Muscle Stress and the Use of Body Mechanics

Kathleen Ann Keeler

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MUSCLE STRESS AND THE USE OF BODY MECHANICS

by

Kathleen Ann Keeler

A Thesis
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Faculty of The Graduate College
in partial fulfillment of the
requirements for the
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MUSCLE STRESS AND THE USE OF BODY MECHANICS

Kathleen Ann Keeler, M.S.
Western Michigan University, 1988

The purpose of this study was to examine the amount of lower back muscle stress produced during lifting tasks, using variations in weight and postures. Electromyographic activity of the erector spinae muscles at the L4-5 vertebral level was measured.

Thirty healthy female subjects participated in the study. Each subject lifted loads of two given weights using both the stooped and squat lifting postures. Electromyographic activity was recorded and averaged throughout each lift.

Results indicated that increased weight resulted in increased stress on the erector spinae muscles, regardless of posture. The squat lifting posture was found to be more stressful on the erector spinae muscles than the stooped posture, however the squat lift is recommended because it may provide the best protection for the lumbar spine.
ACKNOWLEDGEMENTS

I would like to express deep appreciation to my advisor, Barbara Hemphill, for her patience and assistance with this project. I would also like to thank Cindee Peterson and David Smith for their support. I am indebted to Mary Ann Bush for her instruction and help on this project. I would also like to thank Lucy Wells and Deb Young for assisting me with data collection.

I would also like to thank my family for their support and to Dave Fongers, who will always be in my heart.

Kathleen Ann Keeler
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Muscle stress and the use of body mechanics

Keeler, Kathleen Ann, M.S.
Western Michigan University, 1988
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CHAPTER I

INTRODUCTION

Background of the Problem

Health specialists including occupational therapists emphasize the use of proper body mechanics during lifting (Howland, 1953; Macdonald, 1976; Millen, 1974). Howland (1953) described body mechanics as an activity with the purpose of shaping development toward the prevention of postural and orthopedic defects. Howland stated that good posture was necessary for proper functioning of all organs, self image, breathing, and would alleviate pain through release of tension in the lower back. Several studies investigated the effects of lifting postures on muscle activity of the lower back (Delitto, Rose, & Apts, 1987; Fish, 1978; Floyd & Silver, 1955; Hart, 1985). The squat lift posture was recommended by the authors, however, the studies illustrated no differences between lift types in regard to muscle activity.

The literature reported that the weight of the object lifted effected muscle stress in the lower back. Delitto et al. (1987) found that erector spinae muscle electromyographic (EMG) activity increased with increasing weight. Fish (1978) found higher erector spinae activity...
and disc compression as weight increased. These two studies suggested a relationship between muscle stress and weight.

The present study examined the amount of lower back muscle stress produced during lifting tasks, comparing variations in amount of weight lifted and lifting technique. Subjects in previous studies were predominantly men, this study was done with young women.

Research Questions

The author formulated the following research questions:

1. Is there a relationship between stress and weight during lift?
2. Is there a relationship between stress and lifting technique?

The author researched the questions by reviewing the literature on lifting in the following areas: body mechanics, relationship between weight and stress, and types of lifting techniques.

Definitions

Stress

Stress was defined in terms of muscle activity in the erector spinae muscles measured by isometric contractions through electromyography. Increased muscle activity
(elevated EMG readings) was an indicator of increased muscle stress.

**Squat Lifting Procedure**

Type of lift which consisted of lifting with feet spread apart, toes pointed slightly outward, and knees and hips flexed. The back was arched, shoulders back and head tilted upward so that the subject was looking forward. The trunk remained relatively vertical. The subject looked ahead rather than at the object being lifted.

**Stooped Lifting Procedure**

Type of lift which consisted of lifting while bent at the waist with knees straight and feet spread apart.

**Hypotheses**

**First Hypothesis**

**Conceptual**

There is a relationship between stress in the erector spinae muscles of the lower back and the amount of weight lifted.

