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Participatory Ergonomics in a Red Meat Packing Plant, Part I: Evidence of Long-Term Effectiveness

The ergonomics program and activities of a red meat packing plant are described. In 1986 the plant started its program, which was consistent with the Occupational Safety and Health Administration guideline for this industry. During a six-year period subsequent to implementation of the program (1988–1993), the crude incidence rates and lost-time incidence rates increased. There was no consistent pattern of increase or decrease for severity rates, but a shift from lost time to restricted time was noted. The percentage of recordable disorders that were ergonomics related stayed constant. Annual workers' compensation costs (adjusted for inflation) were evaluated for seven years postimplementation of the program (1987–1993). A consistent and progressive decrease was noted. The 1993 expense was 20% of the 1987 expense. These results, limited by their descriptive nature and the hazards unique to red meat packing plants, suggest some changes in injury/illness statistics and workers' compensation costs that might follow implementation of an ergonomics program.

Keywords: ergonomics programs, participatory ergonomics, program evaluation, red meat packing plants

During 1992–1993 a corporation and one of its plants worked with the investigators as part of a National Institute for Occupational Safety and Health-sponsored demonstration project. The primary purpose of the project was to demonstrate the effectiveness of the participatory approach to solving ergonomics problems in the red meat packing industry. Two other aspects of this project, one related to describing the corporation's ergonomics program and postintervention changes in injury/illness statistics and workers' compensation costs, and one related to the ergonomics teams' assessments of the participatory approach used to solve the targeted ergonomics problems, have been presented elsewhere.^(1,2) In this article the ergonomics activities of the plant are described and postimplementation injury/illness and workers' compensation cost data are reported.

BACKGROUND

Plant Description and History

The plant was located in the upper Midwest of the United States. Since 1977, plant operations involved the slaughtering of hogs and processing of pork. There were approximately 930 workers at the plant of whom 830 were production workers. Approximately 778 of these production workers were represented by Local 22 of the United Food and Commercial Workers (UFCW).

During this project the plant was in the midst of a major renovation project. The Kill Department started installing new lines in September 1993 that were scheduled to be completed by late 1994. Renovation work for the Cut Department was scheduled to start in 1994 and be completed during 1995. Many changes related to the ergonomics teams' activities, especially major design and layout changes, were scheduled for implementation as part of the renovation.

Productivity

In 1985 the line speed of this plant was 625 hogs per hour. This increased to 685 in August 1987,

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followed by another increase to 711 in April 1988. The speed increased again in September 1988 to 726, then to 741 in September 1990. The speed increased to 747 in August 1991 and obtained its current rate, 762, in November 1991. The plant hoped to have the ability to process 1000 hogs per hour post-renovation, but no timetable for reaching this goal had been established.

The Ergonomics Program and Activities

This plant started to implement the corporation's ergonomics program in 1986. The structure of the program was consistent with the guidelines subsequently published by the Occupational Safety and Health Administration (OSHA) for this industry in 1990.⁽³⁾ A corporate ergonomics coordinator oversaw, tracked, and audited the activities of all of the plant ergonomics teams throughout the corporation. A variety of forms and checklists were utilized to identify musculoskeletal and safety-related risk factors (see Table I). Some components of these forms also served as a source of information on employee symptoms.

TABLE I. Factors Addressed in the Surveys and Checklists

Title of Survey or Checklist	Major Topics
Worker Safety Survey ^A	lasting aches or sore spots workstation comfort tool comfort ideas to make your job easier job rotation lighting ideas to make materials handling easier any unsafe conditions or acts continuously bent neck or back excessive wrist bending possibility of sitting possibility of a lean bar differences in work methods among workers objects within easy reach proper equipment operation work methods instruction
CTD Risk Factor Checklist ^B	generic risk CTD factors workstation stability unaccustomed activity work pace personal characteristics
Worker Feedback Form ^C	how long on this job intensity and severity of body-part discomfort ratings of perceived exertion by body part perceived problems with the job recommendations for improvement

^AThe Worker Safety Survey was developed by the company. It is administered plant-wide approximately every two years.

^BThe Cumulative Trauma Disorder (CTD) Risk Factor Checklist, also developed by the company, is used for jobs associated with either a large number of upper extremity disorders, severe upper extremity disorders, a particularly severe injury, or high turnover.

