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The Relationship between Work Related Injury and Participation in Exercise and Recreational Activities

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THE RELATIONSHIP BETWEEN WORK RELATED INJURY AND PARTICIPATION IN EXERCISE AND RECREATIONAL ACTIVITIES

by

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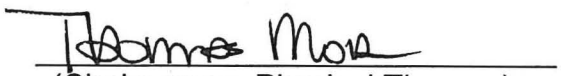
This Scholarly Project, submitted by Stephen Kaiser, Chris Kuhn, and Jay Steckler, in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Advisor and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

(Graduate School Advisor)



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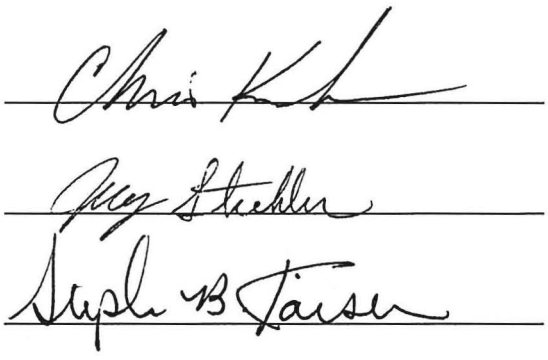
Signature 

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ABSTRACT

Background/Purpose: The cost of health care is on the rise for both employers and employees. Research has shown that exercise in any capacity will improve overall health and fitness levels. Limited research has shown that proper exercise can lead to a decrease in musculoskeletal injuries. With the number of musculoskeletal injuries occurring in the workplace at high levels, establishing a connection between injury reduction and exercise is imperative. The purpose of this study was to determine if there is a relationship between participation in exercise and recreational activities and injury in the workplace.

Methods: A random stratified sample of 396 persons was provided by the University of North Dakota payroll department, representing 20% of the university population. Surveys were sent out and 177 surveys were returned, which represented a 45% return rate. The survey included demographic data, work injury information, and exercise history information. Information of the 177 surveys was analyzed using the Statistical Package for the Social Sciences (SPSS) 11.0 program.

Results: No significant difference was found between work injury and exercise ($X^2(1, n = 177) = .135, p > .05$). A significant relationship was found when comparing injury to cardiovascular RPE ($X^2(8, n = 137) = 16.188, p = .04$).

Discussion/Conclusion: Given the documented benefits of exercise and its relation to overall wellness, the assumption could be made that exercise and recreational activities would reduce the incidence of work injury. However, the results of this study did not meet that assumption. Future research needs to be done to expand on this area. The information collected from this research may be beneficial to the UND Wellness Center, UND Department of Physical Therapy, and the UND Safety and Environmental Health Office.

CHAPTER I

INTRODUCTION

Prevention of injury and disease has thus far been neglected in health care reform efforts, and only a small percentage of the national health care spending has been dedicated to preventive measures.[1] According to the Bureau of Labor Statistics,[1] of the 5.2 million non-fatal occupational injuries and illnesses in 2001, 4.9 million were classified as injuries. According to the National Safety Council,[2] in 1996 work injury costs totaled $121 billion. Of that $121 billion, $60.2 billion was due to wage and productivity losses, and $19 billion was due to medical costs.[2] It has been shown that employees pay an estimated 30% of the national health care bill.[3] This leaves 70% for employers and insurance companies to cover and is thus a growing concern due to increased expenditures for industry.

Despite the documented benefits of exercise to overall health and fitness, recent studies show that only 63% of Americans participate in exercise activities 3 or more times per week.[4] According to a study by Dolliver[5], 51% of Americans do not participate in vigorous sports or physical activities for at least 20 minutes a day. These numbers are due to a myriad of reasons, including time restraints, lack of motivation, apathy, and their perception of an active lifestyle. The biggest challenge of establishing a general exercise or worksite wellness program is to

sustain long-term participation and develop programming strategies that will motivate people to be active, help them enjoy exercising, and enable them to fit activity into their busy lives.[6,7]

Problem Statement

With the increased cost of work injury expenditures reported in the literature, there have not been many research studies that have addressed the benefits of exercise in relation to overall wellness and specifically work injury prevention. Wellness is defined as "a composite of physical, emotional, spiritual, intellectual, occupational, and social health; health promotion is the means to achieve wellness."[8(p1019)] There has been a limited amount of research into the area of general exercise in relation to incidence of work injury. This lack of information must be addressed to access the potential relationship between exercise or activity level and work injury.

Purpose

The purpose of this research study was to determine if there is a relationship between participation in exercise and recreational activities and injury in the workplace. An understanding of this relationship will allow employers and insurance companies to determine if including an exercise portion in a prevention program would decrease the incidence of work injury. Demographic characteristics, job description, work injury information, and exercise information were gathered and analyzed.

Significance

This research study is of great significance for the UND faculty and staff, the UND Wellness Center, physical therapists, physical therapy students, and the authors of this research project. The relationship between activity level and workplace injury is not documented in current literature. The benefits of this study are to allow professionals and the general public an opportunity to see whether participation in exercise and physical recreation activities have an effect on incidence of injury in the workplace. This will also be of importance to the UND Wellness program. This will give them information that can be used as a marketing tool for prevention and wellness programs for faculty and staff here at UND. It is important for us as future professionals because it will give us an opportunity for education as well as for other professionals in the area of prevention and wellness. Also, it may be of benefit for insurance companies because it could decrease the amount of work injury claims filed.

