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Accommodation Project for Physically Restricted Personnel. Phase II: Low Back Project

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Accommodation Project for Physically Restricted Personnel, Phase II: Low Back Project

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Abstract

This report presents a course outline and its associated criteria for a Back Pain Prevention Program for Sandia National Laboratories.

*On leave of absence from the Facultad de Medicina de la Universidad Autónoma de Chihuahua

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Introduction

Low back pain is one of the most common problems in our industrialized society.[1] It is estimated that over 80% of the population has at least one episode of low back pain during their lifetime.[2-7] As a cause of absenteeism from work, it is second only to upper respiratory infections.[8] Those individuals involved in moderate to heavy labor activity have a higher incidence of absenteeism due to back pain than do individuals performing light labor or sedentary work.[1]

The National Safety Council estimated there were 400 000 disabling back injuries in the United States in 1978. Of the total work-related injuries in the country, 20% involved the back.[9] In addition, the Liberty Mutual Life Insurance Company paid a total of $426M in compensation payments for back injuries during 1980. This represented $870K per day for each working day of the year. Liberty Mutual represents about 9% of the insured workers' compensation market.[10]

Sandia's experience with the low back problem is very similar to the national experience. It is a common cause for visits to our Industrial Medical Clinic, and it represents the single largest compensation payment for any one type of injury administered by our Workmen's Compensation Section.

Pathogenesis of Back Pain

The cause of low back pain (if there is such a thing as a single cause) is not fully understood. The etiology is most likely to be multicausal; i.e., it is the result of several factors acting in a given period of time. Back pain appears to be just as common (or perhaps even more common) in sedentary occupations as in those occupations where individuals are more active.[1,11] This is not incompatible with the previous statement that individuals doing heavy labor have more absenteeism. The fact remains that the actual incidence of back pain is really no more common in those individuals doing heavy labor, but it appears to be almost a universal complaint that activity (especially heavy activity) aggravates any preexisting back problem.

Certainly one of the generally accepted factors involved in low back pain is the gradual deterioration of the intervertebral disc (a pad of connective tissue located between each vertebra). This deterioration is rarely associated with isolated trauma but seems to be a degenerative process in which the disc gradually loses its elasticity because of changes in chemical and physical structure.

Multiple factors may act upon this degeneration process to produce what is known as the "Low Back Syndrome;" e.g., an individual with some degeneration may improperly lift a light to moderately heavy object and thereby cause acute pain. Both conditions (the degenerated spine and the physical stress) had to be present simultaneously in order for pain to develop. This is well summarized by Burton:[12]

> "The typical 'work-related back injury' is not a true injury but the final incident in a long series of insults and abuse to the spine ...Damage is directed primarily to the intervertebral discs and zygopophyseal (facet) joints. In the disc, tearing and fissuring of the annulus fibrosus are accompanied by progressive disruption and fragmentation of the nucleus pulposus, which then undergoes resorption as well as herniation through the now-incompetent annulus. The resultant loss of stability allows progressive abnormal movement of and stress on the facet joints, producing typical 'mechanical' low back pain and progressive subperiosteal bone deposition, leading to formation of osteophytes and enlargement of the facet joints themselves."

Within the industrial environment there appear to be three main possible pathophysiological routes by which back pain may be produced:

- Acute strain of a healthy back may occur when the low back structure is overstressed.
- A healthy back may suffer chronic strain (this may be better defined as a series of small acute strains with the individual failing to heal between episodes).
- An individual's low back may suffer an acute exacerbation of a preexisting degenerative problem.

Regardless of the possible etiologies that may underlie the low back problem, the individual will experience discomfort whenever undue external stresses are applied to his back; these stresses may include heavy lifting, continuous repetitive lifting, or continuous and/or repetitive postural stances in stressful positions.

All three pathophysiologic situations allow a preventive approach to the problem of pain. It is questionable as to whether or not any of the degenerative problems that develop over a long period of the individual's lifetime can be prevented. At the present time there is no evidence that this is true; however, it is recognized that many activities tend to aggravate pain in individuals with preexisting back problems. It is within this framework that a preventive program may be developed; our main priority is to prevent the increased severity so characteristic of low back pain.

