The Effect of Body Mechanics Instruction on Work Performance Among Young Workers

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Key Words: primary prevention • work • wounds and injuries

Thirty young workers (aged 14 to 19 years) employed as groundskeepers and custodians were randomly assigned to two groups; one group received body mechanics instruction and the other did not. The instruction focused on proper spinal alignment in the work environment. Instruction on low back pain began with one classroom session before the subjects' first day of work and continued during employment with two on-site sessions. The effect of instruction was evaluated through the observation of body mechanics during actual work performance. The results of the study indicate that the group that received instruction performed significantly better than the control group. This paper also discusses the occupational therapist's role in providing job-specific body mechanics instruction in the work environment as a primary method of preventing low back pain.

Low back pain is the most common cause of disability in industrial societies (McKenzie, 1981). An estimated 80% of the American adult population experiences back pain (Waddell, 1987). In the United States, workers' compensation payments for time lost in 1981 reached $4.6 billion (Dwyer, 1987). Persons who have experienced back injury feel the emotional and physical impact of this disability when attempting to participate in activities of daily living, leisure pursuits, and the fulfillment of vocational roles (Shotkin, Bolt, & Norton, 1987).

Occupational therapists often treat people with disabling back injuries. Flower, Naxon, Jones, and Mooney (1981) described a two-phase occupational therapy program in which a physical disability therapist and a psychiatric therapist worked together to treat the physical and emotional aspects of chronic back pain. Body mechanics instruction was an important component included in both aspects of the program. Bettencourt, Carlstrom, Brown, Lindau, and Long (1986) reported an occupational therapy program in which patients were observed and evaluated in their use of correct body mechanics during simulated work activities. In 1986, Caruso and Chan described an occupational therapy program that assessed the patient's knowledge of proper body mechanics, analyzed the activities of daily living that increased low back pain, and attempted to facilitate the development of problem-solving skills through patient training and education. Treatment, including acute pain management techniques, patient education, work hardening, and assessment of the injured worker's ability to perform specific work tasks, provided the basis for the management of work-related back pain described by Caruso, Chan, and Chan (1987). The interventions used by occupational therapists have been aimed at enabling persons to return to work and reducing their chances of further injury.

Preventive programs that incorporate body mechanics instruction may be effective in producing behavioral change among workers and thus may prevent back injuries. By reviewing the efficacy of preventive programs, occupational therapists can help "implement strategies that will strengthen the relationship between clinical medicine and occupational health" (Rosenstock & Landrigan, 1986, p. 337). The provision of instruction in proper body mechanics to new workers in high-risk job classifications may be an effective forum for primary prevention. Training such workers in correct body alignment during work tasks early in their careers may reduce the risk of later back injury.

Literature Review

The analysis of job demands and the provision of body mechanics instruction to injured workers has become
a central part of occupational therapy's contribution to the industrial health field. Marshall (1985) pointed out that 'because therapists understand the concepts of 'doing,' or work, they are able to analyze activities and assist individuals with skill acquisition' (p. 295). These unique skills can be used to help reduce the current epidemic of work-related back injuries through preventive programs designed to provide job analysis and effective body mechanics instruction tailored to specific work tasks.

Mechanical stress of the spine has been identified as a major contributing factor in the development of low back pain (Majora, 1973; McKenzie, 1981; Nachemson, 1966, 1975; Wang, 1981). Body mechanics instruction to prevent spinal trauma has been suggested as one of the most effective methods of reducing industrial low back pain (Dwyer, 1987; Grandjean, 1980). Dwyer (1987) contended that the 20th century epidemic of low back pain is preventable and controllable with simple measures. Effective preventative methods include proper use of the spine at home, at school, and at work. Public education should be used to reinforce proper body mechanics in the schools, in the media, and in industrial and community low back schools.

Biomechanical positions that have been found to increase the risk of low back injury include (a) maintaining forward stooping position, (b) lifting loads with straight legs, (c) reaching with spinal rotation, and (d) exerting sudden maximal effort (Bergquist-Ulmann & Larsson, 1977; Grandjean, 1980; Nachemson, 1966, 1975, 1976; Wang, 1981). To reduce the risk of low back injury, body mechanics instruction should focus on these areas of movement and positioning in the work environment.

