

## OCCUPATIONAL HAZARD OF FEMALE FILM ROLLING WORKERS AND EFFECTS OF IMPROVED WORKING CONDITIONS

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### ABSTRACT

Occurrence of occupational hazard in the neck-shoulder-arm region was investigated before and after improvement of working conditions of female photographic film rolling workers, who were exposed to repetitive upper limb loading relevant to occupational disorders of keyboard operators. The workers were daily engaged in the manual handling of 35 mm color films in dark rooms; group A workers worked separately, receiving automatically rolled films and canning them by a capping machine, and group B workers operated either a winding or capping machine along a conveyer line, holding the film with hands.

Annual health examinations centering on occupational cervicobrachial disorder were carried out in 1975-1977. In 1975, when the workers worked for 440 min a day with a 60 min lunch recess and a morning and an afternoon rest of 5 min, percentages of workers with the disorder of grade I (local pain), grade II (muscle rigidity or tenderness), and grade III (enlargement of affected regions with lowered muscle strength and neurologic signs) were 38, 22, and 13% of 45 workers in group A and 43, 40, and 11% of 53 workers in group B.

As preventive measures of the disorder suggested by previous studies, the actual operation time of these workers was reduced by 1976 from 353 min to 330 min per day, the number of rest periods other than lunch recess was increased 6 times and a continuous operating time was reduced from 105 min to 55 min. The designing of seats and capping machines also improved and group B workers began to alternate the winding and capping operations every third or fourth day.

Health examinations repeated in 1977 disclosed that the rate of workers with grades I, II, and III of occupational cervicobrachial disorder decreased to 33, 13, and 7% in 61 workers of group A and to 34, 20 and 8% in 64 workers of group B, respectively. Of 38 group A and 45 group B workers examined both in 1975 and 1977, 45% of group A and 44% of group B were found to have a lesser degree of the hazard, 11% of group A and 19% of group B being at aggravated risk.

The results clearly suggest that local muscular loading by repetitive upper limb operations which involve the handling of small objects may lead to occupational hazard, and that improvement of working conditions, in particular a greater number of minor rest periods and reduced continuous operation time, are virtual in preventing such occupational hazard.

Recently in Japan, the occupational hazard in the neck-shoulder-arm region has been increasing in several occupations with advancing mechanization of industrial and office work. The prevention and therapy of the hazard has become an urgent problem since the hazard first occurred among punched-card

perforators around 1960<sup>1</sup>, and today, it is widely accepted that the illness, starting in the neck-shoulder-arm region of the operators heavily loaded with upper limb motions, is occupationally conditioned. The increase in the number of workers compensated for the disease is primarily attributed to the increase of simplified and repetitive tasks under strictly regulated conditions.

Extensive studies of the Committee on Cervicobrachial Syndrome of the Japanese Association of Industrial Health which was founded in 1971 have disclosed that the disease is a functional and organic disorder characterized by local symptoms such as shoulder stiffness, pain or dullness in the neck, shoulders and arms, and general symptoms including general fatigue, headache, dizziness, or sleep disturbances<sup>8,9</sup>. Epidemiological studies conducted in line with the Committee's reports have made it clear that these symptoms result not only from localized muscular work but also from general fatigue by work. The effective means for the prevention and therapy of this hazard, or occupational cervicobrachial disorder, however, have not yet been established.

In the present study, the distribution of the occupational cervicobrachial disorder among female photographic film rolling workers was investigated before and after improvement of working conditions, and the effects of such improvement were evaluated.

#### METHODS

A health examination centering on the occupational cervicobrachial disorder was carried out in 1975 and 1977. Ninety-eight female photographic film rolling workers were examined in 1975 and 124 workers in 1977. The health examination comprised a questionnaire prepared by the Committee on Cervicobrachial Syndrome of the JAIH<sup>7</sup>, medical examinations of localized muscle tenderness, mobility, and measurement of physical structure and muscle strength. Skinfold thickness, grip strength, knee extension strength were measured according to the methods described elsewhere<sup>4,5</sup>. Those suffering from the cervicobrachial disorder were classified according to the classification of the Committee on Cervicobrachial Syndrome<sup>8</sup>. Time studies and electromyographic recording at work were also conducted in 1975.

