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LONGMONT TURKEY PROCESSORS, INC
LONGMONT, COLORADO

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I. SUMMARY

In February 1987 the National Institute for Occupational Safety and Health (NIOSH) responded to a request from the United Food and Commercial Workers Union to evaluate the relationship between work processes/practices at a turkey processing plant and carpal tunnel syndrome (CTS) and other musculoskeletal injuries. This facility produces a variety of meat products primarily for wholesale distribution to the restaurant industry. At the time of the evaluation, 792 workers were employed at the plant. This evaluation was based upon review of available OSHA Logs and company medical data and examination of videotapes of the workstations and workpractices collected for ergonomic analysis.

A review of injuries to personnel was performed using data from OSHA Logs (January 1985 through February 1987) and plant medical logs for January 1987. Comparison rates were obtained through the 1987 Bureau of Labor Statistics (BLS) Annual Report, which are derived from OSHA Log data. A priori classification of job types, based on description of job characteristics (repetitiveness, apparent strength requirement, working postures), categorized jobs as high, intermediate, and low risk of incurring a repetitive trauma injury due to job performance. Using OSHA Log data, it was determined that personnel in high risk jobs (boning, bird hanging, evisceration, unspecified production, raw manufacturing) were more likely than employees in low risk jobs to be diagnosed with CTS (RR=4.53, p=.01) and to incur an OSHA-recordable non-CTS musculoskeletal injury (RR=2.33, p<.001). Similarly, medical dispensary log data showed that high risk personnel were more likely than low risk personnel to report wrist injuries (RR=3.89, p<.001) and to report non-wrist musculoskeletal injuries (RR=3.22, p<.001). Based on BLS injury rates for poultry processing plants, 12.1 injuries were expected to occur among all 792 Longmont employees during January 1987. There were 160 injuries identified in the medical dispensary logs, and only 6 injuries recorded in the OSHA Logs for that period. All Longmont employees have experienced an estimated 15.2 musculoskeletal injuries per 200,000 person-hours worked since January 1985.

Ergonomic evaluation of this facility by analysis of videotaped work processes was performed. A total of 14 production jobs in the Eviscerating Department and 22 in the boning and "specials" lines were videotaped and analyzed for biomechanical risks for work-related musculoskeletal disorders. In general, persons working in jobs in the Boning Department experienced more biomechanical stressors than those in Eviscerating. Analysis showed that one primary risk factor of boning jobs was the number of cuts per day, ranging from 11,520 to 28,800, and the application of high muscular forces with the arm and wrist in non-neutral postures. In the Eviscerating Department, movements ranged from 5760 to 19,200 per day. Only three of these jobs were rated as requiring high muscular force, but many non-neutral postures were required in these jobs. Injury rates in all departments are provided in Tables 1-3.

On the basis of a review of OSHA 200 Log data, there are identifiable groups of personnel at greater risk than others for development of carpal tunnel syndrome and/or incurring other musculoskeletal injury. In addition, a comparison of these findings with medical records data available at Longmont indicates considerable underreporting of injuries in the OSHA Logs. Ergonomic data analysis suggests that many of the employees in high risk jobs are exposed to significant biomechanical hazard in performance of normal activities. Recommendations to control biomechanical hazards are included in Section VIII of this report.

Keywords: SIC 2017, carpal tunnel syndrome, musculoskeletal injury, repetitive trauma, ergonomics, OSHA Logs

II. INTRODUCTION

On August 27, 1986, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation at Longmont Turkey Processors, Inc., Longmont, Colorado. The request, initiated by the United Food and Commercial Workers Union Local 7, sought evaluation of cases of carpal tunnel syndrome and other musculoskeletal disorders that were thought to be associated with job demands.

On February 26 and 27, 1987, NIOSH personnel conducted an investigation at this facility. To accommodate all parties involved (NIOSH, company management, union representatives), the site visit was deferred until this time. The evaluation included a review of available OSHA Logs and company medical records, and videotaping of 36 jobs in the eviscerating and boning lines for subsequent analysis.

III. BACKGROUND

A. Workforce

Longmont Turkey Processors, Inc., which produces meat products for commercial use in the western and southwestern United States, has been in operation since 1951. At the time of our evaluation, 792 persons were employed at the plant.

B. Process Description

The plant primarily processes live turkeys but also uses some partially processed chilled/frozen birds. The live birds are hooked onto a transfer system that transports them through all processes at rates between 12 and 20 birds/minute, at an average working height of 50 inches. Processing of the live birds includes exsanguination, hot water bath defeathering, removal of internal organs by hand and with an assortment of cutting and suctioning tools, manual cleaning of gizzards, removal of the majority of meat by a host of knife-based deboning operations, and diversion of near bare carcasses for mechanical extraction of meat remnants for frankfurter production. Chilled/frozen birds are delivered pre-eviscerated and enter the processing line at the deboning stage.

IV. EVALUATION DESIGN AND METHODS

A. Medical

In order to estimate the rate of injury at Longmont Turkey Processors, it was necessary to obtain estimates of both the number of injuries and the person-time experienced by workers at the plant. The number of injuries was derived from OSHA 200 Logs for the time period from January 1985 through February 1987. We attempted to assess the validity of these OSHA Logs by comparing them to dispensary medical visit logs for January 1987.

OSHA 200 Logs provide a record of "OSHA-recordable occupational injuries," which include deaths and injuries that involve one or more of the following: loss of consciousness, restriction of work or motion, transfer to another job, or medical treatment other than first aid. OSHA Log entries of carpal tunnel syndrome (CTS) and possible CTS were all considered cases of "probable CTS" (pCTS). All sprains, strains (acute), lacerations, fractures, and contusions of the upper extremities recorded in the OSHA Logs were categorized by us as upper extremity musculoskeletal (uem) injuries. All non-head, non-upper extremity injuries of the same type that were recorded in the OSHA Logs were categorized by us as non-upper extremity musculoskeletal (nuem) injuries.