^CThe Worker Feedback Form was developed for use in the demonstration project.

At the study plant there was one plant ergonomics team that oversaw all ergonomics activities plus some department teams. Members of the plant and department teams were trained by the corporate ergonomics coordinator on the development, recognition, and reporting of musculoskeletal disorders; general ergonomics principles; and procedures and processes related to the ergonomics program. Each meeting followed a structured agenda that included review of the previous month's injuries and ergonomics-related medical expenses, analysis and discussion of worker checklists (if any), update on the status of interventions made or proposed, and summaries of good suggestions and success stories. Meeting minutes were forwarded to the corporate ergonomics coordinator. During the demonstration project the plant ergonomics team met twice a month, but they had met more often previously. There were 11 members: 1 production worker, 1 office worker, 1 union steward, 2 maintenance engineers, 3 industrial engineers, 1 production supervisor, the personnel/safety coordinator, and the nurse.

The nature of the historical, ongoing, and planned job changes were varied. Some changes involved modification of existing hand tools (e.g., various knives); purchase of new tools or devices that made the work easier; installation of tool-related equipment (e.g., heated water basins to clean knives); or development and fabrication of special tools. Some changes were related to workstation layout. They usually involved modifying conveyors or conveyor stands or installing adjustable workstands. A few changes involved large-scale modifications, such as automated hog splitting workstations, revised conveyors and work methods for gut snatching, and mechanical assists for handling certain types of boxed products. One worker was added to one job to reduce workload, reduce work pace, and increase task diversity. In general, these interventions not only reduced stresses on workers, but also relieved production bottlenecks.

Table II summarizes the number of projects completed or in

TABLE II. Number of Ergonomics Interventions Made by the Plant's Ergonomics Committee According to Department

Department	Number of Job Changes
Bacon slice	15
Bacon slice/PFLM	1
Edible rendering	1
Fresh sausage	1
G.P. spam	5
Ham bone	7
Hog cut	30
Hog kill	37
Inedible rendering	1
Market ship	2
Office	7
Plant	7
Preparation sausage manufacturing	6
Quality control	5
Sliced smoked meat	2
Smoked meats packing	6
Smokehouse	3
Smokehouse/cure	1
Storeroom	2
Vat/trolley wash	2
Total	141

progress by department. Table III presents a historical summary of plant events and job changes by year. The target departments for this project were Hog Cut and Hog Kill.

TABLE III. Historical Summary of Plant Events Combined with the Number of Ergonomics Interventions Made by the Plant's Ergonomics Committee by Year of Completion

Year	Plant Events	Number of Job Changes
1977	onset of pork operations	
1985	line speed—625 hogs per hour	
1986	onset of ergonomics program	2
1987 (Aug.)	line speed—685 hogs per hour	1
1988 (April)	line speed—711 hogs per hour	1
(Sept.)	line speed—726 hogs per hour	
1989		7
1990 (Sept.)	line speed—741 hogs per hour	20
1991 (Aug.)	line speed—747 hogs per hour	24
(Nov.)	line speed—762 hogs per hour	
1992	onset of demonstration project	54
1993	onset of Kill Department renovations	26
	End of demonstration project	
1994	Kill and Cut Department renovations	3
1995	Kill and Cut Department renovations	
1996	Renovations completed	
Ongoing projects		3
No completion date		3
Total		141

METHODS

Several injury/illness statistics can be used to monitor or evaluate an ergonomics program's effectiveness. Four such statistics were selected for this project. Crude annual incidence rate was calculated by dividing the total number of injuries and illnesses recorded on the OSHA 200 log for 1 year by the average number of workers employed at the plant during that year, then multiplying by 100. Lost-time incidence rate was calculated in a manner similar to the crude incidence rate, except that only the number of lost-time injuries was included in the numerator. Severity rate was calculated by dividing the number of days lost or restricted by the average

number of workers employed at the plant that year. The percentage of recordable conditions that were ergonomics related was calculated by dividing the number of recorded musculoskeletal conditions related to strains, sprains, or repeated motions or exertions by the total number of recorded conditions.

