome. Only 40% of this subject number, 70,000 workers, were examined. Fig. 1 shows the historical changes of the prevalence rate of various kinds of abnormal findings. In recent years the prevalence rate of 6–8% is the second highest following hearing loss in all kinds of occupational compulsory health examinations in Japan. Table 3 shows the prevalence rates of white finger and numbness of finger reported in 1980's compared with those in the 1970's.[4–7]

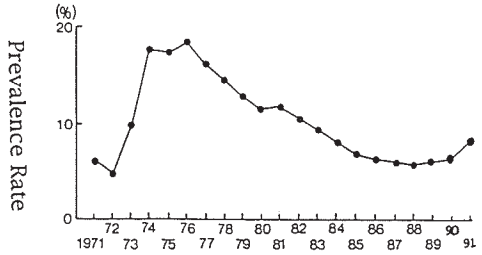

Fig. 1. Historical changes of the prevalence of abnormal findings in annual compulsory health examination of vibration syndrome in Japan

Table 3. Prevalence rate of VWF due to vibratory tools in Japan (1980–)

Vibtatory tools	Job	Time of investigation	Prevalence Raynand's Phenomenon	(%) Numbness of finger
(1) Bush cutters	Private forestry bush cutting Public officer maintenance of road	1989-1990 1985	1.7 (3-13) 0 (1-12)	3.4 (10-43) 22.1 (13-55)
(2) Chain saws	Private forestry wood sawing	1985-1990	2.8-5.3 (8-43)	7.8-15.6 (15-66)
(3) Rock drills	Mine pneumatic drilling	1984	23.1 (8-84)	39.4 (49-67)
(4) Chipping hammers	Stone cutting	1982	36.2 (20-45)	53.6 (7-67)
(5) Pick hammers	Boring tunnel	1982-1983	14.6 (7-35)	19.8 (26-79)
(6) Sand rammers	Steel & Refinery	1989	4.4 (9. 9)	4.4
(7) Air hammers	Steel & Construction	1980-1989	3- 9 (19-27)	2-29 (27-52)
(8) Air grinders	Steel & Construction	1988-1989	3-39 (9-15)	6-46 (20-40)
(9) Handy vibtatory tools	Engineering & Macheinery	1992	3.4 (0.6- 3)	10.7 (3-41)

( ) reported in 1970'

The amount of epidemiological data available has decreased remarkably in recent years, because of general improvements in the conditions concerning vibration problems.

Fig. 2 shows the vibration acceleration level of a variety of vibratory tools as summarized by Dr. Tominaga. These vibration accelerations were measured in recent years. We have several kinds of tools which have vibration acceleration levels greater than 130 dB-AL, for example, rock drills, jackhammers, rivetting hammers, and sandrammers. And grinders cause a high incidence of VWF in the work place even now. Nevertheless, in general, the prevalence rate is decreasing gradually, particularly in the forestry industry where chain saw use is involved.