To determine an estimate of the denominator of the injury rates, i.e., the person-time experienced in the plant, it was assumed that, for each of the years 1985 and 1986, the number of persons employed and personnel distribution by department remained unchanged. Plant personnel reported that there had

been no significant process or workforce changes since January 1985. The time period of January 1, 1985, to March 1, 1987, represents 2.17 years of work exposure per worker.

The May 1987 Bureau of Labor Statistics (BLS) Annual Report of occupational injury and illness data presents injury rates for poultry and egg processors (SIC 2017) in terms of injuries per 200,000 person-hours worked (phw). (Occupational injury rates are usually provided as the number of injuries per 200,000 person-hours, which is the number of hours worked in one year by a moderate-sized work force (100 workers) in a 40-hour week, with a 50-week year). These figures were used for comparison and as a means to calculate the expected injury rate for this cohort of workers.

For separate analysis, dispensary medical logs were reviewed for January 1987. Anecdotal information provided by union representatives suggested that it is common practice among the poultry processors to request supportive wrist splints/wraps for [precipitated] wrist discomfort. Therefore, new log entries of "preventative" wraps were recorded as a wrist injury. Injuries cited in the medical logs as "hand" injuries were not recorded as wrist injuries. All other incidents recorded as work-related musculoskeletal strain or trauma injuries were tallied in accordance with the previously described injury definitions.
Medical files were reviewed, as a third source of information, to further assess injury recording status at this plant. Twenty randomly chosen medical files of workers from Department 1311 (Boning) were reviewed for occurrence of reports of musculoskeletal injury.

Longmont management has defined a number of departments as "production" departments; the others are "non-production" departments. Production departments are as follows: 1211 (bird hanging), 1231 (evisceration), 1311 (boning), 1312 (unspecified), 2111 (raw manufacturing). The production areas were considered to be the areas most likely to place workers at risk for musculoskeletal injuries due to the highly repetitive nature of the work and the upper extremity force and/or postures required to complete job tasks. This judgment was made without regard to the rates of injury in the various departments. Six non-production departments were considered as "intermediate risk" areas for musculoskeletal injuries because usual job tasks required substantial physical exertion, in terms of force and postures used, though these movements may not have been repetitive. These departments include 1111 (live kill), 2131 (packaging), 2141 (box making), 3112 (sanitation), 3132 (maintenance), and 3151 (truck mechanics). Some injuries documented for workers from 2131 may actually represent an etiology from a production work area, since management reported that production personnel with musculoskeletal injury symptoms are frequently transferred to Department 2131. The remainder of the departments were classified as "low-risk" positions. These jobs include office, shipping, and other jobs that are primarily non-production. See Table 1 for a complete list of jobs by risk group. The rate of injury in production personnel was compared to that of employees in the low-risk areas by comparing respective numbers of injuries/person-years at risk in these groups of personnel.

B. Ergonomic

Videotaping and job performance analysis were completed on all personnel in the Boning and Eviscerating Departments. The individual job analysis protocol consisted of counting the number of birds processed per minute, compiling the number of cuts (boning) or number of motions (eviscerating) made per job, counting the occurrence of postures which deviated from neutral, and evaluating workplace attributes such as working height and reach distances. The deviated wrist postures which were noted are: flexion (flx.), extension (ext.), ulnar deviation (dev.), radial deviation, and open-handed pinching. These are shown in Figure 1. Other postures counted involved the arm and shoulder. Pronation (pron.) and supination describe movement of the forearm. Pronation is clockwise rotation of the forearm toward the body (medial rotation). Supination is counterclockwise rotation of the forearm away from the body (lateral rotation). Movement from full supination to full pronation or vice versa requires a 180 degree rotation of the forearm and wrist. Supinating or pronating from the neutral position involves a 90 degree rotation. Shoulder flexion is raising the upper arm in front of the body. Shoulder extension occurs when the arm is moved behind the body. Finally, shoulder abduction (abd.) occurs when the upper arm is moved laterally away from the body as in when a "chicken wing" posture is

assumed.

Muscle force exerted, an important factor in the analysis of biomechanical load on the worker, was evaluated subjectively. If it was obvious that a worker struggled to perform a certain activity, or that several attempts were needed to complete a job component, the job was determined to require high force. Examples of this type of effort were the Peeler/Defatter job and the skinning jobs. If the worker had to make a long cut which required stopping to regrip or reorient the knife blade, the task was similarly rated as high force; Breast Opener is an example of this type of high force job. Other factors noted during the job analysis that influenced the estimation of force exerted were the position of the hands and arms. When the hands can be held close to the body, leverage is highest, and the greatest amount of force can be exerted with the least amount of muscular effort. When the wrist is in a deviated posture such as wrist flexion, wrist extension, or ulnar deviation, more force is required to cut or perform a movement than if the wrist were neutral; examples of jobs with these postural requirements are Breast Opener, Cut Breast Down the Keel Bone, and Remove Breast Fillet. Abduction of the shoulder is also a posture which reduces the body's leverage, resulting in relatively high force exertions; examples of these jobs are Drum Deboner, Remove Thigh Bone, and Breast Opener. All of the job analysis data were collected based on a review of the videotapes played in real time and at slow speeds.