**Operational**

There is a mean difference in stress between lifting a 1.3 kg weight and lifting a 7.9 kg weight.
Null

There is no mean difference in stress between lifting a 1.3 kg weight and lifting a 7.9 kg weight.

Second Hypothesis

Conceptual

There is a relationship between stress and type of lift.

Operational

There is a mean difference in stress between stooped and squat lifting.

Null

There is no difference in mean stress between stooped and squat lifting techniques.

Summary

The use of proper body mechanics while lifting was emphasized by health professionals. Scientists investigated various lifting postures and the effects on the erector spinae muscles, however no differences were found in terms of muscle stress. This study investigated the effects of weight and lifting posture on the erector spinae muscles. The following chapter contains a review of the literature regarding body mechanics, the
relationships between weight and stress, lifting techniques, and electromyography.
CHAPTER II

LITERATURE REVIEW

Theory of Body Mechanics

Back injuries have become a very common disability in modern society. Millen (1974) reported that in a lifetime 8 out of 10 individuals experience low back pain. Back injuries were very costly; in business and industry, back disability was the highest in compensation cost and second in expenditures for sickness benefits (Saunders, 1985).

The use of proper body mechanics was suggested by many experts (Floyd & Silver, 1955; Howland, 1953; MacDonald, 1976; Wolf, Basmajian, Russe, & Kutner, 1979) to prevent or alleviate low back pain and injury. Howland (1953) stated that proper body mechanics during activity shaped development toward the prevention of postural and other orthopedic defects. The author argued that good posture was necessary for proper functioning of all organs, self image, breathing, and health. Howland proposed that proper body mechanics would alleviate backache, release tension in the lower back, and decrease fatigue and mechanical strains on the lower back ligaments and the spinal column.
Research on Lifting Postures

In attempts to determine which postures were the best for lifting, researchers investigated many types of postures in terms of the effect on the human body. Delitto et al. (1987) reported that the "squat" lift technique was advocated by many sources. In this lift, the back remained relatively straight and the hips and knees were flexed. Delitto et al. (1987) reported that the use of a kyphotic posture in which the lower spine curved outward resulted in less erector spinae activity. However, the authors believed that the muscles and ligaments were vulnerable to injury while undergoing stress in this elongated state, particularly when adaptations to guide changes in posture were required. Delitto et al. (1987) suggested that a lift in which the spine was aligned and maintained in natural lordotic posture would provide the optimal protection for the muscles and ligaments of the lumbar spine.

In an analysis of stooped and crouched (squat) lifting methods, Troup (1977) found crouched lifting to require a higher rate of work and increased energy expenditure. The additional energy was required to provide the body with kinetic energy, which was then available for transfer of the load. The author found that the stooped lift required greater flexor torque in the initial portion of the lift. Overall, the data in Troup's study revealed
no differences between lifting methods.

Fish (1978) used filming techniques to calculate muscle torque in a study designed to determine whether stooped lifting was more stressful than squat lifting at the L4-5 level. Results demonstrated no differences between the two types of lifting in four normal men.

Studies by Floyd & Silver (1955), Hart (1985), Troup (1976), and Wolf et al. (1979) reported no differences in erector spinae activity between stooped (bent at the waist) or squat lifting (bent at the knees and hips) styles. Wolf et al. (1979) suggested that measurement of electrical activity of the erector spinae muscles could not be used solely to determine stress levels on the lower back because in the fully flexed position (stooped) the muscles of the back relax. The fully flexed position required the ligamentous structures to provide support for the lumbar vertebral column and the weight of the torso; not until extension did the erector spinae muscles activate (Basmajian & Deluca, 1985; Floyd & Silver, 1955; Wolf et al., 1979). While using proper body mechanics (squat lift), the erector spinae muscles constantly contract to maintain the upright position of the trunk. Floyd and Silver (1955) reported that the use of proper body mechanics prevents putting maximum tension on the ligaments of the lower back, which were the most frequently injured ligaments in the body.
Research On Weight and Stress