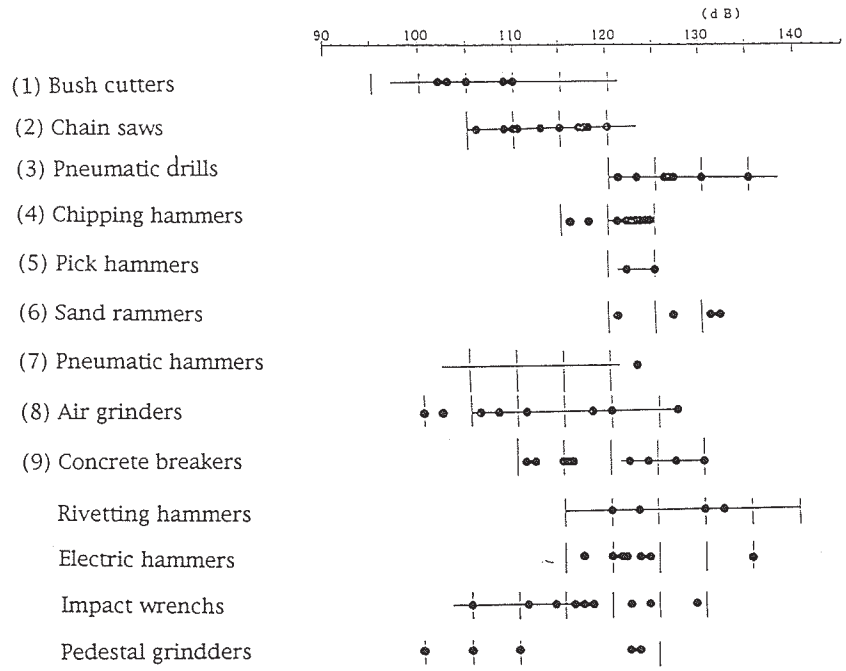

Fig. 2. Vibration acceleration level of vibratory tools in Japan (db: odB ref $10^{-5m}/s^2$)

HISTORICAL OBSERVATION OF VIBRATION EXPOSURE AND PREVENTION IN JAPANESE NATIONAL FORESTS

I have studied the changes of vibration exposure, preventive measures and the prevalence among Japanese national forestry workers.[8,9] This study was carried out in connection with compulsory medical examinations for professional chain saw operators.[10]

Only those workers who had used a chain saw for at least 100 hours per year during one or more years between 1965 and 1985 were selected. The study took the form of a survey of the workers in Kyushu, Southwestern Japan. Fig. 3 shows the historical change in the prevalence rate. The prevalence increased gradually after 1960, the peak value of 18.2% being reached in 1970, and decreased remarkably to none among the users in 1979.

Fig. 4 shows the prevalence rate of VWF in the historical cohort groups based on when chain saw use was begun. The peak prevalence rate was 54.8% in the groups that started the operation in 1959–1960. The rate ranged from 30 to 55% in groups that began to use before

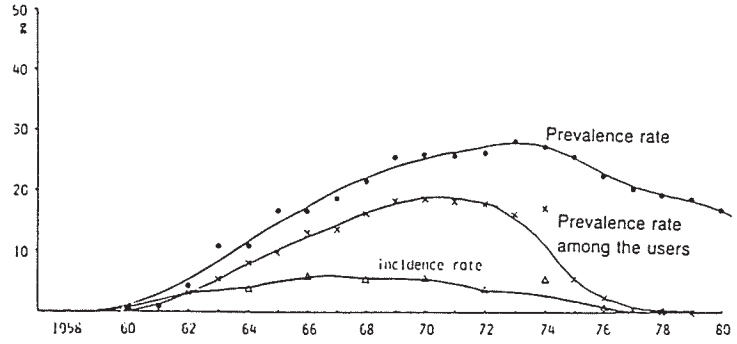

Fig. 3. Change in the prevalence rate and incidence rate of VWF in national forestry workers of Kyushu.

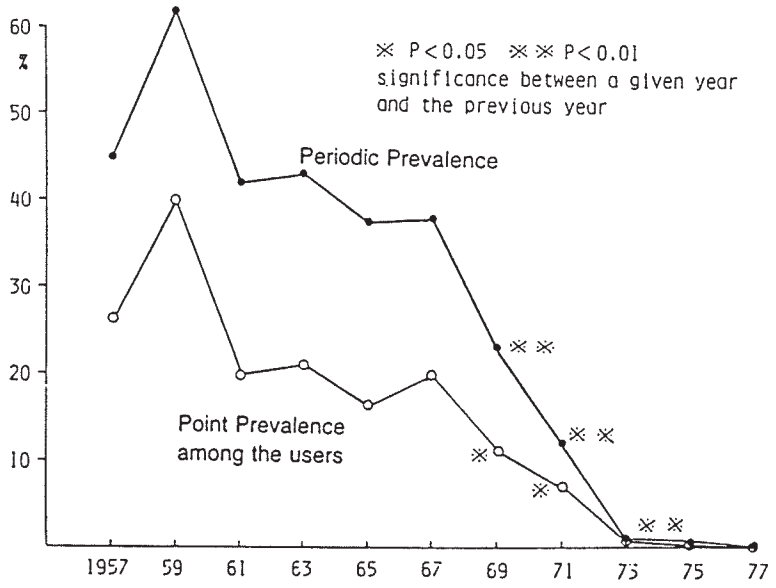

Fig. 4. Prevalence rate of VWF in each cohort according to the time when chain saw use was begun.