The traditional means of back-pain prevention has been to teach the "correct method of lifting."[10] Innumerable commercial training programs have been tried in industry, but no significant reduction in back injuries has been found in companies employing these programs.[14-18] T. Anderson, the originator of the kinetic method of lifting, believes that the methods taught are fundamentally wrong because they are based upon mere mechanics. The actions of lifting are presented to workers as a drill in which the individual has to consciously regulate many parts of his body while performing the lift. He suggests that workers be taught good basic movement, not merely an imitation of a series of positions.[19]

We believe a back-pain prevention program should take advantage of certain types of information from three preexisting areas of knowledge:

1. Those workers involved in heavy lifting know the demands of the job and the easiest way for them to lift heavy objects, whether or not it is the "correct" method of lifting or not.
2. Knowledge of certain physiological parameters in the process of lifting, such as the increases in interdisc pressure created during certain movements of the spine, should be used.
3. There exists a body of knowledge created by those individuals who have low back problems; they know from experience what movements and what types of activities tend to exacerbate their preexisting condition.

A fourth element, absolutely essential to the development of a preventive program, is a very precise and detailed description of the various activities that have a high potential for producing or exacerbating low back pain. If these four sources of information can be used in the development of a simple program, it may be possible at least to relieve some of the problems associated with the low back experience.

Phase II of the Accommodation Project for Physically Restricted Personnel will use the job analysis data from Phase I to develop a back injury-prevention program that will have the following elements:

1. Develop a technique of manual handling that may be substituted for the methods presently used.
2. Develop alternate mechanical methods that may be substituted for the present manual techniques.
3. Develop a program to teach proper manual handling in the context of the identified jobs.

Epidemiology of Back Pain at Sandia National Laboratories

In November 1977, the Industrial Medical Department began using International Classification of Diseases (ICD) codes to computerize information regarding all patients consulting the medical department. With the help of F. W. Dippold of Sandia's Medical Administration Division (3321), the job title of each individual and the number of individuals who consulted the Medical Department for any type of back problem from November 1977 through December 1980 was obtained from the computer files. This information was used to compute the prevalence of back morbidity at SNL as well as its prevalence in each job severity classification (Table 1). The study showed that the workers in the semisedentary occupations had the lowest prevalence of back pain while the labor groups (labor and heavy labor classification) had a greater incidence of back pain complaints. These

findings are in agreement with those of other authors.[1 8 11] During this time there were 1076 individuals who consulted the Medical Department concerning back morbidity while only 172 accident reports listing back pain were filed. This may be explained by the intermittent nature of back pain as well as off-the-job injuries.

Lifting

The lifting requirements of the custodians, mail carriers, and nonskilled heavy laborers are summarized in Table 2. The lifting requirements of the custodial task vary less than those of the nonskilled heavy laborers, and therefore can be described more accurately.

Table 1. Sandia National Laboratories' Back Pain Experience From November 1977 Through December 1980

Class*	Number of Individual Back Pain Patients	Total Number Visits	Visits per Person	Mean Population	Mean Prevalence of Back Morbidity per 1000 Population
Sedentary	305	433	1.42	2565	119
Semisedentary	260	368	1.42	2275	114
Combined	285	461	1.62	2021	141
Labor	105	184	1.75	413	254
Heavy Labor	111	213	1.92	366	303
Unknown	10	13	1.3	44	227
Total	1076	1672	1.55	7684	
Total Back Injury Accident Reports Filed	172				

*Class = Job Severity Classification[11]

