

PROBLEMS THAT CAUSE HEALTH HAZARDS TO SUPERMARKET CASH REGISTER OPERATORS

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ABSTRACT

With the rapidly increasing number of department stores since 1970, health disorders (occupational cervicobrachial disorder, low back pain, eye strain and difficulties arising from exposure to air conditioned cooling) of cash register operators have become frequent. We therefore investigated the causes and found them to lie in the operators' continuous dual task of high-speed work while handling cash registers with a heavy key pressing touch. We proposed possible countermeasures. In 1973 came into force the Operation Control Standards formulated by the Ministry of Labor, and as a result the labor conditions of operators significantly improved and complaints decreased. Although we recognized the favorable effect brought about by the introduction of ECRs which require a light key pressing touch and include a conveyer system designed to reduce the burden on the left hand, it may still be difficult to reduce sufficiently the burden of work, if the amount of goods handled by each worker remains excessive. We therefore stressed the need for further improvements.

RAPID INCREASE IN THE NUMBER OF OPERATORS AND PREVAILING WORK CONDITIONS

Since 1965, the decline in commodity prices, the introduction of the self-service practice to save labor costs, and the rapid development of mass media have fostered the growth of chain stores around supermarkets. Until 1965 the 10 top ranks in corporate retail sales were occupied by department stores. In 1975, however, chain stores occupied 6 of the 10 top companies, including the 1st rank. According to the 1970 census, the number of workers in tertiary industries, including commercial services, accounted for 46.5% of Japan's total number of workers (about 50 000 000) while that of workers in wholesale and retail services for 19.3% (10 120 000)^{1,4}. It is estimated that about 173 000 workers are in service at about 9 400 chain stores. The vast majority of them are female workers at the age of about 20, who are in charge of cash registering and sales; the average length of service is 2-4 years. One of the salient tendencies is that the proportion of part-timers is rising.

In the self-service system employed by chain stores in Japan, goods are arranged on display shelves, from which shoppers pick up by hand any of the displayed goods they want to buy. The goods are collected in a hand carrying basket, to be brought to any of the counter stations. Up to some time in the past, cash register operators (usually called "checkers"), after setting accounts by a cash register, used to put the purchased goods in a bag and deliver them to the shopper. At present, however, other workers (called "sackers") usually assist the checkers in putting the goods in a bag, or in some cases shoppers themselves do the bagging as self-service. In the latter case, there are stores which divide the counter service into key-pressing and cash delivery. When the check-out is completed the cash register operators must pile up the empty baskets behind them, doing all the operations in a standing position throughout the 9 portal-to-portal hours. At super stores, one checker deals with 250–300 shoppers/day, each of whom carries 10 pieces of goods on the average. The number of shoppers per hour rises to 50–80, especially during the busy hours of the day. The food department is the busiest, and several to ten-odd shoppers usually line up in front of the counter station waiting impatiently for their turn to come. The operator picks up such goods as packs of fish, vegetable, milk, meat etc. with the left hand, puts some of them in individual vinyl bags, and presses the keys of the cash register with the right hand. Before 1973 every store employed mechanical cash registers which had a number of keys, arranged at wide intervals that required very heavy pressing and enabled the operator to press the keys correctly without watching the right hand (blind touch method). As a result, it was often observed that operators would flex the fingers or the wrist in order to be able to press powerfully (Fig. 1). It should be considered that intermissions were rarely allowed, except at lunch time and operators remained in service over a very long period of time, pressing more than 10 000–12 000 keys/day⁷. The whole work had to be done within a restricted area of only 1–1.5 m², and the operator had to pile up the empty baskets in a space behind by twisting her body. The working place is usually noisy with commercial announcements (60–75 phon.). Moreover, since no windows are provided, the entire place is poorly ventilated (CO₂: 2 000–40 000 ppm; CO: 20–50 ppm; air borne dust: 0.4–0.6 mg/m³). Furthermore, during air conditioning, the shop is liable to be cooled down excessively (20–23 °C in summer).

As regards fatigue complaints of operators during work, fatigue felt in the right shoulder accounted for 56.5%, that of the left shoulder for 27.1%, and that in the posterior cervical region for 25.7%. The ratio of operators who complained of thirst, visual fatigue, stiffness in the shoulders and mental irritation increased to 40–75% in the morning; in the afternoon, the number of operators complaining of malaise of legs increased, accounting for 90.0%, while that of operators complaining of general malaise also went up. The CFF (Critical Flicker Frequency) value diminished correspondingly, and no significant effect of meal intermission for fatigue refreshment was found⁵.