V. EVALUATION CRITERIA

A. Medical

Cumulative trauma disorders (CTDs) of the musculoskeletal system often occur in workers with jobs that require repetitive upper extremity exertion. These disorders can present themselves as bursitis, ganglionic cysts, musculoskeletal strain, synovitis, tendinitis, tenosynovitis, and/or numerous other specifically described musculoskeletal syndromes. 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.[1-14] The postures most 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. CTDs are considered in many cases to be work-related because these types of postures and movements are required in many manufacturing and assembly jobs in industry. Occupations for which a high incidence of CTDs is known to exist include electronic components assembly, textile manufacture, small appliance manufacturing and assembling, meat processing and packing, fish filleting, and buffing and filing. The incidence of CTDs among these and other industries has not yet been established, but incidences as high as 44 cases per 100 workers per year have been reported.[15] Non-occupational risk factors for CTDs 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 manual work.

Carpal tunnel syndrome was recognized as a clinical entity as early as 1895. However, not until 1947 was this median nerve problem fully described and recognized as a syndrome in medical literature. The presently accepted clinical presentation of the syndrome includes: pain and paresthesias in the hand along the distribution of the affected median nerve, precipitation of similar symptoms at night while recumbent, possible radiation of pain to other portions of the involved extremity, and occurrence of these symptoms secondary to compression of the median nerve within the flexor retinaculum at the wrist.[16-20] Carpal tunnel syndrome may be associated with non-occupational factors such as acute trauma, diabetes mellitus, hormonal factors (use of oral contraceptives, pregnancy, gynecological surgery), rheumatoid arthritis, acromegaly, wrist shape/size, congenital (at birth) defects, and gout.[21] Since a number of these conditions are unique to women, their risk of carpal tunnel syndrome may be elevated. While women have been reported to be at high risk for CTS due to occupational factors, very few studies have compared the rate of CTS in men and women performing identical jobs. Silverstein, et al. found that women and men were at essentially the same risk if performing identical job activities.[22,23]

B. Ergonomic

The first step in conducting an ergonomic evaluation of high risk jobs is to identify and document the nature and frequency of both awkward and static postures. Videotapes and 35 mm still pictures are often taken to aid in this job analysis. If the preliminary analysis suggests that the work requires excessive muscular force, the investigators may need to measure muscle tension to determine aspects of the work task that contribute to excessive force. Muscle tension is measured using surface electromyography (EMG).[1] One study found that workers performing jobs with force levels of 4 kilograms or more were four times as likely to develop a hand/wrist CTD than those workers whose jobs required muscular exertions of 1 kilogram or less.[24] In the absence of techniques like EMG, force can be estimated by weighing tools used and objects handled, or through the use of psychometric techniques for judging the amount of effort required to perform a certain activity.

Both the length of job cycles and frequency of movements present additional risk for CTDs. Job tasks with cycle times lasting 30 seconds or less were found to have an incidence of upper extremity CTDs three times greater than those jobs where the cycle time was greater than 30 seconds.[24] 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.[25-31] The work activities varied and included the following: cutting poultry, keystroking, hand sanding/filing, and packing tea, etc.

Because of the complexity of repetitive motion patterns, it has been difficult to define a critical frequency factor for defining a CTD risk. Therefore, 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. Reduction in risk for precipitation of CTDs and other musculoskeletal injuries is most effectively achieved through the redesign of work stations, tools, and/or reassessment of work methods that are identified through job.

VI. RESULTS

A. Medical

Two hundred sixty-one musculoskeletal injuries were recorded in OSHA Logs from January 1985 through February 1987, accounting for 77 percent of all recorded injuries and illnesses. Of these injuries, there were 150 non-CTS upper extremity musculoskeletal (uem) injuries (57 percent), 89 non-head, non-upper extremity musculoskeletal (nuem) injuries (34 percent), and 22 reported cases of probable CTS (pCTS) (9 percent).

Persons with pCTS were found to be distributed in seven of the 42 departments listed in available employee roster data. All 261 injuries occurred in persons employed in only 23 of the 42 departments. However, all persons employed within these same 23 departments represented 86 percent of the total work force. Two persons noted in the OSHA Logs were identified as employed in Department 7152 (local drivers); however, this department did not exist at the time of our evaluation.

Using OSHA Log data, the rate of injury in production personnel was compared to that of employees in the low risk areas. High risk personnel (production employees) were 2.3 times as likely to incur an OSHA recordable non-pCTS injury as low risk area personnel (RR=2.33, $p<.001$) (Figure 2). Additionally, 59 percent of the pCTS cases (13 of 22) occurred in employees from high risk departments; these employees were 4.5 times as likely as low risk personnel to have had a reportable case of pCTS (RR=4.53, $p=0.01$) (Figure 3).

To determine whether or not the injury rates for this group are excessive, we compared Longmont employee OSHA Log injury rates to those in similar and dissimilar industries, as reported in the Bureau of Labor Statistics Annual Report. The duration of work exposure for all Longmont employees is approximately

1716 person-years (792 x 2.17), or 3,432,000 person-hours, assuming there to be 2000 hours/person/year. As such, all Longmont employees have experienced an estimated rate of 15.2 musculoskeletal injuries per 200,000 person-hours worked (phw) and 19.8 incidents/200,000 phw of all types of injuries and recordable illnesses.

The May 1987 BLS Annual Report of data collected in 1985 reported poultry and egg processors (SIC 2017) as experiencing an overall injury incidence rate of 18.3 musculoskeletal injuries/200,000 phw.[32] Poultry processing is a segment of the "food and kindred products" industry. This industry ranks first among all BLS recorded industries for occupational injury incidence rates at the two digit Standard Industrial Classification (SIC) code level. The estimated injury rate of Longmont employees of 15.2 injuries/200,000 phw (95% CI=7.6 to 22.8) is not statistically different from the rate reported by the BLS for all poultry and egg processors (SIC 2017), 18.3/200,000 phw. However, the injury rate at Longmont Foods is 2.2 times as great as the median rate for all industries and 9.8 times as great as the median rate for the ten industries with the lowest rates. Job processes associated with these "lowest rate" industries have not been carefully characterized; however, it would appear from the types of jobs included that they would involve little significant muscular exertion.

