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Aurora Casket Company
Aurora, Indiana

Daniel J. Habes, M.S.E., C.P.E.
Dorothy Wigmore, M.S.

PREFACE

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ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Daniel J. Habes and Dorothy Wigmore of the Hazard Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Field Assistance by Rick Driscoll. Desktop publishing by Ellen Blythe. Review and preparation for printing was performed by Penny Arthur.

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Health Hazard Evaluation Report 98–0085–2715
Aurora Casket Co.
Aurora, Indiana
October 1998

Daniel J. Habes, M.S.E., C.P.E.
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SUMMARY

On January 14, 1998, the National Institute for Occupational Safety and Health (NIOSH) received a request from the International Brotherhood of Boilermakers, on behalf of local M–300 of the Aurora Casket Co. in Aurora, Indiana. The union asked NIOSH to evaluate concerns that repetitive motion injuries and other musculoskeletal disorders may increase with the introduction of a new production method in the sewing and interior parts casket manufacturing departments.

NIOSH representatives conducted an evaluation April 20–23, 1998. This included videotaping of the job tasks in the sewing/interior departments, review of the Occupational Safety and Health Administration (OSHA) Log and Summary of Occupational Injuries and Illnesses (OSHA Form 200), and distribution of a medical and musculoskeletal disorders symptom questionnaire to the workers.

The OSHA logs indicated that from 1995 to 1998, about 10% of the Company's injuries and illnesses occurred in the "interior" departments (41/346), 83% of which (34/41) involved strains and sprains of the neck, back, shoulders, arms, hands, and wrists. All 49 workers who completed the questionnaires indicated some type of aches and pains, mostly to the shoulders, back, legs, and feet. Many workers also reported that working in the new workstation modules (cells) was associated with high levels of psychological stress.

The ergonomics evaluation showed that the main musculoskeletal stressors were prolonged standing while performing work tasks, excessive reaching to cut material, unassisted lifting of heavy rolls of materials, and handling/transporting finished casket interior components.

NIOSH investigators conclude that there is a high risk of musculoskeletal injury to workers at the Aurora Casket Company who stand for prolonged periods without accommodation for sitting, lift heavy rolls of material from shelves to the workstations, handle bundles of finished materials, and reach across wide tables while cutting materials. Recommendations addressing these and other issues related to the work tasks are contained in this report.

KEYWORDS: SIC 3994 (Casket linings), sewing, stapling, TSS, work modules, lifting, repetitive motion, prolonged standing, musculoskeletal disorders, back pain, postural fatigue, psychological stress.

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INTRODUCTION

On January 14, 1998, the National Institute for Occupational Safety and Health (NIOSH) received a request from the International Brotherhood of Boilermakers, on behalf of local M–300 of the Aurora Casket Co. in Aurora, Indiana. The union asked NIOSH to evaluate concerns that repetitive motion injuries and other musculoskeletal disorders may increase with the introduction of a new production method in the sewing and interior parts manufacturing departments.

NIOSH representatives visited the site April 20–23, 1998. This visit included an opening conference, attended by management and union representatives; a walk–through inspection of the entire facility; videotaping of the job tasks in the sewing/interior departments; review of Occupational Safety and Health Administration (OSHA) Log and Summary of Occupational Injuries and Illnesses (OSHA Form 200); and distribution of a medical and musculoskeletal disorders symptom questionnaire to the workers. The closing conference was held on the afternoon of April 23, 1998.

BACKGROUND

Aurora Casket Co. has been producing coffins in Aurora, Indiana, since 1890. The company employs about 380 workers in two plants (Vanguard and Aurora [the "Hill"]), one–half of whom have tenure of 10 years or more. For most of the time Aurora Casket has been in business, workers made the interiors seated at standard workstations, most of which were for sewing. After seeing a demonstration at an industry trade show, company officials decided to introduce a modular (or cell) method known as the Toyoda Sewing System (TSS). Its main element is to have workers stand and rotate through the various tasks in a cell of workstations until a completed piece is produced. This replaces the traditional "bundle" production method in which workers at a given workstation continually produce the same piece components, passing them in bulk to the next station. TSS is supposed to provide greater output with fewer workers than the bundle style of production by reducing material handling and storage costs.

The change to the TSS system required the purchase of new sewing machines and adjustable workstations, and training for workers. These activities were completed at the Vanguard plant in November 1997 but were not fully in place at the Aurora ("Hill") plant at the time of the NIOSH visit. The TSS system also included changing from hourly wages to a group incentive pay plan at Vanguard, and from an individual to group incentive plan at the Aurora plant.

Vanguard occupies the Company's original 1890 site, producing standard-gauge steel caskets with little variety in interior and exterior styles. The "Hill" is the newer of the two plants, producing standard- and heavy -gauge caskets, made of materials such as stainless steel, bronze, and copper, with a large variety of interior materials and exterior finishes. Work schedules are standard 8–hour shifts with ½ hour for lunch and 15–minute breaks in the morning and afternoon. There are two shifts at the Aurora plant, while the Vanguard plant worked only the 7:00 a.m. to 3:30 p.m. shift. Because of the drop in output that occurred while the TSS system was implemented, workers in the new cell modules at both plants worked mandatory overtime to complete a full day's production. The main work tasks evaluated in the interior departments at the Hill and Vanguard plants were cutting, sewing, and panel assembly. All workers observed during the evaluation of these tasks were women.

Job Descriptions

The finished caskets are made of metal, having either a full ("hinge") or ½ lid. The inside of the casket includes the pillow and the throw, and the material that is visible while viewing an open casket is called the throwout. Other interior components of a casket are the lining and the overlay (the part that covers the closed part of the casket). These components are produced by the sewers. The lids are finished with upholstered cardboard materials, which are made in the panel departments. Specific job descriptions follow.

Cutting

Aurora Plant (Hill)

Cutters use bulk rolls of material to make patterns for use in the sewing and panel cells. Most of the material is cut in bulk from 48–inch wide rolls on a long cutting table. The cutter loads the roll of specified material onto a mechanical spreader which distributes layers of material on the table so that many patterns can be cut at one time. The cutting table is 35.5 inches (in.) high and 73 inches wide. The spreader rides on tracks located on the edge of the table. After the material is spread, the cutter lays a pattern on the material, marks the cut lines with a chalk pad, and cuts the layers of material with either a hand–held electric cutter or a large stand–up cutter, depending on the number of layers being cut simultaneously.

Material cut in low volume, or patterns made with 60-inch-wide material, are cut by hand at separate nearby tables. The cuts are made on single sheets of material with conventional shears. These tables are about 36 inches high, and surrounded by mats. The three workers at the separate tables, and the two workers operating the spreader and the pattern cutter, rotate positions during the work day. In each position, the rolls of material are lifted and carried to the cutting tables by the worker from nearby shelves, ranging in height from 14 to 77 inches. The rolls range in weight from 25 to 90 pounds. The frequency of lifting varies during the day depending on product mix, but is usually two or three lifts per hour. Rolls of material can be entirely used once they are on the cutting table, or they can be carried to and from the cutting tables several times during the day. After they cut and fold the material, the cutters carry the bundled pieces to the interior and panel modules by hand, or place them on a rolling cart for the supplier to move.

Two other jobs were observed in the cutting area: cutting wadding, and surging. Wadding is cushioned material used as the backing of a pattern or sandwiched between two layers of material. It is cut at a standard cutting table (48-in. wide) with a track–mounted electric shear, equipped with a 30–inch long handle. The worker unravels the appropriate amount of material onto the track, and makes the cut by sliding the shear along the track. The wadding width varies from 16 to 36 inches. At the time of the NIOSH visit, material 20 inches wide was being cut.

Surging is a stand-up task where material is fed through a machine which applies a straight and finished edge. The worker reaches for raw materials from the top shelf of a multi–tiered cart (51 inches) and places finished materials on the middle tier of the cart (36 inches). The height of the surge table was about 40 inches. In an area adjacent to the cutting area, surging was also done as a seated task.

At the time of the NIOSH evaluation, the cutting area was functioning in the bundle production method described earlier. Company plans were to eventually integrate these job tasks into a module, along with the interior sewing and panel modules.

Vanguard Plant

At the older Vanguard plant, one worker was responsible for the cutting table. She operated the spreader, cut the patterns, and delivered materials to the sewing and panel modules. The operation of the spreader and cutting of the patterns was similar to that at the Aurora plant. The cutter also loaded and operated the shearer, a machine that bonds two layers of material together using heat and embosses a raised pattern onto the two layers to produce a stitched pleat effect. (This job was not observed at the Aurora plant.) The cutting of 60-inch material was not observed at Vanguard. Even though the modular concept was more fully implemented at Vanguard than at Aurora, there were plans to rearrange and relocate the modules, possibly affecting the cutting operations at this location.

Interior Sewing

Except for noted differences, the sewing modules at Vanguard and the Hill were the same. Each had two sewing modules. Each was set up in the shape of three sides of a rectangle with either three or four workers and six sewing machines. The floor space ranged from 20 to 30 feet long and 6 to 8 feet wide. Each sewing machine was installed on an adjustable–height workstation and operated by foot pedals that could be adjusted for position and right or left foot activation. All workstations in both plants were adjusted to 39–44 inches in height. For each workstation, the distance from the edge of the table to the needle on the sewing machine was about 10 inches. Effective reach distances to the sewing needles were about 17 inches because the workers had to stand away from the table edge to allow for clearance of material and to operate the foot pedals. Material for the interior components was in the modules, some laying on standard height carts (36 inches) and some hanging above the surface of the workstations at 75 inches. At any given time, a module is supposed to be producing two complete assemblies. The TSS method of sewing provides for time balance among sewing operations by a method called back–bumping. The last operation in the process is designed to take the least amount of time. When the sewer in that position completes an assembly, the worker goes to the first position, "bumps" the work there, and each worker moves to the next position in the cell. The theory is that no sewer has to wait or hurry up to keep pace with any other worker in the module.

The Aurora plant had a seated sewing area that produced assembly types that had not yet been integrated into the cells. Examples include interior components made of velvet and components for hinge-lid caskets. Hinge lids are on caskets that open fully, as opposed to the more common ½ –lid styles. Hinge-lid components were being produced at Vanguard at the time of the visit. They are sewn in the same manner as the ½ lids but require the alignment and movement of materials up to 132 inches long. These units usually comprise less than 10% of a day's production.

Panel Assembly

Two panel modules at the Aurora plant and one at Vanguard produced the interior components for the casket lids. The panel modules were shaped like the sewing modules, ranging in length from 24 to 30 feet and in width from 5 to 7 feet. The center and side panels of the casket lid are stapled or glued to cardboard panels during the various operations. The workers stand at the same type of workstations found in the sewing modules. The staple guns are air–powered, operated with a finger trigger. Some of the staple guns were counter–balanced with overhead mounting systems, while others were situated on the table top. At Vanguard, there were two table–top staple machines that resembled sewing machines, (called mini–stitchers); they were operated by a single foot pedal. Most of the materials were within the easy reach of the worker above the level of the table, while some of the cardboard panels were situated below table height. Finished panels are stacked on either flat or multi–tiered carts and later transported to the assembly departments by members of the panel modules. At Vanguard, the table heights were set at between 36 and 39 inches. At Aurora, the table heights in the panel cells were adjusted between 37 and 40 inches.