#### RESULTS AND DISCUSSION

The workers were daily engaged in the manual handling of 35 mm colour photographic films in dark rooms: group A workers worked separately, receiving automatically rolled films and capping them by a capping machine, group B workers operated either a winding machine or a capping machine along a conveyer line, holding the film with hands.

Table 1 shows the result of time studies in 1975. The cycle period of operation was as short as 4–6 sec for capping in group A and 6–8 sec for winding and 3–5 sec for capping in group B, the number of operations per day totalling 5 500, 4 000, and 6 500, respectively. Electromyographic recordings

TABLE 1  
Operation, cycle period, and output of the film rolling work.

	Winding machine	Capping machine	Automatic winding machine and capping machine
Working operation	Taking a film from the film stock box in front (72-78 cm from the floor) Setting the film to a reel Setting the reel to the rolling shaft (75 cm from the floor) and winding the film Putting the wound film on the conveyer (72.5 cm from the floor)	Taking a wound film from the conveyer at the right side Putting the wound film into the film case Setting the case to the capping machine (capped by the machine)	Taking an automatically wound film in front (96 cm from the floor) Putting the wound film into the film case Setting the case to the capping machine (capped by the machine)
Cycle period	6-8 sec	3-5 sec	4-6 sec
Number of operations per day	c. 4000	c. 6500	c. 5500

indicated that shoulder muscles were continuously contracting during operations, the integrated activity of the trapezius reaching 10-38% of that of the maximum voluntary contraction, a level significant enough to produce chronic muscle fatigue<sup>6</sup>.

Until February 1975, the workers worked 440 min a day with a 60 min lunch recess and a morning and an afternoon rest of 5 min, the maximum continuous operating time being 105 min. As preventive measures of the

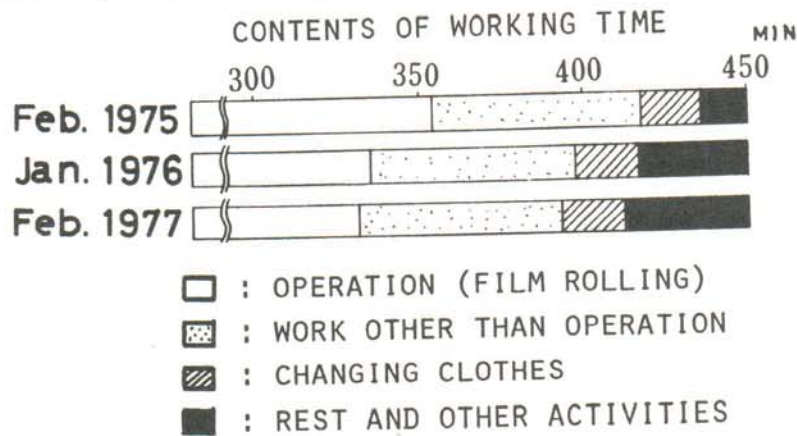


FIG. 1 - Changes of the contents of working time of the film rolling workers.



disorder suggested in previous studies<sup>2,3</sup> the working time arrangement was changed as shown in Figure 1; the actual operation time per day was reduced by 1976 from 353 min to 330 min, the number of rest periods other than the lunch recess was increased to 6 and the maximum continuous operating time reduced from 105 min to 55 min. As a result of shorter working time, the number of operations per day in 1977 decreased to about 86% of that in 1975.

At the same time, the designing of seats, capping machines, and conveyer lines also improved and the group B workers began to alternate the winding and capping operations every third or fourth day.

Figure 2 gives the distribution of the workers examined in 1975 and 1977 by age. Most of them were under 30 years of age. Figures 3 and 4 show the grades of disorder on the basis of the health examinations in 1975 and 1977. Percentages of the workers with the disorder of grade I (local pains), grade II (muscle rigidity or tenderness), and grade III (enlargement of affected regions with lowered muscle strength and neurologic signs) were 38, 22, and 13% for 45 workers of group A and 43, 40, and 11% for 53 workers of group B, respectively. In 1977, the rate of workers with the occupational cervicobrachial disorder decreased to a considerable extent, the rate of those with grades I, II, and III being 33, 13 and 7% for 61 workers of group A and 34, 20, and 8% for 64 workers of group B, respectively.