Research Question

Does participating in exercise or recreational activities reduce the risk of injury in the workplace?

Hypotheses

Null Hypothesis: There is no relationship between exercise and work related injury.

Alternate Hypothesis: There is a significant relationship between exercise and work related injury.

CHAPTER II

REVIEW OF LITERATURE

The literature review will outline past research into exercise and prevention and the common types of injuries that occur in the workplace. Discussion of the benefits of exercise from a physiological standpoint, prevention programs, and their documented cost/benefit ratios will also be included.

Employee absenteeism can be a problem for any business and employers are looking for a way to decrease it to keep employees on the job.[8-11] One possible way to do this is to promote employee exercise. There have been studies that report a significant relationship between exercise and absenteeism.[8,9] Jacobson and Aldana[8] studied 79,070 adult U.S. workers and analyzed statistics on weekly exercise, days per week of aerobic activity that were greater than or equal to 20 minutes, and absent days from work per year. A significant relationship between exercise and absenteeism was found (X^2 = 280.37, $P < 0.05$). One day of exercise was associated with lower absenteeism when compared with no exercise, and two days of exercise was more favorable than one day of exercise.[8] No differences were found between any other combinations of absenteeism and exercise frequency.[8]

An additional study completed by Muto and Sakurai[9] showed that there is a significant relationship between exercise and absenteeism. A group of 21,924

male workers placed into three sections by frequency of exercise: exercisers I (engaging in exercise less than once a week), exercisers II (once or twice a week), and exercisers III (more than three times a week). The proportions of absences in groups I, II, and III were 10%, 10%, and 14% lower than of non-exercising workers respectively.[9]

In contrast, there have been few studies that say there is no significant relationship between absenteeism and exercise.[10] An example of one of these studies was completed by Boyce et al,[10] who examined a population of 514 male and female police officers. ANOVAs revealed no significant relationship between overall fitness levels and absenteeism.[10]

Like illness related absenteeism, employers face a challenge with short-term disability and long-term disability of their employees. Worksite health promotion programs have been shown to decrease this problem.[11] A study by Schultz et al[11] found that participation in a worksite health promotion program might lead to reduced short-term and long-term disability days used. This six-year study was comprised of 4,189 male manufacturing company employees. Absences were compared between participants and non-participants. The percentage of non-participants absent on any given day was greater than that of participants.

Frequency of exercise can also play a big part in short-term disability usage by employees.[11] A study done by Serxner, Gold, Anderson, and Williams,[12] titled "The Impact of a Worksite Health Promotion Program on Short-term Disability Usage," found that employee participation in a worksite health

promotion program had a significant impact on average net days lost in short-term disability absence. The three-year study included 1,628 employees in a large telecommunications company. Participating employees were compared to non-participating employees. Days lost significantly increased from 33.2 to 38.1 in the non-participant group and decreased from 29.2 to 27.8 in the participant group. A six-day difference was found between groups, which represented a 20% program impact. This study found that employee participation in health promotion program had a significant impact on the average net days lost for short-term disability absence.[12]

There are a variety of different behavioral risk factors that can also influence employee absenteeism. Berterra[13] reported that these risk factors included smoking, obesity, excess alcohol, elevated cholesterol, high blood pressure, inadequate seat belt use, and lack of exercise. The highest annual excess illness cost per person was due to smoking at $960 and the lowest, $130, was due to lack of overall exercise.[13] The decreases in absenteeism due to short-term disability (STD) and long-term disability (LTD) can be due to an effective prevention program. This program should not only include physical fitness but overall wellness along with knowledge of injury prevention in the workplace.

When work injuries that lead to absenteeism and decreased productivity occur, the most common type of injury is to the musculoskeletal system.[14] These injuries can occur to any part of the body and include sprains, strains, and tears to all parts of the musculoskeletal system. Improper lifting, overuse injuries, or

trauma may cause these injuries.[14] In November 2002, the Institute for Health and Productivity Management reported that musculoskeletal conditions, such as low back pain and repetitive motion strain, were the leading cause of absenteeism in the work place.[15]

The number of injuries occurring in the work place is staggering. The Bureau of Labor Statistics reported in 2001 that of the 4.88 million total occupational injuries, 2.47 million of those were cases without lost workdays and 2.41 million were with lost workdays.[14] These numbers have decreased consistently over the past 5 years, with a reported 7.1 cases per 100 full-time workers in 1997 to 5.7 in 2001.[14] These decreases could be attributed to employees not reporting injuries or from an increased awareness and knowledge of injury prevention.[14]

In 1999, the Bureau of Labor Statistics reported that the leading musculoskeletal injury in the workplace was due to sprains/strains, and the second and third leading causes were low back pain and carpal tunnel syndrome, respectively.[14] The most common locations of those occupational injuries were the neck and back. Studies have shown that pushing and pulling can also lead to and is associated with shoulder strains and low back pain.[16-18] These problems again could be attributed to improper education on lifting techniques, poor posture, and ergonomically deficient work areas.