Fish (1978) found differences in stress between weights using the stooped lift in a study with able-bodied men. Delitto et al. (1987) measured the electromyography (EMG) of the erector spinae muscles in two different lifting postures and three different weights. Delitto et al. (1987) found increased EMG activity with increased weight lifted, as did Andersson, Ortengren, and Herberts (1977). Andersson et al. (1977) also determined that stress in the lower back increased as the angle of forward flexion of the trunk increased under a fixed load, measured up to 50° of flexion. In a subsequent study, Andersson, Ortengren, and Nachemson (1978) confirmed increased stress with increased weights through myoelectrical and disc pressure measurements. The results of the 1978 study also indicated that as weight was moved closer to the body, stress decreased. Similarly, muscle stress increased as weight was moved away from the body. Andersson et al. (1978) found that erector spinae muscle activity decreased at large angles of flexion, but the weight of the trunk must still be supported for equilibrium. The investigators found that disc pressure increased as trunk flexion increased. Andersson et al. (1978) stated that the "main advantage to the [squat lifting posture] is that it is possible to bring the object closer to the body" (p. 33). More emphasis should
be placed on reduction of object sizes and distribution of
the load so that lifting can be done close to the body,
decreasing the stress placed on muscles and vertebral
discs (Andersson et al. 1978). Andersson's et al. (1977,
1978) studies examined the effects of lifting on male
workers.

Troup (1977) stated that "in spite of the common
association between back injuries and the handling of
materials at work there are still no acceptable standards
of what can be handled with safety or for how it should be
properly done" (p. 201). In a compilation of studies
designed to determine maximum acceptable limits of lifting
tasks, Snook (1978) reported that strength and endurance
vary greatly among individuals regardless of sex, there­
fore there was no one maximum weight that was acceptable
to everyone.

Most research done on lifting postures and the use of
weights studied men only (Andersson et al., 1977; Floyd &
both men and women, however the reported results were
combined. This did not account for physiological dif­
ferences between sexes. Wolf et al. (1979) studied the
differences in EMG activity between sexes in several
static and dynamic positions. The authors found differ­
ences between men and women and stated that "EMG data
during dynamic movements in a normal population cannot be
grouped for men and women within a specified age distribution" (p. 228).

Instrumentation

Electromyography

Electromyography was a technique of measurement of muscle activity which allowed an estimate to be made of the duration and magnitude of stresses in the spine (Troup, 1977). EMG was used as a measurement technique by many investigators (Andersson et al., 1977, 1978; Delitto et al., 1987; Floyd & Silver, 1955; Hart, 1985; Wolf et al., 1979; and others). Andersson and Ortengren (1984) reported that it was possible to predict lumbar disc pressure using back muscle myoelectric activity at lumbar levels. Troup (1977), however, pointed out that EMG was limited because it did not provide information regarding "the passive component of muscle tension or the mechanical state of the contractile elements of the fiber" (p. 203). Wolf et al. (1979) emphasized that electromyographic data during dynamic movements could not be grouped for men and women within a specified age distribution because of individual variation.

Electrode Placement

Basmajian (1980) and Cram (1985) recommended surface electrode placement at the L3-4 vertebral level for
measurement of erector spinae muscle activity. Floyd and Silver (1955) placed surface electrodes over the lumbar erector spinae muscles bilaterally at the L3 vertebral level. They found that this placement recorded electrical activity adequately and did not pick up extraneous electrical activity from adjacent muscles.

Nouwen (1983) positioned the active electrodes at the L4-5 vertebral level in a study which involved chronic low back pain patients in the standing position. Other researchers investigated EMG activity with electrode placement in several placements on the paraspinal muscles (Andersson & Ortengren, 1984; DeVries, 1968; Wolf et al., 1979).