Table 2. Lifting Requirements of Selected Vocations

Vocation Major Lifting Tasks	Object: Weight Range (lb)	Object: Common Dimensions (inches unless otherwise noted)	Components of Lift: Horizontal (H)	Components of Lift: Vertical (V)	Location of Lift
Custodians					
Recycle Pickup	10 - 47	16×24×12 15×12×10½	6-35 in.	0 - 35 in.	Floor to waist height
Recycle Stacking	10 - 27	7½×3¼×14½	6 in. - 10 ft	(−)35 - 18 in.	Floor to knee height
Mop Squeezer	15	9½×12×16	<36 in.	<36 in.	Floor to waist height
Mop Bucket	14 - 20	15×17×14 ℄ handle	≤24 in.	≤36 in.	Ankle to waist height
Trash Baskets	1 - 18	15½×9½×13 to 18½×18½×29 ℄ handle	16 in. - 15 ft	≤35 in.	Midleg to waist height
Trash Bags	6.5 - 42	<35×35×35			
Trash Barrels	15 - 95	24×22×32 ℄ handles	6-12 in.	18 - 50 in.	Ankle to shoulder height
Restock Boxes	10 - 47	10×13×16	24 in. - 15 ft	6 - 48 in.	Ankle to shoulder height
Light Furniture	25 - 37	Variable	<6 ft	<24 in.	Knee to chest height
Light Debris	<3 oz	<1×1×1	<3 ft	<36 in.	Floor to waist height
Hand Tools	<4	Varied	Varied	Varied	Varied
Cleaning Machinery	40 - >100	Varied (large)			
Rugs	15 - 30	5×8 ft	<20 ft	<6 ft	Floor to reach height
Water Bucket	18 - 21	15×17×14 ℄ handle	Varied	<3 ft	Floor to waist height
Light Objects	<1	<4×4×4	Varied	Varied	Total range of motion
Mailcarriers					
Mail Baskets		36×17¼×11½	27-47 in.	8 - 12 in.	At waist height
Begin route	36 - >100				
End route	16 - 53				
Mail Pouches					
Begin route	6 - 75	<30×15½×9	Carried long distances on shoulder	Depends on personal height	From floor to shoulder Table to basket Basket to shoulder
End route	6 - 46				
Boxes	6 - 50	Varied from 12×10¼×5¼ to 22×27×13	27-62 in. 24-60 in. 24-47 in.	18 - 28 in. 12 - 30 in. 8 - 18 in.	Ankle to thorax height Ankle to thorax height Ankle to waist height
Ramps	77 - >100	36×54×¼ to 42×48×3½ ℄ arm	12-24 in.	24 - 48 in.	From ankle height
Mail Tubs	70	44×32×36	24-36 in.	24 - 35 in.	Ankle to waist height
Mail Carts	42 83	19×37½×30½ 20×36×33	24-36 in. ~12 in.	24 - 35 in. (−)6 to 6 in.	Ankle to waist height At waist height
Loose Mail	<10	Varied	2-16 in. Carried <50 ft	14 in.	At 39 to 54 in. above floor
Nonskilled Heavy Laborers					
Jack Hammer	95 33	36×6×6 30×4×4	Varied <50 ft	6 - 12 in. Varied	At waist height At waist height
Boxes	5 - >100	24×16×12 16×16×16 12×15×10	Varied <30 ft	24 - 36 in.	Floor to waist height
Furniture/Equip.	23 - >100	Varied	Varied	Varied	Floor to reach height
Trash Pickup	<1 - 50	Varied	Varied	Varied	Floor to reach height
Hand Tools	3 - 19	Varied	Varied	Varied	Floor to reach height

Lifting methods currently used by the above mentioned employees revealed the following 10 major unsafe lifting procedures and techniques:

1. Lifting items that weigh near the maximum of employee's physical capability.
2. Lifting heavy items above chest level.
3. Lifting with legs straight.
4. Lifting with a bent back.
5. Lifting with load held away from body.
6. Lifting without the body being balanced.
7. Twisting during a lift and/or carry.
8. Lifting from a cramped position.
9. Lowering load in any of the above positions.
10. Unilateral lifting and carrying of moderate to heavy loads.

Improper lifting is only one of the contributing factors causing exacerbation of back pain or an acute strain of a healthy back. Other activities which can contribute to back pain causation are repetitive and/or prolonged forward bending, prolonged sitting, repetitive twisting of the torso, static or dynamic pushing/pulling, and prolonged driving/riding in a motorized vehicle.

Specific tasks that have back-pain potential, along with the specific physical and ergonomic aspects of each task as currently performed by the observed SNL employees, are listed in Table 3 for the entry level labor positions and in Table 4 for the nonskilled laborers.