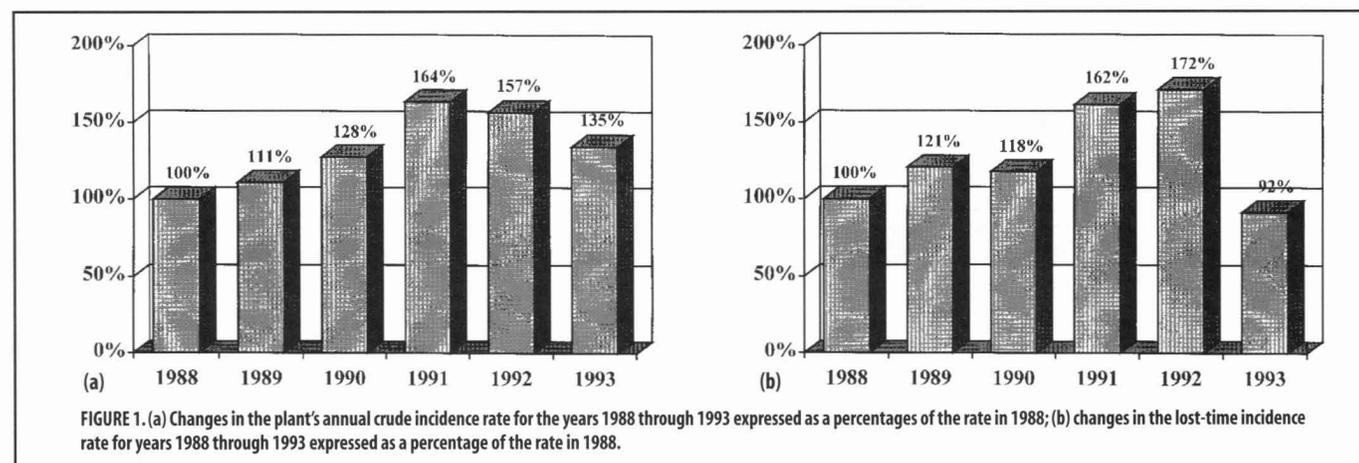
The OSHA 200 logs were maintained by an on-site occupational health nurse in accordance with Bureau of Labor Statistics guidelines. Since OSHA 200 records were retained only five years, consistent with OSHA record-keeping requirements, injury/illness data were available for years 1988 through 1993. As a result, the available data only describe postimplementation changes.

The company preferred not to publish its crude incidence rates, lost-time incidence rates, or severity rates directly; therefore, the results are presented in the form of a percentage relative to a baseline year. For the injury/illness statistics, the rates for 1988 (the first year) were chosen as the baselines and assigned values of 100%. Rates for years 1989 through 1993 were expressed as percentages of the 1988 rates. The annual percentages of recordable conditions that were ergonomics related are absolute figures.

Workers' compensation cost data were available for the years 1987 through 1993. In this project, annual workers' compensation costs were compared using constant dollars (adjusted for inflation). According to the corporation's top insurance executive, the company's average annual rate of inflation for this expense was 12% in this time period. As with the injury/illness statistics, the company preferred not to report its absolute dollar figures; therefore, the same baseline year used for the injury/illness data, 1988, was used as the baseline, and all other years are reported as a percentage of 1988.

RESULTS

The crude incidence rate increased more than 60% between 1988 and 1992 (Figure 1a). This increase may drop over time, as



noted for 1992 and 1993, but not necessarily to the 1988 baseline level. The lost-time incidence rate increased approximately 70% between 1988 and 1992, and a significant decrease was not observed until 1993 (Figure 1b). Restricted days accounted for 26% of the total lost or restricted days in 1988 versus 60% in 1993. This suggests that, in combination with increased early reporting, workers were more readily assigned alternate duty assignments, thus reducing lost days while increasing restricted days.

Figure 2 illustrates the percentage changes in severity rates. No consistent pattern is readily evident, but there is some suggestion that the severity rate may be starting to progressively decrease in recent years.

