THE CORNING CORPORATION BACK INJURY PREVENTION PROJECT: THE EFFECTS OF AN EXERCISE PROGRAM ON SELF-REPORTED BACK DISCOMFORT

by

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(ABSTRACT)

A back injury prevention program was developed, implemented and evaluated for employees at Corning Corporation. Subjects included 38 manufacturing employees; 21 in the intervention group and 17 in the control group. The subjects included slightly more males (62%) than females (37%), significantly more whites (87%) than African Americans or other minorities (13%), and an average age of 30-39 years. The intervention involved frequent stretching exercises done throughout the 12 hour workday. A two-way ANOVA was used to access self-reported back discomfort reported by a questionnaire during pre- and post- intervention periods. Although no significant interactions between groups across time occurred, there was a decline in discomfort for both groups. A correlational analyses was used to study the relationship between participation in the stretching exercises and discomfort. The correlation coefficient for the frequency of discomfort variable reached significance and the region of discomfort approached statistical significance. Statistical significance was not evident for intensity, duration and

level of discomfort variables. Except for the relationship between increased participation in the intervention program and a increased reduction in frequency of discomfort, statistical evidence is absent regarding the benefit of the intervention. However, other positive results support the possibility of program continuation.

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CHAPTER I

INTRODUCTION

Back injuries have become a major health threat in the workplace, affecting as many as 35 percent of the work force and accounting for about 25 percent of all compensation claims (Shi, 1993). Physical therapists who treat injured workers usually site poor work habits, poor physical fitness, bad posture, aging and inadequate self-care of the working body as the chief sources of cumulative trauma disorders such as back injury (Hebert, 1992). Cumulative trauma disorders occur when the musculoskeletal system is damaged through wear at a rate faster than the body's rate of repair (Hebert, 1992). The cumulative trauma disorder disease process results from two sources of tissue damage which includes repetitive motion causing wear damage and sustained posture causing a loss of blood supply to working tissues (Hebert, 1992).

Corning Corporation, a Blacksburg-based manufacturing company of catalytic converters, revealed an interest in the implementation of a back injury prevention program under the direction of the Community Health Education program at Virginia Tech. Both management and employees at Corning were surveyed regarding their interests in back health opportunities available through a Virginia Department of Health grant awarded to Virginia Tech last summer. In addition to strong employee interest, back strains accounted for the highest frequency of lost time accidents during 1993 at Corning Corporation. Four specific tasks have been identified at Corning by a local physical therapist that have a high potential for musculoskeletal injury, particularly affecting the back. The tasks include lifting 40-50 lb bags into waist high intake bins between 20-30 times per shift, repeatedly lifting and twisting/turning with mild to moderate loads of ceramic filters, extended periods of inspecting ceramic filters with potential for work below the eye level and occasional throwing of 10-15 lb ceramic tubes 15-20 feet into a waste bin.

CHAPTER II

LITERATURE REVIEW

The literature demonstrates numerous examples of favorable exercise programs and effective intervention strategies used to prevent and reduce back injury in the manufacturing industry. Hansford, Blood, Kent and Lutz (1986) looked at radial and ulnar artery circulatory changes at the wrist in manual workers performing repetitive tasks. A significant decrease in blood flow was evident after manual labor was performed for 1.5 hours (Hansford et al., 1986). Handsford et al. (1986) compared the effects of two preventive interventions, exercise and rest. Blood flow was restored after five minutes of rest, but increased to a greater degree with a five minute exercise program (Hansford et al., 1986).

Sawyer (1987) demonstrates a reduction in cases of carpal tunnel syndrome among employees at Diversified Products, a fitness equipment manufacturer, after an on-site exercise program was implemented. Diversified Products experienced 11 cases of carpal tunnel syndrome in the nine month period prior to the intervention and only one case in the two years after initiation of the effort (Sawyer, 1987). The program featured flexibility and strengthening exercises twice daily for 10 minutes prior to the employee's break. The company foreman directed the exercises each day (Sawyer, 1987). No information was provided regarding employee compliance. Since the program was offered during company time and in a group format it could have been mandatory.

Lutz and Hansford (1987) reviewed the success of an in-house ergonomics task force developed to control cumulative trauma disorders at Ethicon, Inc., the worldwide leading manufacturer of sutures and wound closure products. The initiation of a twice daily seven minute employee exercise program was a major component of the comprehensive ergonomics program at Ethicon (Lutz & Hansford, 1987). Medical department visits for carpal tunnel syndrome complaints decreased 62 percent following the intervention (Lutz & Hansford, 1987). Employees participated voluntarily at an average rate of between 80-90 percent on company time (Lutz & Hansford, 1987).

Allers (1989) demonstrates the success of pre-work stretching programs in Oregon that have shown injury reductions between 56 and 96 percent. Employee groups meet at the worksite and do exercises together lead by a manager or employee who has been thoroughly trained in correct stretching techniques (Allers, 1989). Fifteen stretches targeting all the body's major muscles groups take approximately 10 minutes (Allers, 1989). After three to six months of exercising, four to six pre-stretch warm-up exercises are often added only increasing the time to 12 minutes per day (Allers, 1989). Stretches move joints to their point of tension and the workers hold the position for 20 seconds (Allers, 1989). Employees are also encouraged to stretch briefly several other times during the work day (Allers, 1989). Participation rates are not included. It is likely that employee participation is fairly low since the program is before work.

Kellett, Kellett and Nordholm (1991) evaluated the effect of a weekly exercise program on short-term sick leave attributable to back pain for employees of Marbodal AB, Scandinavia's major producer of kitchen units. The evaluation revealed that a weekly exercise program resulted in a 50% reduction of sick leave for people with relatively short episodes of back pain (Kellett et al., 1991). The exercise program allowed employees in the study to exercise 1.5 hours per week on company time under the agreement that they would also exercise once per week on their own time (Kellett et al., 1991). There was an average of 77 percent compliance at each session (Kellett et al., 1991).