The employees in a professional university population as a whole encompass a wide variety of occupations that expose its members to a variety of musculoskeletal injuries. These positions include employees from faculty,

executive/administrative, technical support, clerical/administrative support, service occupation, operator/laborer, sales, and precision production and crafts worker. The positions which the employees hold may put them at greater risk of certain musculoskeletal injuries.

The correlation between exercise and work injury has been assumed to be positive. The benefits of regular exercise have been documented in research.[19-24] These documented results could allow for the assumption that exercise would have a positive effect on injury prevention, but there have not been studies done that have looked at these two specific variables.

A recent study has shown that 37% of Americans do not participate in regular exercise activities.[6] This number has increased 12% from totals in 1999.[1] In the last 20 years, the obesity rate has climbed and currently 64.5% of Americans are classified as being overweight.[25] Obesity has been connected to increased risk of cardiovascular disease, increased stress on joints and soft tissue, diabetes, and may increase the likelihood of injury.[25] These reported numbers are a reminder that people need to be educated on the effects and benefits of exercise. This education can also be translated to the workplace and may help to decrease or prevent work injury.

The benefits of exercise have been documented repeatedly in the literature.[19-23] The benefits of flexibility and resistance training have also been documented.[21] The flexibility and resistance exercises should be performed two to three days per week for 20 to 30 minutes.[21] Resistance training has also been shown to be the most effective method available for improving muscular strength

and endurance and it can lead to improved health factors associated with prevention of chronic diseases.[20] Recent research has indicated that stretching programs that include flexibility exercises may benefit employees by increasing flexibility and preventing injuries due to muscle strain.[26]

Aerobic exercise has been shown to decrease the likelihood of cardiovascular risk factors,[27] heart attacks,[27] strokes,[28] osteoporosis,[29] diabetes,[30,31] depression,[27] and colon cancer.[21,32] Cardiovascular exercise combined with resistance training and flexibility exercises has been shown to improve flexibility,[29] strengthen muscles,[29] maintain joint function,[33,34] decrease the incidence of low back injuries,[35] maintain mental fitness,[36] and decrease pain[37-39] and fatigue.[21,40] It has been shown that cardiovascular exercise performed three to five times per week for 30 to 50 minutes will show marked improvements in health.[40]

According to Vuori,[19(p276)] general physical activity has been shown to positively influence most of the "structural components of the musculoskeletal system that are related to functional capabilities and the risk of degenerative diseases." It has also been shown that physical activity has the potential to postpone or prevent musculoskeletal disorders. Physical activity can promote increased strength and flexibility.[21,41] This increased strength and flexibility can lead to an overall decrease in musculoskeletal disorders. Vuori[19] states that scientific evidence is sufficient to recommend lifelong physical activity as a healthy lifestyle in order to enhance musculoskeletal health and function for individual and population levels.

It is becoming increasingly reported in the literature that worksite prevention and wellness programs are being implemented in an attempt to decrease injury in the workplace and control costs that result from these injuries. The Wellness Council of America reports that 80% of companies nationwide with 50 or more employees offer some kind of prevention and wellness program.[42] According to DiNuble,[1] benefits of workplace exercise programs for the employer include: (1) reduction in health care and insurance costs, (2) declines in absenteeism, (3) decreased injury rates (work related and compensation claims), (4) decreased injury related absences, (5) decreased turnover rate, (6) improvements in job performance and productivity, and (7) increased job satisfaction.

Employers face many challenges in trying to control costs and implement effective wellness programs. The biggest challenge of the worksite wellness program is to sustain long-term participation.[43] Shephard[43] reports that, when a program is established, one-third of the employees are likely to join, but of those new members, one-half are likely to become non-compliant within a few months. Shepard[43] also reported that there has been a greater response to worksite wellness program participation in the university populations. He concluded that it could be due to the relaxed schedules of a university population, which may allow for more faithful program participation or a higher level of education among the participants may enhance the impact of the wellness message.

The cumulative cost benefit from worksite wellness programs has been estimated at $500-700 per worker per year.[43] It can also save the employee an

estimated $225 per year.[44] Those benefits were attributed to reduced inpatient use, fewer mental health visits, and fewer outpatient visits.[44] Initiating and sustaining work site wellness programs is not without cost.[1,45,46] Studies have shown that benefit/cost ratios ranged from .76 to 3.43 with numbers > 1 indicating savings for the employer. Another study reported the cost benefit ratios increased to 1.15 to 5.52 when these programs were included in a comprehensive health promotion package.[44] The benefit of these ratios was due to the dollars saved from lower medical costs, absenteeism, and disability expenses.