Summary

The use of proper body mechanics for reduction of stress in the lower back were supported by many sources. The squat lift technique was recommended most often although it has not yet been determined to be the best method physiologically. Concern was expressed regarding stress on the vertebral discs during use of the stooped lifting posture. The efficacy of squat method of lifting for relief of pain and improvement of function has not yet been well documented (Fish, 1978).

Weight was reported to have an effect on muscle activity; increases in weight resulted in increases in EMG
activity of the erector spinae muscles. EMG was commonly used in determining muscle stress during lifting. Its use is limited, however it does provide useful information regarding stress during lifting.

The present study examined erector spinae muscle activity at the L4-5 vertebral level to determine whether there are significant differences in lifting at a lower vertebral level. The following chapter describes the methods and procedures used in this investigation of the effects of lifting two different weights and two different postures on the erector spinae muscles of normal young women.
CHAPTER III

METHODS

Subjects

Thirty healthy female subjects, ranging in age from 18 to 34 years with a mean age of 22.7 years, participated in this study. All subjects were without history of back or knee strain as reported by the individuals. Participants were recruited from the student population of Western Michigan University. Before commencement of the activities, the procedures were explained to the subjects and all questions were answered. Subjects read and signed a consent form (see Appendix A) approved by the university's Human Subjects Institutional Review Board.

Procedure

In preparation for the application of the EMG electrodes, the skin at the placement site was cleaned with rubbing alcohol and slightly abraded to ensure good surface contact and to reduce skin resistance. A pair of adhesive electrode strips were applied bilaterally on the skin surface overlying the muscle bellies of the lumbar erector spinae muscles at the L4-5 spinal level. The interelectrode separation for each pair was active
electrodes was 4.5 cm. The ground electrode for each pair of active electrodes was located directly between them. Prior to beginning the research activities, the subjects were reminded that they had the right to stop the test at any time.

The techniques of the stooped and squat lifts were demonstrated to the subjects prior to the performance of each lift. Each subject practiced the movement until the investigator was satisfied that the subject understood the desired lifting technique, at which time the subject performed the lifts.

In order to rule out order effect, half of the subjects were randomly assigned to perform the squat lifting technique first, followed by the stooped lifting technique. The remainder of the subjects performed the stooped lifting method first. All subjects were allowed recovery time between lifts.

Subjects performed both methods of lifting with each of two loads. The first load consisted of a 1.3 kg wooden crate only, the second load was the same crate containing a 6.6 kg weight. The subjects lifted the crate from floor to waist level, at which time the investigator took the crate from the subject. Each load was lifted three times. According to Snook (1978), the maximum acceptable weight of lift for 90% of women at the vertical and horizontal distance which was required in this study is 13 kg. This
The investigation was well within this limit, using a maximum of 7.9 kg.

The subjects were instructed to use the appropriate lifting technique to lift the crate upon signal from the investigator. The subject completed the lift while electromyographic activity was recorded. The readout on the digital monitor for both left and right sides was recorded for the upward portion of the lift for each trial. The digital integrator averaged the EMG output from each side of the body during the 2-second lift.

Subsequent to data collection, all subjects were instructed that the squat lift technique was determined to be the preferred lifting technique in back injury prevention particularly when lifting heavy loads.

Instrumentation

Through the use of electromyography, the stress on erector spinae muscles can be measured by recording muscle activity during movement. The electromyographic instrument (EMG M-57) and the digital integrator (Model D-200) used in this study were manufactured by J & J Instrument. The EMG M-57 measured muscle action potentials (MAPS) in millivolts. The digital integrator reported the average muscle activity bilaterally over a 2-second time period, the duration of the lift. Two preamplifiers, electrode leads, silver/silver chloride electrodes, ground
electrodes and adhesive electrode strips were used.

