



Florida Cooperative Extension Service

Proper Lifting, Pushing and Pulling to Prevent Strains, Sprains and Lower Back Pain¹

William J. Becker²

Injuries--such as lifting, pushing and pulling--are caused by overexertion and are among the more frequent types of occupational injuries in the United States. They happen to both men and women, and to workers of all ages. These kinds of injuries--along with slips, trips and falls--result in sprains, strains, hernias and lower back pains. Next to headaches, these types of injuries are the second most common medical complaint in our country. Furthermore, next to colds, they are the second greatest cause of lost workdays in the general work force.

THE COST OF INJURIES

Back injuries alone cost American industry 10 to 14 billion dollars in workers' compensation costs and about 100 million work days annually. Add the costs of hernias, sprains and strains to other body parts and it is evident that these types of injuries are the major accident cost in the workplace.

INJURIES IN FLORIDA AGRICULTURE

The problem is severe in Florida agriculture. There are in excess of 3,000 serious injuries to agricultural workers annually. (A serious injury is defined as one which results in the worker missing one week or more of employment.) Approximately 75 percent of these injuries is the result of improper lifting, pulling, pushing (overexertion) or from slips, trips and falls. Of these injuries, 40 percent or more

are sprains and strains and of these nearly 50 percent are to the back. Most of the remaining sprains and strains are to joints of the lower or upper extremities: the knees, ankles, hips, the wrist, elbow or shoulder.

As shown in Table 1, the percentage of serious injuries caused by lifting, pushing and pulling in the seven major occupational areas in agriculture range from a low of 43.5 percent in livestock production to a high of 65 percent in horticultural production occupations. The vast majority of these serious accidents results in sprains and strains.

Another important cause of sprains and strains are slips, trips and falls. These account for a total of 12 percent in horticultural service occupations to 32.1 percent of the injuries in livestock production occupations.

THE COST OF WORKERS' COMPENSATION

Workers' compensation costs for these serious accidents resulting in sprains and strains range from an average of \$3,647 in livestock production occupations to \$6,899 in horticultural service occupations. Such accidents cost Florida's agricultural industry well over 10 million dollars annually in workers' compensation alone. Add to this the pain and suffering and the disruption to families and businesses, it becomes apparent that prevention of these problems need to be addressed.

1. This document, Circular 823, was published July 1989 and last reviewed October 1992 by the Florida Cooperative Extension Service. For more information contact your county Cooperative Extension Service office.
2. Professor and Extension Safety Specialist, Agricultural Engineering Department, Cooperative Extension Service, Institute of Food and Agricultural Sciences (IFAS), University of Florida, Gainesville, Florida 32611.

The Institute of Food and Agricultural Sciences is an equal opportunity/affirmative action employer authorized to provide research, educational information and other services only to individuals and institutions that function without regard to race, color, sex, age, handicap, or national origin. For information on obtaining other extension publications, contact your county Cooperative Extension Service office.

Florida Cooperative Extension Service / Institute of Food and Agricultural Sciences / University of Florida / John T. Woeste, Dean

Table 1. Types of accidents in the various occupational areas leading to serious sprains and strains and their costs.*

Occupational Area	Percentage of Accidents			Average Cost of Accident
	Lifts, Pulls, Pushes (overexertion)	Slips, Trips, Falls (all types)	Other	
Livestock Production	43.5	32.1	24.4	\$3,647
Fruit and Vegetable Production	47.0	28.0	25.0	3,771
General Farm Production	51.9	30.4	17.7	5,373
Horticulture Production	65.0	17.0	18.0	6,274
Agricultural Services	51.0	23.0	26.0	5,340
Livestock Services	60.0	26.0	14.0	6,034
Horticultural Services	51.0	12.0	37.0	6,899

* Based on 1987 statistics provided by the Florida Division of Workers' Compensation.

Table 2. Body parts most frequently affected by sprains and strains.