1967–1968. It decreased significantly in groups that began the use in 1969–1970 and subsequently. In the groups that began to use after 1971–1972, only a few cases occurred among 280 workers.

What are the main causes of such a remarkable change in the state forestry sector? We have tentatively divided the efforts made to prevent vibration syndrome over the last 30 years into five stages in accordance with the introduction of preventive measures.[1] In stage 1, from 1966 to 1969, chain saws with an anti-vibration handle were introduced and investigations began for early diagnosis. Attempts were made to keep workers warm at rest cottages, working places and while commuting. In stage 2-a, from 1970 to 1972, time restriction on chain saw operation and early diagnosis were introduced. In stage 2-b, from 1973 to 1974, time restrictions were

completely in place and improvement of chain saws gradually continued. A job regulation system for the workers suffering from vibration syndrome was introduced. Early treatment involving hot spa therapy was tentatively begun. In stage 3, from 1975 to 1980, a health care system was established for early checking of vibration hazards and early therapy. Improvements of reciprocal chain saws progressed, and remote control saws were introduced without time regulation. Newly designed chain saws, which have improved engine balance and a low level of vibration, namely, rotary engine chain saws and opposed twin-cylinder reciprocal engine chain saws, appeared. The noise and weight of chain saws gradually decreased. In stage 4, from 1981 up to the present, new light-weight bantam chain saws with low vibration level were introduced for limbing. Chain saws with warm handles were introduced widely in cold northern areas. This comprehensive system for prevention has proved successful. Fig. 5 shows the change in acceleration levels of chain saw handle, from 1965 to 1980.

When we compare the relationships between the results of long term cohort study and the consequences of preventive measures for vibration syndrome, the most important factor is the decrease of vibration exposure (improvement in chain saws plus the time restriction system).[11] The second is the hygienic work regulation, in particular, attempts to keep the workers warm while commuting and at rest cottages. Then, the periodic early health check up system and treatment have had important effects on the prognosis of VWF as shown in Fig. 6 presenting the prevalence rate of VWF from the time of occurrence in each cohort.[12]

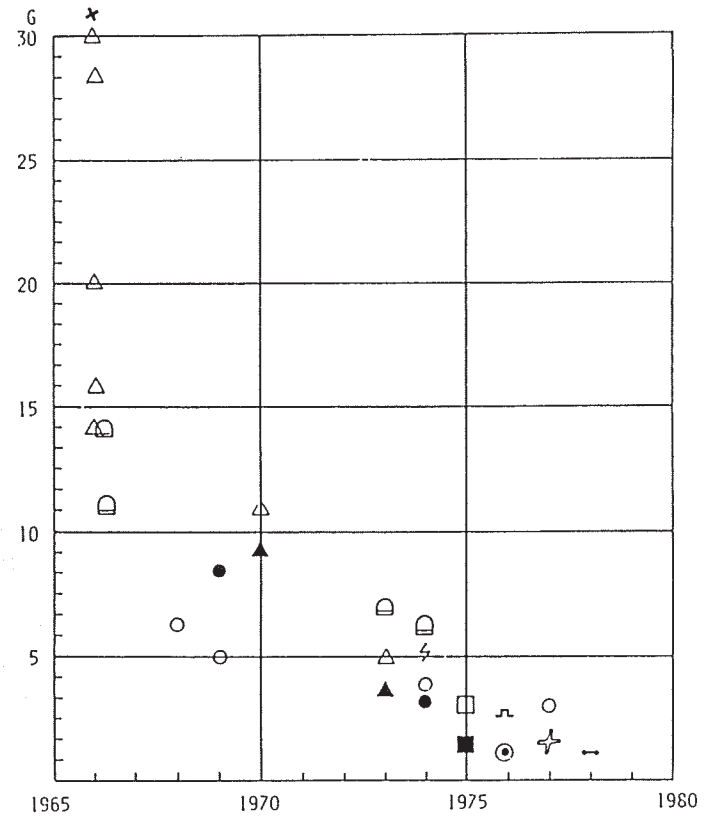

Fig. 5. Changes in acceleration levels of chain saw handle (mark: type of chain saw).