An employee fitness program may not only decrease number of disability days used, but it can also decrease health care costs.[43,44] In a study by Baun, Bernacki, and Tsai,[47] titled "A Preliminary Investigation: Effect of a Corporate Fitness Program on Absenteeism and Health Care Cost," 517 employees were studied to determine differences in health care costs and absenteeism among participants and non-participants in a corporate health and fitness program.[47] Total health care costs among participants were lower (males $561, females $639) than among non-participants (males $1,003, females $1,535).[47] But due to a large variation in individual costs, the differences between participants and non-participants were not statistically significant. However, ambulatory health care costs were significantly different: participants (males $408, females $243), non-participants (males $486, females $883).[47] Shephard[43] states that the most effective/cost effective tactic is to provide a moderately equipped facility coupled

with an active outreach to non-participating employees, one-on-one counseling, and a corporate environment that encourages a healthy lifestyle.[43]

The cost of health care is on the rise for both employers and employees. Initial research has shown that health and prevention programs are saving companies money and decreasing absenteeism and STD and LTD levels.[13] Research has shown that exercise in any capacity will improve overall health and fitness levels.[21] Proper exercise can lead to a decrease in musculoskeletal injuries.[26,41] With the number of musculoskeletal injuries occurring in the workplace at high levels, establishing a connection between injury reduction and exercise is imperative. This new knowledge can help insurance companies and employers establish better preventative strategies to further combat the increased cost of worksite injury.

CHAPTER III

METHODOLOGY

A survey was used as a foundation for the research design. The survey was utilized to collect data in order to answer the research question, "Does participating in exercise or recreational activities reduce the risk of injury in the workplace?" To assure a representative sample, a survey was distributed to a random stratified sample of full-time University of North Dakota faculty and staff members. This random stratified sample of 396 persons was provided by the University of North Dakota Payroll Department. The sample represented approximately 20 percent of the university working population.

This sample was chosen because of the type of population and the ease of access to the population. This population included a variety of different job descriptions and could accurately reflect a general public workforce. Surveys could be distributed easily and inexpensively to the UND population through the intercampus mail system. This research project was approved by the Institutional Review Board at the University of North Dakota (see Appendix A). Informed consent was implied secondary to completion and return of the survey.

The researchers designed the self-administered survey independently with help from faculty advisors. Overall survey format and question content were then reviewed by the director of the department of health and safety at the University

of North Dakota. A pilot study was designed and distributed by the outpatient physical therapy supervisor to the physical therapy staff at Altru Health Institute. This pilot study was conducted to assess content and to assess participant understanding of the survey. The findings of the pilot study were used to refine the survey.

The criteria for distribution of this survey required that the subject was a full-time benefited employee working for the University of North Dakota and not holding any other full-time position outside of the university. Student employees and work-study participants were not eligible.

Survey

The survey distributed to the sample population at the University of North Dakota was four pages in length and was divided into four sections. The four sections included demographics, job description, work injury information, and exercise information. The sections in the survey included both open-ended and closed-ended questions. A copy of this survey is included in Appendix B.

The demographic section included the sex of the respondents, age in years, and the number of years at their current positions. Employees were identified as faculty or staff. Staff designation was further delineated by the following categories as defined by the human resource department at UND:[48] Executive/Administrative, Tech Support, Clerical/Administrative Support, Service Occupation, Operator or Laborer, Sales, and Precision Production and Crafts Worker. The respondents were instructed to choose the job category that most closely fit their current job at the university.

The work injury information section asked the subjects if they had been injured at their present jobs in the past two years. Subjects who answered yes were asked to complete a work injury information chart, and if they answered no, they did not complete the chart and moved on to complete the exercise information section. The work injury information included the location of each injury, the cause of each injury, the classification of each injury (mild, moderate, or severe), and the days missed from work as a result of that injury. Subjects experiencing multiple injuries were asked to provide specific information for each injury.

All subjects were required to complete the exercise information section of the survey regardless of work injury history. The exercise information section required the subjects to complete a chart of different types of exercises indicating the days per week, minutes per episode, and rate of perceived exertion (RPE). A chart indicating the RPE scale was included. The rating system for the RPE used the range of 6 to 20, not 1 to 10. This was chosen because it was easy to access, follow, and has been proven reliable and valid in monitoring an individual's exercise tolerance.[21] The categories of exercise were divided into cardiovascular, weight training, aerobics classes, yoga/tai chi, recreational sports (basketball, tennis, volleyball, and softball), swimming, golf, martial arts, leisure activities (gardening, yard work, and dancing), and other. Finally, the subjects were asked to report any change in the amount of exercise or activity in the past two years compared to the rest of their adult life by signifying more, less, or the same.

Procedure

The survey was distributed via inter-campus mail April 3, 2003, to subjects who had been previously chosen and assigned to the sample population. Postage was not required. A cover letter, included in Appendix B, explaining the process was attached to each survey. The cover letter explained the purpose of the research, supplied contact information, and guaranteed the subjects that the information provided in the survey would remain confidential. The subjects were instructed to return the completed surveys to the University of North Dakota Department of Physical Therapy by April 25, 2003.

Reminder cards were distributed two weeks following the initial mailing of the surveys. This card was sent as a thank-you to those who had responded to the survey and as a reminder to those who had not returned their survey. The card also stated that if the subjects were in need of another survey, they could request another copy and one would be sent to them.

Collection of the surveys was concluded May 15, 2003. Upon receipt of the surveys and conclusion of the collection period, the information was entered into a data file for statistical analysis.