Occupational Area	Percentage of all accidents which are sprains and strains	Percentage			
		Back	Upper Extremities	Lower Extremities	Other Locations
Livestock Production	33.2	45.0	20.9	27.5	6.6
Fruit and Vegetable Production	46.5	45.0	21.0	27.5	9.0
General Farm Production	46.8	46.0	22.6	21.3	10.0
Horticulture Production	30.3	46.0	20.0	24.0	10.0
Agricultural Services	40.0	48.0	17.0	22.0	13.0
Livestock Services	39.0	50.0	10.0	22.0	8.0
Horticultural Services	42.0	55.0	12.0	26.0	7.0

LOCATIONS OF INJURIES TO THE BODY

In two occupational areas--fruit and vegetable production and general farm production--nearly 50 percent of all serious accidents are sprains and strains. See Table 2. This table also indicates that in all the occupational areas, 45 to 55 percent of serious sprains and strains are to the back. These figures certainly

provide evidence that those conditions or activities which result in sprains and strains are a major safety problem in Florida's agricultural occupations.

The portions of the upper extremities most frequently experiencing a serious sprain or strain are the shoulder and wrist. For the lower extremities, the knee is most frequently sprained or strained.

DEFINITIONS OF TERMS USED IN THIS ARTICLE

Some terms used throughout this publication are defined below. These are:

Acute pain is a "self-limiting" condition that often improves and disappears within a few days to a few weeks.

Chronic pain is a persistent condition or one that recurs from time to time.

Lower back pain can be the result of damaged ligaments or muscles, but can also be the result of ruptured or slipped discs, arthritis, stress and several other causes.

Serious injury, as used in this publication, is one which causes the employee to miss one week or more of work.

Sprain is defined as the stretching or tearing of ligaments from a sudden or violent twist of a joint.

Strain is defined as the stretching or tearing of muscles from a sudden or violent action.

CAUSES OF LIFTING, PULLING AND PUSHING INJURIES

If one would look at a typical joint in the human body, be it a finger, wrist, elbow, shoulder, hip, knee, ankle or toe, you would find it to be a place where two or more bones meet, held in place by ligaments and muscles. Excessive stress on the joint from lifting, movement or other trauma can cause excessive stretching or tearing of the muscles (strain) or ligaments (sprain) resulting in acute pain.

Taking a look at the human back (Figure 1), we see a column of 33 vertebrae separated by small, round discs filled with a thick fluid, all held together by ligaments and muscles. If the ligaments and muscles are weak, the vertebrae and discs can become misaligned, usually in the lower back at or below the belt line. With excessive lifting, a sudden fall, or other traumatic action a disc can rupture or slip. Over a period of years of back overuse, and with aging, the discs may simply "wear out" and the individual may live with chronic pain for years. Other back pain can be a muscle strain or a ligament sprain. These acute injuries normally heal within a few days.

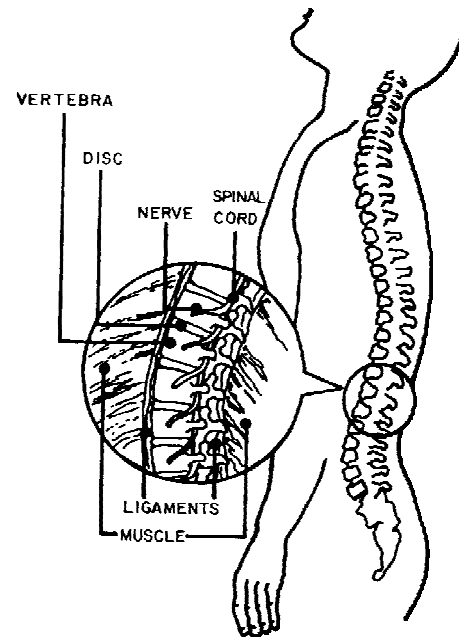


Figure 1. The human back showing the area which is frequently injured, resulting in lower back pain.

RESPONSIBILITY FOR INJURIES

As early as the 1930's, researchers pointed out that 80 to 90 percent of all accidents are caused by the "unsafe acts of persons" as opposed to "unsafe mechanical or physical conditions." Human failure, they indicated, is the primary cause of accidents. Therefore, you are most often the cause of these injuries and you must assume the responsibility to prevent them.

Our human failures are in three major areas:

The cognitive area: Our thoughts, attitudes and opinions.

The psychological area: Our feelings and emotions.

The physiological area: Our strength, reaction times and health.

Combining these human failures compounds the risk of injury. Example: If we "think" (cognitive) that lifting a bulky 100 pound object is safe, if our "macho" emotion (psychological) encourages us to prove it, but our strength (physiological) fails, the result can be a serious back injury, not caused by the heavy object,

but by human error. Our beliefs, our feelings, and our own physical limitations get us in trouble.