Table 3. Physical and Ergonomic Aspects of Tasks as Currently Performed at Sandia National Laboratories by Custodians and Mail Carriers

Vocation	Task	Physical and Ergonomic Aspects of Task
Custodians	Moving light furniture	Lifting from waist height, pulling, pushing with arms, twisting of torso.
	Spot scraping of floor	Kneeling, bending from waist with knees straight or bent, squatting, reaching.
	Picking up debris from floor	Very light lifting, bending from waist with knees straight or bent, back bent, squatting, reaching.
	Occasional reaching under heavy furniture	Light lifting with bent back and twisting of torso, reaching, pushing, and pulling.
	Push/pull wet mop	Forward, backward, sine wave, lateral and arching movements of arms, twisting of torso, bending from waist; effort ranges from wiping floor with wet mop to hard scrubbing.
	Rinsing and squeezing mop	Bending from waist with knees straight or bent, applying forceful downward pressure on squeezer handle, lifting of wet mop into and out of bucket.
	Pushing wheeled mop bucket	Pushing, pulling, bending, reaching.
	Sweeping: short handled broom	Bending forward from waist with knees straight or bent, kneeling, squatting, reaching, twisting torso.
	Vacuum cleaning	Pushing/pulling in forward and backward direction, bending from waist with or without bent knees, twisting of torso, unilateral reaching, and lifting of canister over small barriers.
	Recycle pick up	Lifting recycle boxes from floor or from stack no more than 3 ft high (vertical distance (v) = 0 to 35 in.); lateral movement of less than 3 ft (horizontal distance (h) = 6 to 35 in.) to cart or dolly; lowering of load and placement on cart or dolly stacked no more than three high (v = 0 to 35 in.).

Table 3. (Cont)

Vocation	Task	Physical and Ergonomic Aspects of Task
	Push four-wheeled cart or two-wheeled dolly	Pushing, lifting, twisting torso.
	Recycle stacking	Lift box from cart or dolly (v = −35 to 18 in.); horizontal movement of boxes to stack no more than two high (h = 6 in. to 10 ft); lowering of load usually accomplished during horizontal movement.
	Pushed wheeled trash barrel (occasionally carry large trash bag)	Pushing, pulling, twisting of torso, lifting, carrying.
	Lift and empty trash basket or small bag into barrel (or bag) v = 37 in., h = 16 in. to 15 ft)	Lifting, reaching, pulling, twisting of torso, bending.
	Replace trash basket or install new small bag	Bending, stooping.
	Pull out and replace wall-mounted trash baskets	Lifting, pulling, pushing.
	Remove and replace top and/or exterior sheath of some larger trash cans	Lifting, bending, carrying.
	Remove full large plastic bags from barrels if needed	Lifting, pulling.
	Replace large plastic bag if needed	Bending.
	Carry plastic bag occasionally	Carrying.
	Discard plastic bag with trash or empty trash barrel into dumpster (v = 18 to 50 in., h = 6 to 12 in.)	Lifting with knees bent or straight.
	"Scrub" restroom fixtures	Squatting, bending from waist with knees bent or straight, reaching, stooping, and twisting of torso.
	Dismantle vacuum canister	Lifting, twisting of torso.
	Scrub interior and exterior of canister	Bending with knees bent or straight, squatting, lateral bending, twisting of torso, unilateral hand and arm motion in scrubbing motion.
	Shake rugs	Lifting, bending from waist with knees bent or straight, squatting, reaching, carrying, vigorous up and down motion of arms with associated back and forth movements of trunk.
	Carrying water bucket	Unilateral lifting and carrying, static bending.
Mail Carriers	Sorting mail	Standing or sitting, reaching (v = 18 in., h = 15 to 44 in.); twisting of torso; walking (h = 4 ft 6 in. to 37 ft); lifting (v = 14 in., h = 2 to 16 in.) (bins stand 39 to 54 in. high and are 11 in. deep).
	Carry mail/boxes	Carrying boxes, bending from waist with knees straight or bent, stooping or squatting to pick up dropped items, boxes, mail pouches, etc.
	Organize and load/unload mail	Lifting, carrying, pushing, pulling, walking, pushing/pulling cart.