Data Analysis

Data collected from the 177 returned surveys, representing 45% of the overall sample population, was entered into the Statistical Package for the Social Sciences (SPSS) 11.0 program by the researchers. Two-tailed Chi-square analysis was utilized in comparing relative data. This analysis was used to assess relationships between exercise participation, exercise history,

demographic data, work injury, and job description. Demographic information, including frequencies, mean, median, and mode, was also analyzed and reported. The Alpha level to test for statistical significance was considered significant at the .05 level.

Inclusionary and exclusionary data used in the data analysis was as follows:

1. The person had to participate in the exercise/recreational activity a minimum of nine months out of the year.
2. Activities which were seasonal in nature were not included.
3. Exercise/recreational activities must be beyond activities of daily living.
4. The activities could not be part of work activity.
5. Exercise information was not used if all three sections of the exercise chart were not filled out.
6. Complete work injury information was required for inclusion.
7. Demographic information used in statistical analysis included age, gender, job description, and the number of years held at that job description.
8. Work injury information was included for statistical analysis which included the location, cause, classification, and the number of days missed due to the injury.
9. Exercise information was used that included the days per week, minutes per episode, and RPE of each exercise activity.

10. Average RPE, total exercise minutes, average minutes per episode, and average days were also used in the statistical analysis from the exercise portions of the surveys returned.

Information collected from 37 surveys was not included in the study. Twenty-seven of the surveys were not included because the respondents included information in their exercise history that was performed seasonally rather than year round. Nine surveys contained one or more exercise portions not completed and one survey was returned completely blank.

Data Reporting

These data were conducted and submitted to fulfill the requirements for the scholarly project and the Master of Physical Therapy degree at the University of North Dakota. The results will be submitted to the faculty advisor of this project, the Director of the UND Wellness Center, and the Director of Health and Safety at UND. The results will also be available through the Harley E. French Library of the Health Sciences at the University of North Dakota.

CHAPTER IV

RESULTS

Of the 396 surveys sent out, 177 were filled out and returned for a return rate of 44.7%. Sixty-two percent of the subjects to send back a completed survey were male and 38% were female. The average age in years of the subjects was 44.84 (range 23 years to 68 years), and they have been at their current jobs for an average of 9.58 years (range .25 years to 35 years). The largest percentage of subjects were faculty, 46.9%, followed by 19.8% clerical positions, 19.2% executive and administrative positions, 11.3% technical support, and 2.8% service positions.

Of the 177 subjects in the study, 88.7% reported to exercise and/or participate in recreational activities. Table 1 shows the different types of exercise and activities reported, the number of subjects participating in each type of activity, the average days per week spent participating in each type, the average minutes per day spent participating in each episode, and the average RPE reported from each type of activity. Cardiovascular exercise was the most frequently performed exercise. See Fig 1 for the breakdown of all exercise frequencies reported.

The question of "what has been your exercise level in the past two years compared to the rest of your life?" was answered by 174 of the 177 subjects.

Table 1. Descriptive Frequencies of Exercise Variables.

Type of Exercise	Number of Participants	Average Days Per Week	Average Minutes Per Day	Average RPE
Cardiovascular	137	3.69	35.77	12.89
Leisure Activities	87	2.83	70.17	11.59
Weight Training	52	2.54	31.83	13.48
Recreational Sports	20	1.43	63.48	12.85
Aerobic	16	3.31	36.88	14.50
Pilates	10	2.65	30.25	12.40
Yoga	9	3.00	35.00	11.56
Swimming	6	2.83	45.00	13.33
Martial Arts	1	2.00	60.00	13.00

Forty-six percent reported it was the same as in the past two years, 36.8% said it was less in the past two years, and 17.2% indicated an increase in exercise/activity in the past two years.

Eight percent or 14 out of 177 subjects said they had been injured at their present jobs within the past two years. Out of the 14 subjects who were injured, one was injured more than once in the past two years. Table 2 shows the frequency of the location and cause of the injuries reported. Out of the 14 subjects who were injured, one subject stated that his/her injury resulted in missed work days. Table 3 shows the classifications of injuries.