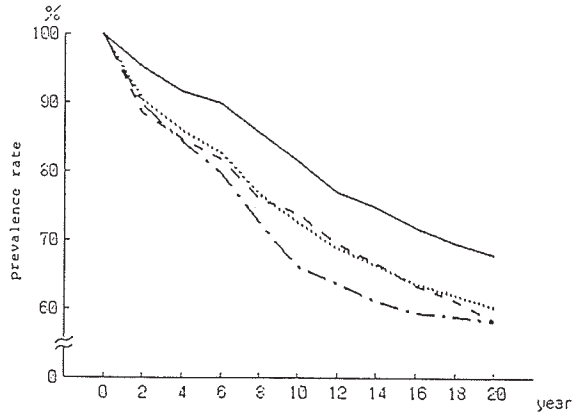

Fig. 6. Prevalence rate of VWF from the time of occurrence in each cohort —— before 1960; – – – 1960–1964; – · – after 1965; · · · · · total

COMPREHENSIVE PREVENTION SYSTEM FOR WORKERS USING VIBRATORY TOOLS

The comprehensive prevention system used in Japanese national forests consists of the following five systems. (1) Health care system; (2) Work regulation system; (3) Improvement system of mechanized tools; (4) Warming system to protect against cold conditions; and (5) Education and training system. In practice, in the cases of many kinds of pneumatic vibratory tools, it is very difficult to improve the mechanical vibration system. Therefore, the work regulation system will have to play an important role. However, as mentioned before, the poor economic situation has stopped the promotion and the spread of these measures, in particular among the self employed and in small industries. As a result, some work places still have severe VWF conditions as shown in Fig. 7. Moreover, government authorities have difficulties in gathering information about risk population and work places.

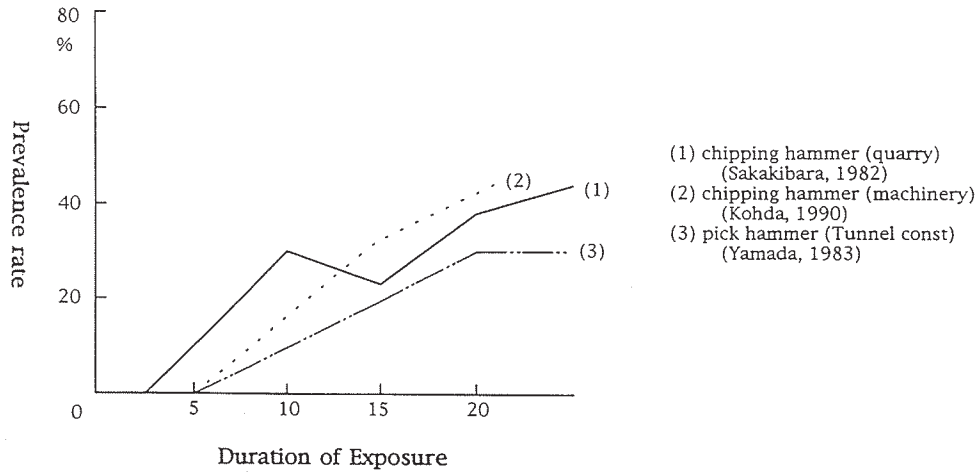

Fig. 7. Prevalence rates of VWF by duration of vibration exposure in some work places

The principles we have followed in efforts at prevention have been medical and technological cooperation in the research work and cooperation among specialists, workers and administration in the practical application. We have made consistent efforts based on these principles in order to assure effective prevention in Japan.

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