We asked the operators which of the current assignments they most disliked. The answers we obtained were as follows: (1) The closing time is too



FIG. 1 – Mechanical cash register and home position of each finger by the blind touch method.

late, reducing their free time: 42.9%; (2) Exhaustion in dealing with the shoppers: 29.0%; (3) The working time is too long: 23.9% (4) Humiliating relations with their seniors or fellow workers: 22.4%; (5) The physical work involved is too heavy: 19.0%.

HEALTH HAZARDS AND FACTORS OF THEIR FREQUENT OCCURRENCE

It was towards 1970 that cash register operators began complaining of pains, numbness, dullness or weakness in their shoulders, neck, arms and fingers, or of finger tremor. Furthermore, they often complained of symptoms such as eyeache, decreased visual acuity, headache, dullness in the head, irritation, insomnia and anorexia. In a health survey conducted in 1970 by Hosokawa and

co-workers³ at a shop, 8 of 27 cash register operators were considered to require medical treatment on account of positive complaints, tenderness and induration of muscles, motor disturbance of the neck and shoulders, positive Morley's test, peripheral circulatory disturbance and disturbance of perception, and decrease in muscle strength (29.6%), while 11 operators (40.7%) were considered to require a follow-up observation. The authors submitted these results to the Japanese Association of Industrial Health in 1972⁵.

In those days, the trade unions of a number of super stores, becoming aware of the occurrence of patients, took up the problem; in 1972 they organized a conference for the prevention of occupational hazard to health. Representatives of the trade unions of major super stores throughout Japan participated in the conference, conducting a nationwide questionnaire survey among operators.

Workers who served for a short length of time accounted for a large percentage, i.e. 42% were serving for less than a year, and 23% for more than a year but less than two years.

Those who pressed keys of cash registers for less than 240 minutes/day, accounted for 36%, those who did the same for 240–269 minutes accounted for 44%, and those who did the same for more than 270 minutes, for 20%.

Operators who dealt with less than 200 shoppers/day constituted 13% of the respondents of the questionnaire, their proportion decreasing to 5% on busy days. Those who dealt with 200–499 shoppers/day accounted for 70%, or only 42% on busy days. Those who treated more than 500 shoppers per day accounted for 17%, and on busy days for 48%.

The height of the working desks and cash registers were not adjustable. Operators of less than 150 cm in height (about 20%) had to raise their elbows high, bend their wrists and assume undesirable positions (4% were left-handed operators who could not move their right hand skilfully; all cash registers were designed for right hand use). They did not receive any physical examination required to check their fitness for the service, while the majority had received technical training for only a week or two. They were subjected to efficiency (speed) competitions among stores, and individuals were encouraged by being awarded prizes⁹.

As for the health conditions, more than half the respondents complained of "easy fatigue, stiff shoulder", "dull body" and "dull legs". About 35% complained of "dull arms and fingers", 10–15% complained of an "ache in their shoulders" and "benumbed arms and fingers"⁹.

The results of a survey (A) of 84 cash register operators conducted by the authors in those days were compared to those of a survey (B) of 52 key punchers. Stiff shoulder cases were 54.8% for (A), and 42.3% for (B). Shoulder ache cases were 25.0% for (A), and 1.9% for (B). Stiff neck cases were 54.8% for (A), and 9.6% for (B). In all cases, (A) was larger in number than (B). The number of cash register operators, who complained of finger ache or numbness, was twice that of key punchers. Medical findings, too, indicated that (A) was significantly larger in number than (B) with respect to the following: muscle pressure pain of the upper extremities, pain on movement of the neck, motility disturbance, decreased

grip strength and tapping, abnormality of volume pulse wave, and hypopalles-
thesia. From these results it was concluded that heavy pressing of keys by cash
register operators and repeated heavy burdens on the muscles were the major
causes of health disturbances incurred by cash register operators, and that
measures must be undertaken to reduce them.

PROPOSITIONS OF OPERATION CONDITIONS AND THE LABOR MINISTRY'S OPERATION CONTROL STANDARDS

In the summer of 1972, the authors in view of the significance of the data
presented above, approached the Ministry of Labor to call its attention to the
necessity of preventive countermeasures against health disturbances, especially of
those against occupational cervicobrachial disorders. The Ministry of Labor, in
February 1973, asked the Shoulder-Arm-Neck-Syndrome Committee of the
Japanese Association of Industrial Health for advice on possible preventive
countermeasures. In reply, the Committee submitted a comprehensive and
concrete report, in terms of the number of keys pressed, length of working time,
intermission time, shifts, working environment and health care. At the end of
March 1973, the Ministry of Labor formulated the Operation Control Standards
for Cash Register operators, and called for their implementation by the respective
stores. These national operation control standards were the second of their kind
in Japan, following the operation control standards for key punchers
implemented in 1964. The new standards required that at busy stores or during
busy hours there should be a 10 minutes intermission after each 60 minutes of
continued work, alternation of work between checkers and sackers at the cash
register machine, and improvement of the working environment.