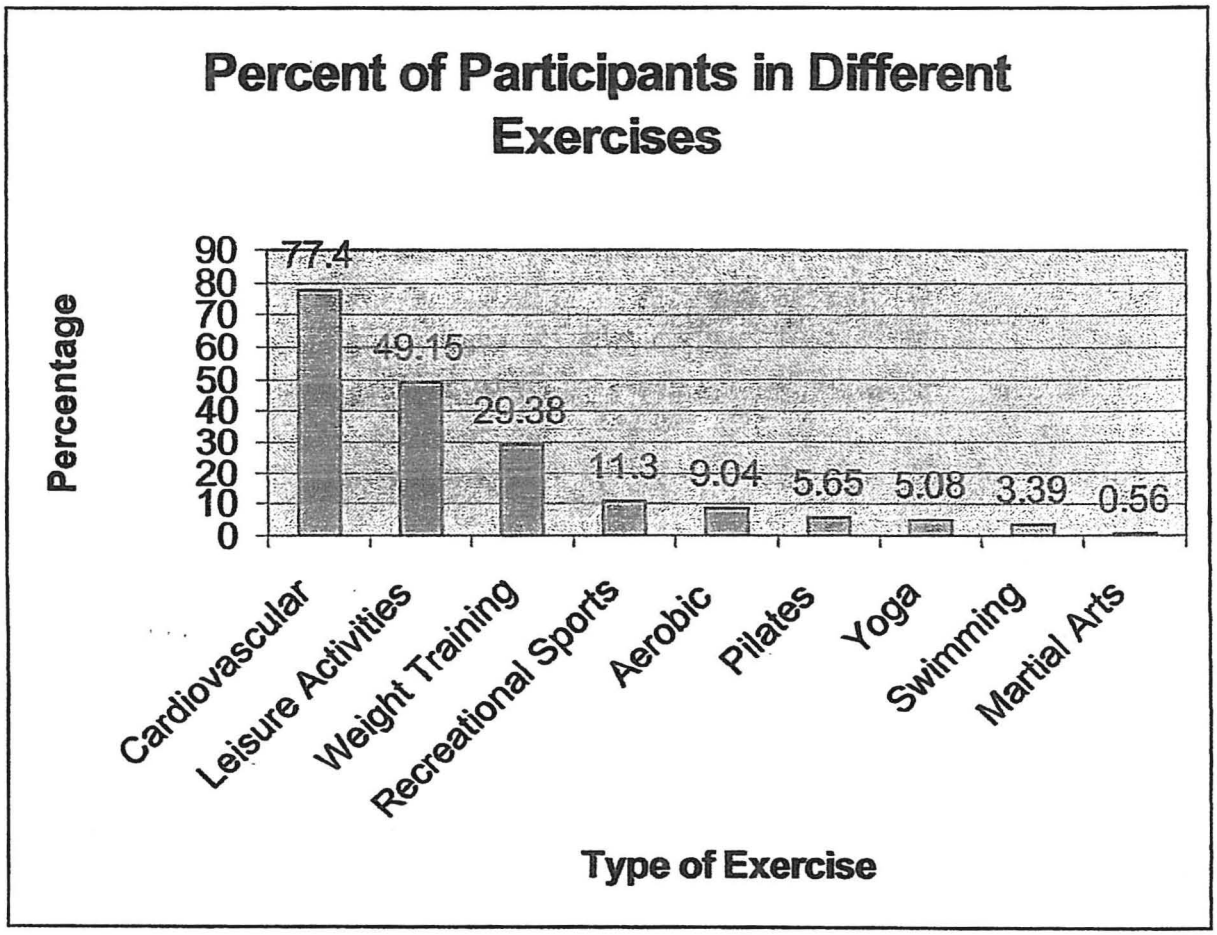

Figure 1. Type and frequency of exercise participation

Table 2. Descriptive Frequencies of Location and Cause of the Injuries Reported.

Location of Injury	First Injury	Second Injury	Third Injury
Head	1	0	0
Neck	0	0	1
Elbow	2	0	0
Wrist	1	1	0
Hand	1	0	0
Pelvis	1	0	0
Hip	1	0	0
Knee	2	0	0
Ankle	1	0	0
Multiple Areas	4	0	0
Causes of Injury	**First Injury**	**Second Injury**	**Third Injury**
Slip/Trip/Fall	7	0	0
Repetitive Activities	4	1	1
Caught Between Objects	1	0	0
Multiple Causes	2	0	0

Incidence of injury was crossed tabbed according to subjects participating in exercise, gender, age, job description, years worked at present job, and past exercise history. Our main question on whether participation in exercise or

Table 3. Descriptive Frequencies of the Classifications and Number of the Injuries Reported.

Classification of Injury	First Injury	Second Injury	Third Injury
Mild	6	0	0
Moderate	5	1	1
Severe	3	0	0

recreational activities decreased the risk of injury in the workplace was analyzed and no significant difference was found between groups (X^2 (1, n = 177) = .135, p > .05). Of the 14 injuries reported, 12 or 85.7% participated in exercise or recreational activities. Fifty-eight percent of the injuries occurred in workers who exercised on average greater than three days per week and 83.3% reported exercising greater than 30 minutes per episode and at an RPE between 11 and 15.

There was shown to be no significant relationship with injury and any of the demographic variables. These variables included age, gender, job description, number of years worked at current job position, or current exercise history compared to the rest of their adult life.

Of those injuries reported, 72.7% were female and 27.3% were male. Seventy-one percent of the injuries reported were over 40 years old. There were 42.9% of the injuries reported from clerical/administrative support job positions, 28.6% from faculty, and 14.2% from executive and tech support job positions.

Seventy-one percent of the injuries reported have been at their current job position greater than two years.

Work injury was also compared to the specific exercise categories of days per week, minutes per episode, and rate of perceived exertion (RPE). These were analyzed to see if there was a specific exercise or frequency that decreased the risk of injury. Results of these variables are shown on Table 4. The only significant relationship found was with injury and cardiovascular RPE ($X^2(8, n = 137) = 16.188, p = .04$). Of those 137 respondents, 89.8% reported an RPE of 11 to 15.