In a review article, Hebert (1992) argues that faulty work design is not the primary cause of cumulative trauma disorder. Instead he demonstrates that employees are like "industrial athletes" who need preventative stretching exercises to avoid job related injuries (Hebert, 1992). Company injury records, reviewed 6 to 12 months following implementation of exercise programs, showed a dramatic decline in lost-time injuries and lost-time days among many employers (Hebert, 1992). Hebert (1992) acknowledges 100 companies that have successfully used stretching exercises limited to 45 to 60 seconds performed every one or two hours throughout the work day. Exercise plans vary depending on the specific jobs, but all the successful companies focus on neck posture muscles, shoulder joint structures, wrist and forearm muscle groups, lower back extension and relaxation response (Hebert, 1992). The basic plan usually includes the chin tuck, lateral neck stretch, relaxation response, wrist flexor stretch, tennis elbow stretch, and the standing back bend (Hebert, 1992). Finally, Hebert (1992) confronts the concern of lost productivity. It has been consistently observed that investing one minute of stretching every hour or two will often increase production due to a reduction in worker fatigue (Hebert, 1992). All the companies report excellent compliance and report that workers are very willing to perform stretching exercises that reduce daily fatigue and discomfort from their work (Hebert, 1992).

Hebert (1993) points to worker behaviors such as poor posture habits and inadequate fitness-for-work as the main source of most cumulative trauma disorders, exasperated by socio-political problems. Such socio-political problems include workers that are more willing to seek expensive lost-time compensation claims for minor disorders, women who are more medically vulnerable to cumulative trauma and greater awareness about cumulative trauma disorders among workers and physicians (Hebert, 1993).

Hebert (1993) reviews five essential strategies required to eliminate cumulative trauma injuries in the workplace. These strategies include correcting faulty work design, comprehensive training of managers and workers to adopt cumulative trauma avoidance behaviors, job rotation frequent enough to provide effective interruption of stressful job demands, stretching frequently during the workday to reduce fatigue and restore circulation and finally, enforcement of all parties to carry out their respective prevention roles (Hebert, 1993). Hebert (1993) points to the "industrial athlete" concept again which stresses taking perfect care of the body to reduce fatigue and discomfort as the chief motivater of employee participation in stretching exercises.

The literature shows the benefits of numerous employee stretching programs in terms of restored blood flow, reduced back injury cases, reduced lost time or sick leave from back injury, reduced fatigue and increased productivity. On the other hand, there is minimal discussion of changes in self reported back, neck and shoulder discomfort from employees after they participated in a worksite stretching program. In fact, self reported back discomfort was discussed in only one of the articles reviewed. Kellett et al. (1991) reported that 78 percent of employees who initially experienced back pain in a Swedish study saw improvement following an exercise program. The improvement reported was independent of the duration of the workers symptoms and the same for all age groups (Kellett et al., 1991). It is important to note that the stretching activities were just a component of a more comprehensive back school offered to employees. Furthermore, Kellett et al. (1991) did not include information regarding how discomfort was measured by the employees.

To expand the research on self-reported back discomfort, this study examined self-reported back discomfort both before and following a worksite stretching exercise program. No other related interventions were undertaken in combination with the self-reported back discomfort study. The purpose of the study was to determine if an exercise intervention would reduce back discomfort among Corning employees. My primary research hypothesis was that the intervention group would report a significant difference in back, shoulder or neck discomfort pre- verses post- test time. My secondary research hypothesis predicted a relationship between employee participation rates in the stretching program and back, shoulder and neck discomfort. The intervention involved 60 seconds of stretching exercises per hour during each 12 hour shift and two minutes of exercises during the shift overlap. The significance of the study is that the intervention could eventually be offered to the entire Corning workforce in an effort to reduce company wide back, shoulder and neck discomfort among workers. The long-term goal of the program is a reduction in the back and overall musculoskeletal injury rate among Corning employees as well as fewer related medical claims.

CHAPTER III

METHODOLOGY

Subjects

A musculoskeletal injury prevention program was developed, implemented and evaluated for employees at Corning Corporation, a major industry in Montgomery County. Corning employs approximately 200 production workers and managers in the manufacture of catalytic converter components for automobiles here and abroad. The average age of a Corning employee is 35. Forty percent of the workforce is female and 12 percent are minorities. The average education level is 13 years for production workers and 16-18 years for management. The average annual income is $40,000.

Production teams volunteered to participate in the study at Corning. Each production team consisted of approximately 12-15 employees. Two of the teams were randomly selected from the volunteers as the experimental group. Two waiting list control groups were used for comparison. Team A & E and B & F worked on the same calendar days, with one team scheduled for the day shift and the other for the night shift. Therefore, the random assignment was organized so that either A & E or B & F were grouped together as the intervention or control group.

Each team combination was assigned a number and the first team number corresponding to a set of random numbers became the intervention group and the other the control group.

Instruments

Process Measures: A self-reporting system was used to measure employee participation in the back injury prevention program (see Appendix A). There are unavoidable problems associated with the accuracy of any self-reporting mechanism, such as reliance on the honor system. In order to maximize the criterion-related validity of the self-reporting system, members of our program team made several visits to Corning during the intervention period to spot check compliance with the exercise protocol. Visits were made with and without the employee's knowledge. Employees were observed during their floor exercise period to examine participation levels and to determine if the stretching techniques were reflective of our directions. In addition, team exercises were initiated by the team leaders each hour on the half hour rather than leaving the exercises up to each employee to do on their own schedule.

Outcome Measures: Back discomfort was measured using a back pain questionnaire pre and post intervention (see Appendix B). The questionnaire was developed based on the basic symptom characteristics of discomfort including intensity, duration, frequency, and level of impairment. A Likert like scale was used to measure back discomfort on the questionnaire. Possible answers ranged from 0 - 5. Zero represented no or minimal discomfort while five indicated maximum discomfort. A pain map was also included on the questionnaire to confirm the precise region of discomfort. The pain map was divided into three sections for the purpose of scoring. The neck and shoulder areas constituted one region, the mid-back another and the lower back a third region. Respondents received one point for each pain region identified on the map. A total of three points were possible per respondent.

The questionnaire was pre-tested with a student group to identify ambiguities, misunderstandings or other inadequacies. To ensure content validity of the questionnaire, members of the employee safety team and a local physical therapist examined the items to judge whether they were adequate for measuring what they were intended to measure and if they were representative of the behavior domain under study.

Although measures were taken to ensure instrument validity, the reliability of both the self-reports and questionnaires were difficult to control. It was impractical to ask subjects to repeat the questionnaire beyond the five times during baseline and follow-up data collection. Therefore, the degree to which employees consistently reported their participation and discomfort is unknown.

