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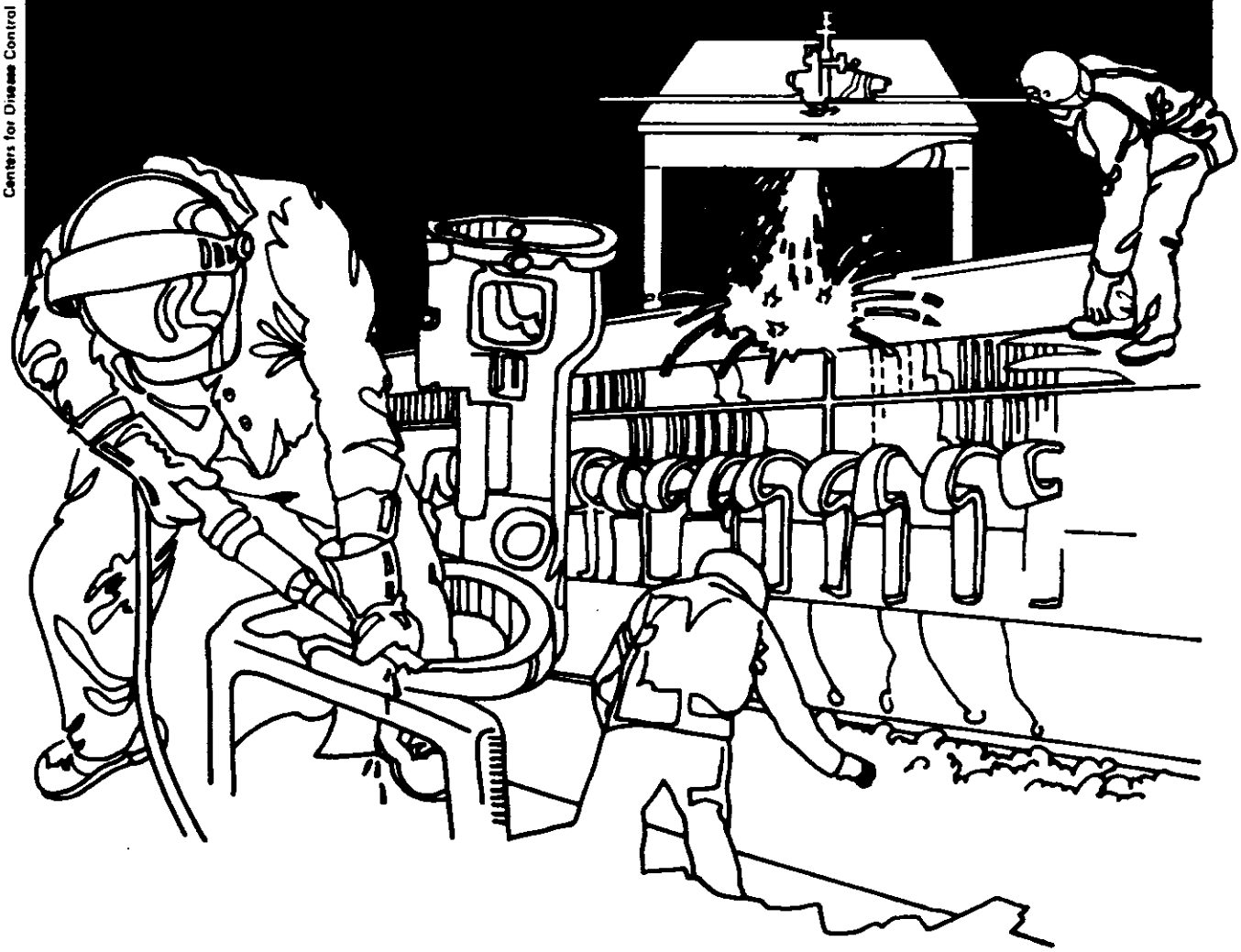

Health Hazard Evaluation Report

HETA 88-345-2031
KROGER COMPANY
OXFORD, OHIO

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HETA 88-345-2031
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KROGER COMPANY
OXFORD, OHIO

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I. SUMMARY

On August 15, 1988, the National Institute for Occupational Safety and Health (NIOSH) received a request from the employees of Wells Mill Street SavOn of the Kroger Company in Oxford, Ohio, to evaluate musculoskeletal injuries, primarily in the upper neck and shoulders, thought to result from operating registers at the express checkout.

An initial ergonomic and medical evaluation was conducted on November 7, 1988. This consisted of observation of work practices, videotaping and still photography of the operation of the checkout, and private medical interviews with seven employees. Measurements of the workstation were recorded so that working heights and reach distances could be determined.