In order to determine which departments, if any, might be experiencing elevated injury rates, departmental rates for all OSHA Log recorded injuries were calculated. Departmental rates ranged from 0 to 33 injuries/200,000 phw. The highest rates occurred in maintenance (33.0), boning (32.4), sanitation (25.0), and raw manufacturing (23.0) (Table 1). In addition, the rates of OSHA Log recorded pCTS were calculated by department, and are presented in Table 2. Although it is apparent that the majority of the pCTS injuries were distributed among three departments (boning, raw manufacturing, packaging), no statistically significant difference in rates among departments is seen, in part because of the relatively small number of recorded events. Review of dispensary medical logs revealed that employees had sought treatment for 173 musculoskeletal conditions during January 1987. Thirteen of these incidents were not included in the analysis because the March 1987 employee roster from which we worked did not include the affected employees' names; therefore, employment and department of work could not be validated. (Seven of those 13 incidents were wrist injuries, five were other upper extremity musculoskeletal injuries, and there was one non-upper extremity injury.) The remaining 160 musculoskeletal injuries occurred in 109 different persons (14 percent of all employees). These injuries consisted of 53 total wrist problems (4 explicitly symptomatic persons plus 49 receiving "preventive" wrist wrapping support), 80 (50 percent) non-wrist upper extremity injuries, and 27 (17 percent) non-upper extremity injuries. Thirty-five of 53 (66 percent) of the dispensary-logged wrist injuries occurred in personnel from Departments 1311, 2111, and 2131 (Table 3). High risk area personnel were three times more likely to report to the dispensary with non-wrist injuries than their low risk area peers (RR=3.22, $p<0.001$). High risk area employees were four times more likely to solicit medical department attention for a wrist injury or wrist supportive measures than both the intermediate and low risk groups combined (RR=3.89, $p<0.001$). The relative risk is undefined in the high versus low risk group comparison because no injuries were reported by low risk group personnel.

Six musculoskeletal trauma injuries of all types were reported in the OSHA Logs for January 1987. Based on BLS injury rates in poultry processing plants, 12.1 injuries of all types would have been expected to be reported in the OSHA Logs for January 1987. The combined 160 musculoskeletal injuries and probable injuries seen in the dispensary during January represent an incidence of musculoskeletal problems at a rate of 13 times expected, were all injuries recordable by OSHA definition. (OSHA requires that any injury that involves "loss of consciousness, restriction of work or motion, transfer to another job, or medical treatment [other than first aid]" be recorded.) Not all of the dispensary recorded incidents were considered OSHA-recordable events; some received "first aid" treatment only. In fact, 49 of the 53 medical log entries tallied as wrist injuries were for "preventive" wrist support, and 31 injuries were managed by wound cleaning and dressing only, reportedly "minor" trauma. The remaining 80 injuries, not specifically referred to as preventive, or "minor," or not appearing to have received only first aid treatment by description of the medical staff, represent an injury rate of 6.6 times the expected rate of 12.1 injuries for the month of January. To assess further the consistency of medical recordkeeping we reviewed a number of personnel medical files. Twenty

randomly chosen medical files of workers from Department 1311 (boning) were reviewed. These 20 persons had jointly experienced 41.2 person-years in the workplace since January 1985. A review of their records resulted in finding 6 occurrences of a "reportable injury" (4 outcomes of "lifting restrictions," 1 change to light duty, 1 fracture resulting in an assessed 15 percent disability status). These injuries represent a recordable injury rate of 14.5 injuries/200,000 phw in the cohort of the 20 persons represented by these files. However, none of these incidents was found to be documented in the OSHA Log. Some type of musculoskeletal injury was documented in 17 of the 20 files. In four of the 17 files we found record of signs noted on physical evaluation and/or historical symptoms consistent with CTS, but the diagnoses recorded were left hand dysesthesia, chronic tenosynovitis, overuse syndrome, and in one case there was no recorded diagnosis. A variety of strain and/or traumatic injuries were recorded for the other 13 persons.

B. Ergonomic

The data comprising the various analysis parameters of each job are summarized in Table 4. A total of 14 production jobs in the Eviscerating Department and 22 in the boning and "specials" line were analyzed. Inspection jobs were not analyzed because they lacked sufficient motion content.

In general, the total number of cuts or movements made per job are based on processing of approximately 20 birds per minute in the Eviscerating Department, and 12 birds per minute in the Boning Department, 8 hours per day. Cycle time, however, was calculated by dividing the actual number of birds processed by the amount of time elapsed on the video tape collected. This resulted in some jobs in the Boning Department appearing to be moving at greater than 12 birds per minute. These are Remove First Joint Wing, Remove Wing Bone, Separate Drum and Thigh from Carcass, and Drum Deboner. Workers on these jobs performed the required cuts ahead of pace in order to make time to "steel" their knives (recondition the edge), which on average appeared to be done as often as every third or fourth bird. This added motion pattern, accounting for about 3800 forceful movements per shift, should be added to the total number of cuts per day to accurately estimate the postural demand of the job.