When the authors reviewed cardiovascular exercise for the non-injured subjects: (1) 52.7% exercised three days a week or less. (2) 69.6% exercised 30 minutes or less per episode. (3) 90.5% were at an RPE of 11 to 15 for their cardiovascular episodes. When comparing that to cardiovascular exercise for the injured subjects: (1) 70% exercised greater than three days per week. (2) 70% exercised 30 minutes or less per episode. (3) 80% were at an RPE of 11 to 15 for the cardiovascular episodes.

When comparing weight training between the two groups, three out of the five reported injuries participated in weight training three days a week or less for 30 minutes or less per session. Of the non-injured group, 80% reported an RPE between 11 and 15 for each session. The non-injured subjects reported that 89.4% participated 3 days a week or less, 74.5% were at 30 minutes or less per episode, and 85.1% were between 11 and 15 on the RPE scale.

Table 4. *Chi*-Square Statistics of Injury vs. Exercise Type.

Exercise Type	df	Significance
Cardiovascular Days	11	.601
Weight Training Days	8	.370
Aerobics Days	3	.712
Yoga Days	4	.843
Recreational Days	4	.978
Swimming Days	4	.199
Leisure Days	11	.784
Cardiovascular Minutes	17	.728
Weight Training Minutes	12	.440
Aerobics Minutes	6	.939
Yoga Minutes	3	.268
Pilates Minutes	5	.745
Recreational Minutes	8	.651
Swimming Minutes	4	.199
Leisure Minutes	17	.448
Cardiovascular RPE	8	.04[a]
Weight Training RPE	8	.676
Aerobics RPE	4	.777
Yoga RPE	5	.109
Pilates RPE	5	.230
Recreation RPE	9	.897
Swimming RPE	2	.301
Leisure RPE	11	.084

[a]Significant at alpha level .05.

Considering leisure activity, 75% of the workers who reported injuries participated three days a week or less, 75% were at 30 minutes or greater per episode and between 11 and 15 on the RPE scale. Comparing that to the non-injured participants, 68.4% reported participating 3 days a week or less, 73.4% were at 30 minutes or greater per episode, and 75% were between 11 and 15 on the RPE scale.

The researchers also looked at injury compared with average days per week, total exercise minutes per week, average minutes per bout of exercise, and the average RPE for the bout of exercise. Descriptive statistics of those variables are in Table 5. The results of injury compared to these average exercise variables are listed in Table 6.

No significant relationship was found between any of the variables. When looking at average days per week, 58.3% of the injuries reported exercising more than 3 days per week, while 60.7% of the non-injured subjects reported exercising 3 days per week or less. On average, 65.7% of the subjects who reported injuries participated in exercise activities greater than 90 minutes per week and 83.3% on average were between 11 and 15 on the RPE scale. On average, 52% of the subjects in the non-injured group were exercising on average less than 90 minutes per week and 88.5% were between 11 and 15 on the RPE scale.

Table 5. Descriptive Statistics of Exercise Intensity and Frequency.

Category	Groups	Frequency	Percentage
Average days per week	3 days or less	93	59.2
	greater than 3 days	64	40.8
Average minutes per episode	30 minutes or less	53	33.8
	greater than 30 minutes	104	66.2
Total weekly exercise minutes	less than 90 minutes per week	80	51.0
	90 minutes or more per week	77	49.0
Average RPE	RPE 6-10	12	7.9
	RPE 11-15	133	88.1
	RPE 16-20	6	4.0

Table 6. *Chi*-Square Analysis of Injury vs. Exercise Intensity and Frequency.

Exercise Variables	df	Significance
Total exercise minutes (2 groups)[a]	1	.204
Mean days per week (2 groups)[b]	1	.197
Average minutes (2 groups)[c]	1	.193
Average RPE (3 groups)[d]	2	.719

[a]Groups were: (1) Less than 90 minutes per week and (2) greater than 90 minutes per week.
[b]Groups were: (1) 3 days a week or less and (2) greater than 3 days per week.
[c]Groups were: (1) 30 minutes or less per episode and (2) greater than 30 minutes per episode.
[d]Groups were: (1) RPE between 6 and 10, (2) RPE between 11 and 15, and (3) RPE between 16 and 20.

CHAPTER V

DISCUSSION/CONCLUSION

Given the documented benefits of exercise and their relation to overall wellness, the assumption could be made that exercise and recreational activities would reduce the incidence of work injury. However, the results of this study did not meet that assumption.

Survey Demographics

Demographic information collected from those surveyed was as follows: 62% of the respondents were female and 38% were male. These numbers varied with the percentages from the Affirmative Action Office at the university. In 2002, 52% of the total employees were male and 48% were female.[49] Race was not reported. The average age of the subjects was 44.84 years.

The most common job description reported of the respondents was faculty at 46.9%, followed by clerical at 19.8%, executive/administrative at 19.2%, and tech support and service at 11.3% and 2.8%, respectively. The high percentage of faculty response could be attributed to the fact that faculty positions deal with and understand the importance of research compared to the other occupations at the university. Also, faculty positions at the university compose a majority of positions and represent almost 30% of the staff according to the affirmative action office survey statistics in 2002.[49] They also have clerical assistants who

distribute their mail and have better personal access than a service employee would have.