On December 12, 1988, representatives of NIOSH, Kroger Co., and the United Food and Commercial Workers Union (UFCWU) met to discuss the results of the initial ergonomic evaluation. Discussion of this evaluation resulted in a consensus as to the possible causes of the employee complaints:

(1) Reaching the far corner of the check stand may cause excessive trunk flexion.

(2) The keyboard's height and distance from the cashier may cause excessive static stress and shoulder flexion.

(3) Improper work practices such as scanning bulky or heavy items may be a contributing factor.

On January 13, 1989, a baseline symptom questionnaire was completed by 23 full-time or fill-in cashiers. Subsequently, Kroger instituted the following changes in the express checkout work practices and design:

(1) A physical barrier was placed at the far corner of the check stand to reduce excessive trunk flexion.

(2) A telescoping keyboard was installed to reduce static stress and shoulder flexion.

(3) All cashiers and fill-ins were required to view a videotape on proper checkout work practices.

On September 1, 1989, approximately four months after institution of these changes, the symptom questionnaire was repeated on 19 of the same cashiers. There was a significant decrease in neck, back, or shoulder as well as low back, buttock, or leg symptoms in the follow-up investigation, but there was no change in arm, forearm, or wrist symptoms. The most effective intervention to reduce musculoskeletal discomfort from the employees' perspective was the adjustable keyboard.

Data from this investigation indicated that an ergonomic hazard existed from the operation of the express checkout due to excessive trunk and shoulder flexion and body twisting. Initial changes in the workplace design resulted in a significant decrease in symptoms, but further improvements will require more extensive interventions. Additional recommendations are provided to further improve the workstation ergonomics.

KEYWORDS: SIC 5411 (Grocery Stores) Ergonomics, intervention study, checkout registers, cashiers

II. INTRODUCTION

On August 15, 1988, NIOSH received a request for a health hazard evaluation from the SavOn Grocery store of the Kroger Company in Oxford, Ohio. NIOSH was asked to evaluate musculoskeletal pain, primarily in the upper neck and shoulder, resulting from the operation of the express checkout.

An initial survey was conducted on November 7, 1988. A follow-up questionnaire survey was conducted on January 13 and September 1, 1989. The latter survey was conducted after Kroger had completed the three initial consensus ergonomic recommendations agreed upon in a meeting on December 12, 1988, between representatives of NIOSH, Kroger Company, and the United Food and Commercial Workers Union (UFCWU). These three recommendations were:

(1) Reaching the far corner of the checkstand may cause excessive trunk flexion. Therefore, a physical barrier should be placed at the far corner of the checkstand.

(2) The keyboard's height and distance may cause excessive static stress and shoulder flexion. Therefore, a telescoping keyboard should be installed.

(3) Improper work practices, such as scanning bulky or heavy items, may be a contributing factor. Therefore, all cashiers and fill-ins should view a videotape on proper checkout work practices.

III. BACKGROUND

The Kroger store employs 150-160 persons, of whom 84 are full-time employees (at least 32 hours per week). The number of designated cashiers is 19, 13 of whom are full-time. An additional 15 individuals run registers as fill-ins. Peak hours at the store are 3 PM-9 PM; Friday, Saturday, and Sunday are the busiest days. There are as many as 10 different shifts per day.

In March, 1988, Kroger introduced the express checkout at the Oxford store. This checkout replaced a regular checkout, and was designed to increase front-end efficiency by making an additional register and scanner available for peak hours.

The difference between the express checkout and the other checkouts lies mainly in the type of checkstand used. The express checkout uses a Reynolds checkstand, which is designed to accommodate two registers and scanners. The Almar checkstand, used in the other checkouts, accommodates only one register and scanner.

The Reynolds checkstand permits the addition of another scanner in the space occupied by one Almar checkstand by eliminating much of the storage spaces for groceries built into the Almar checkstand (i.e., the conveyor belt, chute, and bagging area). This is a natural consequence of the different uses of the two stands; the Almar checkstand is designed for large grocery purchases, while the Reynolds stand is designed to process fewer items per purchase, in this case, 12 or less.

The Reynolds checkstand was pretested by Kroger in another store and was reportedly found to be a comfortable and easy checkstand to use. This checkstand is used in many Kroger stores as a space and time saving device. Kroger knew of no other complaints involving these checkstands in other stores and pointed out that they received only two complaints from the Oxford store.

The private interviews with seven employees, conducted during the opening visit of November 7, 1988, revealed that complaints were clustered primarily in the neck, upper back, and shoulder, as well as somewhat in the lower back, buttocks, and legs, with very little in the arm, forearm, and wrist. The interviewed employees also indicated that certain design characteristics of the checkstand seemed to cause their discomfort. In particular, the far corner of the checkstand was difficult to reach, the keyboard was awkward to operate, and the components of the workstation were widely separated, requiring constant twisting in its operation.