Poor physical condition, poor posture, lack of exercise, and excessive body weight contribute to the number and severity of sprains and strains. Degeneration of the spine, due to aging, is also a major contributor to lower back pain, but is frequently misdiagnosed as a sprain or strain. Only four percent of all serious back injuries are true sprains, strains or fractures, and most are the results of degeneration of the spine caused by aging and the abuse we give our back. Most back injuries, however, occur in persons 24 to 40 years of age.

There is little evidence that heavy vs. light work affects back problems; indeed, it appears that individuals who regularly do heavy work have fewer back problems. Dr. David Imrie, a noted back specialist, in his book "Goodbye Backache" says, "If you go to underdeveloped countries where people work much harder physically than we do, you hardly hear of backaches. You have to wonder if the problem is not that people these days do too much, but too little." It is not so much how much we lift or move, it's how we do it and how we maintain our body. It seems that back injuries, sprains, strains and degenerative problems are associated more with physical conditioning and body mechanics. Back injuries can be minimized by better physical conditioning, which results in stronger muscles to hold the spine in proper alignment, as well as by less body weight for the back to support.

Another cause of strains and strains is our practice of lifting, pushing or pulling when our muscles are stiff or at rest. Athletes never participate in rigorous activity without first loosening up and stretching. They call it "warming up". They are "waking-up" their muscles and increasing the flow of blood to these muscles. Athletes do not go from a state of "at rest" to physical activity without first "waking-up" their muscles.

The design of work stations is another cause of sprains, strains and back pain. Workers should be able to maintain proper posture while working. Prolonged sitting or standing, particularly in uncomfortable positions, can cause muscle fatigue which then leads to leg and back problems. Work stations or practices which cause workers to stand, stoop, reach, or twist improperly can also promote sprains and strains.

Attempting to lift or otherwise physically move a heavy object, or repetitive moves of even light-weight objects, along with slips, trips and falls, including jumps, are other causes of sprains and strains.

PREVENTION OF LIFTING, PUSHING AND PULLING INJURIES

There are two methods for reducing sprains and strains in the workplace: design and work practice modification.

Design Modification

By redesigning the workplace it might be possible to eliminate the lifting, pushing and pulling entirely by mechanical means. Examples: Use forklifts to move items, self-propelled or riding lawn mowers do not require pushing, and mechanical power to eliminate some pulling activities.

Another design modification would be to change the size, shape and weight of the container. This has been done in many areas. Example: Feed, seed and fertilizer bags in the 80 or 100 pound sizes are no longer common. Nevertheless, many objects are still difficult to handle. Easier, safer methods of moving or lifting materials should constantly be sought.

Work stations, for workers who spend long hours in a standing or seated position, must be designed to reduce stress to the back and legs. A cushioned floor, a low footrest to enable workers to raise and lower their legs, and a work table of proper height are all important.

Seated workers should be at a height comfortable for their work. Their knees should be slightly higher than their hips, and a footrest should be provided. The seat should provide support for the lower back. Finally, the work should be arranged to minimize stooping, excessive reaching and twisting at the waist.

Work Practice Modifications

Workers can modify their work practices in the following ways:

- Lift objects comfortably, not necessarily the quickest or easiest way.
- Lift, push, and pull with your legs, not your arms or back.

- When changing direction while moving an object, turn with your feet, not by twisting at the waist.
- Avoid lifting higher than your shoulder height. Use a step stool or ladder to move objects at these heights.
- When sitting, sit with your knees slightly higher than your hips, with a firm backrest for your lower back. Move, cross and uncross your legs frequently.
- Sit in a vehicle as you sit in a chair, with your knees slightly above your hips, with support for your lower back.
- When standing while working, stand straight. Avoid bending at your waist. For prolonged standing, use a low footstool for alternate resting of your legs and for altering your stance. Wear comfortable, supportive shoes.
- When walking, maintain an erect posture, wear slip-resistant, supportive shoes. The majority of slips, trips and falls can be prevented by wearing quality work shoes with slip-resistant heels and soles.
- When carrying heavy objects, carry them close to the body and avoid carrying them in one hand.
- When heavy or bulky objects need to be moved, obtain help or use a mechanical aid such as a dolly, hand truck, forklift, etc.
- When stepping down from a height of more than eight inches, step down backwards, not forward.

