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VIBRATION EXPOSURE AND SYMPTOMS IN POSTAL CARRIERS USING MOTORBIKES

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ABSTRACT

An investigation was made on vibration exposure among postal carriers using motorbikes (mainly letter carriers) and vibration symptom manifestations as a means to obtain information on hand-arm vibration exposure limits. The first report deals with the correlation of vibration and cold exposure with white finger symptoms. The group in which daily vibration exposure was greatest, for which the 4-hour equivalent value of the frequency weighted vibration acceleration was estimated to be above 2 m/s^2, showed a greater incidence of white finger than other groups, and the changes synchronized with the timing of motorbike antivibration measures. This group, however, also displayed evidence of varying degrees of cold-exposure white finger. The vibration exposure limit was considered to be over 2 m/s^2 as the 4-hour equivalent value of the frequency weighted vibration acceleration.

Key Words: Vibration, Postal carrier, Motorbike, Vibration syndrome

INTRODUCTION

In Japan, motorbikes are preferred by postal carriers for transport. Among some 70,000 mail-men, about 60,000 now make postal deliveries around the country. The handle vibration is basically the same as experienced in chain saws or other engine-equipped tools, and their daily vibration exposure has been in the range between 1 m/s^2 and 3m/s^2 in terms of 4-hour equivalent value of the frequency weighted vibration acceleration. Letter carriers are thus classical examples of persons exposed to long-term low-intensity vibration, and all of the information needed is available for study (i.e., vibration exposure per day, history of vibration exposure, information on physical condition).

Data are now being carefully analyzed, and this initial report presents the relation between the incidence of white finger and the amount of vibration exposure.

VIBRATION EXPOSURE DURING DELIVERY

There have been two kinds of motorbikes, depending on the manufacturer. Both types came out in anti-vibration models in the 3 years between 1979 and 1981. Then the vibration reduced to a half or 1/3 in the frequency weighted vibration acceleration value.

Measurement method

Field surveys on the amount of vibration exposure/day from motorbike deliveries were conducted in 1978, 1979 and 1992. The subjects of the survey were 56 carriers serving 56 areas of

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7 post offices in 7 cities. The motorbikes used were 41 of the older, pre-antivibration models and 15 of the later anti-vibration models.

In the earlier 2 surveys, the left handle vibration was sampled at 3-second intervals and recorded by a semiconductor memory along with running speed. Vibration directions measured were the largest axis; vertical for anti-vibration models and horizontal for pre-1979 model motorbikes. In the 1992 survey, the vibration in both directions, engine r.p.m. and speed were recorded on magnetic tape continuously. In both cases, data were fully recorded from the time when the mailmen left the post office until the time of return thereto.

Vibration exposure from motorbikes

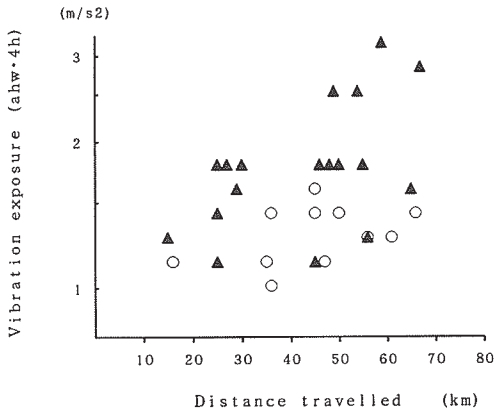

Fig. 1. Distance travelled and vibration exposure
▲ old type, ○ anti-vibration type

Based upon the data, we obtained the exposure amount for all days and the 4-hour equivalent value of the frequency weighted acceleration ($a_{hw(4h,eq)}$). The exposure amount differed with the type of model (old or antivibration), but largely ranged from 1 to 3 m/s^2. This vibration exposure amount also differed according to the delivery area and work conditions in performing the deliveries.

In cities, of course, there is great population density, so delivery area per carrier is small and dtravelling distance per day is not great. With many delivery sites, the carrier must stop and mount or demount often, taking his hands off the handles frequently to insert mail into postboxes. Thus, vibration exposure is very often interrupted. These interruptions of vibration exposure number more than 500 in metropolitan delivery areas sampled; which means frequent halts of 10 to 20 seconds each, accounting for over 2 hours in all, or up to 60% of postal delivery time. Deliveries in outlying districts or mountain areas, on the other hand, reverse this situation. The delivery area tends to be very large and distance travelled is great. Stops are few and so vibration exposure is interrupted much less.