IV. EVALUATION DESIGN AND METHODS

A. Ergonomic

The workstation design and job requirements of the express lane registers were analyzed. Measurements were taken of the workstation to determine reach distances and heights required to perform various aspects of the task. Cashiers working at these registers were videotaped during the initial visit, and their motion patterns were analyzed. Any effect of the modifications made based on the initial recommendations was evaluated by questionnaire as described in Section B (below).

The videotapes were analyzed to determine average cycle time, the number of items checked in an order, the number of scans, and frequencies of movements and awkward postures. Awkward postures include shoulder flexion, twisting or flexing of the body, and extensive reaching for items placed at the edge of the counter. A cycle was defined as the completion of an order, from the initial reach for a grocery item until the completion of the payment process. Cycle time, therefore, included the time required for scanning, bagging and payment.

1. Repetitiveness

Assessment of the repetitiveness of the job was completed by quantitating the cycle time, the number of scanning motions, and frequencies of movement and awkward postures assumed by the cashiers. Because of the lack of information on the relation between repetitiveness of "unstructured" tasks (various unrelated activities included in the cycle: scanning, bagging, and tendering) such as this job and physical stress, calculation of these values provided an indication of the number of movements performed, but no statement regarding the extent of the related stress can be clearly made.

In other jobs that consist of more structured tasks, in which the same activity is performed routinely, low repetitiveness has been defined as fewer than 10,000 movements per day, medium repetitiveness as 10,000 to 20,000 movements per day, and high repetitiveness as greater than 20,000 movements per day (1). In relation to cycle time, low repetitiveness was defined as a cycle time greater than 30 seconds, and high repetitiveness as a cycle time of 30 seconds or less.

2. Posture

Postures that may impose stress to the musculoskeletal system were identified from the videotape. The frequency of these postures was recorded. These postures include rotation of the body, shoulder abduction (movement of the arm away from the body), flexion of the trunk, and shoulder flexion. Trunk flexion and shoulder flexion were often held for a relatively long period possibly causing static fatigue. The number of scans were also recorded, providing an indication of the movements performed by the hand/wrists.

B. Medical

The baseline survey, conducted on January 13, 1989, obtained information on height, age, and sex, years employed by Kroger, and hours per week running the regular and express checkout, as well as quantifying baseline musculoskeletal complaints ascribed to work, non-work, the regular checkout, and the express checkout, using the Cortlett-Bishop figure (2). After discussions with NIOSH, Kroger placed a barrier at the far corner of the checkstand, made the keyboard's height adjustable, and required all cashiers and fill-ins to watch a videotape of proper work practices in the operation of checkouts. A follow-up questionnaire survey was conducted on September 1, 1989. This survey quantified musculoskeletal complaints ascribed to the express checkout using the Cortlett-Bishop figure and, in addition, asked the employees to rate the effectiveness of each of the changes on any neck, upper back, or shoulder and lower back, buttock, or leg discomfort they might have.

Symptoms from the Cortlett-Bishop figure were clustered into three groups: 1) upper back, neck and shoulder; 2) lower back, buttock, and leg; and 3) arm, forearm, and wrist. The highest symptom within each grouping was coded, with severe coded as 3, moderate 2, mild 1, and none 0.

C. Statistical Analysis

In the ergonomic analysis, repetitiveness and postures were determined for several cycles (orders) for each cashier. Average cycle time, number of scans, and frequency of the postures described were calculated within each series of orders completed by a given cashier (within cashier). Averages for the same parameters were calculated across all analyzed trials as an indication of the variability between cashiers (across cashiers).

All questionnaires were analyzed using the statistical package in EpiInfo, except for matched data, which was manually analyzed using the Wilcoxon signed-rank test.

V. ERGONOMIC PRINCIPLES - Cumulative Trauma Disorders

Cumulative trauma disorders (CTDs) of the musculoskeletal system often occur in workers whose jobs require repetitive upper extremity exertion. These disorders include bursitis, ganglionic cysts, musculoskeletal strain, synovitis, tendinitis, tenosynovitis, and/or numerous other specifically described and ill-defined musculoskeletal syndromes. These disorders affect the nerves, tendons, and tendon sheaths of the upper extremity. Studies have shown that these disorders can be precipitated and aggravated by activities associated with repetitive exertion, particularly if completion of the tasks requires significant application of force in an awkward posture (3-16). Some postures often associated with upper extremity CTDs are wrist extension and flexion, ulnar and radial deviation of the wrist, open-hand pinching, twisting movements of the wrist and elbow, and shoulder abduction. Tasks requiring considerable time to be spent in trunk flexion or rotation of the body can also place stress on the lower back. CTDs are considered in many cases to be work-related because these types of postures and movements are required in many occupational tasks.