Low back schools and clinical programs have been developed by both occupational and physical therapists to address the need for body mechanics instruction in industrial settings. Currently, little is known about the efficacy of these programs.

Dehlin, Berg, Andersson, and Grimby (1981) studied the effect of physical training and body mechanics training on low back pain symptoms among nurse's aides and found that the effect was negligible. These researchers examined the effect of training on the psychological perception of work; however, they made no attempt to determine whether lifting techniques actually changed as a result of the training.

A follow-up study of the Swedish Back School examined whether patients had changed their work positions as a result of learning the principles of reducing back strain (Forssell, 1980). Three fourths of the patients reported that they had corrected their work positions. No attempt was made to observe and evaluate the patients within their work environment, however, because all of the data were gathered through self-reports.

Linton and Kamwendo (1987) reviewed 16 studies of low back schools and found that a general lack of information exists to support the effectiveness of this intervention technique. Low back schools administered as classroom instruction typically included material concerning spinal anatomy, rest positions, body mechanics, and strengthening exercises and were taught to patients already experiencing some degree of low back pain. Many of the studies reviewed lacked proper control and measurement techniques, so conclusions regarding the efficacy of low back schools cannot be made with the existing data. Linton and Kamwendo suggested that further research is needed to determine the amount of knowledge participants retain and the amount of behavioral change implemented as a result of body mechanics instruction.

Carlton (1987) studied body mechanics instruction and subsequent work performance and found there was little transfer of knowledge to actual working conditions. He discussed the strength of workers' preestablished patterns to explain the lack of application of training to the work environment and suggested providing intervention early in a person's work career to stimulate subcortical learning of proper lifting techniques. Carlton also suggested providing job-specific instruction in the work environment.

The present study evaluated the effect of on-the-job body mechanics instruction on the work performance of newly employed young workers. Training that was job-specific and reinforced at the job site was used to improve biomechanical positioning during the work tasks of lifting, lowering, pulling, and transferring objects. The following questions were asked:

1. Is there a significant difference in the use of proper body mechanics in the work environment between workers who receive instruction and those who do not receive instruction?
2. Is there a significant difference between the task scores (i.e., for lifting, lowering, pulling, and transferring) of the workers receiving body mechanics instruction and those not receiving instruction?

Methodology

Subjects

Thirty subjects were selected from a group of young workers participating in a summer youth employment program. The subjects ranged in age from 14 to 19 years. Their previous work history ranged from 0 to 24 months of part-time employment. I assumed that this population had not yet developed maladaptive work postures or poor lifting techniques in the workplace because of their lack of work experience.
Instrument
A criterion-referenced Body Mechanics Evaluation Checklist (see the Appendix) was designed with criteria established by Broer (1973) and substantiated by Frederick, Clark, Brown, Nelson-Allen, and Amble (1979). The checklist was used to evaluate each worker’s lifting, lowering, pulling, and transferring of objects in the work environment.

During the subject’s lifting and lowering, the following factors were evaluated: (a) simultaneous bending of the hips and knees; (b) ear/hip/shoulder alignment; (c) body square to object; (d) feet shoulder-distance apart; (e) object close to body before rising or lowering; and (f) trunk control during rise with no spinal torque. The following factors were measured during the subject’s pulling of an object: (a) proper foot placement (one foot forward); (b) body square to load; (c) simultaneous bending of the hips and knees; and (d) no forward trunk flexion. While transferring an object through lateral movement at waist level the subjects were rated on (a) keeping the object close to the body (avoidance of horizontal displacement); (b) aligning object in midline (maintaining spinal balance); (c) turning as a unit (no spinal rotation); and (d) hip/knee/shoulder alignment.

The subjects were rated on the lifting, lowering, pulling, and transferring of an object during the tasks in which these movements were first observed by the evaluator. If the task was done correctly, it received a score of 1. A total of 20 points was possible on the body mechanics evaluation. An evaluator trained in the observation of correct body mechanics was hired to serve as the rater. The evaluator was blind to the workers’ assignments to either the experimental or control group.

Procedure
Two job classifications were included in this study—custodial helpers and groundskeeper assistants—both of whom performed frequent lifting, lowering, pulling, and transferring motions. Historically, youth hired within these two classifications in this program reported back injuries more often than those in other job categories.