METHODS

Ergonomic

The ergonomic evaluation included a walk–through survey of the "interior" manufacturing areas of the Vanguard and Aurora plants to determine how the jobs are performed and some discussion with employees. Representative jobs in the cutting, panel, and sewing areas of each plant were videotaped to document the postural demands and repetitiveness of the jobs. This information was extracted from the video through playback analysis in real time or in slow motion.

Medical

The medical portion of the evaluation included a review of the OSHA 200 logs from 1995 to April 1998, interviews with workers, and distribution of a short medical questionnaire to all workers who were in the areas investigated during the NIOSH visit. In the questionnaire, those who had pain or discomfort in the last 12 months were asked to fill in a "body map" indicating the location of pain, the extent to which it hurt (0 "no pain" to 5 "worst imaginable pain" scale), and what they thought caused the pain. A copy of the questionnaire and body maps can be found in Appendix B. Workers were not restricted to rating their aches and pains on general areas of the maps, e.g., the upper arm or the neck/shoulder region. They could indicate their aches and pains wherever they were felt. Each entry made on the body maps was recorded as an "instance." The instructions given to the workers allowed them to indicate more than one instance of aches or pain or intensity on a general area of the body. The workers were also asked to report any other information they considered to be important.

EVALUATION CRITERIA

Overexertion injuries, such as low back pain, tendinitis, and carpal tunnel syndrome, are often associated with job tasks that include: (1) repetitive, stereotyped movement about the joints; (2) forceful manual exertions; (3) lifting; (4) awkward and/or static work postures; (5) direct pressure on nerves and soft tissues; (6) work in cold environments; or (7) exposure to whole–body or segmental vibration (Armstrong, Radwin, and Hansen 1986; Gerr, Letz and Landrigan 1991; Rempel, Harrison and Barnhart 1992). The risk of injury appears to increase as the intensity and duration of exposures to these factors increases and recovery time is reduced (Moore and Garg 1995). Although personal factors (e.g., age, gender, weight, fitness) may affect an individual's susceptibility to overexertion injuries/disorders, studies conducted in high–risk industries show that the risk associated with personal factors is small compared to that associated with occupational exposures (Armstrong, *et al*. 1993).

In all cases, the preferred method for preventing/controlling work–related musculoskeletal disorders (MSDs) is to design jobs, workstations, tools, and other equipment to match the physiological, anatomical, and psychological characteristics and capabilities of the worker. Under these conditions, exposures to task factors considered potentially hazardous will be reduced or eliminated.

The criteria used to evaluate the jobs at the Vanguard and Aurora plants were workplace and job design criteria found in the ergonomics literature and recommendations for acceptable lifting weights as determined by the NIOSH Revised Lifting Equation (Waters, *et al.* 1994).

The NIOSH lifting equation (NLE) is a tool for assessing the physical demands of two–handed lifting tasks. A full description of the components of the NLE is provided in Appendix A. In brief, the equation provides a recommended weight limit (RWL) and a lifting index (LI) for a lifting task, given certain lifting conditions. The RWL is the weight that can be handled safely by almost all healthy workers in similar circumstances. The LI is the ratio of the actual load lifted to the RWL. Lifting tasks with an LI $\leq$1.0 pose little risk of low back injury for the majority of workers. Tasks with an LI > 1.0 may place an increasing number of individuals at risk of low back injury. Many researchers believe that tasks with an LI > 3.0 pose a risk of back injury for most workers (Waters, *et al.* 1994).

RESULTS

Medical

OSHA 200 Logs Review

Vanguard Plant

Interior and panel workers at Vanguard accounted for one of 25 reported injuries or illnesses for the whole plant in 1995, 2 of 34 in 1996, 9 of 38 in 1997, and 2 of 14 for the first four months of 1998. Of these 14 total entries for the period reviewed, 12 were for "strains" of the back, shoulders, wrist and/or neck. Recorded as injuries, rather than illnesses, the strains led to three workers being off the job and later having restricted duty, three others on restricted duty, and no lost time or restrictions for the remaining workers.

Aurora (Hill) Plant

Panel and interior workers at the Aurora plant accounted for 6 of 72 injuries and illnesses in 1995 (5/6 musculoskeletal–related), 5 of 68 in 1996 (4/5 musculoskeletal–related), 14 of 67 in 1997 (12/14 musculoskeletal–related), and 2 of 28 for the first four months of 1998 (½ musculoskeletal–related). The 22 entries affecting the musculoskeletal system, reported as strains/pains/disorders to the back, shoulder, wrist and/or neck, were logged as injuries, 15 of which required no lost time or restricted work.

Questionnaire and Body Maps

Forty–nine of the distributed questionnaires were returned to the NIOSH investigators from workers at both plants (38 from Aurora and 11 from Vanguard); all respondents were women. At Aurora, cutters averaged 46 years of age and 14 years tenure; panel workers and sewers averaged 48 years of age and 16 years of service. At Vanguard, cutters averaged 41.5 years with 8 years experience, sewers averaged 44 years with 11 years seniority, and the average age of panel workers was 46 with 16.5 years on the job.

All 49 workers reported some kind of ache or pain in the previous 12 months, almost all of which they associated with their work. A complete picture of the workers' reports of musculoskeletal aches and pains can be found in the body maps in Appendix. B.

There is one body map for each of the main areas at the Vanguard and Aurora facilities. The cell material handlers were included with the cell sewers at each plant. The scale for pain intensity was compressed for reporting purposes such that a score of 1 was designated as "low," scores of 2 and 3 were labeled "medium," and scores of 4 and 5 were called "high." If workers indicated a range in their scale recording, the average was calculated.

Body Maps – General Results

Aurora workers reported more aches and pain than the Vanguard workers. The cutters at Aurora reported the most pain overall, with 25 indications at the neck, shoulder, and back, the number of aches at the lower leg and feet among the Aurora cutters was comparable to other groups. Twelve of the cutters' 25 indications at the neck, shoulder, and back were of the highest intensity. Vanguard panel workers reported the least amount of pain overall, including just one instance of medium foot pain. However, they were also the smallest group. Aurora plant (Hill) panel workers reported as much neck, shoulder, and back pain as the Hill cutters (26 instances, 13 high intensity) but not as much foot pain as the cutters. Sitting sewers at the Aurora plant reported more neck, shoulder, and arm/wrist pain than their standing counterparts, but no foot or lower leg pain.

Body Maps – Specific Comparisons

At Vanguard, seven workers in the two sewing modules reported medium- and high-intensity aches and pains in the neck, shoulders, lower back, elbow, wrists, knees, and feet. No knee or foot problems were recorded within the last year on the OSHA logs, and only one musculoskeletal problem involving the knee was reported during the 1995–1998 time period. Similarly, four workers at Vanguard reported symptoms in the area between or near the shoulder blades, but only one entry for shoulder problems was found on the OSHA 200 logs in the last year.

Workers linked their aches and pains in the upper extremities (hands, arms, neck, and shoulders) to repetitive motion, unfolding material, the way they stand, and the foot pedal position. They associated aches and pains in the legs and feet with overtime work and standing too long.

Aurora plant and Vanguard panel workers reported aches and pains in their lower back, neck, shoulder, wrist, and legs/feet. Aurora panel workers, in particular, noted high-intensity aches and pains in the upper back, elbow, and neck. Panel workers at both plants attributed neck and shoulder pains to working with their head bent all day, psychological stress, reaching, repetition, pulling panels through the gluing machine (Aurora), and general overuse of the right arm. They linked arm and hand/wrist aches and pains to staple gun use, lifting materials at the work table, and repetition. They associated back problems with stress, standing, looking down at the work, lifting and pushing carts, and adjusting tables. They attributed leg and foot pain to pushing carts and standing all day.

At Aurora, there was a noticeable difference in the distribution of aches and pains between the workers who still sat at their work and those who were in the modules. Five workers who were still sitting completed body maps. They reported 18 instances of pain in the neck and shoulder area (7/18 high intensity), 5 for the lower back, and none involving the feet. The 14 workers in Aurora sewing cells reported 13 instances of pain in the neck and shoulders, 2 in the low back, and 21 instances of aches and pains in the lower legs and feet. Standing, especially with their weight on one foot, dominated the reasons workers in the sewing modules at Aurora gave for their leg and foot pain. Tension, reaching too high for parts, lifting material rolls, adjusting work surface heights and pulling and turning material were cited as the cause of neck and shoulder problems.

Many workers thought chairs would reduce their aches and pains, whatever the workstation arrangement. Both the sitting and the standing sewers at Aurora indicated that stress levels were increasing from quotas and the pressure to produce. Many were concerned about heat in the summer and the lack of proper ventilation to cool their work areas.

Workers in the cutting jobs at the Aurora plant reported aches and pains in both upper and lower extremities and headaches linked to stress. Their musculoskeletal symptoms were similar to those of the other workers, involving the feet, knees, hips, lower back, neck and shoulder, elbows, and hand/wrist. However, they reported more aches and pains than other workers.

Cutters linked their pain to stress, repetitive motion, moving material trucks, lifting, and improper work surface heights. Neck and shoulder aches and pains were linked to reaching, and hand and wrist problems were attributed to gripping scissors and using power saws and knives. Back problems among cutters were attributed to non–adjustable work tables, and foot problems to standing and inadequate floor mats.

The workers also consistently referred to three issues in their general comments: stress, heat, and ventilation. Other issues included lack of emergency exits and poor lighting, uncleanliness of the washrooms, lack of chairs for breaks, and inadequate space in the eating area at the Hill plant for breaks and lunch. A complete list of worker concerns can be found in Appendix B.

Workers in all areas of both plants reported that stress levels had increased in the last year. In both the written comments and interviews, stress was often linked to the new sewing cells and related production quotas. Some workers linked stress to musculoskeletal problems in the neck, shoulder, and/or back.

Ergonomic

Cutting

The main ergonomic stress factors in the cutting areas for both plants were the long reaches required to mark and cut patterns on the spreading tables (up to 48 in. at Vanguard and 60 in. at Aurora), having to lift rolls of material for transport to and from the storage shelves, and the material handling required to deliver finished materials to the sewing and panel modules. The 48– and 60–inch reaches at the Aurora plant were made once per set, or about once every 15 minutes per worker. In making these cuts, workers leaned over the table and stood on one foot to complete the task. Most of the other cutting at the manual tables involved shorter reach distances, done with the electric shears as the material was being folded and then cut. This folding required some additional material handling and awkward postures of the cutters' wrists and shoulders.