The most demanding of the jobs analyzed were the ones comprised of many cuts/movements per day, high force demands, or both. Some of these in the eviscerating area are: Neck Skin Slitter, Three Pointer, J-Cutter, Remove Heart, and Peelers/Defatters. Lung Gun Operator required the most number of movements per shift in the department (28,800), but these were mostly "in-and-out" type movements made with a suspended vacuum tool while the wrist was in a neutral position. For this reason, the job was not considered to be as stressful as some of the others. The Crop Puller task, by contrast, seemed to require high force with the wrist flexed, but the relatively low repetition rate (5760 per shift) served to lessen the job's overall biomechanical demand.

In general, the jobs in the Boning Department were more demanding than those in the eviscerating area. Some of the jobs which appeared to have considerable biomechanical stress content were: Remove First Joint Wing, Drum Deboner, Skinner, Remove Thigh Bone, Breast Opener, Cut Breast Down the Keel Bone, and Remove Breast Fillet. So difficult were these jobs, that the only ones which could even be described as "moderate" were: Remove Wing Bone, Breast Trimmer, Oyster Removal, and Carcass Remover. White Meat Trimmer and Dark Meat Trimmer seemed to require low force levels. However, because of the many cuts (28,800), the use of a vibrating tool (Whizard knife), and the complex patterns of motion required (many circular cuts), these jobs were also judged to be very stressful.

VI. DISCUSSION

The repetitive nature of some jobs performed by Longmont personnel and the environment (some frozen meats, sharp knives, protrusive edges on metal surfaces, wet floors) in which they work, places them at high risk for traumatic injury, musculoskeletal strain, and cumulative trauma disorders. Examination of a random sample of medical records of Boning Department employees and analysis of the dispensary medical visit logs indicate that the OSHA Log data underestimate the employee morbidity caused by acute musculoskeletal injury and cumulative trauma disorders.

OSHA Log information is likely to underreport acute and chronic musculoskeletal injury due to differences in individual interpretation of the meaning of a "recordable event" and due to the reluctance of some diagnosticians to label injuries as "work-related." Discher et al., at the University of Washington, reported such a lack of completeness of OSHA Log data when they reviewed illness/injury histories of a cohort of 2040 workers via direct medical survey, OSHA Log recording of the events, and Worker's Compensation recording of the events.[33] Fine et. al. found that the incidence of recorded musculoskeletal injury was from 4 to 93 times as great when comparing company medical log data to OSHA Log recorded events in a cohort of automobile manufacturing workers.[34]

At Longmont, the plant physician maintains part-time hours, and an evaluation of the employee by a plant nurse determines whether or not the employee will receive further evaluation by the physician. Conversation with dispensary nursing personnel did not provide evidence of existence of a specific triage algorithm by which physician evaluations are scheduled. An additional problem is the use of varying diagnostic terminology to describe cases that present in the same or very similar clinical manner. Inconsistency in use of diagnostic terminology diminishes the confidence with which a document such as the OSHA Log can be reviewed in the absence of corroborating medical file data to ensure appropriate disease classification. Given the high rate of injury in this industry, additional physician evaluation and surveillance of Longmont personnel, with particular attention paid to consistency of classification of disease is warranted. The present rate of OSHA Log documentation of injuries at Longmont Foods, in particular, may significantly underestimate the true number of occurrences of musculoskeletal injury.

OSHA conducted an inspection of this facility prior to our evaluation. As part of the inspection, an audit of the companies OSHA 200 Log (Record of Occupational Injuries and Illness) recordkeeping was conducted. When these records were compared to state compensation claim records, OSHA found that the company had considerably underreported the number of injuries in the OSHA Logs. OSHA subsequently issued citations to the company for their failure to accurately document lost-time injuries among their employees.

Meat and Poultry cutting and packing have long been recognized as jobs that impose biomechanical stress to the upper extremity. In spite of this, relatively few studies have been conducted in this industry to identify hazards and formulate recommendations for control of upper extremity disorders. One such study, however, was performed by Armstrong, et al. in a turkey processing plant in the southeastern United States.[1] The departments in this plant that experienced the highest number of musculoskeletal disorders were Trimming, Boning, and Thigh Skinning, similar to the pattern at Longmont. As an example of a very difficult job, the paper presents an in-depth analysis of the thigh boning operation. At 3780 turkeys per shift (7.9 per minute for 8 hours), and 4 cuts per turkey, the total number of cuts per day was estimated to be 15,120. The same operation at Longmont, performed in a similar manner, requires that 23,040 cuts be made per day, 52 percent more than reported in Armstrong's study. This comparison suggests strongly that pace is a major contributor to the CTD incidence at Longmont and that this rate of work is greater than at other companies producing a similar product.

The Bologna Packing job in Department 2131, which was looked at because of a reported history of frequent wrist injuries (Tables 1-3), was judged to involve tasks that were highly repetitive, though requiring little force. The job did require a considerable number of movements per day (17,280), but these were coupled with probable low muscular force and absence of awkward postures. The apparent high frequency of musculoskeletal complaints in personnel in this department may reflect results of injuries sustained in other jobs/departments, or the highly repetitive nature of their jobs.

During the initial tour of the plant, it appeared as though there was a problem of "line balance" in the plant. Some jobs were not equal in work content to those preceding or following, making it difficult for some workers to keep up with the line speed. An instance where this was judged to be a particular problem was in the Boning Department between the Remove First Joint Wing operation, and the Remove Wing Bone job. The former job required handling of every other bird, the latter, every bird. In spite of the reduced load, Remove First Joint personnel bear a significantly greater biomechanical burden on a total number of cuts per day basis, 23,040 cuts for the Remove Joint operation versus 11,520 cuts for the Remove Bone task. Balancing the number of cuts made for these two jobs would possibly make it easier for the worker performing the first operation.