Procedures

The program was conducted from February 16 to April 9. Prior to the program commencement, all study participants were asked to complete a discomfort survey to confirm that back, neck and shoulder discomfort was prevalent at Corning (see Appendix C). Then, the program was launched with a half hour orientation kick-off meeting during a shift overlap for both the experimental and control groups. The orientation focused on administrative issues such as questionnaire clarification and completion as well as the distribution of informed consent forms. Then, only in the intervention group was the rationale for stretching exercises discussed and an exercise demonstration viewed. The intervention group of production workers were also trained and encouraged to complete stretching exercises once per hour during their 12 hour shift for 60 seconds and during their shift overlap for about two minutes.

The stretching exercises were developed by Shala Davis, Assistant Professor of Health & Physical Education at Virginia Tech and Mylinda Burnett, PT, from Blacksburg

Physical Therapy, based on the specific needs of Corning employees. The purpose of the exercises was to reduce back, shoulder or neck discomfort from repetitive motion tasks performed by the Corning employees. The specific exercises and area targeted for discomfort reduction are as follows: the neck stretch (cervical spine), the upper trapezius stretch (cervical spine), the inferior capsule stretch (shoulder), the standing backward bend (back), the wrist extensor stretch (wrist), the chest/bicep stretch (cervical spine), the seated low back stretch (back), the standing yoga stretch (gluteal muscles) and the pectoral stretch (cervical spine). Employees were asked to perform the first six exercises mentioned above each hour during their shift while they were working on the floor. Employees were instructed to hold the stretch for 10 seconds per exercise or five seconds per side if the exercise required alternating arms and hands. The remaining three exercises were performed during the shift overlap. Employees were instructed to hold these stretches for 10 seconds, including those that required alternating legs. Exercises were repeated twice during the shift overlap. A detailed diagram with instructions on how to do each exercise was provided to each intervention group participant (see Appendix D). An exercise training video was also produced that featured employee volunteers from the intervention group. The videotape was placed in a central location for employees in the intervention group to review throughout the study time period.

Incentives were used to motivate employees to exercise regularly. Ideas for incentives were generated at an employee safety team meeting to ensure that they would be valued by the workers. The employees chose Walmart gift certificates. Employees received a $5.00 gift certificate for each week of 90 percent or better participation. For example, the employees could exercise a total of 65 possible times during a one week period. Participation totals were calculated for employees at the end of each week. Those employees reporting exercise totals of 59 (90% of 65) or better received certificates.

Both the intervention and control groups completed a daily back discomfort questionnaire one week before and one week following the intervention. The baseline and follow-up data is based on these daily ratings of discomfort for the five shift period before and after the intervention. A comparison was conducted to determine if the stretching exercises impacted self-reported back, neck and shoulder discomfort among the employees. Employees completing at least three questionnaires during baseline as well as follow-up data collection periods were retained for the analysis.

Analysis of Data

An experimental research design was used to access self reported back discomfort pre- and post- intervention. A two-way analysis of variance was used to analyze the data. This statistical test produced the main effects of group and time as well the interaction of the two.

A correlational analyses was used to study the relationship between participation in the stretching intervention and its influence on self-reported discomfort among Corning employees. The overall participation rate for each employee was compared to their specific discomfort change score and a correlation coefficient and a probability were then produced.

CHAPTER IV

RESULTS

Descriptive Statistics

The employees participating in the study appear to fairly representative of the overall Corning workforce. There were a total of 21 employees in the intervention group and 17 employees in the control group. Males were in the majority, with 71 percent in the intervention group and 53 percent in the control group compared to 60 percent in the total employee population. Most of the employees were white, with 90 percent in the intervention group and 82 percent in the control group compared to 88 percent in the total workforce. Finally, the age range in the intervention group was 20-46 years old. The age range in the control group was similar with employees 23-49 years old. The majority of employees in both groups were in the 20-29 (42%) age category, followed by 40-49 (32%) and then, 30-39 (26%). The average age of a Corning employee is approximately 35 years (see Table 1).

Insert Table 1 here

Table 1

Characteristics of Experimental and Control Group Members

Characteristics	Experimental N=21	Control N=17	Total N=38
Gender			
Male	71%	53%	63%
Female	29%	47%	37%
Race			
White	90%	82%	87%
African American	10%	18%	13%
Other	0	0	0
Age			
20-29	38%	47%	42%
30-39	29%	24%	26%
40-49	33%	29%	32%

Hypothesis Testing

A two-way ANOVA was used to test my primary null hypothesis that there would be no differences within groups (intervention groups and control groups) across time (pre- verses post-test). My research hypothesis was that there would be differences within groups across time. Dependent variables included frequency, intensity, duration, level and region of back, shoulder and neck discomfort. There were no significant group by time interactions (see Figures 1-5). Discomfort means and standard errors are reported for the intervention and control groups at pre- and post-test time (see Table 2).