Table 3. (Cont)

Vocation	Task	Physical and Ergonomic Aspects of Task
	Driving/riding	Upper body twisting, turning, unilateral and bilateral arm motions.
		Great vibrational and shock compressional loading on spine with the currently used small motorized mail vehicles.
		Driver must bend from waist while seated, reach diagonally to the right and exert a significant force at arm's length to push or pull a lever to change transmission between forward and reverse.
	Pickup and delivery of mail	Kneeling, squatting, or bending to obtain computer runs.
	Put down mail pouch or stop mail cart	Repetitive forward bending.
	Carrying mail pouch	Unilateral lifting, bending from waist with knees bent or straight, stooping or squatting, repetitive bending and twisting of trunk, unilateral loading of spine and asymmetrical loading of knee joints due to support of pouch by only one side of body, bending, stooping, and/or squatting, carrying pouch up and down stair steps.
	Lifting and carrying boxes	Bimanual lifting, bending from waist with knees bent or straight, stooping or squatting, unilateral loading of musculoskeletal system or bilateral loading, bending forward, reaching, leaning.
	Lifting cart over curbs	Straight back lift from waist height; v = −6 in. to 6 in., h = 12 in.
	Lift ramps onto/from vehicle from dock	Lift, pull, push ramp (h = 12 to 24 in., v = 2 to 4 ft), unilateral or bimanual lift.
	Lift tubs and carts into/out of vehicles	Lift object with help from co-worker; h = 24 to 36 in., v = 24 to 35 in. from ankle to waist or waist to shoulder height; bending, reaching, and twisting of torso during lift.
	Lift basket into/out of vehicle	Lifting (v = 8 to 12 in. at waist height, h = 27 to 42 in.), twisting during lift increases risk of injury; action usually requires minimal bending, stooping, or squatting.
	Pushing baskets	Reaching, bending from waist, and pushing either unilaterally or bimanually.
	Pull baskets	Reaching, twisting of torso during pull, and pulling unilaterally (v = 8 to 12 in. at waist level, h = 27 to 36 in.).
	Push mail cart/mail tub	Pushing, pulling, sudden rotational forces, wheels catching in carpet, holes in road, or poor state of repair of cart greatly increase risk of musculoskeletal injury due to sudden unilateral and bilateral shear, tensile, and rotational forces created by sudden stoppage or change in direction of cart.

Table 4. Physical and Ergonomic Aspects of the Activities/Body Positions That Have Back Trauma Potential for Selected Nonskilled Heavy Laborers

Activity/ Body Position	Task Examples in Which the Activity/Body Position is a Component	Physical and Ergonomic Aspects
Lifting	Lifting, digging, pulling weeds, using pick, posthole digging, trash pick up, cement mixing, jack hammer, office moves	Lifting distances for these nonroutine type tasks encompass the entire lifting spectrum, with the majority of lifts occurring between midcalf and shoulder level. Knees and/or back may be straight or bent. Loading of the spine may be unilateral or bilateral. Often twisting occurs during the lift.
Carrying	Carrying items/tools, edging lawn, trash pickup, office moves	Back and/or knees may be bent or straight. Loading may be unilateral or bilateral. May involve climbing stairs.
Push/Pull	Moving wheeled furniture; pushing of cart; pushing lawn mower; moving of furniture, equipment, or boxes; pulling water hose; open/close door; pushing small items out of path; raking, sweeping, scooping with shovel; starting lawn mower; hoeing; using pick; mixing cement	Any dynamic or static push/pull action in any direction. Forward bending with a bent back is a common occurrence.
Bend/Leaning	Lowering tailgate; searching for small items; orientation; supporting/balancing equipment or furniture	Body in a forward or lateral bending position, and supported or partially supported by another object, or supporting another object.
Forward Bending	Searching for item, pull weeds, pick up trash, digging, ranking, hoeing, edging lawn, watering plants, using jack hammer, using pick, posthole digging, mixing cement.	Forward bending from waist with knees straight or slightly flexed.
	Digging, searching for item, pick up small objects.	Lateral bending from waist without actively lifting or carrying object.
Stooping	Looking for small items, hoeing, watering plants, digging	A forward leaning from the waist (less body angleation than with forward bending) with head lowered.
Twisting	Carrying, digging, trash pick up, lifting	Axial rotation of trunk in relation to pelvis.
Driving/ Riding	Truck, lawn mower, forklift, backhoe, tractor	Driving or riding in or operation of motorized vehicle may involve twisting of torso.