Data Analysis

A counterbalanced crossover design was used to test the hypotheses in this study. In order to determine whether an order effect was present, a two-tailed $t$ test for independent samples was used. No order effect was present. Two-tailed $t$ tests for related measures were used to analyze the data obtained from testing the conditions of the two independent variables, weight and lifting posture, alpha was set at $p < .05$. Bilateral data from the three trials of each type of lift at each given weight were averaged and combined to provide means used in the $t$ tests. Preliminary data analysis indicated that there were no differences between readings obtained from left and right erector spinae muscles, therefore the readings from left and right erector spinae muscles for each type of lift at a given weight were averaged together in subsequent data analysis.
CHAPTER IV

FINDINGS

Results

Two-tailed t tests for related measures were used to analyze the data. Tables 1 and 2 represented the results of this study. In Table 1, the results indicated that lifting 7.9 kg was more stressful on erector spinae muscles than lifting 1.3 kg regardless of lifting style. Table 2 demonstrated that the squat lifting posture was more stressful on the erector spinae muscles than the stooped lifting posture.

Table 1

Effect of Weight on Erector Spinae Muscle Activity Regardless of Lifting Posture

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3 kg</td>
<td>61.69 mV</td>
<td>25.48</td>
<td>7.16*</td>
</tr>
<tr>
<td>7.9 kg</td>
<td>80.98 mV</td>
<td>37.39</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at p < .05, df = 29.
Table 2
Effect of Weight and Lifting With Stooped Versus Squat Postures on Erector Spinae Muscle Activity

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3 kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stooped</td>
<td>29.03 mV</td>
<td>13.36</td>
<td>6.43*</td>
</tr>
<tr>
<td>Squat</td>
<td>36.85 mV</td>
<td>17.89</td>
<td></td>
</tr>
<tr>
<td>7.9 kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stooped</td>
<td>32.66 mV</td>
<td>13.50</td>
<td>6.33*</td>
</tr>
<tr>
<td>Squat</td>
<td>44.13 mV</td>
<td>21.04</td>
<td></td>
</tr>
</tbody>
</table>

* Significant at p < .05, df = 29.

Discussion

The data supported the first operational hypothesis that there was a mean difference in stress between lifting a 1.3 kg weight and lifting a 7.9 kg weight in normal young women. There was enough evidence to reject the null hypothesis. This result agreed with a study by Andersson et al. (1977) in which individuals lifted loads of various weights. The authors found that EMG activity increased as the load increased. The present study confirmed several other studies (Andersson et al., 1978; Fish, 1978; Snook, 1978; Wolf et al., 1979) which determined that as weight lifted increased so did stress on the muscles of the lower back, regardless of posture.
The data also supported the second operational hypothesis that there was a mean difference in stress of the erector spinae muscles between stooped and squat lifting. There was enough evidence to reject the null hypothesis. Results indicated that squat lifting was more stressful for this population than stooped lifting.

The result of the second hypothesis was surprising because it was contrary to findings of previous studies. Review of the literature found no differences between the stooped and squat lifting postures with regard to muscle activity (Fish, 1978; Hart, 1985; Wolf et al., 1979). Promoters of proper body mechanics during lifting recommended the squat lifting posture because it was possible to bring the load closer to the body, decreasing mechanical strains on the lower back and ligaments (Andersson et al., 1978; Delitto et al., 1987, Howland, 1953). Evidence from the present study helped support the discussion by Floyd & Silver (1955), Howland (1953), and Troup (1977) that the erector spinae muscles constantly contract during the squat lift, preventing maximum tension on the ligaments of the lower back such as was indicated during stooped lifting.

Reasons for the findings may be that the present study dealt with female subjects which had not been thoroughly researched in the past. A study by Wolf et al. (1979), which included both male and female subjects,
found differences in EMG activity between men and women, particularly in the 18 - 29 year age range. Thus, the authors suggested that during dynamic movements in a normal population, data could not be grouped for men and women. Therefore, the results of the present study should pertain only to females and only to those subjects which the researcher examined. Differences in comparison with other studies may also reflect variations between male and female lifting postures. Wolf et al. (1979) reported only 10 - 20 trunk flexion during squat lifting by several young women which was believed "to account for the higher EMG levels for women in this age group" (pg. 227).