LIFTING THEORIES AND TECHNIQUES:

There are numerous lifting theories and techniques, of which the "straight-back, lift-with-your-legs approach", is the most common and most frequently promoted. But after decades of promotion and training this approach to lifting has not been widely accepted by workers, and there is little or no evidence that it has reduced the number or severity of injuries.

In more recent years, numerous other theories and techniques have been promoted, criticized and discarded. There are hip-flexing, kinetic-lifting, stooped-posture and pelvic-tilt techniques, among others, which all have both positive and negative

considerations. Presently, however, there is no "one-best" lifting method for all lifts, for all people.

Basically, there are seven rules for safe lifting which have been developed over the years. Some of these are similar to rules of the past; others are new and different. They are presented below:

Lift Comfortably. Choose the position that feels best, with or without a straight back.

Avoid Unnecessary Bending. Do not place objects on the floor if they must be picked up again later.

Avoid Unnecessary Twisting. Turn your feet, not your hips or shoulders. Leave enough room to shift your feet so as not to have to twist.

Avoid Reaching Out. Handle heavy objects close to the body. Avoid a long reach to pick up an object.

Avoid Excessive Weights. If the load is too heavy, get help or use a mechanical device, if possible.

Lift Gradually. Lift slowly, smoothly and without jerking.

Keep in Good Physical Shape. Get proper exercise and maintain a good diet.

AT-HOME MODIFICATIONS

Sprains, strains and lower back pain on the job can be partially caused by what you do or do not do at home. Below are some recommendations to follow.

- Maintain a reasonable weight, eat nutritious meals, and exercise to maintain well-conditioned muscles.
- Sleep on a firm mattress and avoid sleeping on your stomach. When sleeping on your side or back, bend your knees. Place a pillow under your head, another between or beneath your knees.
- When you awake, remember that your muscles are still at rest. Gradually stretch your leg, arm, back and stomach muscles before you get up. Do some more stretching exercises after you are out of bed. Some exercises for your consideration are provided in the section entitled, "Treatment of Lifting, Pushing, and Pulling Injuries." Early

morning is the recommended time for these exercises, but any time of the day is all right. More important than the time of day is the development of a regular exercise program. This is particularly important for individuals who do limited physical work, but a regular exercise program is also valuable for individuals who are involved in heavy physical labor.

THINK BEFORE YOU LIFT

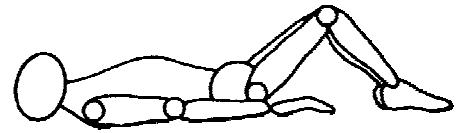
There is one final important rule: "**THINK BEFORE YOU LIFT**". It is better for workers to use their own common sense than to teach them specific lifting, pushing, pulling, walking, climbing or jumping procedures. This is not to imply that unsafe behaviors should not be pointed out to others and corrected. For example, "common sense" may tell certain people to jump down from heights of several feet. Certainly, when people exhibit this type of behavior or when they attempt to carry two hundred pounds, the errors of their behavior should be brought to their attention. Remember, you are the major cause of your injuries; therefore, you have the major responsibility for preventing them.

EXERCISES TO IMPROVE YOUR PHYSICAL CONDITION

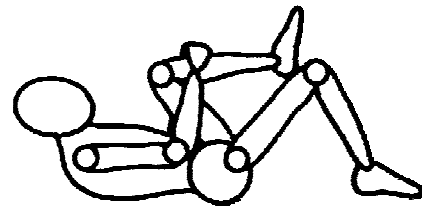
Below are some recommended exercises to strengthen and increase the flexibility of important muscle groups, particularly in your back, abdomen and legs. These exercises are NOT designed to increase endurance, strengthen your heart or improve circulation. To accomplish such goals, aerobic-type exercises such as fast-paced walking, jogging, running, dancing or swimming are required.

The following exercises ARE designed to increase flexibility and strengthen and condition your muscles. They need not be exhausting.

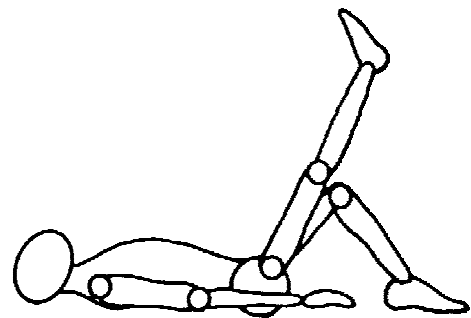
HOWEVER, AS WITH ANY EXERCISE PROGRAM, IT IS RECOMMENDED THAT THESE EXERCISES BE CONDUCTED WITH THE APPROVAL OF YOUR PHYSICIAN. IF ANY PAIN DEVELOPS AND PERSISTS, MEDICAL ATTENTION SHOULD BE SOUGHT IMMEDIATELY.