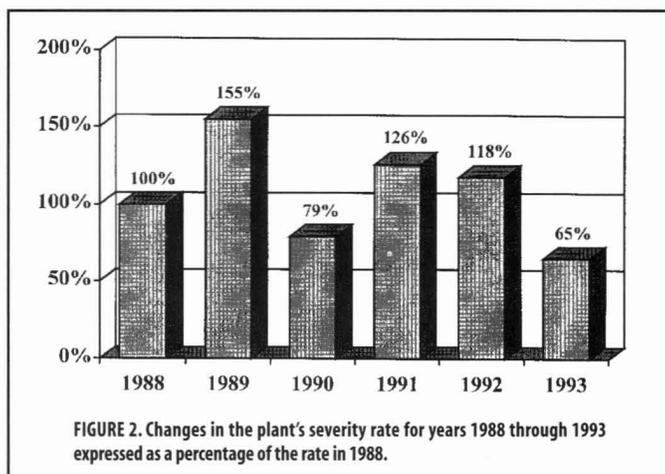


FIGURE 2. Changes in the plant's severity rate for years 1988 through 1993 expressed as a percentage of the rate in 1988.

The percentage of total recordable conditions that were considered ergonomics related are illustrated in Figure 3a. This percentage has been almost constant at 40% during this time period.

As shown in Figure 3b, there was a clear pattern of decline for inflation-adjusted annual workers' compensation expenses between 1987 and 1993. The 1993 expenses were only 20% of those in 1987 (an 80% decrease).

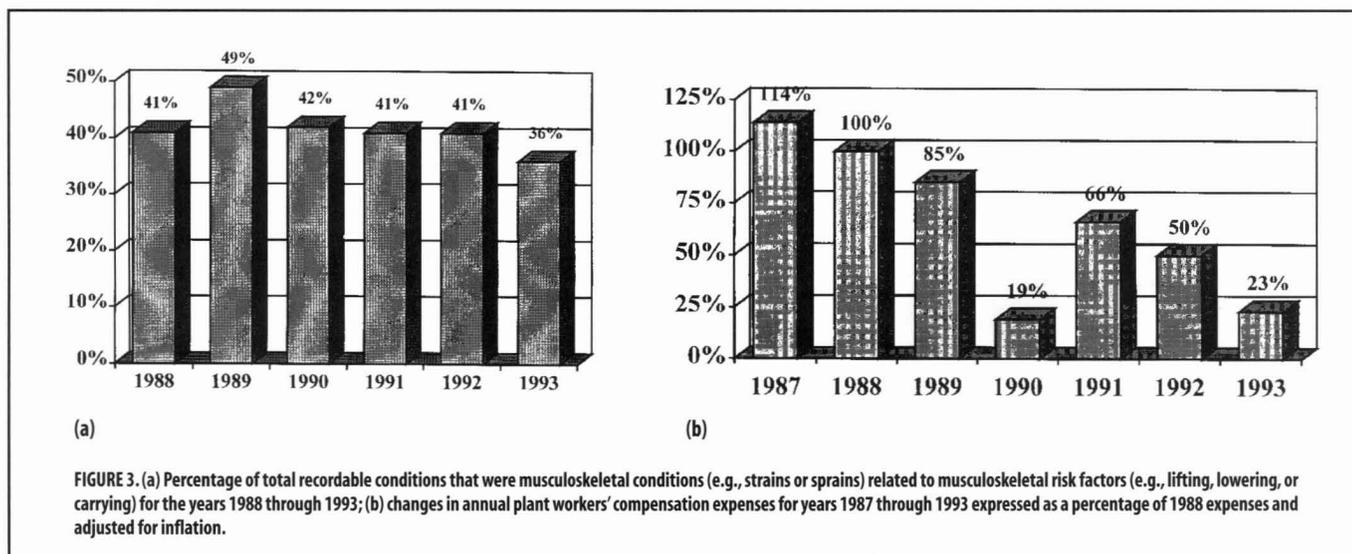


FIGURE 3. (a) Percentage of total recordable conditions that were musculoskeletal conditions (e.g., strains or sprains) related to musculoskeletal risk factors (e.g., lifting, lowering, or carrying) for the years 1988 through 1993; (b) changes in annual plant workers' compensation expenses for years 1987 through 1993 expressed as a percentage of 1988 expenses and adjusted for inflation.