Because occupational factors are considered to be important in the development of these disorders, few non-occupational antecedents of CTDs have been identified or reported. Examples of non-occupational risk factors include hobbies and recreational activities, such as woodworking, tennis, weight lifting, knitting, and sewing. All of these pastimes impose physical demands on the musculotendinous system similar to those of occupational tasks. There are several factors which may

precipitate occupational cumulative trauma disorders. Among these are excessive muscular force, short length of job cycles, and a high frequency of movements. One study found that workers performing jobs with force levels of approximately four kilograms (kg) or more were four times as likely to develop hand/wrist CTDs as those workers whose jobs required muscular exertions of one kg or less (17). Job tasks with cycle times lasting 30 seconds or less were found to be associated with an incidence of upper extremity CTDs three times greater than those jobs where the cycle time was greater than 30 seconds. In studies reporting an increased incidence of CTDs where the number of hand movements were recorded, the range was from 5000 to 50,000 repetitions per day (7, 18-26). The work activities were varied and included cutting poultry, keystroking, hand sanding/filing, and packing tea.

Because of the complexity of repetitive motion patterns, it has been difficult to define a critical frequency factor for defining a CTD risk. Recently, however, guidelines for using frequency of movement as a method for assigning risk to a repetitive task were applied in a study of a meat processing and packing plant (1). Low risk was defined as fewer than 10,000 movements per day, medium risk as 10,000 to 20,000 movements per day, and high risk as 20,000 or more movements per day. These frequency-of-movement criteria are intended merely as guidelines for judging the relative strain of a hand intensive job task. It is also important to note that other factors associated with the performance of a work activity, such as high levels of muscular force, and awkward postures, would reduce the number of movements defining each of the risk categories. The current strategy for reducing the risk of CTDs for a certain task is to minimize exposure to job factors that are biomechanically stressful, i.e., high force, awkward postures, and high repetition rates. This is most effectively achieved through the redesign of work stations, tools, or work methods that were identified through job analysis as risk factors for CTDs.

VI. RESULTS

A. Ergonomic

Table I presents the average values of ergonomic variables among cashiers analyzed while working at the express lane registers. The average time to complete one order (cycle time) was approximately one minute both within and across cashiers. The average order consisted of 3.9 items. The average number of scans per order was 4.2 within cashier. Cashiers used the keyboard located at shoulder height approximately four times for each order. Keying was done to enter prices of certain items, or when scanning was unsuccessful and when tender was received. The average for the combination of the scanning and keying activities was eight (within cashier) or nine (across cashiers). This indicates that the cashiers on average perform two

or three extra scans or keying activities per order. Occasionally, the same height of static shoulder flexion as held during the keying action was held by the cashier when receiving payment or returning change to the customer. These movements were also included in the recorded number of shoulder flexions. The frequency of trunk flexion or rotation was 1.3 times per order within cashier. Shoulder abduction within cashier was 1.7 times per order and 1.1 times across cashiers. It was noted that cashiers of shorter stature tended to have increased frequency of shoulder abduction due to the need to grasp an item beyond their reach. Often these cashiers would stand on their toes to allow them to reach further, even though that solution imposes stress on the lower extremity and reduces stability. Another technique for grasping the items was to reach across the body with the hand opposite from the counter. This technique would be less effective with regards to the reach distance, but it allowed the cashier to grasp the item, scan it and place it in the bag at the end of the counter using the same hand. This method eliminated the exchange of the item between hands after the scanning that was required if the hand closest to the grocery storage area was used initially.

Based on extrapolation of the repetition seen in the time period videotaped, the average numbers of total movements and awkward postures within a series of orders were estimated to be 2,863 and 1,340, respectively, for the stated two-hour period of working at the express register. For comparison to the values found in other 'structured' work, this work would require 11,452 total movements, with 5,360 of those being awkward postures, in an eight-hour period.

B. Medical

1. Baseline Survey

a. DEMOGRAPHICS AND OCCUPATIONAL INFORMATION

The baseline survey was completed on 23 of 34 eligible employees (68%), the follow-up survey on 19 of these 23 (83%). Average age was 42. Thirty percent were male, seventy percent female. Average hours working the express checkout was 9.9, with a range from 1 to 20. The average length of employment with Kroger was almost 15 years (Table II).

b. SYMPTOMS

Only two employees noted musculoskeletal pain away from work that they felt was not work related. One employee missed work because of this (Table III).