These standards were applied during the period 1973-1975. The Ministry
of Labor conducted spot inspections in the fall of 1973. The results were as
follows: improvements of cash registers 12% (38% being planned); restrictions of
continuous operation time 47%; introduction of an intermission 33%; shifts (or
having shoppers do the job of sackers) 95%. On the other hand, the following
problems were found: inadequate illumination 27%; failure to carry out
environmental measurements 87%; less than 1 m² of working space 12%; lack of
chairs 63%; lack of resting room 21%; failure to conduct special health
examinations 78%; failure to give health education 58%; failure to give health
counselling 74%. At major enterprises with trade unions, labor agreements were
signed by the workers and the management, and countermeasures were
consistently undertaken. At small stores where there are no trade unions, there
were considerable delays in taking the required countermeasures. However, with
the introduction of countermeasures, complaints of fatigue of the whole body,
fatigue of nerves, shoulder discomfort, languid hands or arms, and malaise of the
lower extremities and lower back, steadily decreased. With the introduction of
the compensation system, the apparent number of patients requiring medical
treatment increased greatly in both 1973 and 1974, but started to decline in 1975.
By 1977 at most stores the number of patients under medical treatment had
decreased to 1/8 or 1/10 of that in 1973^{3,11}.

In 1973, we conducted medical examinations of about 800 workers employed at one of the most prominent super stores in Japan. According to the results, in 1973 20% required medical treatment and 45% required follow-up; in 1975, the respective percentages dropped to 6% and 43%².

According to a questionnaire survey of workers' complaints, 15.6% indicated improved machine handling, 15.5% indicated lightened pressing of keys, 11.7% indicated reduction of the number of shoppers to deal with, 4.0% were relieved by the reduced time required for pressing the keys of the cash register, 10.3% felt a reduced dullness in their hands and arms, and 17.4% referred to more consideration shown by the store manager¹⁰.

PROBLEMS OF ELECTRONIC CASH REGISTERS

Since 1975, mechanical cash registers (MCR) the keys of which are hard to press, have been replaced by electronic cash registers (ECR) at almost all major stores. In Japan, NCR and SWEDA cash registers have been the most popular. Since 1973, the manufacturers have improved their models in various ways. The key pressing touch has lightened, and the required working force has been sizably reduced from 600–2500 g to 50–200 g⁶. The number of keys has remained unchanged. However, the treatment of pressing mistakes of repeat operations have been simplified, and the spacing between the keys has been narrowed.

However, when an ECR is handled under the conventional labor conditions called the blind touch method, in which the keys of the cash register are pressed by the right hand without watching the machine, while the goods are handled promptly by the left hand, errors and mistakes in pressing are liable to occur. At super stores where a variety of goods are sold at the lowest possible prices, these mistakes or errors are prohibitive. Accordingly, operators must quickly press the keys while shifting the gravitational center of the body to the right and left during which the eyeballs have to make quick horizontal movements. If it is intended to improve work efficiency and speed by using an ECR, the burden of these movements must be alleviated.

The authors conducted a questionnaire survey of 112 MCR workers and 179 ECR workers at super stores who were working under identical conditions (Table 1). In both cases more than 20% of all respondents complained that they sometimes find it difficult to see the labels, that their legs get easily cold, and that the ventilation is poor. In contrast to ECR workers many MCR workers (30.4%) complained of the great resistance of the keys to press. MCR workers also indicated the feeling of physical fatigue (16.1%). Conversely, compared to MCR workers, more ECR workers complained that they were too busy (22.9%), that it was sometimes difficult to see the labels (44.1%), and that they got irritated by noise (20.7%). This may be partially explained by the fact that electronic cash registers were preferentially installed on busy counters. In any case, it appears that, with the adoption of ECRs, work efficiency was improved.

As for the fatigued regions of the body after work, the MCR workers' complaints referred to the shoulders (64.3%), the arm (46.6%), the neck (34.8%),

TABLE 1
Evaluations for working conditions in MCR and ECR operation.