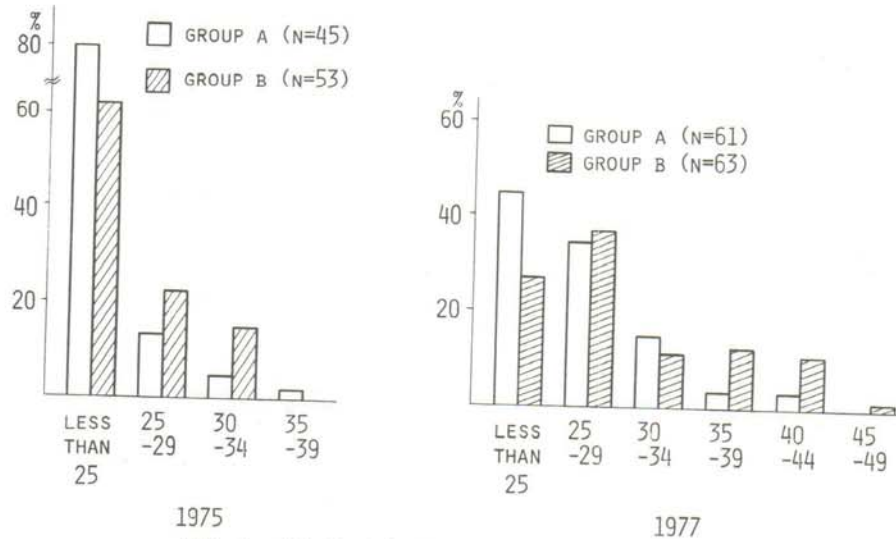


FIG. 2 - Distribution of the examined workers by age.

A total of 81 workers, 38 from group A and 43 from group B, were examined in both 1975 and 1977. Table 2 gives the physical structure and muscle strength of 78 workers studied both in 1975 and 1977. The means of body height and body weight did not change during the two years and were similar to those

FIG. 3 - Result of the health examination in 1975, according to the grades of the occupational cervicobrachial disorder as established by the Committee on Cervicobrachial Syndrome.

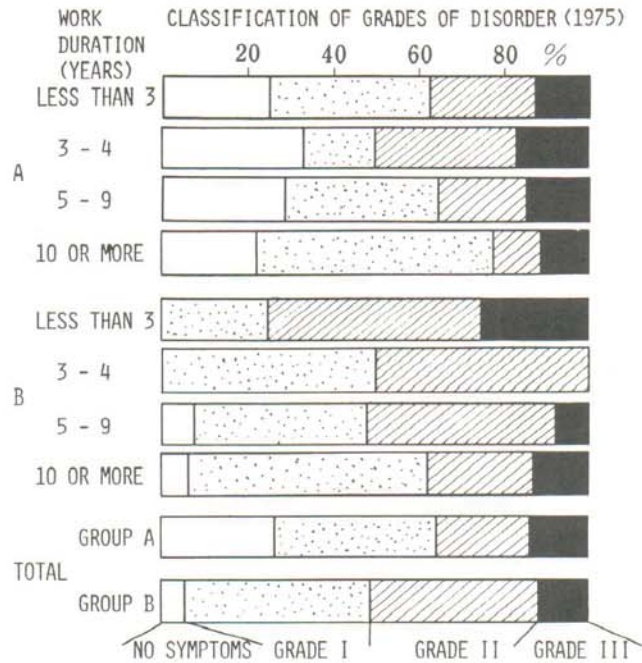


FIG. 4 - Result of the health examination in 1977, according to the grades of the occupational cervicobrachial disorder as established by the Committee on Cervicobrachial Syndrome.

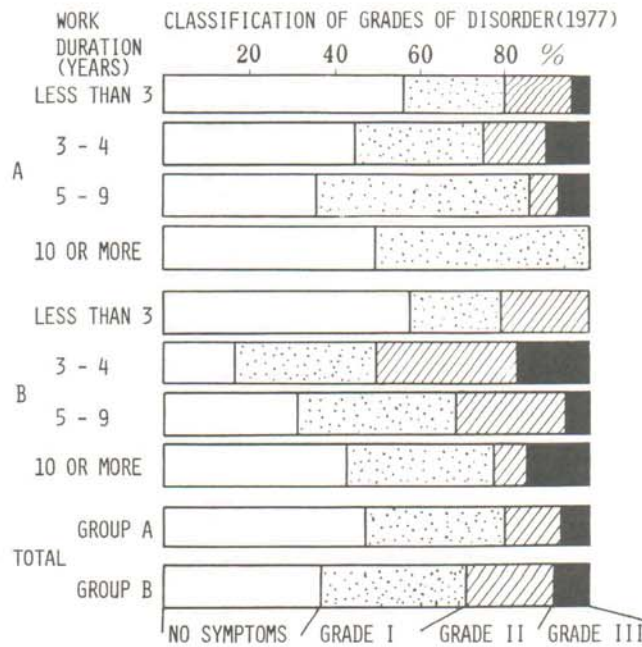


TABLE 2  
Physical build and muscle strength levels of workers who were examined in 1975 and 1977,  
N = 78.