Other observed postural stresses in the cutting area were bending over to reach the scanner keypad on the spreader (height =19 inches), and shoulder and forearm extension from using the cutting machine in the wadding area. These postures were associated with the wadding cut task because of the length of the handle on the cutter (30 inches) and because the cutting tool was moved the entire length of the cutting track (48 inches) when the material being cut was less than ½ that amount.

Using the NLE to assess the lifting of rolls of material from the storage racks to the attachment spindles on the spreader or the cutting tables indicates that the rolls should weigh no more than 26-30 pounds to provide a lifting index = 1. The assumptions underlying this weight range are that lifts are compact and made occasionally, initial lifting heights are from 14 to 77 inches (the dimensions of the storage racks) and the rolls of material could be lifted safely by the majority of the worker population. Lifting rolls of material that weigh 90 lbs would result in a lifting index of greater than 3, which is a hazardous lifting condition for most workers. For more details about the NLE, see Appendix A.

Sewing Modules

The primary ergonomic risk factor observed in the sewing modules was the requirement to stand, often on one foot, without being able to sit. Much of the standing was in a prolonged static posture because, in general, the sewers in the modules were not rotating through positions in the TSS prescribed back–bumping manner. When they did rotate, it was usually after each worker had completed the task she began at her workstation. Sewers stood on one foot at times because foot pressure has to be released from the pedal as pieces of material were realigned and repositioned on the work surface. Intermittent application of pressure on the foot pedals was observed to be more frequent during sewing of large pieces of material together, such as in blankets or throws used in hinged-lid components.

In general, standing work should be designed so that reach distances do not exceed 20 inches, and workplace heights should be below elbow height, which for the average woman is 40.5 inches (± about 2 inches). When sustained activity is not required and the bend is made at the hip or waist, reaches can be as much as 32 inches (Eastman Kodak 1983). For work requiring downward forces, such as moving material forward while sewing, the work height should be about two inches below elbow height (Konz 1979). The height and reach distances observed in the sewing modules at both Aurora and Vanguard (about 17 in. maximum reach and 39–44 in. workstation height) were consistent with these workstation design guidelines, considering individual differences. In some cases, the workstations that sewers rotated to were adjusted to heights above their own standing elbow height.

The primary concern regarding the design of the workstations at the two plants was whether workers should be sitting or standing.

In general, seated workstations are preferred when:

1. Items needed for the task cycles can be easily supplied and handled within the work space
2. Foot pedals are used

3. Hand forces greater than 10 lb are not required
4. Fine assembly or precision tasks are done for the majority of the shift

Standing workstations are preferred when:

1. The workstation does not have knee clearance for a seated operation
2. Objects weighing more than 10 lb are handled
3. High, low, or extended reaches in front of the body are frequently required
4. Operations are physically separated and require frequent movement between operations
5. Downward forces must be exerted, as in wrapping and packing operations

Table 1
Preferred Workstation Selections Based on Task Parameters (Eastman Kodak, Vol. I)

Parameters	Heavy Load and/or Forces	Inter–mittent Work	Extended Work Envelope	Variable Tasks	Variable Surface Height	Repetitive Movements	Visual Attention	Fine Manipulation	Duration > 4 Hours
Heavy Load and/or Forces		ST	ST	ST	ST	S/ST	S/ST	S/ST	ST/C
Intermittent Work			ST	ST	ST	S, S/ST	S, S/ST	S, S/ST	S, S/ST
Extended Work Envelope				ST	ST	S/ST	S/ST	S/ST	ST/C
Variable Tasks					ST	S/ST	S/ST	S/ST	ST/C
Variable Surface Height						S	S	S	S
Repetitive Movements							S	S	S
Visual Attention								S	S
Fine Manipulation									S
Duration > 4 Hours									

Note: S=sitting; ST=standing; S/ST = sit/stand , ST/C = standing, with chair available

Table 1 provides similar and additional guidance about determining the set up of workstations based on task parameters. The table groups task characteristics in pairs and provides the preferred workstation type in the intersecting box. The task characteristics of "duration > 4 hours," "fine manipulation," "visual attention," "repetitive movements," and "variable surface height," are all associated with sewing. Combining them, the preferred workstation type is always sitting. When "heavy load/forces," "intermittent work," and "extended work envelope" (long reach distances) are combined (none of which are usually required in sewing), the preferred workstation type is standing.

All other combinations of the task characteristics result in some combination of sitting and standing or standing with chair available as the preferred workstation design.

The criteria listed above (but not Table 1) state that standing should be considered if operations are physically separated and require frequent movement between operations. This is a task parameter in the sewing modules when the jobs are performed as TSS prescribes.

Each module was adequately furnished with padded surfaces for standing, and most workers appeared to be wearing sensible, cushioned shoes. Floor space in the modules was limited, confined further by the presence of material carts and racks.

Panel Modules

The main ergonomic stressors in the panel modules were having to stand all day and holding and operating the staple guns. Fastening materials to the cardboard backing also required pulling the material tight as the stapling took place. This was less evident at the Hill plant than at Vanguard because many of the materials were glued at the Hill plant. Some impact force or "jerk" was transferred to the hand as the staples were driven against the metal workstation surface, but this force could not be measured. Typical lid assemblies required 85 staples, and hinged lids took as many as 115. Flipping the panel assemblies while attaching sides to the center panel required rotation and flexion of the shoulders. The panel modules were better suited to standing than the sewing modules because fewer foot pedals were used. Also, operating the pistol–grip staple guns at seated workstations would require flexion of the wrist unless the table tops were tilted toward the worker. Standing enabled the workers to maintain a more neutral wrist posture while stapling with the pistol handled tools.

Sewing: Standing versus Sitting

Several video sequences were analyzed to determine if there was a difference in the time or effort required to sew standing versus sitting. There were sitting operations only at the Hill plant, and these were for operations not yet assigned to modules. As such, a direct comparison of the time required to sew standing as opposed to sitting was not possible. However, a few video sequences were analyzed in an attempt to discern any differences between the two methods.

First, measurements were made of the time needed to perform a sub–task called "needle passes," (pushing aligned materials through the needle of the sewing machine before deactivating the foot pedal and pausing to realign materials). Depending on the component being made, the material, and the number of materials to be aligned per pass, the length of a pass could be 4 to 12 inches. Sewing an entire side of a pillow (about 30 inches) could be accomplished in one pass and was observed in both methods. One time study comparison examined assembling pillows: the first video sequence was of a silk pillow made by a standing worker at Vanguard, and the other a velvet pillow made by a sitting worker at Aurora. The sequence at Vanguard lasted 55 seconds, and the average time per pass was 1.7 seconds. The sequence at Aurora lasted 49 seconds, and the average time per pass was 1.9 seconds.

Second, other video sequences were analyzed to calculate the amount of cycle time that sewing comprises for purposes of determining how much time could potentially be saved if there actually was a difference in sewing time between standing versus sitting, even though this was not able to be determined with the video sequences collected during this evaluation. For a number of video samples of standing workers lasting 16.3 minutes, the actual time sewing was 7.5 minutes or 46%. Video samples lasting 15.7 minutes for sitting workers indicated that 9 minutes, or 57% of the time, was spent sewing. Workers in each group spent the remainder of their time getting material, aligning edges, cutting with the scissors, measuring parts, folding completed assemblies, and testing the integrity of seams and corners. Standing sewers seemed to have an easier time getting materials and disposing of finished parts, while sitting workers appeared to more easily align and maneuver parts at the workstation. At sitting workstations, workers are closer to the sewing machine needle, which decreases reach and viewing distances.

Miscellaneous Observations

There were no chairs for workers to sit on in the modules during breaks or when the flow of work was interrupted, such as when materials were being delivered to the assembly areas. There were not enough seats in the cafeteria to accommodate everyone who was on lunch break at the same time, so some workers sat on the floor or on makeshift seats in their work areas while eating.

The workstations at Vanguard and Aurora were similar in design and adjustability, but those at Vanguard were less substantial and less stable. At the Aurora plant, metal troughs were mounted in the front and back of the workstations to accommodate long pieces of material. The Vanguard workstations did not have the troughs, making it difficult to maneuver long pieces of material during sewing operations. One worker sewing hinged lid components placed the material in a waste material basket to avoid dragging it on the floor as an operation was being performed.

The staple guns were quieter at Aurora than at Vanguard, although the equipment and layout was essentially the same at both locations.

DISCUSSION

Medical

There were some differences in the way workers reported the location and intensity of aches and pains on the body maps. Some workers reported multiple instances of pain in what could be considered one general body area. For example, five sitting sewers and nine panel workers at the Hill reported 21 and 15 instances of pain in the shoulder/neck region, respectively. This may make it seem like their pain in those areas was dramatically worse than their standing and Vanguard counterparts. However the body maps are interpreted, what is most important about the information obtained from them is that all workers reported pain to the shoulder/neck, back and upper extremity, and standing workers reported more lower leg and foot pain than sitting workers.

There are two possible explanations for the difference between the OSHA 200 logs and the workers' body maps and comments. The employees either work in pain and don't report their injuries, or most of the aches and pains have occurred in the relatively short time since the modular cells were put in place. Considering the work force's age and years of experience, the former is likely the case. However, the introduction of the modules did alter the exposure to musculoskeletal injury risk factors for all workers, even those at the Aurora plant who continued to sit and sew. These workers, who used to sew the complete line of interior products made by the company, began to work exclusively on the components not yet done in the sewing modules. Typically, these were the most difficult items to sew – the heavy velvet buggy patterns and the larger hinged-lid interiors and blankets. For those sewers assigned to modules, much of the pain reported, particularly to the lower extremity, likely got worse since the work cells were implemented. A recent study of workers at an appliance factory found that workers who stood for more than four hours per day, or who stood and used foot pedals, reported significantly more lower extremity aches and pains than workers not having these job exposure factors (MacDonald, *et al.* 1998). At the Hill and Vanguard plants, long work days likely increased the frequency and severity of the aches and pains reported.

Vanguard workers may have reported fewer aches and pains because of the fewer and simpler styles produced there, or it may be an indication that the workers were becoming accustomed to working in the cells. Unaccustomed repetitive work has long been associated with the development of cumulative trauma disorders to the upper extremity (Conn 1931; Wilson and Wilson 1957). The workers at the Hill plant, who had not been fully trained to work in the modules, and were not used to standing while working, may have experienced a similar unaccustomed work reaction to both the upper and lower extremities.

Many workers reported that social factors associated with working with others in the modules, the pressures to meet production quotas, and the low job control within the modules caused a great deal of stress, which led to or exacerbated their physical problems. Many further reported that the environmental issues that bothered them, such as heat and ventilation, added to their stress. A comprehensive review of psychosocial factors and work–related musculoskeletal disorders concluded that monotonous work, high perceived work load, time pressures, and lack of social support were associated with the onset of such disorders (Bongers, *et al.* 1993). Another study linked psychosocial factors to musculoskeletal disorders in a population of garment workers (Brisson, *et al.* 1989).