DISCUSSION

Before discussing the findings, there are several methodological limitations related to interpreting the information in this report. First, the results were descriptive, i.e., there were no control or comparison groups. Second, the data related to measures of effectiveness were limited to the postintervention time periods, so no pre-versus postintervention comparisons were possible. As a result, this project could not prove that the plant's ergonomics program caused the changes in measures of effectiveness. In terms of methodological strengths, data sources were stable during the observation period. Record-keeping practices at the plant were consistent with OSHA guidelines, and the same individual maintained the logs during the observation period. Even if this individual had a systematic bias in his or her record-keeping practice, it would not explain the year-to-year changes. The annual workers' compensation cost data were obtained from the one insurance carrier that provided this service throughout the observation period. The census data was obtained from the plant's Human Resources Department.

At this plant the annual crude incidence rate increased by more than 60% after the ergonomics program was implemented. Employee training on early recognition and reporting of musculoskeletal conditions was believed to be a major contributing factor to this observation. It was not clear that the crude incidence rate was decreasing during the observation period. This finding suggests that an increase in crude incidence rate might be expected following implementation of an ergonomics program, and that it may take years for the incidence rate to fall back to its preimplementation level, if ever. The pattern is not consistent with "wind-fall" reporting of old cases (as opposed to new cases) because the incidence rate stayed relatively elevated for several years. If effectiveness is measured by a crude incidence rate yardstick, institution of a participatory ergonomics program appears to require a long-term perspective. In fact, an increased crude incidence rate may reflect an effective program.

Contrary to the observations of others,⁽⁴⁻⁶⁾ this plant's lost-time incidence rate increased postimplementation. Comparison of

Figures 1a and 1b suggests that the crude and lost-time incidence rates followed the same pattern of change over time. Employee training in early recognition and reporting could be considered as one potential explanatory factor. A second factor could be the timetable of the interventions. Table II reveals that 61% of the ergonomic interventions were implemented during or after 1992; therefore, changes related to the majority of the interventions may not have been evident in the 1992–1993 injury/illness data. A third factor could be the nature of musculoskeletal hazards in the meat packing industry. Even though 53% of the recordable lost-time conditions during 1988–1993 were ergonomics related, more than two-thirds of these conditions were acute strains or sprains of the low back, neck, or shoulder; therefore, program elements targeted to the prevention of nonacute musculoskeletal conditions would not necessarily alter the occurrence of acute injuries.

As of 1993 there was no consistent pattern of change in the plant's severity rate. Comparison to the crude and lost-time incidence rates failed to suggest a relationship. There was no identifiable circumstance to explain the drop in severity rate in 1990. There was, however, a shift from lost days to restricted days. The plant's ergonomics program may have contributed to this observation through three possible mechanisms: (1) encouraging the early recognition and reporting of musculoskeletal conditions that were associated with less impairment; (2) an increased availability of "light-duty" jobs as a result of ergonomics-related improvements; or (3) changes in medical management practices.

The percentage of ergonomics-related disorders did not change significantly during the observation period. Again, this finding might be explained by the timetable for changes scheduled for implementation during the renovation.

In terms of workers' compensation costs, the plant experienced significant decreases in annual expenditures. Based on inflation-adjusted dollars, the annual workers' compensation costs decreased 80% over six years. There was no increase in workers' compensation cost during this observation period, despite the contemporaneous increases in crude and lost-time incident rates. Comparison of Figures 1d and 1e suggest that the drops in expenditures in 1990 and 1993 coincided with the drops in the severity rates for those years.

Even though no specific data were collected regarding quality and productivity, these issues were discussed during the project.

Based on conversations with workers and management, quality had probably increased, but never decreased, on certain jobs. In this industry, productivity is generally measured in terms of line speed (hogs per hour). Market and economic forces are the primary determinants of the required line speed. In this plant the ergonomics program was viewed as a mechanism to help the plant reach its productivity goal while simultaneously reducing worker exposure to musculoskeletal stressors.

CONCLUSIONS

The observations associated with this project suggested that the long-term effects of a participatory ergonomics program in a red meat slaughtering and meat processing plant included:

- an increase in the crude incidence rate;
- an increase in the lost-time incidence rate;
- no predictable change in the severity rate, but a shift from lost days to restricted days;
- no change in the percentage of recordables that were ergonomics related; and
- a consistent and progressive decrease in annual workers' compensation costs.

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