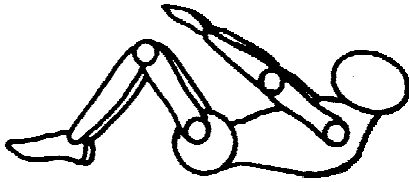
PELVIC TILT: Lie on your back with knees bent and your forearms behind your head. Keep your back down. Firmly tighten your buttock muscles, hold for five seconds and relax. Repeat this exercise five times.



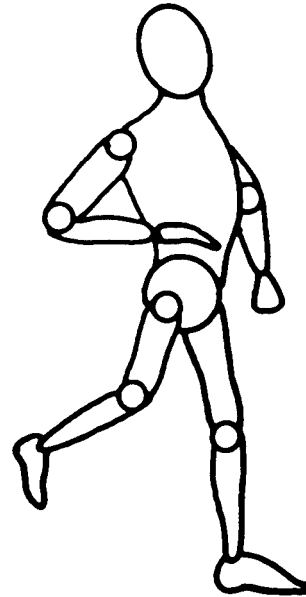
KNEE-TO-CHEST RAISE: Again, lie on your back with knees bent, your forearms behind your head. Raise your right knee to your chest, hold for five seconds, and return the leg to the starting position. Repeat the exercise five times with each leg. Then repeat the exercise five times raising both legs at the same time.



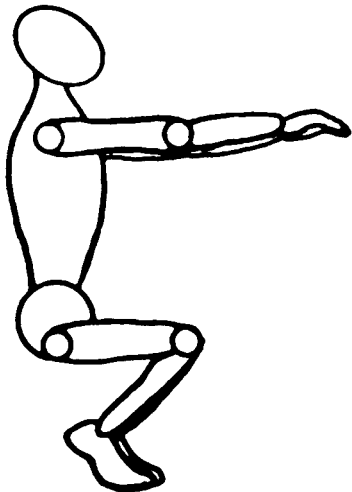
SINGLE LEG RAISE: Assume the same position, on your back, knees bent and forearms behind your head. Slowly raise one leg while straightening it out, then raise it as far as possible. Hold for five seconds and slowly return the leg to the starting position. Repeat the exercise five times with each leg.



HALF SIT-UP: Assume the same position, on your back with knees bent, but with your arms crossed over your chest. Slowly raise your head and neck until your chin touches your chest. Continue raising, stretching your hands to your knees. Hold for five seconds and then slowly return to the starting position. Repeat the exercise five times.



HAMSTRING STRETCH: Sit on the floor, legs straight out in front of you with toes up, heels no more than six inches apart. Bend forward slowly reaching for your toes. Hold forward position for five seconds and slowly return to the starting position. Repeat the exercise five times.



STRAIGHT BACK BEND: Assume the standing position, feet no more than six inches apart, arms to your side. Bend at the hips and knees until thighs are parallel to the floor. Hold for five seconds, raise to standing position. Repeat the exercise five times.

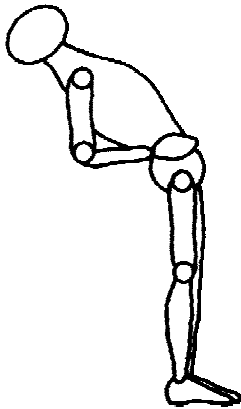
OVERALL CONDITIONING: If physical activity is not part of your daily routine, regular aerobic exercise should be. Aerobic exercise, such as running, walking or swimming, will help keep your body in condition.

AGAIN, THESE TYPES OF ACTIVITIES SHOULD BE DONE WITH THE APPROVAL OF YOUR PHYSICIAN.