Insert Figures 1-5 here

Insert Table 2 here

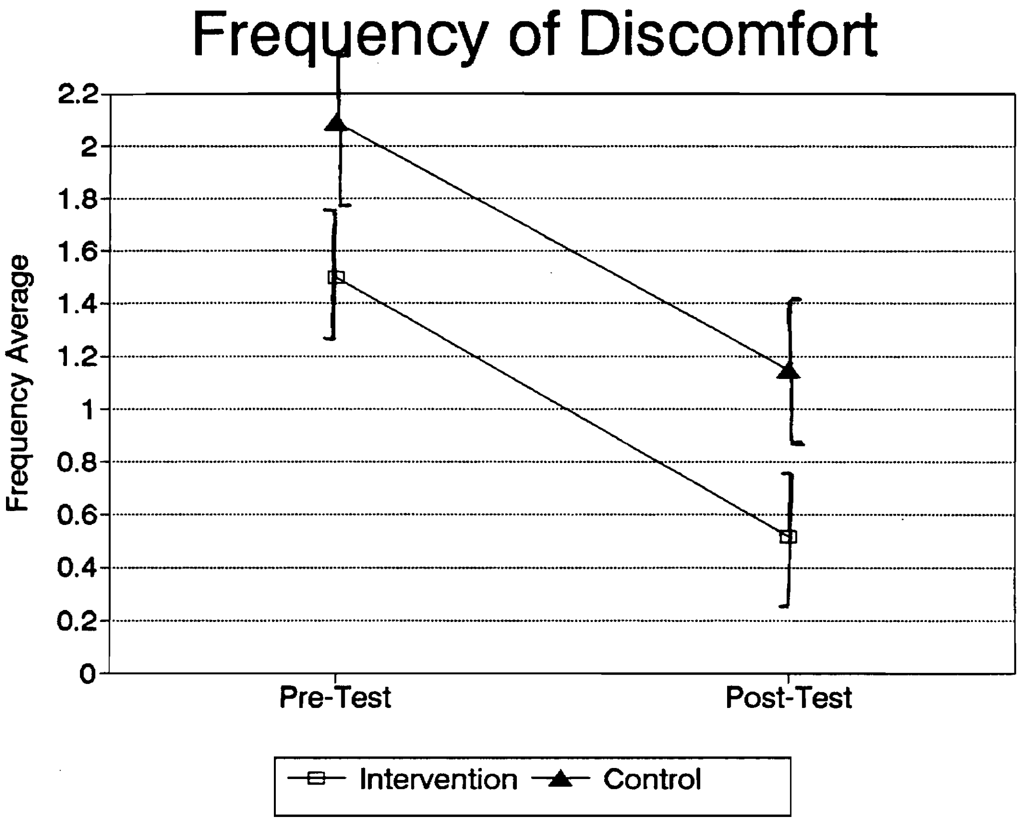

Figure 1. Frequency of discomfort in the intervention and control groups during pre- and post-test periods.

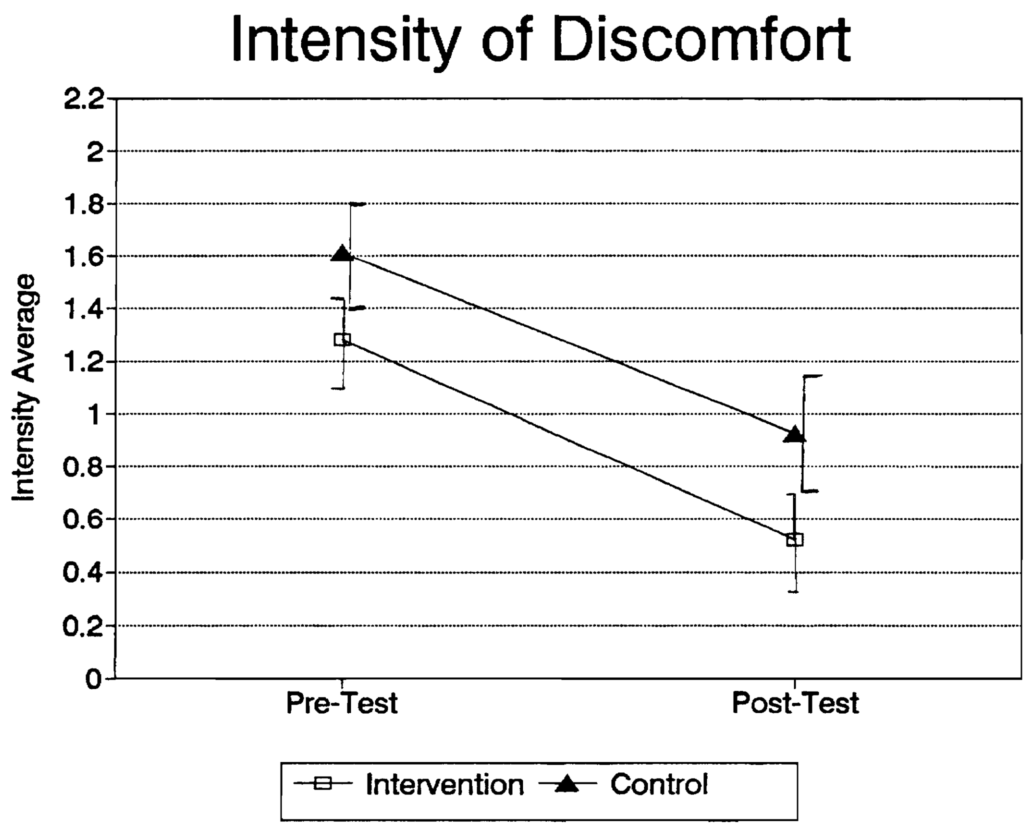

Figure 2. Intensity of discomfort in the intervention and control groups during pre- and post-test periods.

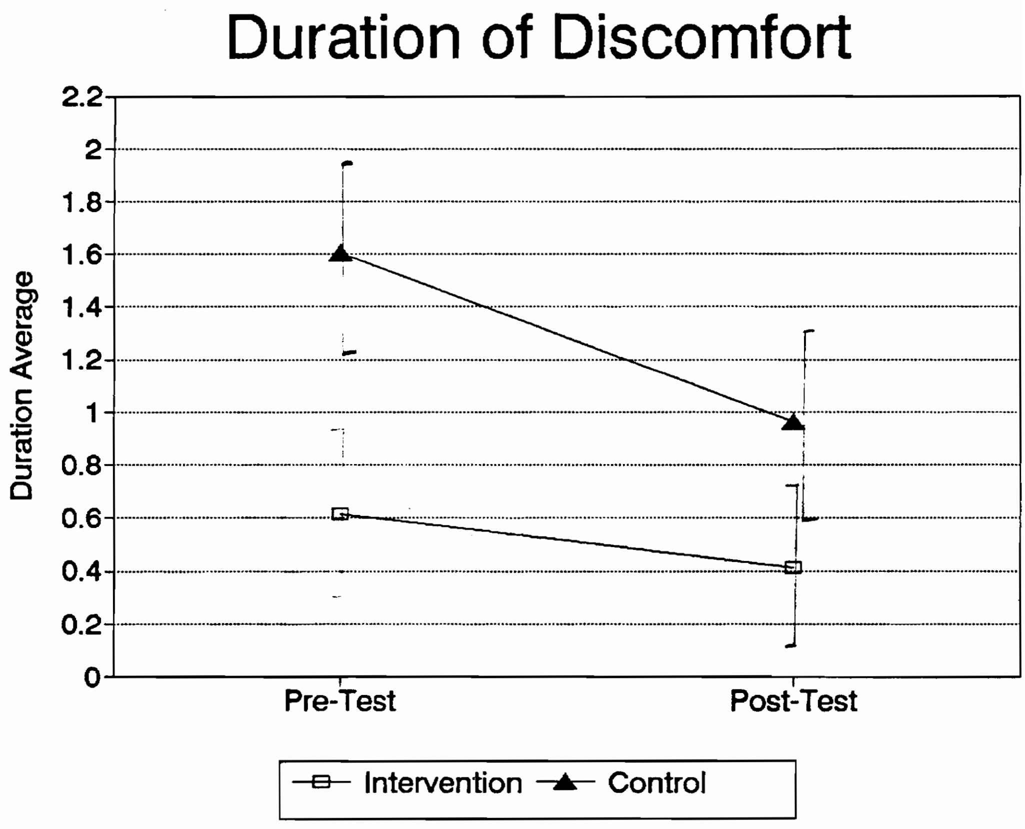

Figure 3. Duration of discomfort in the intervention and control groups during pre- and post-test periods.