WORK-RELATED SYMPTOMS

At the time of the baseline survey, ten employees (43.5%) noted some discomfort when running the regular checkout while all 23 noted discomfort operating the express checkout. Employees felt they could operate the regular checkout for an average of 5.7 hours, with a median of 3 hours, without discomfort. The average time to discomfort operating the express checkout was 1.4 hours, with a median of 1 hour. (Table III)

DISTRIBUTION OF SYMPTOMS, AND THEIR MAXIMUM SEVERITY, BY THE PLACE THE SYMPTOM OCCURRED

There were substantial differences in the distribution of symptoms ascribed by the workers as being caused by the different parts of the work and non-work environment (Table IV).

Twenty-two employees (96%) had some neck, upper back or shoulder discomfort at work; in 9 (41%) of these, it was severe. Nineteen employees had some lower back, hip, or leg complaints at work; in 9 (47%), this was severe. Thirteen employees had some work-related arm, forearm, or wrist complaints, of which 4 (31%) had severe pain.

There was no significant relationship between total hours running registers, hours running the regular checkouts, or hours running the express checkouts and symptoms.

2. Follow-up Survey

a. COMPARISON OF SYMPTOMS RELATED TO THE EXPRESS CHECKOUT BETWEEN THE BASELINE AND FOLLOW-UP SURVEY

All employees experienced some discomfort while operating the express checkout during the baseline survey. On follow-up, 15 employees (79%) experienced some discomfort (Table V). This was a non-significant change.

The median time to discomfort while operating the express checkout at baseline was one hour, with a range of zero to three hours. On follow-up, the median was still one hour, but the range was zero to 12 hours. This was also non-signficant change (Table V-A).

Eighteen employees (78%) had required some medication for symptoms related to operating the express checkout at baseline, but only five (26%) required medication at follow-up (Table V). This was a significant improvement (Table V-B, $p<.05$, two tailed Wilcoxon signed rank test).

The maximum days to recovery from express checkout-related discomfort was four at baseline and two on follow-up (Table V). This was also a signficant improvement (Table V-C, $p<.05$, two tailed Wilcoxon signed rank test).

b. COMPARISON OF SITE-SPECIFIC SYMPTOMS BETWEEN THE BASELINE AND FOLLOW-UP SURVEY

Twelve employees experienced less neck, upper back, or shoulder discomfort on follow-up when compared to baseline (Table VI-A). Two employees experienced more discomfort. This was a significant improvement (one-tailed Wilcoxon signed-rank test $p<.025$).

There was no significant improvement in arm, forearm or wrist symptoms on follow-up (one-tailed Wilcoxon signed-rank test $p>.05$). Four employees had less discomfort on follow-up, and five employees had more discomfort (Table VI-B).

There was a significant improvement in lower back, buttock or leg discomfort on follow-up ($p=.025$, Wilcoxon one-tailed signed-rank test). Two employees had more discomfort on follow-up, while five had less discomfort (Table VI-C).

c. EMPLOYEE ATTITUDES TOWARD THE CHANGES

Employees who completed the follow-up questionnaire were asked to evaluate the effectiveness of the three interventions in reducing their discomfort and whether it improved the functioning of the checkstand.

Overall, five employees (26%) felt the adjustable keyboard was the most effective intervention at reducing their musculoskeletal discomfort, while four (21%) felt the barrier was the most effective. None felt the training tape was most effective, while ten (53%) felt that none of the interventions were effective in reducing their discomfort.

On specific questioning, fourteen (74%) felt the keyboard was an improvement. Thirteen (68%) felt it made the operation of the keyboard easier, seven (37%) felt it made its operation more comfortable, five (26%) felt it reduced their upper back, shoulder or neck discomfort, and two (11%) felt it reduced their lower back, buttock or leg discomfort. In addition, two felt it caused problems with the operation of the express checkout (specifically, large items were harder to scan, and it was occasionally loose, requiring adjustment).

Ten employees (53%) felt the barrier on the far corner of the checkstand was an improvement. Eight (42%) felt it improved the functioning of the checkout, seven (37%) felt it reduced their bending and stretching for groceries, five (26%) felt it decreased their neck, upper back, or shoulder discomfort, and four (21%) felt it reduced their lower back, buttock, or leg discomfort. One employee (5%) felt the barrier caused problems (specifically, customers leaned groceries on it, making them harder to reach).

Fourteen employees (74%) watched the training video. Ten of these (71%) felt it was informative, three (21%) felt it reduced their upper back, neck, or shoulder discomfort, and one (7%) felt it reduced their lower back, buttock, or leg discomfort.