Mechanical Aids for Manual Materials Handling

The major materials-handling tasks performed by the custodians are trash pickup and removal, recycle collection and storage, and restocking supplies, which account for 21%, <1%, and 4%, respectively, of the "average" workday. The materials-handling tasks of the mail carriers involve the actual pickup and delivery of mail (14% of work time), carrying a mail pouch (4% of work time), carrying boxes (<1% of work time), lifting moderate to heavy items (~108/day), and pushing/pulling (9% of work time).

Because of the potential of the engineering and administrative modifications recommended in an earlier report[1] and the widespread area in which the material-handling tasks take place, we do not believe additional types of material-handling equipment are warranted at this time for the Grade 1 custodians or the Grade 33 mail carriers.

The materials-handling tasks performed by the nonskilled heavy laborers are more demanding in both frequency and actual weight lifted, especially for the "Telecon" crew and the Excavating crew. The Grounds crew occasionally requires extensive manual materials handling. In addition to the engineering and administrative modifications that were recommended in an earlier report,[20] the following mechanical aids are suggested:

1. A manually operated forklift with power lift and power drive, less than 30 in. wide, with tines less than 2 in. thick, and with a lifting capacity of at least 1500 lb. This piece of power equipment, to be used primarily by the "Telecon" crew, would greatly assist in the movement of furniture/equipment in office areas, especially in carpeted areas.
2. A very small skid-steer loader to be used primarily by the Grounds and Excavating crews. This piece of equipment will be very useful in hauling and spreading large quantities of gravel, fertilizer, rocks, earth, etc, into or out of cramped areas where the workers would otherwise be required to do it by hand.

Manual Materials Handling Training Program

We previously recommended that a training program in material handling be developed and instituted at SNL.[11,20] Such a program should provide basic training in proper lifting and body postures as well as job-specific material-handling techniques.

The training should be performed by experts in the various fields, with the administration, logistics, and follow-up studies performed by the training coordinator. The functional back anatomy, physiology, and biomechanical theories should be taught by a physical therapist, a nurse practitioner, physician assistant, or a biomedically trained safety professional. Preventive physical fitness should be taught by a physical therapist, exercise physiologist, or athletic trainer. A psychologist, physician, or counselor should teach the relaxation portion of the course. The basics of proper posture and lifting should be taught by an adequately trained safety professional with assistance from a registered physiotherapist. The job-specific lifting and posture requirements should be taught by each employee's immediate supervisor, who has been trained properly and certified with close liaison and technical support from the Safety Department.

The major advantage of an employee's supervisor teaching the job-specific materials-handling and posture techniques are as follows:

1. It reinforces the administrative policy that the supervisor is responsible for the proper job-related training of his/her employees.
2. The supervisor will be more conscious of (and more responsive to) the correct materials-handling performance of his/her workers.
3. Employees will become more interested in correct body postures and materials-handling techniques when their immediate supervisor has the responsibility and accountability for that portion of their training.
4. The immediate supervisor is in the best position to know the specific difficulties and hazards in his/her areas of responsibility.

Using a small group of experts to teach the basics has the advantages of increased acceptance of information coming from known authorities on the subject and a high potential to keep the program current by incorporating new information and research findings. The topics listed in the course outlined in Table 5 should be discussed on an elementary level only so a basic appreciation of the problem can be achieved. Most of the course time should be spent in the practical aspect of proper materials handling.

The general outline recommended for a Back Pain Prevention Program (BPPP) at SNL is a modification of the Back Care Clinic program outline[21] used at EG&G Las Vegas and is presented in Table 5. The EG&G program was modified in many ways, but the most important modification was the addition of the job-specific posture and material-handling training by the employees' immediate supervisor.