Finally, a recent follow–up study of the associations between psychosocial factors at work and back and limb disorders concluded that work organization issues seemed to predispose workers to musculoskeletal disorders (Leino 1995). Recognition of this association may be important in efforts to prevent further problems.

Ergonomic

A primary theme regarding the NIOSH evaluation at Aurora Casket Co. was evaluating whether or not the cell production method increased the workers' risk of injury. Results notwithstanding, sewing tasks have historically been associated with musculoskeletal disorders, particularly to the neck and shoulders (Vihma, *et al.* 1982) and the upper limbs (Punnett, *et al.* 1985). The videotape analyses showed little difference in the involvement of the upper extremity between working sitting and standing, so no matter what is concluded regarding this theme, jobs at the company (if unchanged) will remain risk factors for musculoskeletal disorders. The reports of musculoskeletal aches and pains among the sewers who have always sat is further confirmation of the general risk of sewing machine work.

It is not surprising that the Aurora plant cutters reported the most aches and pain. (The one cutter at Vanguard was included with the sewers, a group which also reported a substantial number of aches and pains.) The cutters' jobs required more lifting and more reaching than any group in either plant. Most of the rolls of material they lifted and carried weighed more than the maximum 26–30 pounds that the NLE indicated should not be exceeded. The reach distances at the cutting and spread tables were usually longer than the maximum of 32 inches consistent with good ergonomic design. Reach distances should be reduced, but reaching is only a part of the entire task. Eliminating the more stressful activity to the back - lifting heavy rolls of material- may be enough to reduce workers' back and shoulder pain.

The workstations at both plants were adjustable for height and tilt, but for practical purposes, the workstations were not conveniently adjustable. Many workers reported that it was too difficult and time–consuming to adjust the workstations. From observation, it was obvious that the adjustments needed to be made during rotation would never be attempted. The issue of workstation adjustability and the range of heights needed to accommodate a heterogeneous workforce, provides some insight into the difference between sitting and standing workstations. The range in elbow rest height (above the seat height) for a sitting worker is about 4 inches (5^{th} percentile female = 7.13 in., 95^{th} percentile male = 11.6 in.) and about 10 inches when standing: (5^{th} percentile female = 36.9 in., 95^{th} percentile male = 46.8 in.), (Kroemer 1989). This means that a workstation set at a fixed height, the reality at Aurora and Vanguard, would accommodate more workers if they could sit rather than stand.

In general, the manufacture of sewn garments and apparel goods requires a higher percentage of production workers than other manufacturing industries (80 % versus 70%) (Berg, *et al.* 1996). This explains why efforts to reduce the amount of direct labor in the industry have been the main means for manufacturers to cut costs and improve productivity. TSS is a theory–based system which aims to reduce the high cost of direct labor by placing workers in modules, where entire assemblies are produced by a cross–trained team, rather than having each worker produce the same subassembly over and over. According to an organization promoting TSS (Americas 21^{st}, Greenville, South Carolina), the module concept results in greater productivity per person through reduced handling time, having a fully–balanced line at all times, reduced effects of seasonal shifts and absenteeism due to cross–trained workers, elimination of delayed handling of repairs because flaws in product are identified immediately, and overall reduction in staff. Irrespective of the extent to which modular systems actually deliver on these promises (as recently as 1992, only 9 % of the U.S. apparel industries practiced the modular concept [Dunlop and Weil 1996]), there is no mention that workers must stand with no possibility of sitting. The TSS concept includes rotation of workers through the various stations in the module, but some of the tasks in the modules at both Vanguard and the Hill are long enough to make sitting, at least at one workstation per module, feasible without interrupting the flow of work. Indeed, many of the workers in the modules were not rotating anyway – they may as well have been sitting. This fact, coupled with the strong case for sitting or sit/stand stations as the most appropriate for the type of work performed in the modules (see Results section), and the number of workers reporting foot and lower leg aches and pains from standing, points strongly for a sitting option in the modules.

Although workers reported aches and pains in their lower extremity and feet, many liked performing their jobs while standing and said they would never want to go back to sitting all day. Standing and moving around is good for the body. Compressive forces at the low back are higher in the sitting postures than when standing (Magora 1972). Moderate activity, such as rotating through tasks in the cells, reduces foot swelling (Winkel and Jorgensen 1986). However, there should be a sensible balance between sitting and standing in any sedentary activity. For example, a recent study of office workers whose workstations were modified to include sit/stand adjustable furniture found that workers felt more energetic and less tired by the end of the workday (Paul 1995).

The available literature shows that modular work cells do not necessarily allow operations to be completed faster. They do show that allowing the module to work as a smoothly running unit is more productive (Dunlop and Weil 1996; Berg, *et al.* 1996). Video analyses of the time to complete work tasks in modules versus sitting at workstations (presented in Results section) are consistent with what is stated in the literature in as much as the results were inconclusive, indicating no significant time difference between the two methods, and that use of the sewing machine is only 50% of the work cycle anyway. Actually, the principles of TSS were being circumvented by allowing workers not to rotate, and by using the efficient module workers as material handlers. These departures from the concepts underlying the modules may have led to increased reports of foot and leg pain (from static standing) and of shoulder and back aches and pains from having to lift rolls of materials and push carts of finished assemblies in addition to the other physical activities of their regular jobs.

CONCLUSIONS

1. The workers at the Aurora Casket company experience many musculoskeletal aches and pains that are related to the physical requirements of their jobs, such as prolonged standing, lifting heavy materials, handling finished materials, and reaching across tables to cut materials. The long hours of work and other production pressures likely increase the severity and/or duration of these health problems.

2. Standing while performing the various casket interior–making tasks does not pose any additional risk to the workers versus sitting, except for the effects on the lower limbs and feet due to prolonged standing.

3. The unassisted lifting of rolls of material poses a high risk of back pain or injury to workers. This is particularly the case with the cutters who lift materials and also reach across tables to cut material and patterns. Of the two activities, the lifting poses the greater risk of injury to the workers.

4. Panel assembly tasks are more suited to standing than sewing tasks, but workers on both jobs need the option of sitting during work and during rest breaks.

RECOMMENDATIONS

General

1. Provide all workers, including cutters, panel workers, and sewers, the option for sitting. This can be accomplished by providing chairs or sit/stand furniture in the modules, or by dedicating one or more workstations in the modules as sitting or sit/stand.

2. Provide more seating in the modules and break areas so that everyone can choose to sit during rest and lunch periods.

3. Provide material handlers for delivering materials to the modules and to the cutting areas. The material handlers who deliver the rolls of material to the cutting areas should have appropriate material handling equipment. This could be a rolling hand truck with an adjustable height bed that can be raised or lowered to the height of the material on the storage racks and similarly adjusted to the height of the machine or workstation to which it is delivered. Carts should have handle heights between 36 and 44 inches, and the force to set the cart in motion should not exceed 50 lbs.

4. Provide appropriate anti–fatigue mats for workers to stand on while performing work tasks. If workers stand without much movement, the mats should be cushioned up to ½–inch thick to promote comfort in the lower legs (Redfern and Chaffin,1995). If workers are moving from station to station in the cells, the mats should be cushioned, but thinner (up to 3/8 inch thick) to facilitate walking and prevent tripping. Mat edges should be beveled for maximum safety and ease of sweeping..

5. Evaluate and address the environmental and social causes of stress that affect the workers' health, job satisfaction, and productivity.

Cutting

1. Provide a shorter handle or a T–shaped grip on the handle of the wadding machine to avoid excessive shoulder flexion and extension while moving the shear along the cutting track. Also, add a stop on the track to control how far the shear moves to cut materials less wide than the track.

2. Reduce the width of the cutting tables so that reaches do not exceed 32 inches. If this modification to the spread table is not feasible, determine if back and shoulder aches and pains can be remedied by eliminating the need to lift and handle rolls of material.

3. Relocate the bar code machine on the cutting table at Aurora to eliminate the need to bend over to access the keypad. The keypad should be located at table height and tilted away from the worker for easy visibility (ensuring also there is no glare). The top of the keypad should not exceed 42 inches.

Cells

1. Redesign all workstations for easy height–adjustment by workers. Table tops equipped with a counterbalanced height adjustment mechanism will allow workers to adjust the height with one squeeze of a bar that locks into position when she takes her hand off the bar. As a minimum, the tables should be adjustable between the ranges of 36.5 – 40.5 inches.

2. Modify the workstations in the Vanguard sewing cells to be more stable, and include troughs in front and back to prevent long pieces of material from making contact with the floor.

3. Relocate materials storage shelves on the panel workstations so that all materials are above the height of the work surface to allow for easy access and elimination of the need for workers to move away from the workstation while retrieving some panel components.

4. Counter–balance staple guns in the panel modules so that the workers do not have to bear the weight of the tool when using it.

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Table 2
Frequency Multiplier (FM) for NIOSH Lifting Equation

Frequency Lifts/min	Work Duration					
	≤ 1 Hour		≤ 2 Hours		≤ 8 Hours	
	V < 75	V ≥ 75	V < 75	V ≥ 75	V < 75	V ≥ 75
0.2	1.00	1.00	.95	.95	.85	.85
0.5	.97	.97	.92	.92	.81	.81
1	.94	.94	.88	.88	.75	.75
2	.91	.91	.84	.84	.65	.65
3	.88	.88	.79	.79	.55	.55
4	.84	.84	.72	.72	.45	.45
5	.80	.80	.60	.60	.35	.35
6	.75	.75	.50	.50	.27	.27
7	.70	.70	.42	.42	.22	.22
8	.60	.60	.35	.35	.18	.18
9	.52	.52	.30	.30	.00	.15
10	.45	.45	.26	.26	.00	.13
11	.41	.41	.00	.23	.00	.00
12	.37	.37	.00	.21	.00	.00
13	.00	.34	.00	.00	.00	.00
14	.00	.31	.00	.00	.00	.00
15	.00	.28	.00	.00	.00	.00
>15	.00	.00	.00	.00	.00	.00

† Values of V are in cm; 75 cm = 30 in.

Table 3
Coupling Multiplier (CM) for NIOSH Lifting Equation

Couplings	V< 75 cm (30 in)	V ≥ 75 cm (30 in)
	Coupling Multipliers	
Good	1.00	1.00
Fair	0.95	1.00
Poor	0.90	0.90

APPENDIX A

The Factors Comprising the NIOSH Revised Lifting Equation

Calculation for Recommended Weight Limit

RWL = LC * HM * VM * DM * AM * FM * CM
(* indicates multiplication.)

Recommended Weight Limit

Component			Metric	U.S. Customary
LC	=	Load Constant	23 kg	51 lbs
HM	=	Horizontal Multiplier	(25/H)	(10/H)
VM	=	Vertical Multiplier	(1–(.003|V–75|))	(1–(.0075|V–30|))
DM	=	Distance Multiplier	(.82+(4.5/D))	(.82+(1.8/D))
AM	=	Asymmetric Multiplier	(1–(.0032A))	(1–(.0032A))
FM	=	Frequency Multiplier	(From Table 2)	
CM	=	Coupling Multiplier	(From Table 3)	

Where:

H = Horizontal location of hands from midpoint between the ankles.
Measure at the origin and the destination of the lift (cm or in).