Unless the plant is totally automated, there is no way to eliminate manual activity in the processing of turkeys. To a

certain extent, complex patterns of motion and considerable levels of muscular force are dictated by the raw product and the tools used. Specialized knives for certain jobs, a comprehensive program of knife sharpening, work place redesign, and various administrative practices such as training, rotation, and medical monitoring should reduce the incidence of CTDs for these types of hand intensive tasks. Over the past 4 years, the company has attempted to improve medical surveillance, instituted more job rotation, doubled the number of times knives are sharpened, and added relief workers to the Boning Department.

VII. CONCLUSIONS

A. Employees in high risk departments within Longmont are 2.3 times as likely to incur an OSHA-recordable injury as low risk personnel (based upon existing OSHA Logs).

B. Employees in high risk departments are 4.5 times as likely as those in low risk departments to have a reportable case of possible carpal tunnel syndrome (based upon existing OSHA Logs).

C. The incidence rate for musculoskeletal injuries reported on the OSHA 200 Log for Longmont employees is similar to the rate reported for other American poultry processing plants (based on comparison with BLS rates).

D. Comparison of data from medical dispensary visit logs and OSHA 200 Logs for the same time period indicates that the OSHA Log data considerably underestimate the employee morbidity caused by acute musculoskeletal injury and cumulative trauma disorders.

E. Comparison of data from medical files and OSHA 200 Logs indicates that not all reportable incidents identifiable by this source have been documented in OSHA 200 Logs.

F. In general, the jobs in the Boning Department are more physically demanding (requiring more forceful movements of the upper extremities) than those in Eviscerating. Analysis showed that the chief biomechanical demands of boning jobs were the number of cuts, ranging from 11,520 to 28,800 per day, and application of high muscular forces with the arm and wrist in deviated (non-neutral) postures.

VIII. RECOMMENDATIONS

A. Adequate training and promotion of safe work practices should be universal; there was anecdotal reporting of inadequate training at boning positions.

B. On jobs where there is wrist flexion and ulnar deviation (see Table 4), substitute ergonomically designed knives for the straight handled Dexter Russell knife that is used for every cutting job. An example is the pistol handled knife recommended in Armstrong's study of turkey processors.[1] These knives have been shown to reduce muscle force and deviated wrist postures while making complicated cuts, such as those observed at Longmont. There are several operations such as Drop Thigh, Knuckle Cut, Tab Cut, and Breast Opener, where the workers held their knives in a stab posture (Table 4). At least one company is developing a special knife for use with a stab grip. For operations using scissors, ergonomically designed scissors should be considered.

C. Institute a comprehensive program of knife and scissors sharpening.

D. Provide adjustable foot stands for workers making cuts/movements at levels of shoulder height and above. This recommendation can be considered for any job where "shoulder flexion" was listed as a major posture (Table 4), but is especially appropriate for the Carcass Breaker and Three Pointer jobs.

E. Continue to study ways to balance the work load among employees in the Eviscerating and Boning Departments, and improve the general work load distribution throughout the plant.

F. Decrease line speeds at least in departments with recorded injury rates that exceed the median injury rate of all industries reported in the May, 1987 BLS Annual Report (Departments 1311, 2111, 2131, 1211). Line speeds should be lowered as much as is practically feasible.

G. Develop a surveillance program that will identify workers with early signs of carpal tunnel syndrome and other musculoskeletal disorders of the upper extremities so that appropriate medical treatment including work restrictions, job rotation, physical therapy and rest can be provided.

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XI. Distribution and Availability of Report

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 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. Longmont Turkey Processors Inc., Longmont, Colorado
2. United Food and Commercial Workers Union, Local 7
3. International Union of Operating Engineers, Local 1
4. NIOSH Denver Region
5. OSHA Region XIII

For the purpose of informing affected employees, 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 1

OSHA Log-Recorded Musculoskeletal Injuries

Longmont Turkey Processors
Longmont, Colorado
HETA 86-505

January 1985 - February 1987

Department	#Cases	Incidence Rate*
High Risk:	117	(16.2)
1311-boning	68	(32.4)
2111-raw manufacturing	36	(23.0)
1211-bird hang	2	(18.2)
1231-evisceration	10	(8.7)
1312-unspecified production	1	(4.5)
Intermediate Risk:	106	(21.7)
3132-maintenance	30	(33.0)
3112-sanitation	19	(25.0)
2131-packaging	49	(20.9)
3151-truck mechanic	4	(16.7)
2141-box making	3	(8.6)
1111-live kill	1	(3.6)
Low Risk:	35	(6.9)
3142-receiving	2	(22.2)
2911-byproducts	6	(21.4)
2121-oven operator	5	(20.8)
3125-shipping	12	(19.7)
4112-admin. support	1	(16.7)
3121-quality control	3	(11.5)
4131-data processing	1	(7.7)
2171-packaging	2	(4.9)
4111-administration	1	(4.5)
3133-compressor operator	1	(4.5)
3114-security	1	(3.9)
All Other	0	(0.0)

* estimate of cases/200,000 person-hours worked.
0.0 represents values less than 0.05

Table 2

OSHA Log-Recorded Probable CTS Cases

Longmont Turkey Processors
Longmont, Colorado
HETA 86-505

January 1985 - February 1987

Department	#Cases	Incidence Rate*
High Risk:	13	(1.8)
2111-raw manufacturing	4	(2.6)
1311-boning	8	(1.9)
1231-evisceration	1	(0.9)
Intermediate Risk:	7	(1.4)
2131-packaging	6	(2.6)
3112-sanitation	1	(1.3)
Low Risk:	2	(0.4)
4112-admin. support	1	(16.7)
2121-oven operator	1	(4.2)
All Other	0	(0.0)