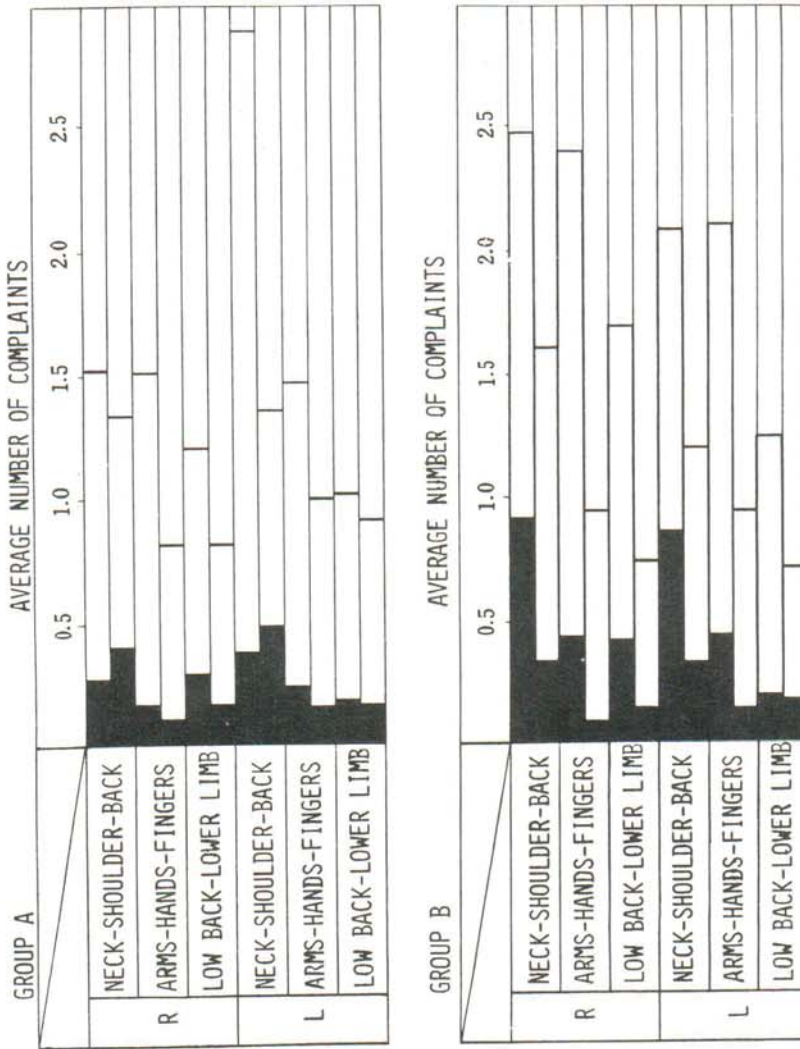
		1975		1977	
		Mean	S.D.	Mean	S.D.
Age		27.7	6.7	29.7	6.9
Body height		153.5	5.4	154.2	5.4
Body weight		50.3	7.0	50.4	7.2
Skinfold thickness		14.6	3.8	15.8	4.9
Grasp strength	right	27.2	4.5	29.0	4.5
	left	24.7	3.7	27.2	4.5
Back muscle strength		65.5	14.5	72.5	14.2
Leg extension	right	32.8	9.4	38.3	7.6
	left	31.7	8.9	37.0	8.2
Arm abduction	right	9.7	2.4	13.9	2.5
	left	9.4	2.2	12.7	2.6

of Japanese females of the same age. The mean skinfold thickness indicating body fat deposit increased from 43.8 mm in 1975 to 47.3 mm in 1977, while the strength level of gripping, knee extension, back muscle, and upper arm abduction significantly increased in the two-year period. It is significant that the muscular strength increased with decreasing work load.