V = Vertical location of the hands from the floor.
Measure at the origin and destination of the lift (cm or in).

D = Vertical travel distance between the origin and the destination of the lift (cm or in).

A = Angle of asymmetry – angular displacement of the load from the sagittal plane.
Measure at the origin and destination of the lift (degrees).

F = Average frequency rate of lifting measured in lifts/min.
Duration is defined to be: < 1 hour; < 2 hours; or < 8 hours assuming appropriate recovery allowances.

APPENDIX B

Worker Comments and Body Maps

Comments from Aurora workers

Hill – panels

- when put table up (i.e. raised height) once, was told was too high and unsafe for others
- people hurt cranking tables – not easy to do
- exit blocked by cutting table and can't open in summer
- need a chair – have to sit on floor at break – break area isn't big enough (for all)
- extra break when overtime is involved
- stress is far greater on us than the work
- need a chair
- need extra break when we work 9–10–11 hours
- has had cortisone shots in elbow four times
- need a chair for breaks and lunch – "We stand all day and a chair isn't too much to ask for."
- break area isn't large enough for everyone
- extra break for time over 8 hours
- "The stress factor is 10 times worse than the physical labor."
- need a chair to sit on for breaks and lunch. "After standing you need to sit."
- lunch area's not big enough for everyone
- "Adjusting tables after a tall person is on it is hard on your back. They make everything for tall people (hard to get your supplies for shorter people)."
- they took all the chairs out
- "The cells are to (sic) stressful and to (sic) close with people and different personality's (sic). I will stress the cells are very stressful and tension is awful."
- staples too small so catch fingers on them and bleed

Hill – sewing (cells)

- "I put Pillow Fill down because that (sic) my regular job."
- "I've been on different jobs for over yr. I was in Panel Cluster Jan. 97 to Feb. 98. The pain was better while working in cluster till they started up the night cluster. The shelves was to high for me to reach because of being short plus I already had problems with my shoulder and back, really my whole right side."
- "I went to chiropractor on my own because of problems I 'd had before."
- "My problems was caused from the way we use to do my job and machine, since they have put new pillow machine in it's lot better."
- "I'm glad we get to change around where we didn't before."
- "Why is there no lights that come on when electric goes out or exit signs?"
- "After standing over long periods of time, I begin to ache in legs and feet and sometimes in left hip area."

- "Machines are hard to roll up to position we need them."
- "Sometimes material is hard to unload especially if a lot of velvet."
- "Since I've been standing I've noticed more broken veins in my legs that I did not have before."
- "I like the process, verses (sic) sitting all day. I enjoy doing the different kinds of work. I don't fall asleep on the job now. I love the machines, being able to adjust." (Worker with more than 20 years with company)
- "I think the most problem will be for the ladies that has sat for 10 to 20 years." (Worker under 30 years old, in plant 3 years)
- "I've always sat and sewed and loved it and reached up to hand the finish interiors onto a overhead conveyor why my right shoulder problem started. I can live with it but there is a ouch in there a certain movement. Then in January 98 we were forced into standing in clusters/cells to sew like ostriches. Most weight on left foot while we work pedals with right foot and started OK but soon my arch and heels stated hurting and now it's gone up into my left ankle. The longer the day the worst it hurts standing on it. Standing is definitely taking a tool on this body. I get sharp pains sometimes in my hip and back and wonder what my life will be in 10 – 12 years yet to go to retirement? I feel standing and sitting part time would be better than standing all the time."
- "I love sewing but not stress is because of pressure to get quotas. Rush, Rush Rush to get it out and no room for mistakes and I hate sloppy work and with all the flaws it's ridiculous. Cells is not the answer to good quality work when rush any old way to get it out. (Say the person next to you does sloppy work and you have to straightening out their mess.) Blood pressure medicine and cortisone shots for joints and diet, diet, diet."
- "Fumes and ventilation is also sometimes a problem in our department. No fresh air unless you over by the door. Headaches – eyes burn – not looking forward to summer 90º weather – humidity and material stick. Rush. Need air conditioner."
- "I wonder if standing on concrete will cause vein problems, knee or hip joint problems."
- "Sewing buggy pillow's (sic) especially premium velvet ones and having to turn inside out. Very hard on your arm's. Having to stand for more than 8 hrs. A day. Should be able to sit down for at least part of day if you so choose."
- "I have had a stand up job at one time. The next was all sit down job. Now I have a job where I sit a while then stand a while. This job I have now seems to be a lot easier on my body. We need chairs to sit down on at breaks and lunch. Especially all stand up areas."
- "I had carpel tunnel (sic) surgery resulting from my job. Now I have tendinitis (sic) in my left elbow and was sent to co. Doctor for it but it still hurts. I also have fibrositis which seems worse with overly pushing or shoving. It is extremely (sic) hot during the summer and now we aren't even allowed to have the doors open."

Hill – sewing (old)

- "If I am on my feet and legs very much I have a lot of great pain. (I am on a sit down job.)"
- "It is extremely hot in here in the summer (no air circulating)."
- "Everything is so congested (sic) that I think it is ver unsafe."
- "The trucks with the cluster work are very unsafe, 1) the way the pipes stick out and right at eye level. 2) they are too hard to push around."
- "Always feel so pressured that my blood pressure is high. Very stressful!"
- "Get headaches because of fumes."
- "If ever a fire it will be hard to get out because of everything in the way and so far to go to get out."

- "They expect us to do a certain amount of work a day but keep giving you more to do."
- "In the summer it is very hot in this department. There is one large door they use(sic) to open in the past. They are not opening it this year because they put the material spreader in front of it. We have no windows to open or no fresh air vents toward the back of the room. A lot of people get sick because of the heat in the summer. We also have a lot of heat coming from the office air conditioner."
- concerned about having to move cranks in new cells
- buggies worst – turning hurts shoulder – so does blanket – "You use all your strength to pull."
- CTS surgery 3 years ago on left wrist – sometime swear braces on both wrists – still have lots of problems
- told if not here when start training, will be put anywhere, so waiting to report problems
- concerned about new machines not being high enough because of her height and the need to control the fabric when sewing (she does it with arm and elbow)
- "I can see hip and leg injury in the future with the stand up jobs because they stand with all the weight on one leg."
- "Injury to back, shoulder, and neck when moving tables in sew cell up and down."
- "Stool might help cut down on hip and leg injury. It could help give them a little more support."
- "Area surrounding it is so congested that they would be unable to get out ver fast which could cause a fall with injury. Bad posture can cause harm in neck, shoulder and back for both standing and setting (sic)."

Hill – cutting

- treated for stress, which doctor links to work
- trucks used to deliver work to cells are difficult to manoeuver – design's only been in use for about 6 months
- carpal tunnel surgery on both wrists in Dec./97 and Jan./98
- "I'm being treated for high B/P caused by hypertension and have headaches. Very much stressed out, I feel that it is caused by the job change."
- "The summer heat is going to be bad because we can't open the door and we can't turn the fans on because it blows the material. All the air we get is 2 little windows with slats."
- "<u>Stress</u> is the main factor right now. I feel I am giving 100% but at the present that doesn't seem to be enough. It is better on nights than days."
- too hot, can't open door because of new cutting machine
- can not use fans
- there are extra heavy rolls so much extra lifting
- "TOO MUCH STRESS."
- "everyone is lifting, pushing, pulling, standing in one place causes as much pain as moving about"
- could lift 38–pound rolls 50 – 100 times a day, depending on what doing (could be hand cutting, using spreader)
- "Summer heat. We only have 2 <u>small</u> windows with slats, no air conditioning for us but we get heat and fumes off office air conditioners. We have fans but can't use them because of new cutting system. We have a big garage door but can't open it because of new cutting system. We have no way to get any fresh air."
- "We are also extremely tired because of overtime."
- "The stress we are all under has caused my menstrual cycle to become irregular and other women are also having the same problem. My doctor told me it was due to stress I was under."

- “The new furnace put out gas from a leak and made us all sick. They said it is fixed but it still acts up.”
- “Trucks for work are very hard to move and some have wheels that don’t move at all causing excessive straining.”
- “We were denied new mats.”
- “The circular saw doesn’t stop very quick after it is turned off and is very heavy.”
- “Have complained about bolts of material being too heavy but nothing is done. They could put less yardage on bolts.”
- “Too many cords hanging in the way down on lay cutting area. One girl accidently cut through a cord and sparks started flying.”
- “The pressure and tension in here is at its worst.”
- “We are all scared of the spreader when the material gets stuck in the belt. We are afraid of getting our hands caught in belts.”
- very hot in summer – with closing door, “will be no air flow this summer”
- too much forced overtime
- “Stress, it’s an all over my body experience. Overtime is a killer. Too much forced overtime.
- The stress has messed up my <u>periods</u>, female area.
- “Moving the trucks around that are so hard to move hurts the arms and legs. Also I tripped (sic) over the legs of the trucks. Very dangerous.”
- Summer time. When it’s hot in here the office has there (sic) air conditioner on and the hot air from the air conditioner is on us. This summer will be worse. We are not allowed to open big door for fresh air that we are accustomed to.
- “We had a gas leak in here one time. That was fun. Nobody did anything about for about 2 hours.”
- “Accidents are not treated quickly enough. An accident should be taken care of immediately!”
- “When I fell at 6:00 AM I was not allowed to leave to go to the Dr. or E.R. until 8:30. And then only at my instance (sic). I worked for 2 hours before I went to the E.R.”
- still have pain but not all the time, from lifting

Vanguard – panels

- “Health–wise – break rooms and bathrooms nee attention every day, not just once a week. If people are temporary (sic) in a dept. I feel they should be taught everything there is to do and not just bore them with one thing to do all the time. It also makes it easier on the senior people to be able to switch to other jobs that will make it a little less monotonous (sic) on us.” (19 years seniority)
- bid job is roll/panel but fill in for absent sewing and cutting workers
- “Jack of all trades” is job do most often, working for company 10 + 18 years
- break area not clean – stuff spilled on floor – trash cans should be dumped daily
- women’s bathroom needs better cleaning
- janitor’s job eliminated – needs to be replaced so can keep areas clean

Vanguard – sewing (cells)

- complained to employer and workers’ comp but won’t help her
- had two CTS surgeries (July/97 and August/97) – doc told her not to return to job but company switched doctor
- feel intimidated by management to keep mouth shut

S could hardly walk when cells introduced

S super said was “in your head” —> so “mad and upset” put up with for a day and then insisted on seeing a doc who sent her to chiropractor–rheumatologist, not covered by compensation

S lots of stress, more than there ever used to be – team now, problem if one insists on doing things their way or other person doesn’t do the job

S “When we work 10 hours standing make back and legs hurt worse.”

S **“**I think for myself the machines should be at a height (sic) to suit the person working on it. The machine’s (sic) should be made to let up and down quickly to save time.”