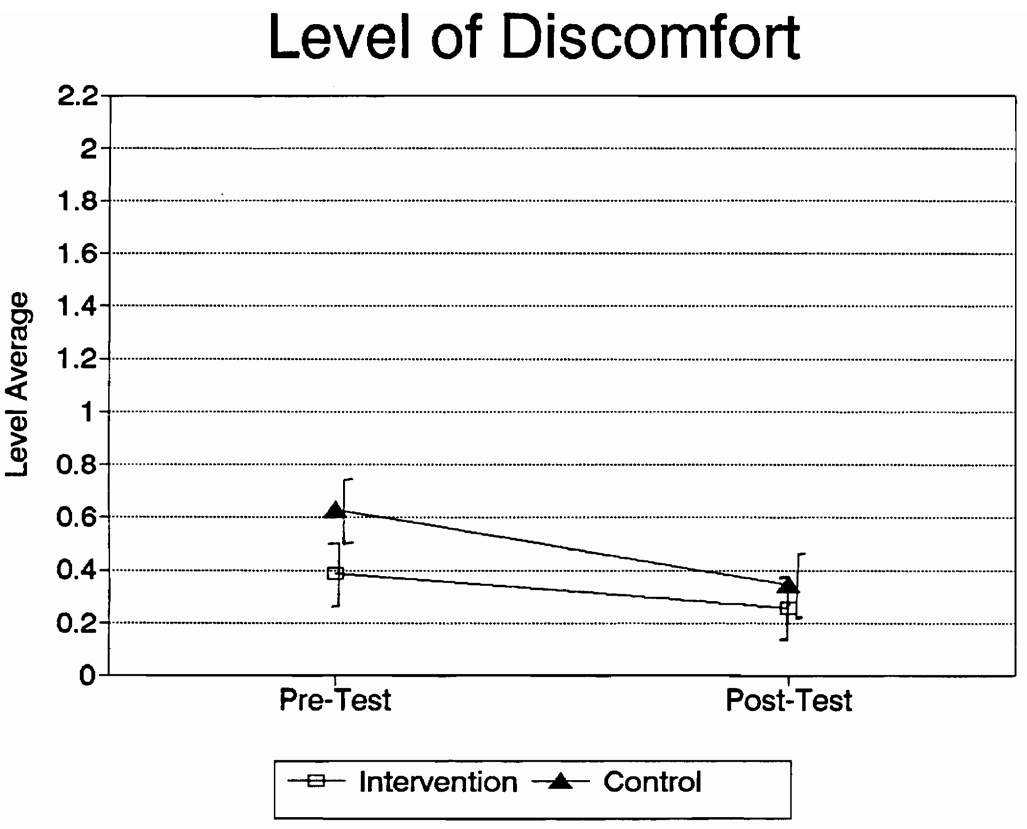

Figure 4. Level of discomfort in the intervention and control groups during pre- and post-test periods.

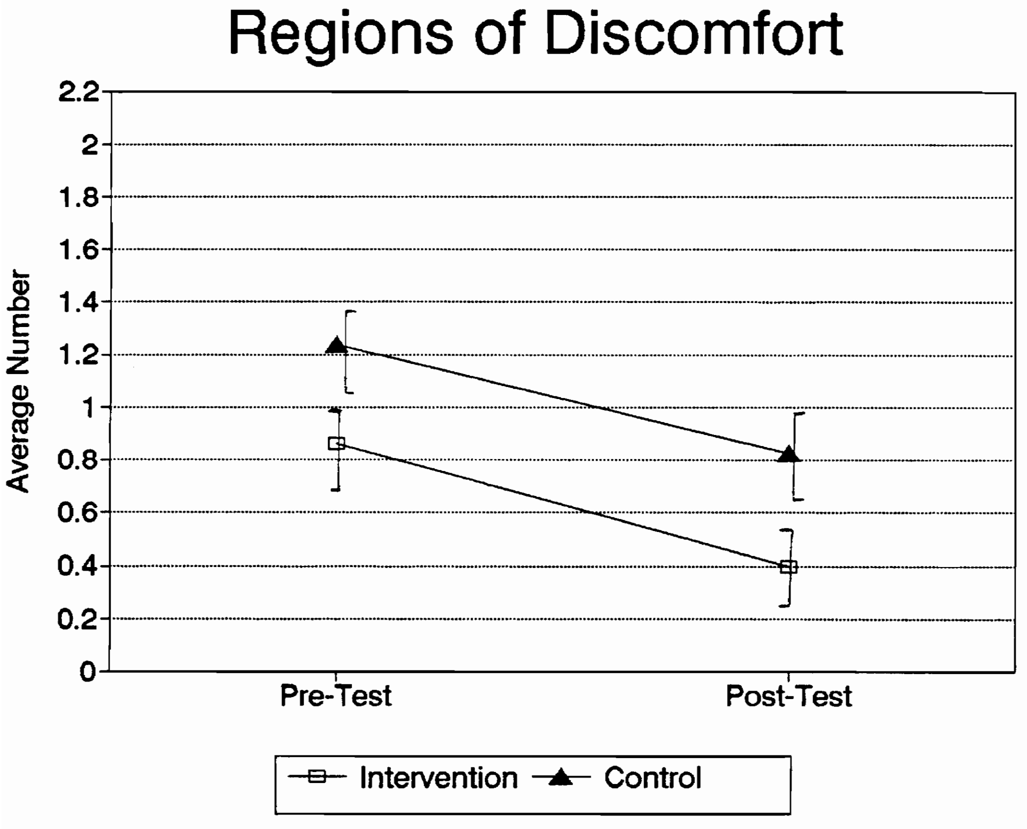

Figure 5. Regions of discomfort in the intervention and control groups during pre- and post-test periods.

Main effects of group were significant for frequency, region and duration variables. Main effects of time were significant for frequency, intensity and region variables.

Visual observations of the data in Figures 1-5 suggested a decline in all five discomfort variables for both the intervention and control groups. Also, the control group reported higher amounts of discomfort in all five discomfort variables compared to the intervention group.