Prior to hiring, job classifications were randomly designated to either the experimental or control group. Each group consisted of 15 positions. The youths were assigned to the positions according to program guidelines and were required to participate in an orientation session before the 1st day of work. To accommodate all of the subjects, two orientation sessions were held for the experimental group and two for the control group; each subject attended only one session.

The experimental group received 1 hr of back school training provided by an occupational therapist experienced in conducting industrial back schools. Body mechanics instruction given to the experimental group subjects included information on the anatomy of the spine and orientation to the principles of reducing mechanical stress in lifting, lowering, pulling, and transferring objects. The principles taught were the straight-back, bent-knee method of lifting and lowering; the maintenance of spinal alignment; the establishment of a wide base of support through proper foot placement; the use of leg strength to provide the power for lifting; and the principle of centering loads when pulling and transferring objects. A slide show demonstrated some of the actual tasks that the youths would be required to perform on the job. This group participated in the learning process through simulated work situations, as suggested by Broer (1973).

The subjects in the control group received 1 hr of safety orientation training provided by a representative of the workers’ compensation insurance company. This training included a movie outlining the role of the brain in decision making and how a person’s mental state affects job performance. It also included a verbal review of guidelines, including wearing proper footwear, keeping the work area clean, securing ladders, and addressing safety concerns with the supervisor. A question-and-answer session was included to actively involve the subjects in the learning process.

I followed the orientation training with two 10- to 15-min site visits with each subject. During these visits, the experimental group subjects received additional job-specific instruction on body mechanics application, while the control group subjects received a review of specific safety concerns for their particular job activity. Two weeks after the on-site visits, the data were collected over 1 week. The subjects had been on the job for a total of 4 weeks at the time of the evaluation.

The independent observer was blind to the subjects’ experimental or control group status. The subjects were unaware of the purpose of the rater’s observations. To avoid the tendency for the workers to alter their behavior, the workers and the site supervisors were told that the observer was performing a job analysis for the program and that they should continue to perform their regular work routines. During the course of the program, several agency personnel were required to do site visits; therefore, the youth were accustomed to being observed during work activities.

Results
The experimental group consisted of 13 males and 2 females. Nine of the subjects in this group performed
groundkeeping work, and 6 performed custodial work. The age range was 14 to 19 years, with a mean age of 16.1 years. The grade level ranged from 7th to 11th grade, and the mean grade completed was 8.6. Within the group, 3 youths had learning disabilities and 4 were juvenile offenders. Twelve of the youths in this group worked 32 hours per week, and 3 worked 20 hours per week.

The control group consisted of 10 males and 5 females. Eight of the subjects performed groundskeeping work and 7 performed custodial work. The age range was 14 to 18 years, with a mean age of 16.1 years. The grade level ranged from 6th to 11th grade, and the mean grade completed was 9.1. Within this group, 3 youths had learning disabilities, 1 was mentally delayed, and 2 were juvenile offenders. Ten of the youths in this group worked 32 hours per week, and 5 worked 20 hours per week.

The data were analyzed with an independent t test to compare the total scores of the experimental and control groups. The experimental group (those who received body mechanics instruction) obtained a significantly higher total score than did the control group (p < .01) (see Table 1).

In the distribution of total scores, 80% of the control group scored 13 or below, and 86% of the experimental group scored 13 or above. None of the experimental group subjects scored below 10 (see Figure 1).

During the activity of lifting, the experimental group's mean score was 4.9 (out of a possible 6 points), compared with the control group's mean score of 3.9, thus indicating better overall performance. The difference, however, was not significant.

During the activity of lowering, the experimental group's mean score again indicated better performance (m = 4.2, out of a possible 6 points) compared with the control group's mean score (m = 3.9). The difference, however, was not significant.

The experimental group's scores for both pulling (p < .05) and transferring (p < .01) items during working activities were significantly better than the control group's scores.

To isolate demographic characteristics that may have influenced the difference in performance between the two groups, I performed several independent t tests between similar groupings of subjects. One such independent t test was performed with learning disabled and mentally delayed subjects eliminated from the sample. Without their scores included, a significant difference still existed between the total scores of the two groups (p < .01). Due to the large number of female subjects in the control group (5) as compared with the experimental group (2), an independent t test was performed with only male subjects to compare their performance on the body mechanics tasks. The male subjects who received instruction in lifting, lowering, pulling, and transferring techniques (i.e., those from the experimental group) scored significantly better (p < .05) when performing these tasks than did the male subjects from the control group.