Where are your aches and pains?

Please answer these questions as best you can. Your answers will be kept confidential. The results will be put together without anyone's name being used.

1. In the last <u>12 months</u>, have you had pain or discomfort in any area in the diagram?

   Yes No

2. **If yes**, please use the diagram to:

   a) mark where you had the pain or discomfort;

   b) rate the intensity or amount of pain or discomfort for each area, using the scale shown (draw a line from the area to the scale you use -- eg.

   ______________ 0 1 2 3 4 5

   c) did you report this to:

   a health care provider? Yes No

   your employer? Yes No

   workers compensation? Yes No

   d) were you off work? Yes No

   for how long? ______________

3. **If yes**, what caused the discomfort or pain?

Body area	Cause

4. We need to know a little about you:

Age ______________

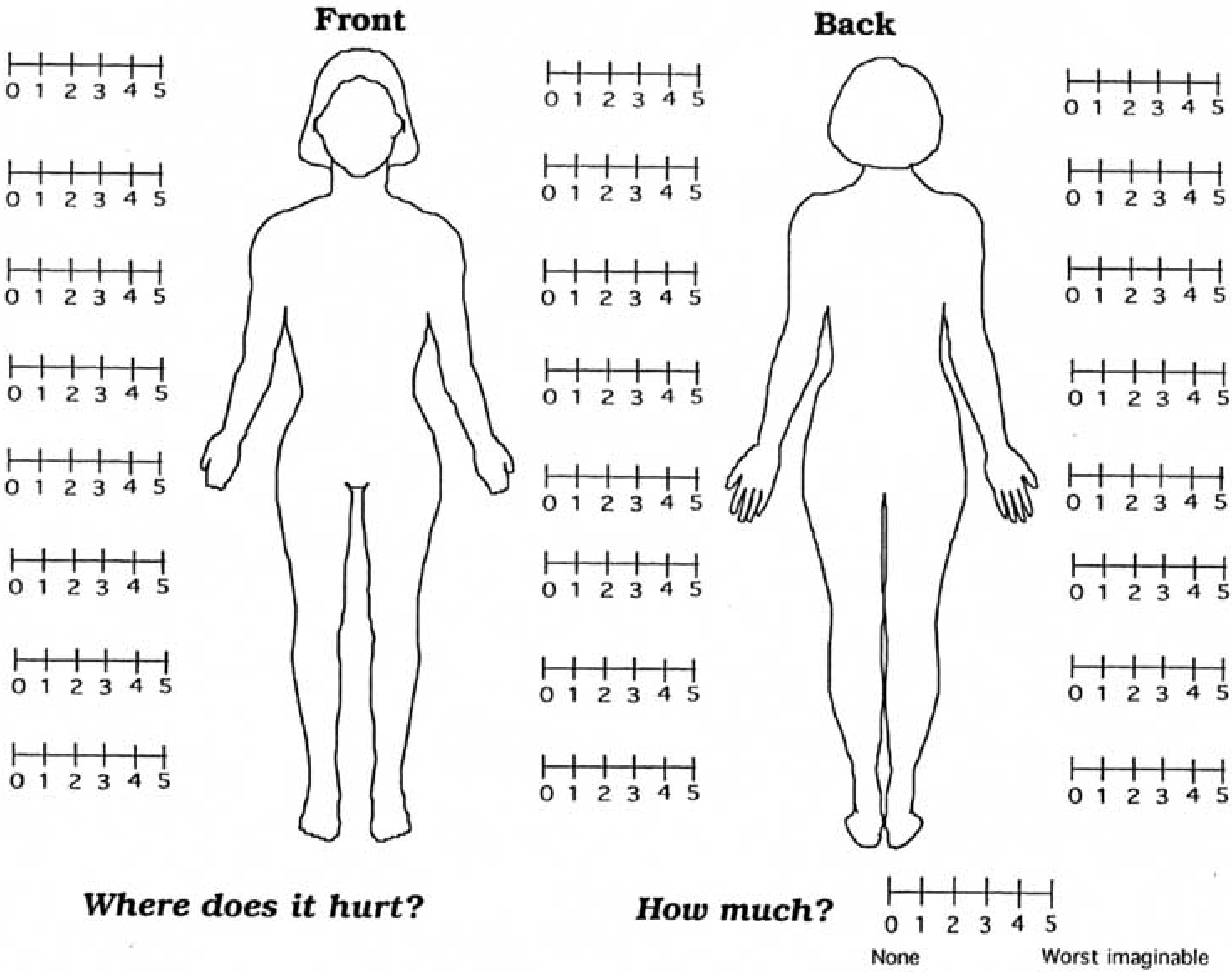
What job do you do most often? ______________

For how long have you been doing this job? ______________

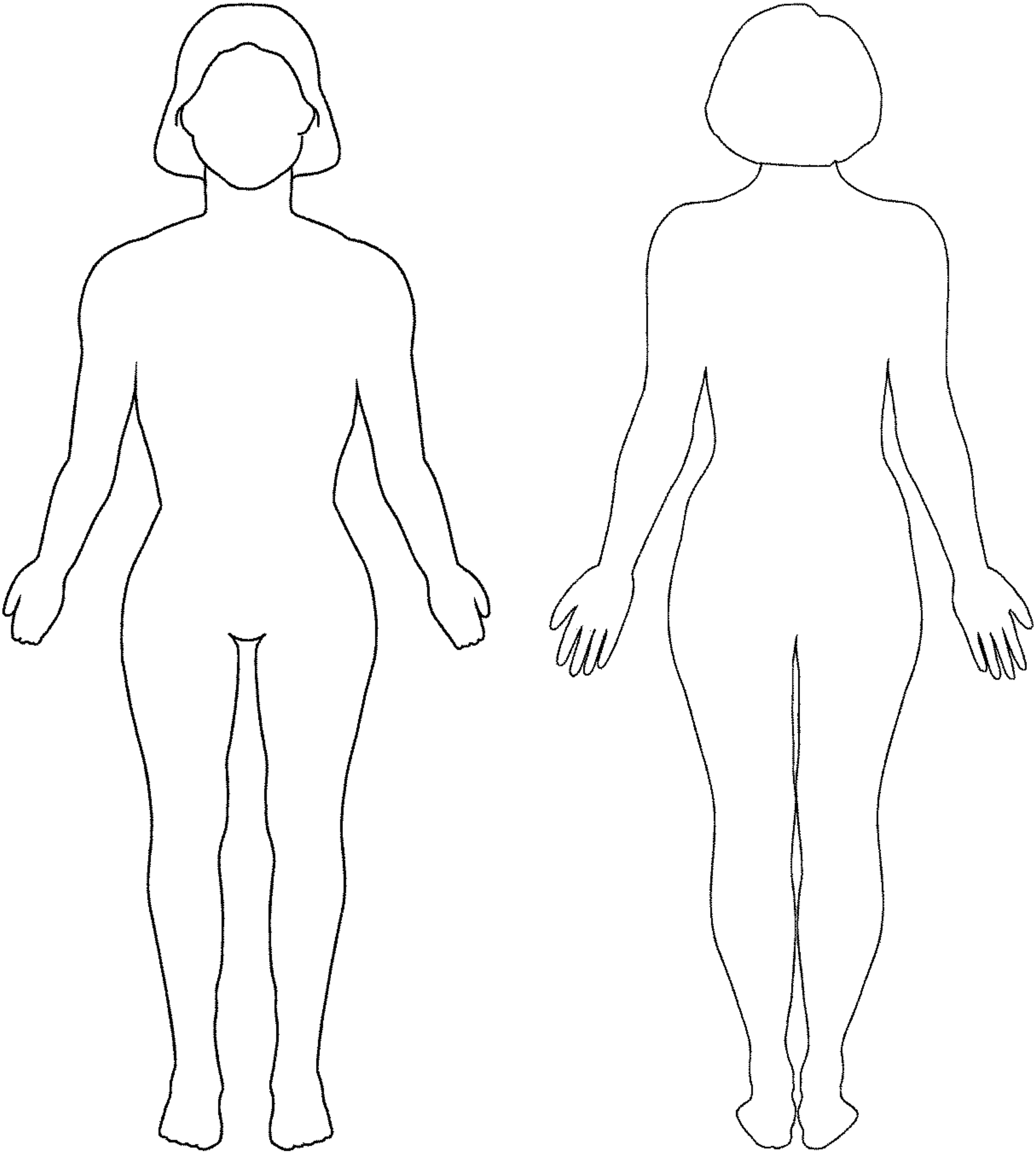
For how long have you worked for this company? ______________

5. Is there anything else you'd like to tell us about pain and discomfort you associate with your work?

Thank you.


Front
Back
0 1 2 3 4 5
Where does it hurt?
How much?
None
Worst imaginable

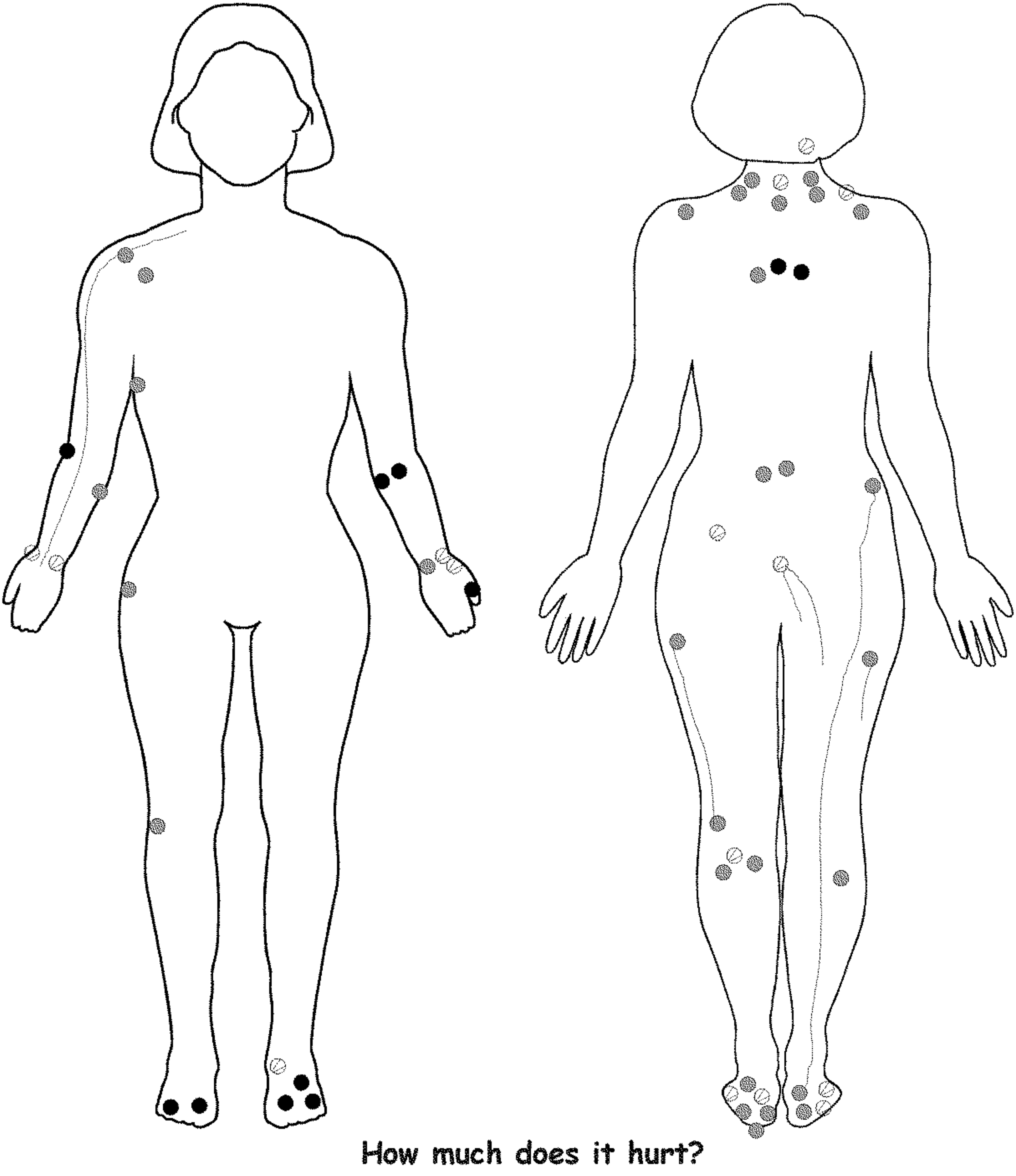
--   workers



How much does it hurt?