Fig. 1 shows the relationship between distance travelled and vibration exposure ($a_{hw(4h,eq)}$) per day. With use of the older models (indicated by the solid triangles), the distance travelled and amount of vibration exposure increase together. Cases with many deliveries tend to have less exposure. In the antivibration models (indicated by blank circles), the part from the engine component is less than half, the road component does not diminish, and other complex components are present, so the level does not fall below 1 m/s^2.

HEALTH SURVEY

Surveys of health and working conditions were conducted on 99,179 postal workers using motorbikes for their jobs, from 1982 to 1987. Among them were 64,155 letter carriers. In the survey, respondents were asked to enter their job experience on motorbikes as well as any symptoms experienced. Data gathered are still under scrutiny. In this preliminary report, we present results for our investigation of a possible connection between white finger incidence and work on a motorbike.

White finger was recognized in 2,131 workers, or 2.1% of the overall. The incidence was 2.8% among the letter carriers. There was a strong correlation of white finger with the number of years riding a motorbike and age, as well as with the size of the delivery area and post office (no. of personnel), the distance travelled per day, number of deliveries and items delivered, among other factors.

The correlation between the size of a given post office and white finger incidence was investigated for units of 10 postal staff members and found to be 2.8–3.3% at post offices with less than 60 employees; where there were more than 70 employees, the figure was 0.9–1.7%. Small sized post offices were usually located in mountain areas or outlying districts with low population, little industry, and fewer items to deliver to fewer locations. For these reasons, both vibration exposure amount and exposure time are increased. Large post offices, on the other hand, are located more often in the center of cities, where conditions are just the opposite; vibration exposure is far less. There are 1,800 post offices staffed by less than 70 employees. Of them 65 were randomly sampled and classified by area conditions. The results showed a 4.3% incidence of white finger in mountain districts, against only 1.9% in urban post office area. These findings reflect differences governed by factors such as the size of the postal delivery area, distance travelled and running time, in relation to vibration exposure.

As mentioned above, there was a strong correlation found between the distance travelled per day and the amount of vibration exposure. The relation between the incidence of white finger and various distances travelled is shown in terms of the number of years of motorbike riding is presented in Fig. 2. Health surveys were conducted for 6 years (1982–1987). We sampled at this time some of the data available for 1982 to 1986.

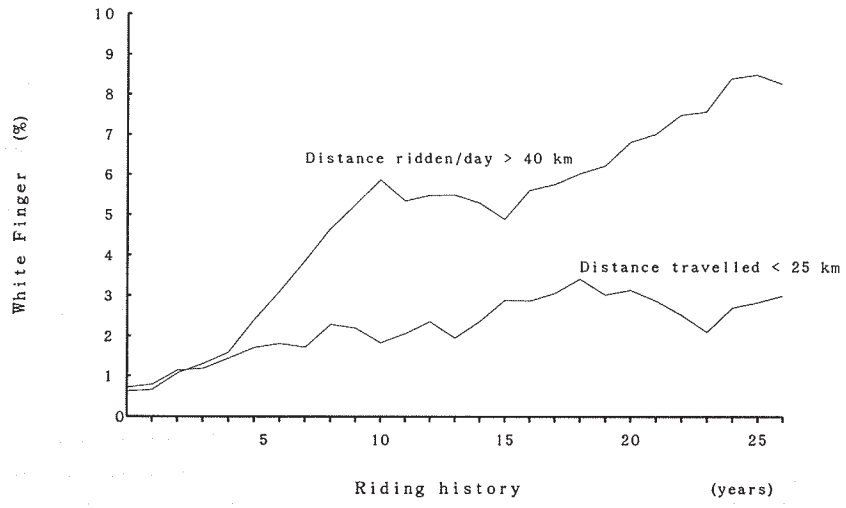

Fig. 2. White finger incidence and riding history

From the working conditions survey, we selected post offices with either a mean distance travelled of more than 40 km/day within a postal district or those post offices areas in which the distance travelled was less than 25 km/day. Then we compared the incidence of white finger among the personnel of the respective post offices. The curve in the figure indicates the smoothing, moving average for each 5-year period. Both groups' running conditions are given in Table 1. The following may be concluded based on the figure.