Significance levels, F-ratios and degrees of freedom are reported for interaction as well as the main effects of group and time (see Table 3). Complete ANOVA tables are included in Appendix E for each dependent variable.

Insert Table 3 here

My secondary hypothesis was tested using a correlational analysis. The null hypothesis stated that there would be no relationship between participation rates and self-reported discomfort rates. My research hypothesis was that self-reported back discomfort would be correlated with participation rates in the stretching intervention

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Table 3

ANOVA Summary: F-Ratio, Degrees of Freedom & Significance

Levels for Main Effects & Interaction of Group & Time

Discomfort	Group		Time		Interaction	
Variables	F	df	F	df	F	df
Frequency	5.37**	1	13.3*	1	0.01	1
Intensity	3.59	1	14.1*	1	0.04	1
Duration	7.40*	1	2.21	1	0.59	1
Level	1.79	1	2.82	1	0.41	1
Region	7.20*	1	8.46*	1	0.03	1

*** p is less than .01**
**** p is less than .05**

program. The correlation coefficent for the frequency of discomfort (.05) was the only variable that reached significance. It is also important to note that the region of discomfort variable approached significance (.14). No other significant correlations between participation rates and discomfort existed. Finally, weekly participation rates declined as the program progressed. Participation rates totaled 89 percent the first week, 79 percent the second and 74 by the final week. Change scores, overall participation rates, correlation coefficients and probabilities are reported for each of the following discomfort variables: frequency, intensity, duration, level and region (see Table 4).

Insert Table 4 here

Table 4

Change Scores, Participation Rates, Correlation Coefficients & Probabilities for Intervention Group

Discomfort Variables	Change Score Mean (SD)	Participation Rate (SD)	r	p
Frequency	.97 (.98)	80% (13)	.44	.05
Intensity	.73 (.77)	80% (13)	.22	.33
Duration	.40 (.99)	80% (13)	-.11	.64
Level	.2 (.48)	80% (13)	-.06	.80
Region	.44 (.57)	80% (13)	.33	.14

CHAPTER V

DISCUSSION & SUMMARY

A stretching intervention was designed to reduce self-reported back discomfort among manufacturing employees at Corning Corporation. The research findings regarding the intervention did not support the primary research hypothesis. Therefore, the null hypothesis was accepted in lieu of the research hypothesis. The risk of a type II error, retention of a false null hypothesis, exists in the study. The research findings regarding the secondary hypothesis supported the research hypothesis for the frequency of discomfort variable only. Intensity, duration, level and region of discomfort variables did not achieve significance. Therefore, the null hypothesis for the frequency of discomfort variable was rejected while accepted for the other four discomfort variables. The risk of a type I error, the rejection of a true null hypothesis exists, for the frequency of discomfort variable. The risk of a type II error exists for the other four variables. Except for the correlational analysis that showed a relationship between participation in the intervention program and a reduction in the frequency of discomfort, there is insufficient evidence for concluding that the stretching exercises reduce back, shoulder and neck discomfort. It is worth exploring some explanations leading to the research results.

There were no significant interactions between intervention and control groups across time as predicted by my first hypothesis. However, a decline in all five discomfort characteristics (frequency, intensity, duration, level and region) was evident for both groups from pre- to post- test time.

Explanations regarding why the control group also reported a decline in discomfort following the intervention program may include cross-over and historical effects. Cross-over effects occur when the control group starts to exercise in a way similar to the intervention group. No evidence exists regarding such cross-over.

On the other hand, some possible historical effects were found. Historical effects can explain such unexpected results when the there is a difference in related job activity at pre- versus post- test time. Both the intervention and control group participated in a workshop offered by Corning on lifting properly during the intervention period. Another historical effect included the replacement of manual lifting by employees with power conveyer belts about halfway through the study. Both the control and intervention groups experienced the change simultaneously. A third historical effect could have been the weather. According to Mylinda Burnett, PT, of Blacksburg Physical Therapy, a decline in self-reported discomfort could be attributable to a change from winter weather in February when baseline data was collected to springtime weather in April when the final discomfort data was collected. People tend to report feeling better in general as the weather improves.

During the preliminary discomfort survey the control group reported much higher rates of discomfort than the intervention group. But, both groups reported relatively low rates of discomfort overall. Despite the initial survey data, the intervention and control group reported higher rates of discomfort on the baseline questionnaire than on the initial survey. Range restriction may provide some explanation for minimal improvement in self-reported discomfort. If the workforce is reporting minimal discomfort levels at the start of the program, chances are low that a large decrease in discomfort following the program would occur. A conservative decrease is a more realistic expectation.

Because the study resulted in inequivalent groups in terms of discomfort at baseline, randomization by individual rather than group may have provided more accurate results. However, randomization by individual could create problems with cross-over effects at Corning.

Group randomization allowed separation of the intervention and the control by the nature of their work schedules. The intervention group always worked the day shift while the control group worked the evening shift and vice versa. This decreased the chances of the control group from being exposed to the intervention exercises.

In retrospect, the administration of the baseline questionnaire to all subjects prior to their group assignment could have reduced the possibility of influenced responses resulting from knowledge of intervention or control group membership. For example, the control group may have exaggerated their discomfort to ensure future inclusion in a back injury prevention program. Subjects could have also been influenced or sensitized by one or two vocal individuals in their groups regarding the extent of their perceived discomfort.

The questionnaire was developed to ascertain information regarding the possible influence of outside activities such as other exercise programs on both groups. The questionnaire also tried to detect differences in job responsibilities among participants. This information would have explained possible confounding factors leading to declines in discomfort for both groups. Unfortunately, both questions were omitted in the analysis because of their lack of clarity resulting in misinterpretation by respondents.

The secondary research hypothesis predicted a relationship between discomfort and participation rates. The frequency of discomfort variable achieved significance indicating that an increase in participation is associated with a greater reduction in discomfort. Region of discomfort was the only other variable that even approaced statistical significance. While the correlational coefficient for the intensity variable was consistent with the research hypothesis, the coefficients for both duration and level were not. It is again difficult to expect a relationship when range restriction is evident among the participation rates. The majority of participation rates were above 70 percent.

In addition, those employees who participated regularly may have neglected the correct stretching techniques and instead focused on high compliance. Decreased discomfort would be expected if the stretching was being done correctly as well as frequently.