◌ Low (less than 2)   ◍ Medium (2 - 3)   ● High(more than 3)

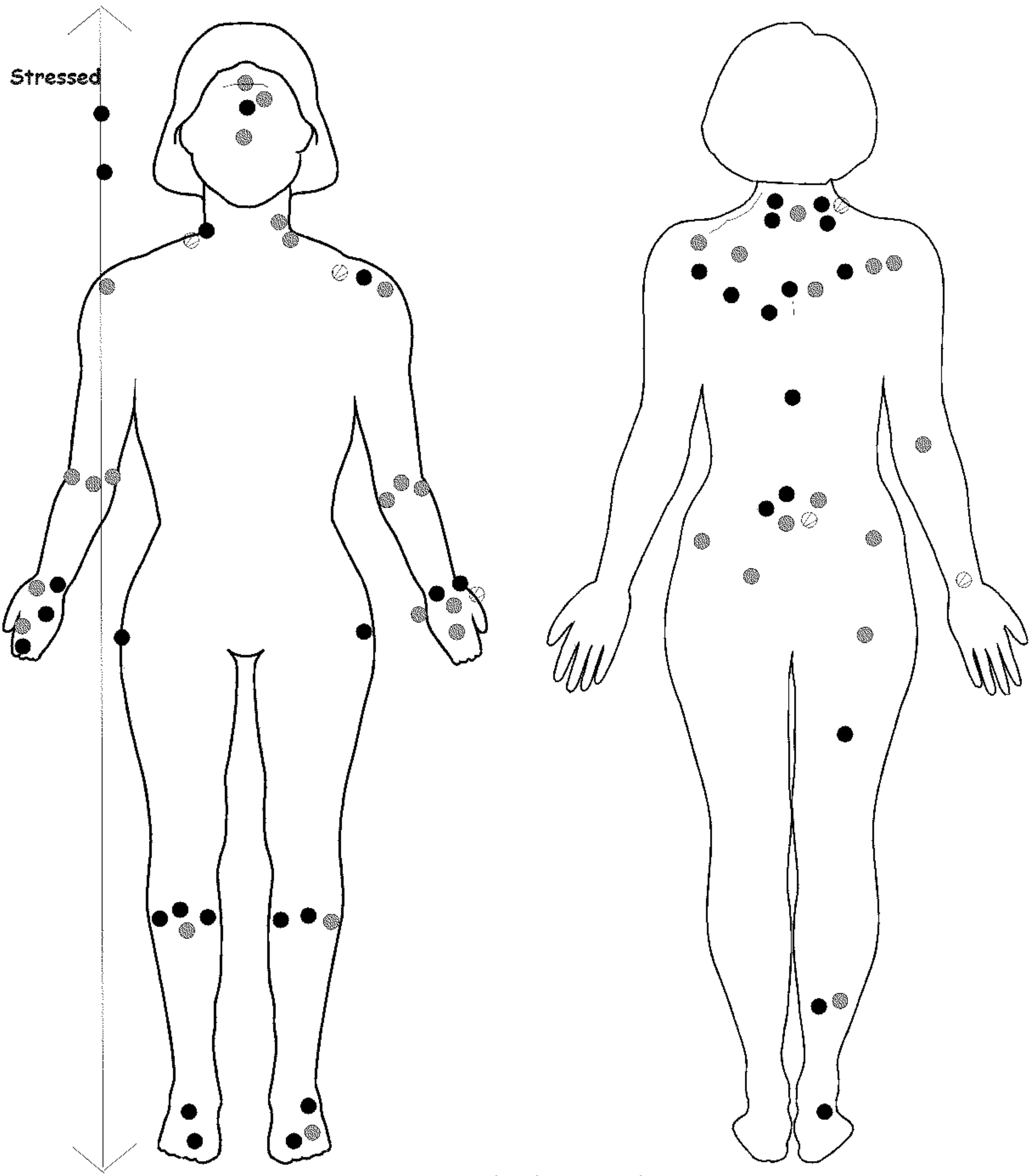
Hill sewing cells -- 14 workers



How much does it hurt?

Low (less than 2) Medium (2 - 3) High(more than 3)