(1) There is no difference between groups for up to 4 years' work. The comparison in this period is only between motorbike carriers using the antivibration models.

(2) The incidence of white finger increases at 5 to 10 years in the carrier group covering long distances. This statistic reflects the conditions prevailing when the older model motorbikes were used.

(3) In the group travelling shorter distances by motorbike, the white finger incidence rises slowly with each passing year before levelling off at 15—20 years.

(4) After 20 years driving, the rate of white finger incidence in the group covering long distances shows a rapid increase.

Table 1. Comparison of Operating Conditions according to Distance of Motorbike Riding.

	A Group (>40 km/day)	B Group (<25 km/day)
No. carriers	6268	8773
Age (years)	38.0 ± 9.9	34.8 ± 8.6
Workdays/week (days)	5.6 ± 0.7	4.6 ± 1.5
Working time (min/day)	248 ± 53	183 ± 59
Distance travelled (km/day)	46.8 ± 11.8	23.4 ± 9.2
No. deliveries	252 ± 132	459 ± 250
No. items delivered	451 ± 321	1,051 ± 609
Use of warm gloves against cold	21.1	15.9

DISCUSSION

From examination of Fig. 2, the days of exposure per week as well as exposure time per day are greater in the group of carriers travelling long distances. Moreover, exposure interruptions during delivery operations are few (Table 1). Based on Fig. 1, we may estimate 1.5 to 3 m/s^2 for exposure on the old-model motorbikes with the 4-hour equivalent value ($a_{hw(4h,eq)}$). In the short-distance group, the value would be about 1.5 m/s^2. In the same way, cold exposure would be more severe in the long-distance group. A greater percentage of carriers would wear warm gloves against the cold in this group, reflecting the weather in their areas.

In Table 2 the white finger syndrome is compared among workers with motorbike-riding histories of up to 5 years, 10 to 14 years and 20 to 24 years. The curve for white finger incidence in the figure shows a good correspondence with the primary Raynaud's phenomenon. The primary Raynaud's phenomenon is said to have an onset after puberty and up to 40 years of age, and those falling into this category more or less showed onset over 80% of the time. Often there was multiple finger involvement. Moreover, in VWF (vibration-induced white finger), it would be difficult to conceive of its occurrence at this level so early in plural fingers on both sides. Occurrence on the thumb would also be rare. Even when estimated for the long-distance group

where vibration exposure at the 4-hour equivalent value would be around 2 m/s^2, the cold-induced white finger could be included in their complaints.

Table 2. Comparison of White Finger Conditions

	Group A (>40 km/day)	Group B (<25 km/day)
0–4 yrs motorbike work		
No. carriers	744	1838
No. complaining of white finger	8(1.1%)	21(1.1%)
White finger on both hands	4	9
Thumb white finger	3	8
No. white finger/carrier	5.1±4.5	3.3±3.5
10–14 yrs motorbike work		
No. carriers	1348	2163
No. complaining of white finger	74(5.5%)	51(2.4%)
White finger on both hands	37	23
Thumb white finger	19	8
No. white finger/carrier	4.0±3.3	3.1±2.8
20–24 yrs motorbike work		
No. carriers	1414	952
No. complaining of white finger	106(7.5%)	24(2.5%)
White finger on both hands	54	10
Thumb white finger	28	3
No. white finger/carrier	4.1±3.4	3.2±3.2

From the findings in Fig. 2, the separation of the lines at 5–10 years history and rising after 20 years in the long-distance goup apparently shows the effect of vibration exposure above 2 m/s^2. On the other hand, data in Table 2 suggest that both groups's white finger phenomena were mainly from the occurrence of the primary Raynaud's phenomena.

Postal delivery work using amotorbike is an operation combining severe cold exposure with weak-intensity vibration exposure. The cold exposure plays the key role in the manifestation of white finger. As to the damage mainly inflicted by the vibration exposure, the threshold is at least more than 2 m/s^2 for 4-hour equivalent value of the frequency weighted vibration acceleration.