Figure 5 gives the rates of complaints concerning pain, dullness, stiffness, or numbness of the neck, shoulders, arms, hands, fingers, lower back, and lower limbs in 1975 and 1977. Almost all of the complaints diminished except those relating to the symptoms felt always at the back, neck, or shoulders. The tendency of reduction of the complaints was more pronounced in group B than in group A.

Figure 6 shows the changes in distribution of various grades of the occupational cervicobrachial disorder from 1975 to 1977 for the same persons. Seventeen workers (44.7%) from group A had a lower grade in 1977 than in 1975, whereas only 4 workers (10.5%) shifted to an upper grade. In group B, 19 workers (44.2%) were ranked in 1977 at a lower grade than in 1975 and 8 workers (18.6%) at an upper grade. These results clearly suggest that improved working conditions, in particular increased number of minor rest periods and reduced continuous operation time, have had marked effects in reducing and preventing the occupational hazard.

The above-mentioned improvement of health conditions in 1977, such as increase of muscle strength, reduction of the complaints, or lowering of the grade of the occupational hazard, could be associated with several factors. But, considering that the reduction of complaints in 1977 was more pronounced in group B workers who worked along a conveyer line, where the pacing and control of the work were more severe than those of group A workers working separately, the increase in the number of minor rest periods might have resulted



■ ALWAYS □ SOMETIMES UPPER ROWS, 1975; LOWER ROWS, 1977.

FIG. 5 - Average number of complaints concerning localized symptoms for workers examined both in 1975 and 1977.



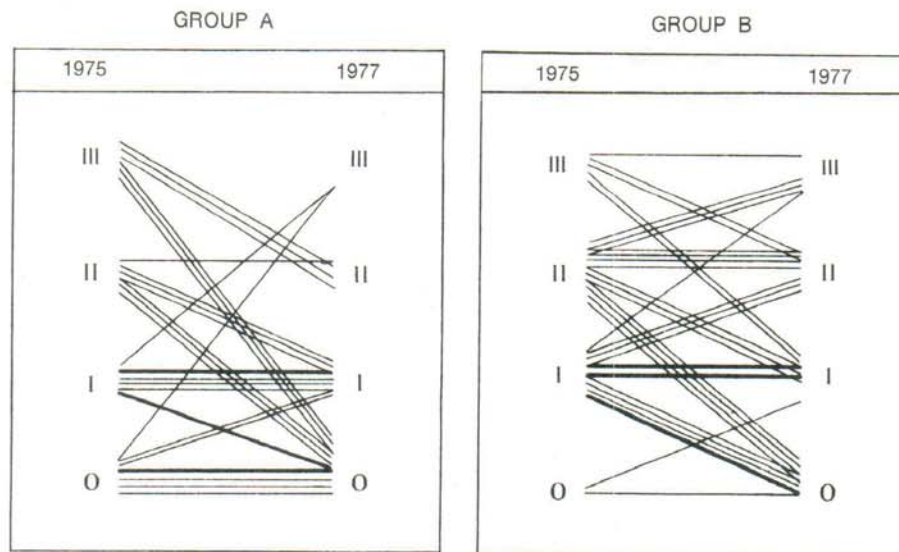


FIG. 6 - Changes in distribution of various grades of the occupational cervicobrachial disorder from 1975 to 1977 for the same examinees.

—, one worker;  
 —, five workers.

in decreased restraint of work. The report by Onishi and co-workers<sup>5</sup> that muscular strength of workers with simplified and repetitive tasks was lower than that of other workers would support the assumption that the reduction of work load produced by improved working conditions could be the main reason of improved health conditions.

#### CONCLUSION

The occurrence of occupational cervicobrachial disorder among female photographic film rolling workers was discussed with special reference to the effects of improved working conditions.

Health examinations performed by the authors have shown that the local muscular loading by repetitive upper limb operations which involve the handling of small objects may lead to an occupational illness in the neck-shoulder-arm region, and that a reduction in the total operating time associated with a shorter continuous operating time and a greater number of minor rest periods, which may inevitably accompany the reduction of the output per person, is one of the primary factors to be taken into account in preventing such occupational hazards. It is suggested that the ergonomic improvement of the methods of work which involve fine hand and finger movements should be undertaken so as to reduce the localized loading of upper limbs and to give more ample time allowances that help the workers insert minor pauses more frequently.



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