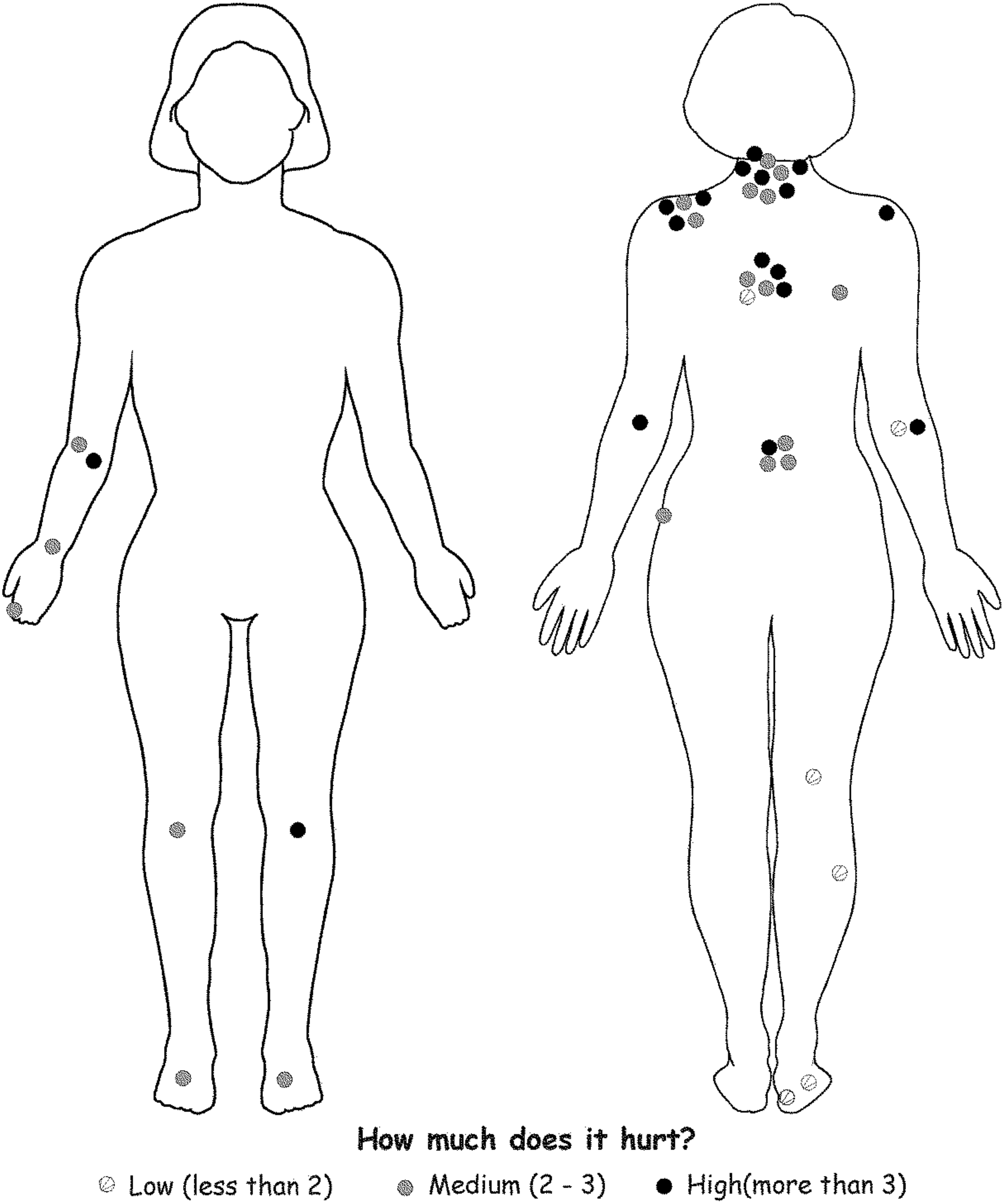
Hill cutting-- 10 workers



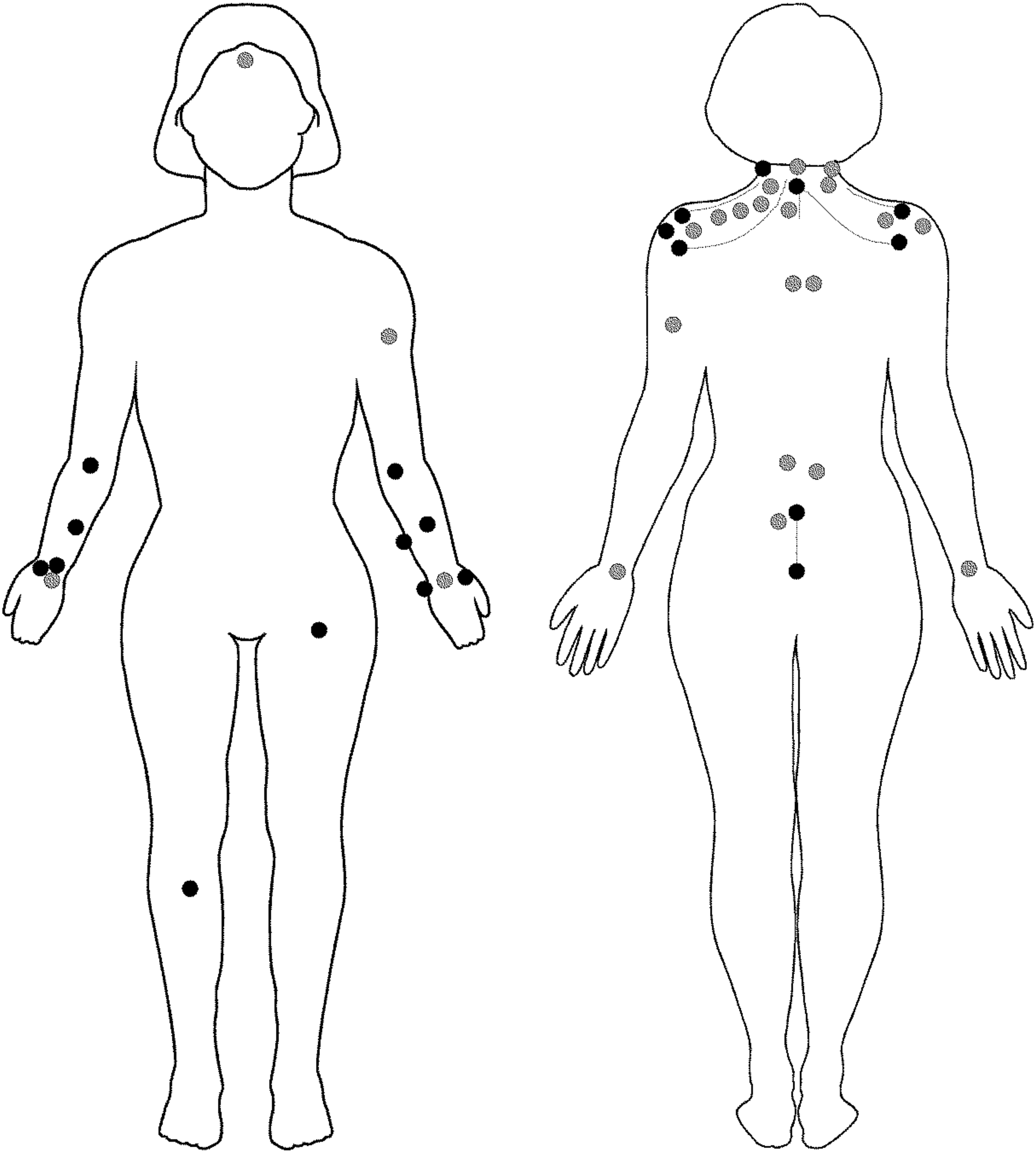
How much does it hurt?

Low (less than 2) Medium (2 - 3) High(more than 3)

Hill panels -- 9 workers



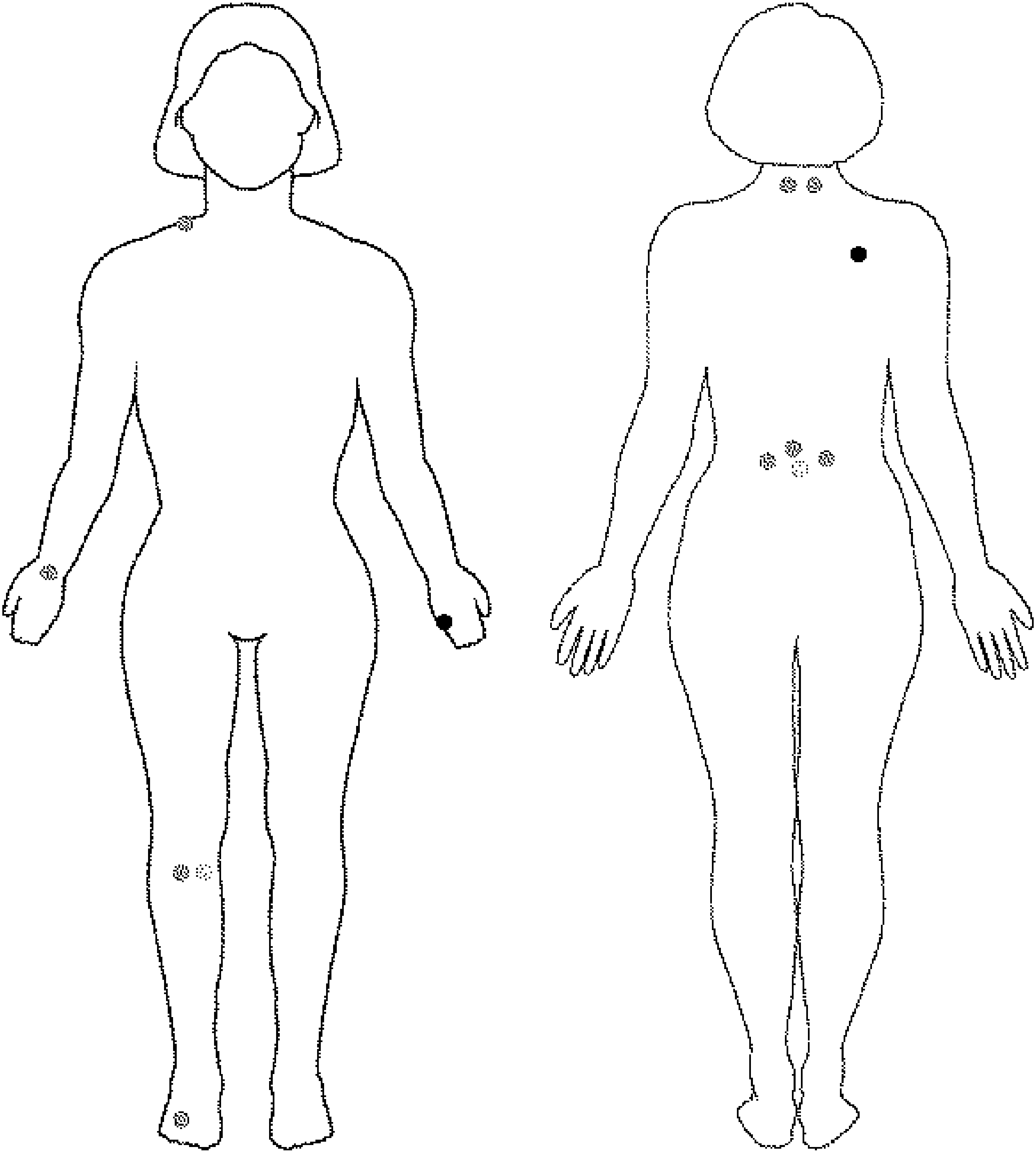
Hill sewing (old) -- 5 workers



How much does it hurt?

Low (less than 2) Medium (2 - 3) High(more than 3)

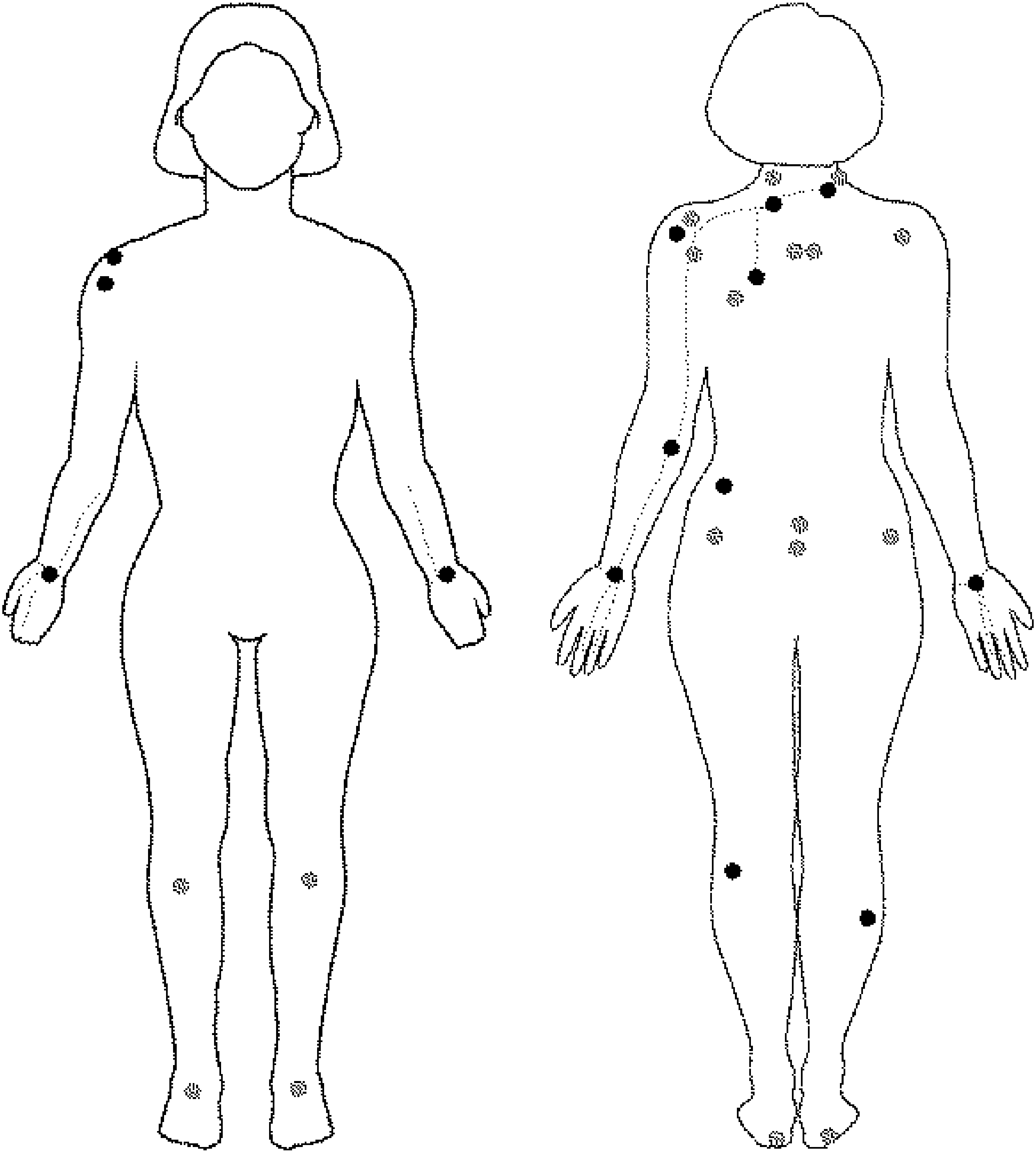
Vanguard panels -- 4 workers



How much does it hurt?

Low (less than 2)   Medium (2 - 3)   High(more than 3)

Vanguard sewing (cells) -- 7 workers



How much does it hurt?

Low (less than 2) Medium (2 - 3) High(more than 3)

For Information on Other
Occupational Safety and Health Concerns

Call NIOSH at:
1–800–35–NIOSH (356–4676)
or visit the NIOSH Homepage at:
http://www.cdc.gov/niosh/homepage.html

National Institute for Occupational Safety and Health
NIOSH

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! Safety and health at work for all people through research and prevention