Questionnaire	MCR (n = 112)	ECR (n = 179)
Excessive height of handling desk	1.8%	5.0%
Insufficient height of handling desk	2.7	5.6
Insufficient area of handling desk	17.0	21.8
Excessive height of cash register desk	7.1	6.2
Inappropriate angle of key board	4.5	4.5
Insufficient height of cash register desk	0.9	2.2
Excessive pressure of registering keys	30.4	10.6
Excessive business	11.6	22.9
Bound to be exposed to irregular intermission	0.9	1.7
Induced to irritation by ambient noise	12.5	20.7
Apt to find difficult in checking the labels	25.9	44.1
Nausea due to air pollution	25.9	25.1
Coolness of the feet	36.6	33.0
Frequent loss of bodily vigor	16.1	11.2
Casual drowsiness	8.9	12.3

TABLE 2
Comparisons of fatigue regions before and after work in MCR and ECR operators (in %).

Region	MCR operator (n = 112)		ECR operator (n = 179)	
	before	after	before	after
Shoulder	50.00	64.3	34.6	61.5
Arms	29.5	46.4	22.9	48.6
Neck	25.0	34.8	12.9	24.0
Back	14.3	25.9	6.7	14.5
Lower limb	7.1	25.9	7.8	28.5
Low back	8.9	24.1	10.1	19.0
Eyes	7.1	19.1	5.6	25.1
Hands	6.3	13.4	3.9	16.2
Fingers	7.1	9.8	4.5	10.6
Head	6.3	7.1	3.9	8.4
Throat	1.8	3.6	2.8	16.2

the back, the legs, the lower back, and the eyes (Table 2). In the case of ECR workers, fatigue was felt in the shoulders (61.5%), the arms (48.6%), the lower extremities (28.5%), the eyes (25.1%), and the neck (24.0%). Thus, there was not much improvement in the health conditions of ECR workers compared to those of MCR workers. Rather, as far as the eyes and lower extremities are concerned, more ECR workers tend to complain of fatigues in those regions. Observation of chronic fatigue (before work) revealed that MCR workers feel fatigue in the shoulders (50.0%) the arms (29.5%) and the neck (25.0%), and ECR workers in the shoulders (34.6%), the arms (22.9%) and the neck (12.9%). Thus, the percentage ratios of fatigue were slightly lower for the latter than for the former.

Comparison of muscular power between the two, however, indicated no significant differences with respect to the back muscular power, grip strength and pinching strength.

Meanwhile, in the case of ECR the key pressing intervals during the actual handling of the goods were significantly shortened when compared to MCR; the pressing of basic keys [4] → [5] was fastest at 57 msec, and the respective pressing of price keys was shortest at 194 ± 117 msec⁸. However, the average interval between pressing the price key and the section key was long at 517 ± 257 msec., while the average pressing interval from the section key to the price key was even longer at 1258 ± 523 msec. It seems that these differences are due to the operation of reading the commodity prices which requires the motion of the left hand. In the case of ECR, the price key pressing time is shorter by about 40% than in the case of MCR, and the pressing time from the value key to the section key is shorter by about 25%. ECRs are designed to relieve operators from the unnatural movement of the fingers which the operation of MCRs requires. Instead, however, ECRs require for each commodity, a side-to-side waving motion lasting about one second and affecting the operator. In the case of ten-key-type cash registers, since [0] is also depressed, the key pressing frequency for each commodity becomes higher than in the case of MCRs⁸.

As for the time intervals of eye movement, an occurrence peak takes place at intervals of 400–500 msec. Namely, an eye movement of about two times per second occurs most frequently. It seems that a considerable length of time is required for recognizing the numerals indicating the commodity prices and letters. As regards body movement, the center of gravity of the body sways twice toward the left leg for each commodity⁸.

In view of the above, it is considered that in order to raise the efficiency of ECRs it is necessary to formulate standards as regards the number of shoppers to be served a day, the kinds of goods to be handled, the number of keys to be pressed, and the working time, to facilitate work in a sitting position, to facilitate the reading of labels, and to relieve the burden on the left hand (or the operation of lifting goods from one basket into another).

Incidentally, it is worth noting that POS (Point of Sales) are beginning to replace ECRs.

PROBLEMS IN THE CONVEYER-INCORPORATED CASH REGISTERING SYSTEM

The conditions prevailing in American and European super stores have been introduced into Japan together with new work systems, one of which is a three-room type cash register counter equipped with a conveyer. Its advantages are as follows:

- baskets containing purchased goods are moved by a conveyer, relieving the burden on the left hand;
- since there are three rooms or outgoing bays, the check-out operation can be done without any haste;

- the operations are done in a sitting position, which removes the problem of chilled legs;
- simple handling of change;
- empty baskets are disposed without the operator having to twist her body.