VII. DISCUSSION/CONCLUSION

Based on the investigation conducted on November 7, 1988, NIOSH investigators determined that there was an ergonomic hazard from the operation of the express checkout. The employee complaints were consistent with this hazard. Initial recommendations for improving the design of the express checkout resulted in a significant decrease in the symptoms. Despite the improvement, there remained a substantial residual of complaints requiring further interventions.

This study illustrated several principles of ergonomic evaluation and intervention:

1. Initial interventions should be directed to the areas of greatest employee concern and complaints.

2. Employees are an important source of information on the ergonomic problems of the work station.

3. The intervention process is iterative, requiring ongoing problem identification, intervention, and follow-up.

The validity of this process is supported by the findings of the study. At baseline, a set of symptoms of greatest concern to the employees was identified, that is, primarily upper back, neck, and shoulder symptoms. Employees were asked to identify the processes that caused the most symptoms in these areas, and the initial ergonomic evaluation and interventions were directed to these areas.

Employees pointed out several aspects of the express checkstand design that they felt contributed to their discomfort. These areas were the keyboard, which they felt was awkward to operate, the far corner of the checkstand was difficult to reach, and the components of the checkstand were widely separated, requiring constant twisting in its operation.

The ergonomic evaluation of the cashiers at the express lanes indicated that frequency of certain movement patterns of different cashiers was similar. The average number of items per order (3.9) would suggest that the combination of scans and keying actions should be four in addition to two keying actions required during payment. The first keying action is to obtain the total, and the second to enter the amount of tender received. The average for the combination of the scanning and keying activities was eight (within cashier) or nine (across cashiers). This indicates that the cashiers on average perform two or three extra scans or keying activities per order. The additional motion was noted in missed scans, and extending the arm near shoulder height during the payment exchange. The reasons for missed scans were varied based on information obtained during the store visit, including dust or smears on the scanner window, location of the bar codes, or poor contrast of the bar codes on items such as aluminum cans or frozen food packages.

The postures that were affected more by stature of the cashier were the flexion of the trunk and shoulder abduction (movement away from the body). Taller cashiers had greater trunk flexion when handling tender at the cash drawer than cashiers of shorter stature. This bending may place additional stress on the neck/shoulder and lower back regions. More shoulder abduction was noted in cashiers of shorter stature, who had to reach beyond their functional reach limit to grasp items placed at the far end of the counter.

The detailed ergonomic analysis was limited to the express lane registers since that was the focus of the hazard evaluation request. However, variations in the style between the express and regular check stands were observed. The regular checkstand allowed the cashier to stand with the feeder belt and scanner to the side. This design minimized shoulder abduction and reaching across the body. The keyboard for this lane was located near waist height in front of the cashier, eliminating the need to reach across the lane at shoulder height, as required for the express lane. The number of movements required for this lane per order was not calculated, but the increased volume of items per order would increase the number of scans, and possibly keying actions, but the frequency of shoulder abduction and shoulder flexion would decrease.

The total number of movements at the express registers calculated for an eight-hour day would suggest that it requires medium repetition with respect to the values reported for more 'structured' tasks. It is important to note that the cashiers assumed awkward postures for approximately 47% of the total number of movements, increasing the risk of injury.

Several factors would affect the frequency of movement. The cashiers were videotaped during a "slow" time, thus, they occasionally experienced intermittent periods with no customers, which would minimize the total movement calculation. Cycle time is influenced by whether the customer pays with cash or check, since the check process usually increases the cycle time and decreases the number of movements per cycle.

After our initial evaluation, several interventions aimed at reducing employee discomfort were implemented. These were initial interventions, reached at a consensus conference among all interested parties. They were chosen by their convenience and ease of use, as well as their predicted effects on reducing the discomfort in the most effected areas, that is the neck, upper back, and shoulder, as well as the lower back, buttocks, and legs. Any further changes would follow an evaluation of their effectiveness.

The barrier at the far corner of the checkstand was designed to reduce reaching and bending for groceries, and was predicted to decrease both shoulder/neck/upper back and lower back/buttock/leg discomfort by reducing shoulder abduction and flexion and trunk flexion. The height-adjustable keyboard was designed to reduce neck, shoulder, and upper back discomfort by decreasing excessive static stress and shoulder flexion and abduction. The training tape was intended to reduce all types of complaints by encouraging good work practices.

We found widespread discomfort from the operation of the express checkstand prior to these interventions. At follow-up, these symptoms had decreased in the area of active ergonomic intervention, that is, the upper back/shoulder/neck, and the lower back/buttocks/leg, but not in the arm, forearm, and wrist, which were not targeted by the intervention.