* estimate of cases/200,000 person-hours worked.
0.0 represents positive numbers with value less than 0.05

Table 3

Dispensary Log Wrist Injuries

Longmont Turkey Processors
Longmont, Colorado
HETA 86-505

January 1987

Department	#Cases	Incidence Rate*
High Risk:	33	(123.5)
1311-boning	23	(148.2)
2111-raw manufacturing	4	(69.4)
1231-evisceration	4	(94.3)
1211-bird hang	1	(250.0)
1312-unspecified production	1	(125.0)
Intermediate Risk:	11	(61.1)
2131-packaging	8	(92.6)
2141-box making	2	(156.3)
3112-sanitation	1	(35.7)
Low Risk:	2	(10.7)
3121-quality control	1	(104.1)
2171-packaging	1	(65.8)
All Others	0	(0.0)

* estimate of cases/200,000 person-hours worked.
0.0 represents positive numbers with value less than 0.05

Table 4

Job Analysis results for the Eviscerating and Boning Departments

Longmont Turkey Processors
Longmont, Colorado
HETA 86-505

March 1987

EVISCERATING DEPARTMENT

JOB NAME	CYCLE TIME	BIRDS/ MIN	CUTS/ DAY	MAJOR POSTURES	COMMENTS
Remove Oil Gland	3 sec.	20	9600	Wrist Pronation	Uses Whizard knife
Neck Skin Slitter	4 sec.	10	19200	Wrist Pron. Shoulder Abd.	Bird too high for 3rd cut
Three* Pointer	2.5 sec.	20	7200	Ulnar dev Supination	Rotates every hour High force, lifts to shoulder ht.
Vent gun operator*	5 sec.	10	4800	R-Ulnar dev. L-Supination	Worker stands on grate, suspended tool
J-Cutter	3 sec.	20	9600	Pronation from initial supin-ated posture	Scissors, circular cuts, difficult job, moderate force
Drawer*	8 sec.	7.5	3600	Wrist flexion	Some reaching,less demanding than jobs preceding it
Remove Heart	3 sec.	20	19200	Pronation, pri-marily neutral	Scissors, movements vary depending on location of viscera
Remove Liver	4 sec.	10	9600	Neutral, some shoulder abd.	Scissors
Gizzard Split	12 sec.	5	7200	R-ulnar dev. L-Wrist Flx.	Scissors, stand on grate
Peelers/* 4efatters	10 sec.	6	8640	Extension, Flx. Left & Right	High Force, some done by hand

Table 4 (cont.)

Job Analysis results for the Eviscerating and Boning Departments

Longmont Turkey Processors
Longmont, Colorado
HETA 86-505

March 1987

JOB NAME	CYCLE TIME	BIRDS/ MIN	CUTS/ BIRD	MAJOR POSTURES	COMMENTS
Lung Gun Operator*	10 sec.	6	28800	Pistol Grip	Stand on grate, tool not suspended
Crop Puller*	10 sec.	6	5760	Wrist Flx.	High force, pull with both hands
Neck Trimmer	3 sec.	20	14400	Ulnar Dev. Demand	Light Force

BONING DEPARTMENT

JOB NAME	CYCLE TIME	BIRDS/ MIN	CUTS/ DAY	MAJOR POSTURES	COMMENTS
Remove First Jt. Wing	8 sec.	6	23040	Ulnar dev., Supination, Shoulder Abd.	Circular cut, steel knife every 3rd bird, very difficult job
Remove Wing Bone	4 sec.	12	11520	Ulnar dev. Wrist Flx.	Easier than job preceding it
Separate Drum and Thigh from Carcass	8 sec.	6	14400	Wrist Ext. Radial Dev.	Knife gripped in stab posture, left hand pulls thigh back
Drum Deboner	8 sec.	6	17280	Ulnar dev. Wrist flx. Shoulder Abd. Supination	high force, very difficult job
Skinner	9.5 sec.	6	23040	Wrist flx. Ulnar dev. Supination	Cuts with knife, pull skin off by hand, very high force demand

Table 4 (cont.)

Job Analysis results for the Eviscerating and Boning Departments

Longmont Turkey Processors
Longmont, Colorado
HETA 86-505

March 1987

JOB NAME	CYCLE TIME	BIRDS/ MIN	CUTS/ DAY	MAJOR POSTURES	COMMENTS
Neck Trimmer	4.8 sec.	12	17280	Wrist flx. Pronation	Score cut made at shoulder height
Thigh Trimmer	5 sec.	12	17280	Pronation from neutral Shoulder Abd. L & R	Pulls thigh with left hand, less force than skinners
Remove Thigh Bone	5 sec.	12	23040	Pronation from neutral, Shoulder Abd.	High force demand
Drop thigh Knuckle Cut Tab cut	5 sec.	12	17280	Shoulder Abd. Pronation from neutral, ulnar dev. Wrist Ext.	One worker holds knife in stab pos., other in power grip
Removal of Wing Meat and Scapula	5 sec.	12	17280	Wrist Flx., supination from neutral	Pulls scapula off w/left hand
Breast Opener	10 sec.	6	11520	Wrist Ext. Shoulder Flx. Ulnar dev. Shoulder Abd. Wrist Flx.	Holds knife in stab posture, Hook in left hand, high force demand
Grading & Skin Pull	10 sec.	6	11520	Wrist Flx. Wrist Ext.	Moderate force, pace, Pulls skin off w/both hands
Breast Trimmer	5 sec.	12	11520	Ulnar Dev. Wrist Flx.	Moderate force demand
Cut Breast Down the Keel Bone	5 sec.	12	17280	Wrist Ext. Ulnar Dev. Shoulder Abd. Shoulder Flx.	Stab grip, high force demand

Table 4 (cont.)