Table 5. Back Pain Prevention Program (BPPP) Outline

I. Basic Principles of Back Injury Prevention
  A. Introduction
    1. Theory and purpose of BPPP
    2. Incidence and prevalence of back injury
      a. National
      b. SNL
    3. Management authority, responsibility, and accountability
    4. Brief overview of course content
  B. Functional Anatomy, Physiology, and Biomechanics of the Back
    1. Basic function and structure of
      a. Vertebral column
      b. Intervertebral discs
      c. Spinal cord and nerve roots
      d. Muscle, ligaments, etc
        (1) Vertebral
        (2) Paravertebral
        (3) Ancillary
    2. Etiology, structural and functional changes, and associated body responses caused by
      a. Acute strain
      b. Chronic strain
      c. Degenerative processes
    3. Specific etiological roles of
      a. Poor physical conditioning
      b. Obesity
      c. Aging
      d. Degenerative diseases
      e. Acute trauma
      f. Chronic subacute trauma caused by poor posture, poor working habits, and improper material-handling techniques
    4. Theories regarding treatment of acute back pain.
  C. Preventive Physical Fitness
    1. Role of proper nutrition and weight control
    2. Advantages of whole body, cardovascular fitness
    3. Specific exercises to prevent acute back strain and exacerbations of chronic back pain with participation of course attendees
    4. Specific exercises to relieve acute back pain with participation of course attendees
    5. Exercises to avoid and why
  D. Basics of Proper Lifting Technique With Participation by Course Attendees
    1. Demonstrate and explain basic correct work postures and criteria for choosing each posture.
    2. Demonstrate and explain basic proper lifting technique and criteria for handling nonuniform items.
    3. Theories connecting poor lifting practices and poor work postures with back pain causation.
  E. Relaxation
    1. Explain interrelationships between stress and disease/injuries
    2. Etiology of various stress-related diseases
    3. Self-determination of degree of stress of each course attendee
    4. Methods of relaxation
  F. Course Summary
    1. Brief review of most important aspects of course
    2. General advice
    3. Orientation for Stage II

Table 5. (cont)

II. Job-Specific Posture and Materials-Handling Technique (to be taught by employees' immediate supervisor for those jobs in which a detailed job analysis has been performed)
   A. Explanation of job-specific materials-handling hazards
   B. Explanation of postures that increase risk of injury
   C. Criteria for choosing alternate postures
   D. Job-specific lifting techniques, using job-specific equipment with participation of employee
   E. Estimation of weight and center-of-gravity of packages/boxes of unknown weight.

During enrollment for the BPPP course, the participant should complete a questionnaire to determine if he/she has any physical limitation which would preclude him/her from participating in any portion of the course. If a participant has such a limitation, that person should still attend the course and participate to the extent possible. All course enrollees with any history of back or joint pain or injury should be examined by a physician and the physiotherapist; restrictions should be instituted when necessary. The basic principles of back injury prevention should be presented in a single half-day course with two appropriately spaced 15-min breaks. The Job-Specific Posture and Materials-Handling Section of the program should be taught on a different day but within 3 days of Stage I.

During both the Preventive Physical Fitness and Basics of Lifting portions of the program, the participants should be closely supervised to assure that they are performing the maneuvers correctly.

In the Basics of Proper Lifting Technique portion of the course, demonstration and practice should not be limited to the lifting of boxes. Sacks, pipes, tools, laboratory equipment, etc, should be used to teach the application of the basic principles to the various sizes, shapes, and weights of items that may be encountered. Both individual and team lifting should be taught. In the Job-Specific Posture and Materials-Handling Techniques portion of the course (Stage II), those items that the employee will encounter in his/her specific job should be used for training purposes.

The Job-Specific Posture and Materials-Handling Techniques should be taught to those employees who work at jobs that have undergone a detailed job analysis. After proper training and certification, the immediate supervisor will teach each of his/her employees. The length of time needed for such instruction will vary depending upon the job, but on the average should take about one hour. During the initiation of the course, the supervisor may need to train more than one employee at the same time, but as new employees enter the organization they should be instructed on a one-to-one basis by their immediate supervisor.

As more jobs are analyzed, more employees will be given the Job-Specific Posture and Material-Handling Technique portion of the course.