The study had several limitations. These included a lack of a control group, self-reported illness, and low participation rate. Because of the nature of the hazard evaluation program, this study was limited to the population of this particular store. Blinding cashiers to the intervention within the store was not possible; neither was it possible to intervene in the ergonomics of one of the two express registers and assign a group of cashiers to operate only this register. A complete medical evaluation at baseline and follow-up was considered, but the nature of the symptoms was such that a specific diagnosis was unlikely in the majority of subjects. Finally, while participation was low at baseline, in follow-up, 83% participated.

Given these limitations, the intervention process was effective in reducing employee complaints. Complaints were reduced in the areas expected, but not in the arm, forearm, and wrist, where there was no specific intervention. This is not consistent with a Hawthorne effect (27), and speaks strongly for the validity of the methodology and the effectiveness of this ergonomic intervention.

The final important finding of the study was that there was still substantial residual discomfort, even in the areas where active measures were undertaken. This illustrates the need for follow-up of all interventions to determine their efficacy, and the iterative, ongoing nature of the intervention process.

VIII. RECOMMENDATIONS

1. Maintain the changes initially recommended, that is, continue the use of the barrier, the height adjustable keyboard, and ongoing education using the videotape. Further improvements within the framework of the initial interventions is possible:

   a. Only 74% of the cashiers had observed the videotape at follow-up. All cashiers should receive this training.

   b. Reduction in the number of scans, minimizing the gripping posture, would be possible if the scan success rate was improved. A clean scanner window improves the scan rate. The cashiers should maintain a clean scanner window at all times.

   c. The horizontal and vertical distances required to reach for the keyboard result in a stressful posture for the shoulder and arm. The position of the keyboard at the side of the lane, as seen in the regular checkstands, eliminates the need for this posture. If changing the position of the keyboard to this location is not possible, designing further adjustability into the keyboard distance and height should be.

   d. The need to reach to the far edge of the counter could be eliminated by the installation of a conveyor belt or by reducing the size of the grocery storage area.

2. The current design of the express checkout is notable for scattering of the work components. In particular, the cash drawer and keyboard are placed opposite from each other. The design should be altered to cluster the components, which would reduce the need for twisting and flexion currently prominent in the operation of the checkstand.

3. Kroger should facilitate the development of a scanner that is insensitive to the cleanliness of the scanner window.

4. Most employees experience discomfort after one hour of express checkstand operation. Employees should be rotated to regular checkstands or other tasks at a maximum of one hour intervals.

5. These suggestions should be incorporated into future design of express checkstands, as well operational checkstands of similar design.

6. Further improvements in design will require ongoing reevaluation and intervention.

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are temporarily available upon request from NIOSH, Hazard Evaluations and Technical Assistance Branch, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5282 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Mr. T. Cliodi, Kroger Company
2. Ms. Rhonda Siegel, Union Steward, UFCWU Local 1099
3. OSHA Region V
4. NIOSH Cincinnati Region

For the purpose of informing affected workers, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Table I

AVERAGE VALUES OF ERGONOMIC VARIABLES
FOR WITHIN AND ACROSS CASHIERS AT THE EXPRESS LANES

	Within Cashier	Across Cashiers
Cycle Time (sec)	59.6	60.5
# Items/Cycle	3.9	3.9
# Scans/Cycle	4.2	5.1
# Keying Motions/ Cycle	3.9	4.2
# Trunk twists-Flexions/ Cycle	1.3	1.4
# Shoulder Abductions/ Cycle	1.7	2.1
Total # Movements/ Cycle	23.7	25.1
Total # Movements/ 2 hr period	2863	3032
Total # Movements/ 8 hr workday	11,452	12,128

TABLE II

Variable	Baseline Survey	Follow-up Survey
Number completing survey	23	19
Average Age (range)	42 (23-59)	40 (23-53)
Sex distribution		
Males (%)	7 (30.4%)	6 (31.6%)
Females (%)	16 (69.6%)	13 (68.4%)
Average Height (range)	5'6" (4'11"-6'4")	5'7" (4'11"-6'2")
Average years at Kroger (range)	14.8 (3-36)	15.9 (4-36)
Average weekly hours at work (range)	39 (20-48)	41 (30-48)
Hours on checkout (total)	28 (3-48)	31 (3-48)
Average hours on express checkout (range)	9.9 (1-20)	12.5 (<1-46)