Job Analysis results for the Eviscerating and Boning Departments

Longmont Turkey Processors
Longmont, Colorado
HETA 86-505

March 1987

JOB NAME	CYCLE TIME	BIRDS/ MIN	CUTS/ DAY	MAJOR POSTURES	COMMENTS
Remove Breast* Fillet	5 sec.	12	11520	Wrist Ext. Wrist Flx.	Breasts hang by skin, high force demand
Breast trim & drop Breast	5 sec.	12	17280	Shoulder Abd. Supination Wrist Ext.,Flx.	Some skinning and trimming of fat as extra operations
White Meat Trimmer	5 sec.	12	28800	Wrist Flx. Supination Ulnar dev.	Whizard knife, moderate force
Dark Meat Trimmer	5 sec.	12	28800	Pronation from Supine, Wrist Flexion	Whizard knife, big circular cut
Carcass Breaker	5 sec.	12	17280	Wrist Flx. Ulnar Dev.	Cuts made at shoulder level, pulls breast w/left hand
Oyster Removal	5 sec.	12	11520	Wrist Flx. Supination from neutral	Whizard knife, low force demand
Carcass Remover*	5 sec.	12	5760	Neutral Wrist shoulder Flx.	Moderate force
Specials Line	20 sec.	3	12600	Neutral Wrist	Remove fat w/Whizard knife
Bologna* Packing	5 sec./ stack	12	17280	Radial Dev.	Low force, hands close to body

* Cuts/day are actually movements per day for these jobs

Figure 1

Longmont Turkey Processors
Longmont, Colorado
HETA 86-505

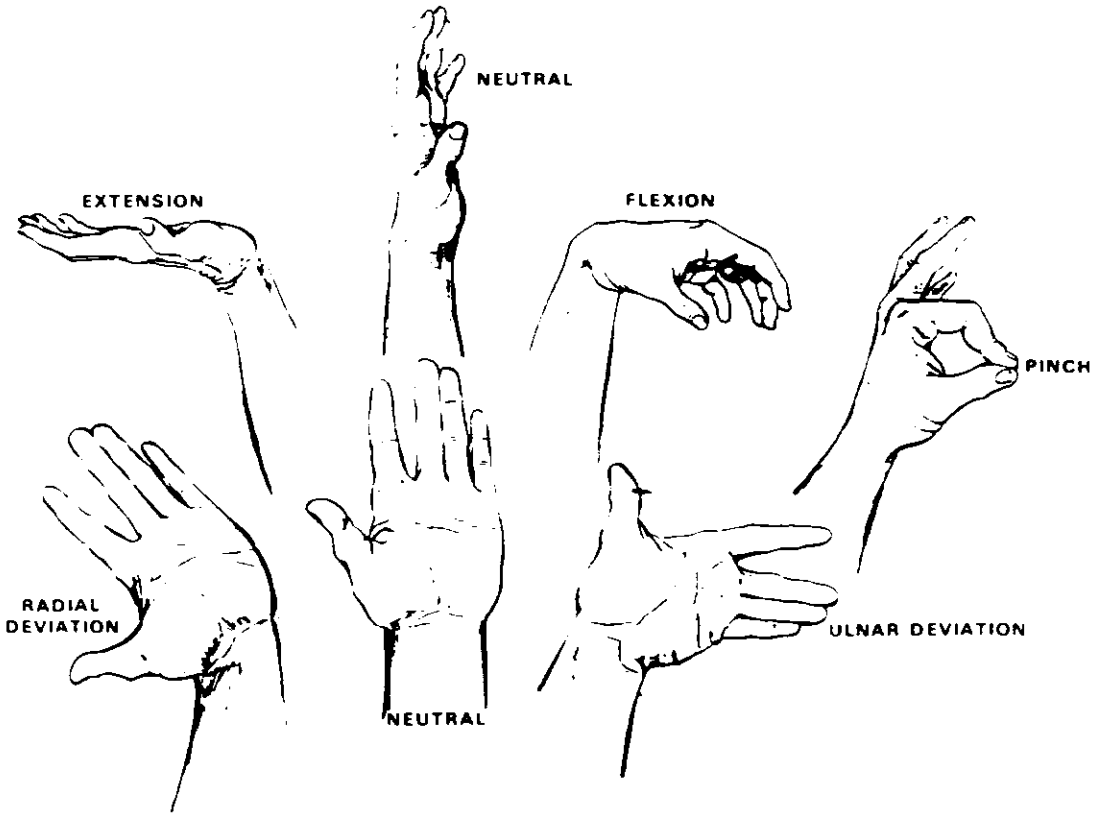

Figure 2

Longmont Turkey Processors
Longmont, Colorado
HETA 86-505

January 1985 - February 1987

Relative Risk for Non-CTS Injury
High-Risk vs. Low-Risk Groups (OSHA Log)

	Injury Risk Group	
	High	Low
Injuries*	117	35
Person-years**	724	505

*Recorded injuries for risk group
**Person-years at risk for the risk group

RR=2.33, 95% CI=(1.62, 3.36), p<.001

Figure 3

Relative Risk for Probable CTS
High-Risk vs. Low-Risk Groups (OSHA Log)
Longmont Turkey Processors
Longmont, Colorado
HETA 86-505

January 1985 - February 1987

	Injury Risk Group	
	High	Low
Injuries*	13	2
Person-years**	724	505

*Recorded injuries for risk group
**Person-years at risk for the risk group

RR=4.53, 95% CI=(1.17, 17.59), p=.01