However, in Japan, several defective aspects have been observed:

- the left hand must be fully stretched for work;
- operators must handle a variety of fragile or vulnerable items such as bottles, bean curds, etc., which are liable to being crushed or damaged;
- change in coins is unwelcome to shoppers and is inconvenient to treat;
- limited area of the outgoing bays creates congestion when the amount of the purchases is large.

Imported cash registers were actually used for experimentation in order to design the most adequate type of cash register to be used by Japanese operators in super stores.

Bird's-eye-view photographs of the working conditions were taken in order to see the distribution of the various positions of each part of the body (Fig. 2 and 3). It was found that the range of movement of the right wrist is limited to an area of 200 cm², while that of the left wrist and of the right elbow covers a wider area; it sometimes extends even over a wider area than is that reached by the fully outstretched arm. Compared to the right elbow, the right shoulder has

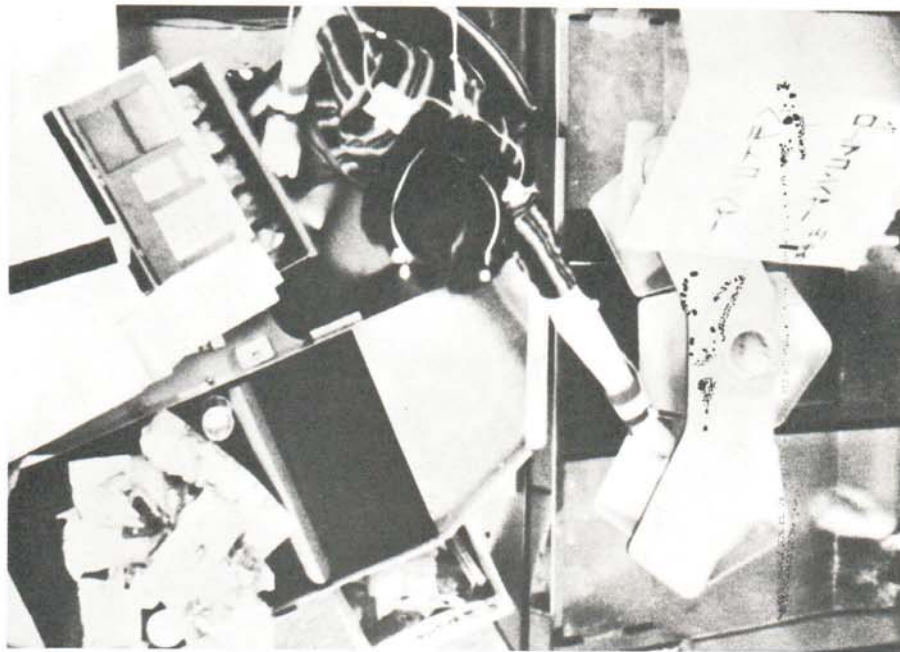


FIG. 2 - Bird's-eye-view photograph of the working conditions.



FIG. 3 - Bird's-eye-view photograph of the working conditions.

a wide range of motion; the head moves over a wider area (600 cm^2). This is because when the checker presses the keys, she turns her head to shift her eyes to the keys, and since the range of work covered by the individual operators exceeds 180° , it becomes difficult for them to concentrate properly on each service. Since the left elbow and the left wrist are used to handle the goods placed on the conveyer, their movement occurs frequently at a right or obtuse angle to the plane parallel to the frontal surface. The operator must move these parts of her body 20 cm back and forth, and 50 cm from side to side, in order to visually recognize the label letters. During busy periods, such movements as twisting the body, moving the left hand from left to right etc., multiply, which puts an increased burden on the wrist. The range of movement of the left wrist, elbow and shoulder can be reduced by training. Nevertheless, it was often observed that it exceeds the optimum working range, especially in moving the goods separation rod, in handing the receipt to the customer, and in handing or receiving change.

In view of the above, it is considered that in order to ensure that all the necessary work is carried out within the range of a certain angle centering on the body, the conveyer width, chair movement and peripheral equipment should be adequately adapted to fit the Japanese physique, and at the same time, that operators should be given proper training. Thus, we proposed that imported machines should be improved accordingly.

Although some improved models are already in commercial use in Japan, importance tends to be attached to improving work density, as exemplified by the fact that frequently chairs are dispensed with and a standing position is adopted.

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