Limitations

The results of this study were limited by several factors.

1. The sample population consisted of volunteers from the WMU student population, thus the results could be generalized to the population of WMU female students nor to all young women because the sample selection procedure was biased.

2. For some subjects, the novelty of the lifting techniques may have affected performance. Subjective observations indicated that subjects were less stressed by the lift they were more accustomed to using. The researcher could reasonably predict which lift the subject
commonly performed outside of the research setting by observing the ease in lifting and electromyographic recordings during testing. This observation could indicate that altering body mechanics might take considerable repetition and practice to develop the lifting style into habit before reduction in muscle stress.

3. Measurement was limited by available technology. Measurements were averages rather than graphed recordings. The onset of the measurement of the lift was begun by the investigator's observation of the subject grasping the box. By averaging muscle activity readings throughout the lift, muscle stress during the later part of the lift may have been masked by muscle relaxation during the initial part of the lift. Instruments with more sensitivity might provide more accurate measurements.

4. The researcher was trained and approved on the use of electromyographic equipment, however the actual mechanics might have caused inaccurate responses. The application of electrodes may also have been a source of error.
CHAPTER V

RECOMMENDATIONS AND CONCLUSION

Recommendations

In determining the benefits of proper body mechanics, there is a need for further study with this population and others participating in lifting tasks. A repetition of this study is suggested using more complete measurement tools such as a pen recorder and automated equipment. Repeating the study with other populations is also recommended. An analysis of variance could be completed with the data from the present study to determine whether an interaction exists between lifting, weight and stress.

Conclusion

Proper body mechanics, including the use of the squat lifting posture, has been promoted for many years by occupational therapists and other professionals. Research has not determined whether one lifting posture is better than others, the most suitable posture may vary with the situation. This study demonstrated that the squat lift is more stressful to the erector spinae muscles than the stooped lifting posture. However, the squat lifting posture avoids placing maximal tension on the ligaments of
the lower back and is more protective of the vertebral column so it remains the most recommended lifting style.
APPENDICES
Appendix A

Data Form
### DATA FORM

<table>
<thead>
<tr>
<th>Subject No.</th>
<th>Age</th>
<th>Weight</th>
<th>Height</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Lt.</th>
<th>Rt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Squat Lift</td>
<td></td>
</tr>
<tr>
<td>Empty crate</td>
<td></td>
</tr>
<tr>
<td>1.3 kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>7.9 kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Stooped Lift |       |       |
| Empty crate |       |       |
| 1.3 kg |       |       |
|       |       |       |
| 7.9 kg |       |       |
|       |       |       |
Appendix B

Questionnaire
Questionnaire

The information on this questionnaire will be kept confidential. Your name and phone number will be used only for purposes of contacting you.

Name:

Phone:

Times and Days when most often available

Age

Height

Weight

Please circle your answer

How would you describe your physical condition?

A. Excellent
B. Good
C. Fair
D. Poor

Do you now or have you ever had back or knee problems or injuries which required medical treatment? Yes No

Have you had any training in manual lifting? for example, by a Physical Therapist or Occupational Therapist

Yes No

Are you allergic to rubbing alcohol, gel (similar to Vaseline), or adhesive? Yes No
Dear Volunteer:

I am a graduate student at Western Michigan University. Participation in this project will contribute to the knowledge of muscle activity during movement. I am seeking volunteers who are female, between the ages of 18 and 35, who have no history of back or knee problems and are in good health.

If you choose to participate in this study, you will participate in a brief activity in which you will lift a 10# book. You will pick up the book from the floor and place it on a table. You will rest for a short time, then repeat the lift. Sensors will be attached to your back to monitor your muscle activity. In order to properly apply the sensors to ensure good contact, rubbing alcohol, gel, and adhesive pads will be used. If you are allergic to any of these products, please withdraw from the study.