Priorities for course attendance should be as follows:

1. New employees in those jobs that have had a detailed job analysis.
2. New employees in other labor and heavy labor jobs.
3. Current employees in those jobs that have had a detailed job analysis.
4. Current employees in other labor and heavy labor jobs.
5. New employees in other jobs.
6. Current employees in other jobs on a first come, first serve basis.

Conclusions

Based on previously published job analyses,[11 20] ten major problem areas in lifting procedures and techniques are identified, lifting requirements for two labor jobs and one heavy labor job are identified and reported, and specific recommendations concerning mechanical aids are made.

A course outline and its associated criteria are presented for a Back Pain Prevention Program. This program differs from most other industrial back programs in that specific postures and material-handling requirements are taught by each employee's supervisor, based on information obtained from detailed job analyses on each individual job.

References

[1]A. L. Nachemson, "Low Back Pain, Its Etiology and Treatment," *Clinical Medicine*, 78:18-24, 1971.

[2]C. Hirsch et al, *Clin Orthop*, 63:171, 1969.

[3]J. Horal, "The Clinical Appearance of Low Back Disorders in the City of Gothenburg, Sweden," *Acta Orthop Scand*, Suppl. 118, 1969.

[4]L. Hult, "The Munkfors Investigation," *Acta Orthop Scand*, Suppl. 16, 1954.

[5]L. Hult, "Cervical, Dorsal, and Lumbar Spinal Syndromes: A Field Investigation of a Nonselected Material of 1200 Workers in Different Occupations With Special Reference to Disc Degeneration and So-Called Muscular Rheumatism," *Acta Orthop Scand*, Suppl. 17, 1954.

[6]M. L. Rowe, "Low Back Pain in Industry: Updated Position," *Journal of Occupational Medicine*, 13(10):476-478, 1971.

[7]C. Hirsch, "Etiology and Pathogenesis of Low Back Pain," *Israel Journal of Medical Science*, 2(3):362-370, 1966.

[8]M. L. Rowe, "Low Back Pain in Industry," *Journal of Occupational Medicine*, 11(4):161-169, 1969.

[9]*Accident Facts* (Chicago, IL: National Safety Council, 1978) p 26.

[10]J. A. Antonakes, "Claims Cost of Back Pain," *Best's Review Property/Casualty Insurance Edition* 82(5):30,1981.

[11]L. L. Young and P. B. Mossman, *Accommodation Project for Physically Restricted Personnel Phase I, Job-Based Criteria*, SAND82-1023 (Albuquerque: Sandia National Laboratories, August 1982).

[12]E. Grandjean, *Fitting the Task to the Man* (London: Taylor and Francis Ltd, 1980).

[13]C. V. Burton, "Conservative Management of Low Back Pain," *Postgraduate Medicine*, 70(5):168-183, 1981.

[14]S. H. Snook and V. M. Ciriello, "Low Back Pain in Industry," *ASSE Journal*, April 1972.

[15]S. H. Snook, *Psychophysiological Indices, What People Will Do In: Safety in Manual Materials Handling* (C. G. Dury, ed) (Washington, DC: DHEW (NIOSH) Publication No. 78-185, 1978) p 63-67.

[16]J. R. Brown, *Lifting as an Industrial Hazard* (Toronto: Labour Safety Council of Ontario, Ontario Department of Labour, 1971).

[17]A. Garg and M. M. Ayoub, "What Criteria Exist for Determining How Much Load Can Be Lifted Safely?," *Human Factors* 22(4):475-486, 1980.

[18]A. Garg and V. Saxena, "Container Characteristics and Maximum Acceptable Weight of Lift," *Human Factors* 22(4):487-495, 1980.

[19]T. M. Anderson, "Human Kinetics in Strain Prevention," *The British Journal of Occupational Safety* 8(93):248-250, 1970.

[20]L. L. Young and P. B. Mossman, *Accommodation Project for Physically Restricted Personnel Phase I Addendum - Job-Based Criteria for Nonskilled Heavy Laborers*, SAND82-1354 (Albuquerque, NM: Sandia National Laboratories, August 1982).

[21]*Back Care Clinic* (Las Vegas, NV: EG&G Energy Measurements Group, Las Vegas Operations, June 23, 1982).

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