Other concerns include the decrease of participants completing the questionnaire from baseline to follow-up in both the intervention and control groups. The study started with 57 subjects and concluded with only 38, a loss of 19 subjects or a decline of 33 percent. This resulted in a much smaller sample than intended and a loss of power in testing significance. More attention was needed to better retain participants. Such a small sample size could also be responsible for the group main effects that showed significance for the frequency, region and duration variables.

Finally, the study was limited by its brief timetable. Sixteen shifts of stretching may not have been enough time to expect significant changes in discomfort among Corning employees. Although statistical significance was not achieved in the ANOVA test, one of the discomfort variables did show signs of clinical significance. Respondents reported feeling some pain at the start of the program compared to almost none at its conclusion for the intensity of discomfort variable.

Although the evidence to support the continuation of the stretching program at Corning is not consistently present, the intervention did not produce harmful effects and may actually have benefits for employees. The program was well received by the Corning workforce and there is enthusiasm regarding its continuation.

This study did not look at the impact of stretching exercises on back, shoulder and neck injury rates where the literature shows multiple benefits (Allers, 1989). Further research in this area is needed to investigate whether such a relationship exists at Corning as supported by the literature. A relationship could provide positive implications for future worksite stretching programs at Corning Corporation.

Based on the results of this pilot study indicating a decline in self-reported back discomfort and a relationship between participation and frequency of discomfort, a stretching program will be offered to all Corning employees beginning in June. The impact of the program on musculoskeletal injuries will be evaluated in a later study.

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APPENDIX A.

Employee Participation Report

Participation Report

Team __

Shift Date: ____________

Please have workers circle each hour, including shift overlap, that they participated in stretching exercises.

Employee #	Hour 6	Hour 7	Hour 8	Hour 9	Hour 10	Hour 11	Hour 12	Hour 1	Hour 2	Hour 3	Hour 4	Hour 5	SO *
________													
________	6	7	8	9	10	11	12	1	2	3	4	5	*
________	6	7	8	9	10	11	12	1	2	3	4	5	*
________	6	7	8	9	10	11	12	1	2	3	4	5	*
________	6	7	8	9	10	11	12	1	2	3	4	5	*
________	6	7	8	9	10	11	12	1	2	3	4	5	*
________	6	7	8	9	10	11	12	1	2	3	4	5	*
________	6	7	8	9	10	11	12	1	2	3	4	5	*
________	6	7	8	9	10	11	12	1	2	3	4	5	*
________	6	7	8	9	10	11	12	1	2	3	4	5	*
________	6	7	8	9	10	11	12	1	2	3	4	5	*
________	6	7	8	9	10	11	12	1	2	3	4	5	*
________	6	7	8	9	10	11	12	1	2	3	4	5	*
________	6	7	8	9	10	11	12	1	2	3	4	5	*
________	6	7	8	9	10	11	12	1	2	3	4	5	*

APPENDIX B.

Discomfort Questionnaire

Employee Number__________

Corning Corporation Back Injury Prevention Project

Back Discomfort Questionnaire

Please answer the following questions. Your answer to each question is voluntary and all answers will be kept confidential. **Do not write your name on this questionnaire.**

Please circle a response to each question based on your experience with back discomfort during your shift.

1. On average, how often did you experience back, shoulder or neck discomfort/pain during your shift?

   0. No back, shoulder or neck discomfort **(Go To Question 6)**
   1. Experienced back, shoulder or neck discomfort one time
   2. Two times
   3. Three times
   4. Four times
   5. Five times or more

2. On average, how intense was the pain/discomfort?

   0. No pain
   1. Very mild pain
   2. Mild pain
   3. Moderate pain
   4. Severe pain
   5. Extremely severe pain

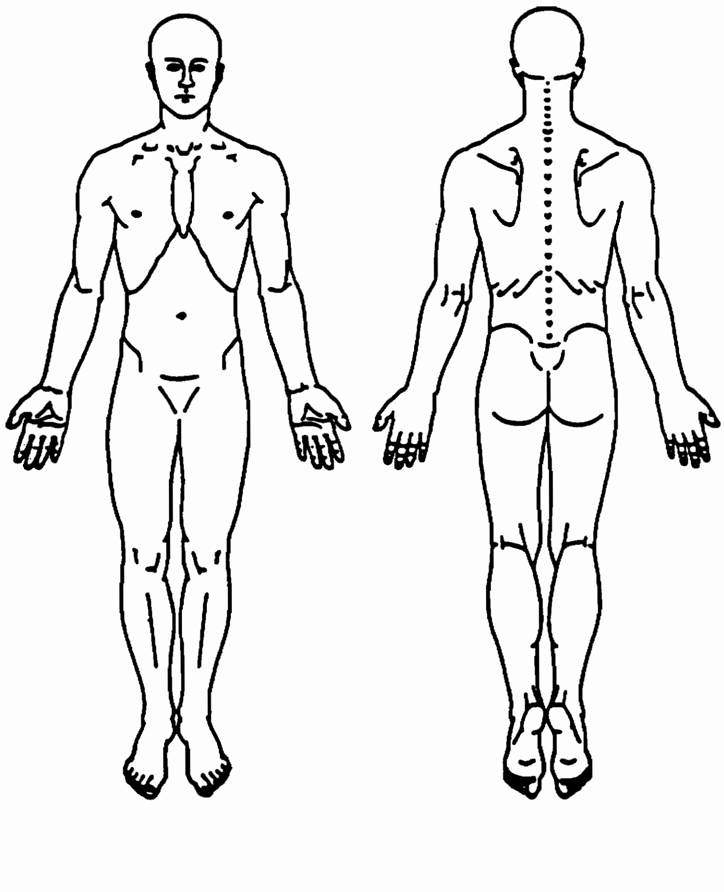
3. On average, how long did the discomfort/pain last?

   0. 2 hours or less
   1. 3-4 hours
   2. 5-6 hours
   3. 7-8 hours
   4. 9-10 hours
   5. 11-12 hours

4. On average, how much did the pain/discomfort impair your daily activities? (ie. at work, home or community)

   0. Not at all
   1. Still engage in most activities without difficulty
   2. Still engage in most activities, but with some difficulty
   3. Inability to participate in some activities
   4. Inability to participate in most activities
   5. Essentially bed ridden when not working

5. Please use the pain map below to shade in the location of your back, shoulder, neck or other discomfort/pain.



6. Have you participated in any of the following activities outside of work since the back injury prevention program started? Please circle all answers that apply.