Conclusion

In this study, the young workers who attended a low back school program and had their learning reinforced while on the job performed work activities using proper body mechanics significantly better than did the young workers who did not receive such instruction. For specific work tasks, the greatest differences in performance between the groups occurred during the activities of pulling and transferring. The youths participating in the low back school program applied the information regarding proper lifting, lowering, pulling, and transferring to their job performance.

The instruction and evaluation occurred within 1 month. Because a follow-up study was not conducted,

![Figure 1. Distribution of total scores on the Body Mechanics Evaluation Checklist.](image-url)

| Table 1 Analysis of Differences Between Subjects on Work Performance Scores |
|---------------------|-------|-----|-----|
| Group              | M     | SD  | Range |
| Experimental (n = 15) | 15.40 | 2.823 | 10 |
| Control (n = 15)    | 11.53 | 3.681 | 13 |
| t test              | 3.228*|

Note. The experimental group received body mechanics instruction; the control group did not.

*Highest possible score was 20 points.

* p < .01.
the long-term effects of this intervention are unknown. During the evaluation of job performance, the rater scored the participants on the first observed job tasks involving lifting, lowering, pulling, or transferring. A longer observation period could provide a more in-depth view of a worker’s ability to maintain proper positioning throughout the workday.

Job-specific instruction may be an effective service that occupational therapists can provide to workers to reduce the risk of on-the-job back injuries. Given increased knowledge of proper spinal alignment early in their careers, workers may be able to develop a greater capacity for identifying positions that could lead to chronic back problems. The expansion of the occupational therapist’s role to include preventive back education programs could lead to a future reduction in low back injuries if workers can implement behavioral change during work performance, as indicated by this study.

Summary

Carlton (1987) suggested that teaching body mechanics before maladaptive work patterns develop could effectively preclude their development. The findings from the present study support the idea that back education should begin during the early years of employment and should include body mechanics instruction specific to the work activities being performed on the job.

Job-specific instruction can aid workers in developing biomechanical rules to follow for their particular work setting. Skills and knowledge may also be developed to help workers cope with difficult job-specific situations. On-site instruction can acknowledge the combination of awkward posture and weight distribution facing the person in the work situation. Modification of the task, the environment, or both can be suggested to reduce spinal strain (Anderson, 1980).

Managers within the health care and insurance industries in the United States have been looking for answers to the current epidemic of low back injuries. Effective body mechanics training programs for reducing the economic and psychological impact of back pain may be one solution. Occupational therapists, with their combined knowledge and skills in anatomy, kinesiology, and job activities analysis, can help by providing effective preventive education.

Mapa (1980) suggested that therapists begin to accept responsibility for helping to prevent back problems by recognizing and treating the underlying biomechanical problems that are apparent in young people. The present study supports the concept that body mechanics instruction can be effective in producing behavioral change during work activities in a youthful population. Further study is needed to document the effectiveness of body mechanics instruction on long-term behavioral change and on the reduction of risk factors among young workers.

Appendix

Body Mechanics Evaluation Checklist

<table>
<thead>
<tr>
<th>Task</th>
<th>Criterion</th>
<th>Possible Score</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifts object from</td>
<td>Bends hips and knees simultaneously</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>floor</td>
<td>Ear/hip/shoulder aligned</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Body square to object</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feet shoulder distance apart</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Object close to body prior to rise</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trunk control during rise, no torque</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Lowers object</td>
<td>Bends hips and knees simultaneously</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ear/hip/shoulder aligned</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Body square to object</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feet shoulder distance apart</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Object close to body prior to lowering</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trunk control during lowering, no torque</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Pulls object</td>
<td>Proper foot placement</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Body Square to object</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bends hips and knees simultaneously</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No forward trunk flexion</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Transfers object</td>
<td>Object close to body</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Object in midline</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Turns as a unit</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hip/knee/shoulder aligned</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Evaluation Score</td>
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<td></td>
</tr>
</tbody>
</table>

Name: __________________________________________
Job Title: ______________________________________
Worksite: _______________________________________
Address: _______________________________________
Date of Evaluation: _____________________________
Evaluator: ______________________________________
Comments: _____________________________________

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References