TABLE III

Place symptoms occurred	# complaining (%)	# with ongoing complaints(%)	# missing work(%)	Avg hrs able to work without discomfort (range - median)
At work	23 (100%)	6 (26%)	2 (8.7%)	NA
Away from work (not work related)	12 (52.2%)	2 (8.7%)	1 (4.4%)	NA
From regular checkout	10 (43.5%)	2 (8.7%)	3 (13%)	5.7 (0-8 hrs - 3 hrs)
From express checkout	23 (100%)	3 (13%)	3 (13%)	1.4 (0-3 hrs - 1 hr)

TABLE IV

Place	Neck/Upper back/ Shoulder # (%)	Arm/Forearm/ Wrist # (%)	Low back/Hip/ Leg # (%)
At work			
None	1 (4.3%)	10 (43.5%)	4 (17.4%)
Mild	5 (21.7%)	4 (17.4%)	2 (8.7%)
Moderate	8 (34.8%)	5 (21.7%)	8 (43.8%)
Severe	9 (39.1%)	4 (17.4%)	9 (39.1%)
Away from work (not work related)			
None	14 (61%)	19 (82.6%)	13 (54.2%)
Mild	2 (8.7%)	1 (4.3%)	0 (0%)
Moderate	4 (17.4%)	1 (43.%)	7 (30.4%)
Severe	3 (13.0%)	2 (8.6%)	3 (13%)
While working the regular checkout			
None	15 (65.2%)	15 (65.2%)	13 (56.5%)
Mild	2 (8.7%)	4 (17.4%)	2 (8.7%)
Moderate	3 (13%)	1 (4.3%)	5 (21.7%)
Severe	3 (13%)	3 (13%)	3 (13%)
While working the express checkout			
None	1 (4.3%)	12 (52.2%)	5 (21.7%)
Mild	5 (21.7%)	3 (13%)	3 (13%)
Moderate	7 (30.4%)	4 (17.4%)	6 (26.1%)
Severe	10 (43.5%)	4 (17.4%)	9 (39.1%)

There was no relationship between age, sex, height, or years employed and symptoms in any setting.

TABLE V

Variable	Before	After
Overall # with symptoms (%)	23 (100%)	15 (79%)
Range of hours able to work express checkout (median)	0-3 (1)	0-12 (1)
Employees requiring medication for symptoms	18 (78%)	5 (26%)
Of employees with checkout-related discomfort, range of days to recovery (median)	0-Ongoing in 4 (1)	0-Ongoing in 2 (1)

Table V-A

Hours able to work the express checkout

Before	After					
	None	One	Two	Twelve	Unlimited	Total
One	2	5	1	0	1	9
Two	0	0	3	1	3	7
Three	0	1	0	0	0	0
Unlimited	0	1	0	0	1	2
Total	2	7	4	1	5	19

(Nonsignificant Change)

Table V-B

Employees Requiring Medication

Before	After		
	Yes	No	Total
Yes	5	10	15
No	0	4	4
Total	5	14	19

($P<.05$, two tailed Wilcoxon signed-rank test)

Table V-C

Days to Recovery from Discomfort

Before	After				
	0-1	One	Two	Ongoing	Total
0-1	2	2	0	0	4
One	5	2	0	1	8
Two	2	0	0	0	2
Five	1	0	0	0	1
Fourteen	0	0	1	0	1
Ongoing	2	0	0	1	3
Total	12	4	1	2	19

($p<.05$, two tailed Wilcoxon signed-rank test)

TABLE VI

TABLE VI-A

Neck/Upper Back/Shoulders

Before	After: None	Mild	Moderate	Severe	Total	
None	0	0	2	0	2	(10%)
Mild	3	0	0	0	3	(16%)
Moderate	3	2	2	0	7	(37%)
Severe	1	1	2	3	7	(37%)
Total	7 (37%)	3 (16%)	6 (31%)	3 (16%)	19	(100%)

($p<.025$, two tailed Wilcoxon signed-rank test)

TABLE VI-B

Arm/Forearm/Wrist

Before	After: None	Mild	Moderate	Severe	Total	
None	7	2	1	1	11	(58%)
Mild	2	0	0	0	2	(10%)
Moderate	1	0	1	1	3	(16%)
Severe	0	0	1	2	3	(16%)
Total	10 (53%)	2 (11%)	3 (16%)	4 (21%)	19	(100%)

(Nonsignificant Change)

TABLE VI-C

Lower Back/Buttocks/Legs

Before	After: None	Mild	Moderate	Severe	Total	
None	3	1	0	0	4	(21%)
Mild	1	0	1	0	2	(11%)
Moderate	2	0	3	0	5	(26%)
Severe	1	1	0	6	8	(42%)
Total	7 (37%)	2 (10%)	4 (21%)	6 (32%)	19	(100%)

($p=.025$, two tailed Wilcoxon signed-rank test)