   0. Outside exercise programs (including walking, aerobics & sports)
   1. Physical therapy
   2. Chiropractic therapy
   3. Prescription medication for back problems
   4. Non-prescription medication for back problems
   5. Other_______________

7. Please circle the answers that best describes the type of job that you performed today/tonight.

   0. Fired inspection
   1. Green
   2. Final Audit
   3. Fired SPC
   4. Green SPC
   5. Forming
   6. Dry Blend
   7. Other

Thank you for taking the time to complete this questionnaire!

APPENDIX C.

Discomfort Survey

<u>Back Discomfort Survey</u>

Safety Team Leader ______________
Production Team ________________

Please survey your production team regarding their back discomfort.

1. During the past **week**, have you experienced any back discomfort?

_______Number of workers experiencing back pain
_______Number of workers **not** experiencing back pain

2. During the past **week**, have you experienced any shoulder or neck pain?

______Number of workers experiencing shoulder/neck pain
______Number of workers **not** experiencing shoulder/neck pain

3. Total number of workers on team ______.

Comments____
____
____

APPENDIX D.

Exercise Diagram

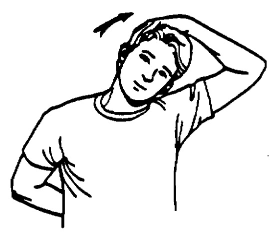
Shift Exercises

Perform these exercises hourly during your shift for 10 seconds each. When the exercise requires alternating arms/ hands, perform for 5 seconds on each side.

CERVICAL SPINE - 26 ☆
Flexibility: Neck Stretch

Grasp arm above wrist and pull downward and across body while gently tilting head.

CERVICAL SPINE - 23 Flexibility: Upper Trapezius Stretch



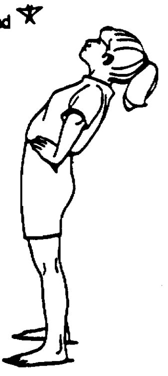
Gently grasp side of head while reaching behind back with other hand. Tilt head away until a gentle stretch is felt.

SHOULDER - 71 Inferior Capsule Stretch

Gently pull on elbow with opposite hand until a stretch is felt in shoulder.

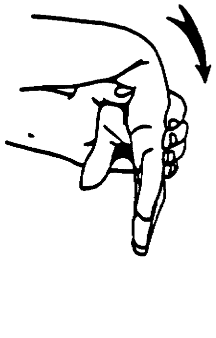
BACK - 44 Standing Backward Bend ☆

Arch backward to make hollow of back deeper.



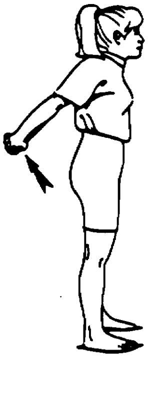
Wrist Extensor Stretch

Keeping elbow straight, grasp involved hand and slowly bend wrist down until a stretch is felt.



CERVICAL SPINE - 29
Chest/Bicep Stretch

Lace fingers behind back and squeeze shoulder blades together. Slowly raise and straighten arms.

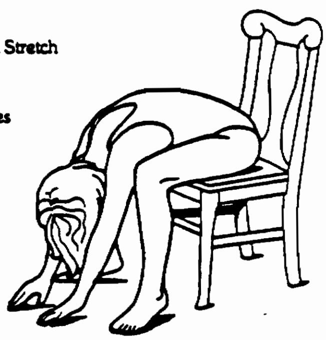


Shift Overlap Exercises

Perform these exercises during your shift overlap for 10 seconds each. If the exercise requires alternating legs, hold each leg for 10 seconds. Repeat the cycle of exercises twice during shift overlap.

BACK - 17
Seated Low Back Stretch

Sit in chair with knees spread apart. Bend forward to floor. A comfortable stretch should be felt in lower back.



☐ **10. STANDING YOGA STRETCH***: Stand as shown with left foot up on chair, spine straight. Place right hand on left knee and twist to left. Hold for count of 5. Repeat to both sides.

APPENDIX E.

ANOVA Tables

Table 5

ANOVA Table: Frequency Variable

Source	DF	Sum-Squares	Mean Squares	F-Ratio	Probability
Test	1	17.5	17.5	13.3	.0006
Group	1	7.1	7.1	6.37	.0233
Inter-action	1	7.4	7.4	0.01	.9406
Error	72	94.7	1.31		
Total	75	120			

Table 6

ANOVA Table: Intensity Variable

Source	DF	Sum-Squares	Mean Squares	F-Ratio	Probability
Test	1	9.8	9.8	14.08	.0004
Group	1	2.5	2.5	3.59	.0623
Inter-action	1	2.5	2.5	.04	.8518
Error	72	50.3	.70		
Total	75	62.8			

Table 7

ANOVA Table: Duration Variable

Source	DF	Sum-Squares	Mean Squares	F-Ratio	Probability
Test	1	3.3	3.3	2.2	.1417
Group	1	11.1	11.1	7.4	.0082
Inter-action	1	.89	.89	.59	.4436
Error	72	108	1.5		
Total	75	123			

Table 8

ANOVA Table: Level Variable

Source	DF	Sum-Squares	Mean Squares	F-Ratio	Probability
Test	1	.82	.82	2.82	.0976
Group	1	.52	.52	1.79	.1849
Inter-action	1	.12	.12	.41	.5224
Error	72	21	.29		
Total	75	22			

Table 9

ANOVA Table: Region Variable

Source	DF	Sum-Squares	Mean Squares	F-Ratio	Probability
Test	1	3.6	3.6	8.46	.0048
Group	1	3.1	3.1	7.20	.0090
Inter-action	1	1.14	1.14	.03	.8700
Error	72	31	.42		
Total	75	37			

VITA

The author was born June 15, 1963. She graduated from Bowie High School, located in Bowie, Maryland, in 1981. After completing high school she attended the University of Maryland where she received a B.S. degree in Journalism -Public Relations. Jane worked as a student intern in the public relations department of MCI Communications Corporation during her senior year at the University of Maryland and at National Geographic Society each summer during college.

After college, Jane joined the National Weather Service as a public affairs specialist. Jane has also worked for both the American Cancer Society and the American Heart Association as a regional director in metropolitan Maryland and Charlottesville, Virginia, respectively.

Jane enrolled in the community health education graduate program at Virginia Tech in 1992, as a full time student. In 1993, she became a graduate teaching assistant with the responsibility of training undergraduate students in CPR and first aid. Upon completion of her graduate degree, she plans to pursue employment in the Roanoke Valley as a health educator.