The information I collect will be coded so that no one will be able to identify you in any way. You are free to stop participating in the study whenever you wish without penalty, participation is voluntary.

Any questions you have about this study will be answered promptly. Please call me at 343-0218.

Thank you.

Sincerely,

Kathleen Fongers

I do not have any known back or knee problems. I am healthy and have no known allergies to rubbing alcohol, gel or adhesives. I agree to report any discomforting symptoms immediately to the researcher. I understand that participation and cessation of the activity is totally controlled by myself. I have read and understood all the above information. All of my questions have been answered and I agree to participate.

Signature of Volunteer

Date
Appendix D

Human Subjects Approval Form
RESEARCH SHOULD NOT BEGIN UNTIL THE PROTOCOL HAS BEEN REVIEWED AND APPROVED BY THE HUMAN SUBJECTS INSTITUTIONAL REVIEW BOARD, WHICH MEETS ON A REGULAR MONTHLY BASIS. PROTOCOLS MUST BE RECEIVED BY THE HSIRB CHAIR AT LEAST SEVEN DAYS PRIOR TO A REGULARLY SCHEDULED MEETING IN ORDER TO BE ACTED ON AT THAT MEETING. PLEASE TYPE EACH RESPONSE - EXCEPT SIGNATURES. REFER TO THE WESTERN MICHIGAN UNIVERSITY POLICY FOR THE PROTECTION OF HUMAN SUBJETS TO DETERMINE THE APPROPRIATE LEVEL OF REVIEW.

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PROJECT TITLE: Muscle Stress and the Use of Body Mechanics

SUBMISSION DATE: Oct. 28, 1987 PROPOSED PROJECT DATES 1/88 TO 4/88
APPLICATION IS: X New Renewal Continuation Supplement

SOURCE OF FUNDING: (if applicable)

Signature of Investigator

STUDENT RESEARCH (Fill out if applicable)

Name of Student Kathleen Fongers Phone 345-0218
Address 713A Garland Circle Kalamazoo, MI 49008
The Research is: X Undergraduate Level
Faculty Advisor Barbara J. Hemphill Department Occupational Therapy

Signature of Faculty Advisor
VULNERABLE SUBJECT INVOLVEMENT (Fill out if applicable)

Research involves subjects who are: (check as many as apply)

1. ___ children
   approximate age ___
2. ___ mentally retarded persons
   check if institutionalized
3. ___ mental health patients
   check if institutionalized
4. ___ prisoners
5. ___ pregnant women
6. ___ Other subjects whose life circumstances may interfere with their ability to make free choices in consenting to take part in research
   (Describe please)

LEVEL OF REVIEW: Please indicate here if you think that the research project is exempt from review, subject to expedited review, or subject to full review.

___ Exempt (Forward 1 application to IRB Chair)
Which category of exemption applies? ___
___ Expedited (Forward 4 applications to IRB Chair)
___ Subject to Full IRB review (Forward 9 applications to IRB Chair)

Comments:

HSIRB ACTION
1. ___ Exempt

   Signature HSIRB Chair Date

2. ___ Expedited ___ Full

   Your application was reviewed and the Human Subject Institutional Review Board (HSIRB) has determined that:

   1. The proposed activities, subject to any conditions and/or restrictions indicated in Remarks below, have (a) provided adequate safeguards to protect the rights and welfare of human subjects involved, (b) established appropriate procedures and/or documents to obtain informed consent, and (c) demonstrated that the potential benefits of the research substantially outweigh the risks.

   2. The proposed activities, for reasons indicated in Remarks below do not provide adequate protection for the rights and welfare of the human subjects.

   At its meeting on ___, the HSIRB (approved) (provisionally approved - see remarks) this application with regard to the treatment of human subjects. The HSIRB categorized this application as:

   1. Involving subjects at no more than minimal risk.
   2. Involving subjects at more than minimal risk.

REMARKS:

   Signature HSIRB Chair Date

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PRINCIPAL INVESTIGATOR: Kathleen Fongers  
DATE: 10/28/87

TITLE OF PROJECT: Muscle Stress and the Use of Body Mechanics

ABSTRACT: Briefly describe the purpose, research design, and site of the proposed research activity.