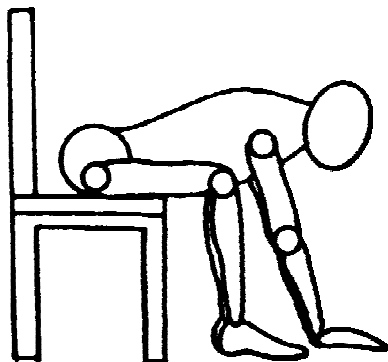
TREATMENT OF LIFTING, PUSHING AND PULLING INJURIES

Muscle fatigue, cramps and spasms are symptoms that muscles have been overworked. This can lead to the more serious problem of muscle strain or pull. Rest, gentle massage, and the application of cold packs for a short time can be helpful.

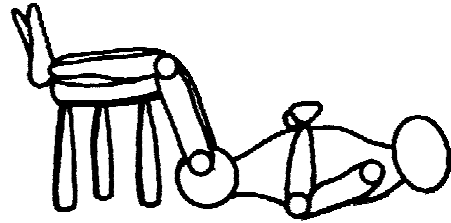
If the problem is tension, minor stress, or pain in the back, the following actions may be helpful:



BACK EXTENSION: Stand in a comfortable position, then place your hands in the lower back area (between your waist and buttocks) and bend backward as far as you can comfortably. Hold this position for one minute. Relax and repeat three or four times.



LOWER BACK FLEXION: Sit on a straight-back chair and lean forward as far as you can, attempting to rest your chest on your knees. Hold this position for three to five minutes.



BACK REST: Lie flat on your back placing the lower half of your legs (calves) on a chair, sofa or bed. Stay in this position for fifteen minutes.

There are times to seek medical attention for sprain, strains and lower back pain. These times are listed below.

- When your employer requests that you seek medical attention.
- When the pain/problem does not show significant improvement by the third day.
- When the problem reoccurs with more frequency or severity.
- When the pain radiates/moves to other body locations.
- When a numbness or tingling sensation is felt.
- When respiratory, digestive, or urinary symptoms, or a fever, accompany the pain or problem.

The first step in the treatment of more serious sprains, strains and back pain is a positive, get-well attitude. Treatment should be under the direction of competent medical professionals, and will usually include ice therapy treatment, gentle massage, stretching exercises, aspirin to relieve pain and reduce inflammation, and return to light-duty work as soon as possible. Such treatment should result in the vast majority of workers returning to full-duty employment in a minimum amount of time.

Bed rest or immobilization of sprained or strained muscles or joints may relieve the pain, but often results in weakening of the immobilized muscles and significantly increased recovery time.

Obviously, serious muscle, ligament, or back injuries may require more extensive treatment,

possibly including surgery and long-term rehabilitation.

SUMMARY

Lifting, pushing and pulling activities cause serious injuries in Florida agriculture. These injuries are normally sprains and strains to the joints of upper or lower extremities or to the lower back. Degeneration of discs and vertebrae cause much lower back pain. Additional causes of sprains and strains are slips, trips and falls.

Redesign of work stations and work practices is probably the most effective method of reducing these types of injuries. Activities which reduce the amount of lifting, pushing and pulling; slips, trips and falls; and the redesign of work stations which enables workers to stand and sit more comfortably have proven successful in reducing these types of injuries.

The physical condition of the worker as a result of proper nutrition and posture, along with an exercise program to increase muscle strength, flexibility and condition, are probably more important than the lifting technique employed.

Finally, comfortable lifting, pushing, and pulling avoids unnecessary bending, twisting, and reaching and will reduce sprains, strains and back injuries. Remember, your actions cause your injuries; your actions can prevent them.

"THINK BEFORE YOU LIFT"

BIBLIOGRAPHY

- Benson, J.B. "Control of Low Back Pain", Professional Safety, Vol. 32, No. 9, September, 1987. pp. 21-25.
- Heinrich, H.W. Industrial Accident Prevention. McGraw-Hill, 1959.
- Imrie, D. Goodbye Backache, Arco Publishing, Inc., 1983.
- James, D. "A Multi-Disciplinary Approach for Reducing Back Injury Disability", Professional Safety, Vol. 30, No. 9, September, 1985. pp. 7-23.
- Jones, D.F. "Back Injury Prevention--Are Our Programs Adequate", Professional Safety, Vol. 30, No. 2, February, 1985. pp. 18-24.
- we, M.L. Backache at Work, Perinton Press, 1983.
- Snook, H. "Approaches to the Control of Back Pain in Industry: Job Design, Job Placement and Education/Training," Professional Safety, Vol. 33, No 8, August, 1988. pp 23-31.