Occupational therapists as well as other health professionals use and teach methods of lifting which are intended to reduce or prevent stress to the lower back. This has become an important area of study since eight out of ten adults experience back pain during their lifetime. It is the intent of this researcher to determine whether improved body mechanics is less stressful on the muscles of the lower back than natural, uninstructed lifting in normal adult females. Volunteers will be sought from the Western Michigan University community at large. Subjects will be randomly assigned to the experimental or control group. Each subject will be asked to lift a 10 lb. object from the floor to waist height in whatever manner is natural for them and place it on a table next to them. Baseline information will be collected during this lift, using an electromyographic (biofeedback) instrument. The control group will repeat the above lift at which time data readings will be taken. The experimental group will receive instruction in body mechanics and the lifting procedure will be repeated using good body mechanics, at which time the data will be collected. Results of the study will focus on the comparison of stress levels of the lower back between the two groups.

CHARACTERISTICS OF SUBJECTS: Briefly describe the subject population (e.g., age, sex, prisoners, people in mental institutions, etc.). Also indicate the source of subjects.

The subjects will be normal adult women between the ages of 18 and 35 who have no past or present condition of back or knee strain as reported by the individuals. Each subject will sign an informed consent form (see attached), fill out a questionnaire, and participate in the activity while wearing sensors which will be connected to an electromyographic (biofeedback) instrument to record the data.

SUBJECT SELECTION: How will the subjects be selected? Approximately how many subjects will be involved in the research?

The subjects will be self-reported healthy WMU women who volunteer for the study by answering an advertisement in the Western Herald. Volunteers will be selected as participants if they meet the requirements of the informed consent form (ICF), report no history of back or knee problems, and have had no formal training in lifting techniques. Approximately 60 subjects will be sought for the study.
CONFIDENTIALITY OF DATA: Briefly describe the precautions that will be taken to ensure the privacy of subjects and confidentiality of information. Be explicit if data is sensitive.

Upon collection of data, numbers will be assigned to subject information to insure anonymity. The researcher will assure the volunteers that the data will remain anonymous through the use of the ICF.

BENEFITS OF RESEARCH: Briefly describe the expected benefits of the research.

The use of appropriate body mechanics (proper posture) in lifting has been emphasized in the rehabilitation literature. This study investigates through electromyography the activity of muscles in the lower back during common lifting. The results will help determine whether the use of improved body mechanics is less stressful on the muscles of the lower back.

RISKS TO SUBJECTS: Briefly describe the nature and likelihood of possible risks (e.g., physical, psychological, social) as a result of participation in the research.

The investigator is properly trained in biofeedback and body mechanics. The lifting activity in which the subjects are being asked to participate is one which is frequently done in every day life. Participants will have the option to withdraw from the research at any point during the study.

PROTECTION FOR SUBJECTS: Briefly describe measures taken to protect subjects from possible risks, if any.

The volunteers will be screened through the use of a questionnaire for possible health problems particularly focusing on the back and knees. Any time during the experiment if the subject reports any discomfort the activity will not continue.

INFORMED CONSENT: Please attach a copy of the informed consent form. If oral consent will be obtained, describe procedures for obtaining and documenting such consent. (Subject should be given a copy of the consent form).

See attached copy of Informed Consent Form.

QUESTIONNAIRES OR INTERVIEW SCHEDULES: If questionnaires, interview schedules or data collection instruments are used, please identify them and attach a copy of what will be used in the project.

See attached copy of the questionnaire.
BIBLIOGRAPHY


Fish, D. R. (1978). Practical measurement of human postures and forces in lifting. In C. G. Drury (Ed.), *Safety in manual materials handling* (NIOSH No. 78-185,