Injury Demographics

Of the 177 returned surveys, 14 or 7.9% reported an injury in the workplace in the previous two years. The lack of reported injuries may be due to employees not being certain of the definition of injury. They may not have thought basic work ailments qualified as injuries. Individuals with an injury may have been less likely to respond despite the guarantee of an anonymous response of repercussions from employers. A lack of responses from subjects in the "blue-collar" job areas may have also been a reason for the low amounts of reported injuries.

The most common areas injured were multiple areas with four injuries, followed by the knee and the elbow with two injuries each. The most common cause of injury was the slip/trip/fall with 50% of the total injuries, followed by repetitive activities injuries at 28.6%. Other reported causes of injuries included multiple causes and caught between objects. Following communication with Jason Uhlir, director of the safety and environmental health office at the University of North Dakota, it was determined that our findings of the percentage of falls were slightly higher than the reported injuries in the fiscal year 2002-2003 at 32.4%. Our findings could be affected due to the decreased number of injuries reported in this study compared to the 278 injuries reported to the safety and environmental health office in 2002-2003. If the reported slip/trip/fall injuries

were decreased by one in this study, the percentage would be comparable to these reported findings in 2002-2003.

Exercise Information and Demographics

Research has repeatedly shown the positive health benefits of exercise.[21,27-41] Aerobic exercise has been shown to decrease the likelihood of cardiovascular disease,[27] cancer,[32] diabetes,[30,31] and stroke[21,28]. The ACSM has stated that combining resistance training with flexibility exercise along with cardiovascular exercise has been shown to decrease pain and fatigue, decrease incidence of low back injuries, and improve flexibility and strength.[21]

Research by Vuori[19] has shown that physical activity and exercise has the ability to halt or postpone the incidence of musculoskeletal disorders.[19] He states that people who commit to lifelong physical activity may increase musculoskeletal health and function. Given all of these recommendations, one would assume that exercise would decrease general musculoskeletal injuries in the workplace. These assumptions were not proven in this study. There was no significance between injury and exercise participation regardless of the type of activity performed.

Cardiovascular exercise was the most commonly reported type of activity. Martial arts was the least reported activity on the list. Cardiovascular exercise included walking, running, jogging, hiking, biking, and treadmill. These activities are easy to perform and easy to access either through outdoor activity or gym activity. This may be the reason it is so readily reported. The lack of martial arts

may not be due to the lack of interest and involvement in the general population but rather due to training and cost associated with martial arts.

A majority of respondents (66.2%) reported participation on average greater than 30 minutes per episode. Statistical significance was shown comparing injury to cardiovascular RPE (p=.04). Of the subjects who reported participating in cardiovascular exercise, 89.8% reported an RPE between 11 and 15 (Fairly light to Hard). The RPE numbers may not be an accurate indicator of the type of exercise being performed due to the subjectiveness of the scale.

Absenteeism/Cost

Employees remaining on the job is an area of cost management for employers. An association between exercise and a decrease in absenteeism is noted in the literature.[8,9] Jacobsen and Aldana[8] reported a significant relationship between exercise and absenteeism, stating that one or more days of exercise was associated with lower levels of absenteeism. Even low level intensity exercises and frequencies show benefit to absenteeism levels. Similar results also were reported by Muto and Sakurai[9] who compared exercising groups to non-exercising groups and absenteeism. The results of this study looked at days away from work specifically due to work injury. The research did report only one missed day of work out of the 14 reported injuries. Due to the lack of days away from work, these authors were unable to analyze and compare this to exercise participation.

This lack of reporting of days missed from work could have been attributed to confidentiality concerns, repercussions from management, severity of injury, or

losing money from missed days. Further research in this area should be addressed.

Berterra[13] stated that decreases in absenteeism due to short-term and long-term disability can be due to an effective prevention program.[13] He stated that the program should include not only physical fitness, but wellness with knowledge of injury prevention in the workplace. Also, studies have shown increased savings due to prevention and wellness programs.[43,44] Although this study did not prove a correlation with injury and exercise participation and did not focus on the prevention and overall benefits of wellness, past studies have shown savings to the employer and employee can be achieved with these worksite prevention and wellness programs. Prevention and wellness has become a major focus at the University of North Dakota. It looks at seven dimensions of wellness and fitness. Studies into the effectiveness in cost reduction and impact of this program will need to be assessed in the future.

Limitations

This study was not without limitations. The major limitation of this study was the low response rate. This could be due to the time of year it was distributed. The survey was distributed in late April. Persons to whom it was distributed could have been tired of filling out surveys because there are so many that come across their desks and may not complete it and it was nearing the end of the school year. The type of people to whom it was distributed may have also played a role. Persons in the service portion who do not have an office to which the survey can be distributed may not have received the survey and thus could

not fill it out. The length may have also been a factor. The survey was 4 pages in length, and although it was simple to fill out, the amount of pages included in the survey may have influenced those borderline employees to not complete the survey.

Another limitation of this survey project may have been the insufficient amount of reported injuries and improper completion of the survey. This affected the overall statistical results and answers to the research question. Concerns by the persons completing the survey may have limited response in this area.

Future Studies

In future investigations, there could be multiple alterations to this study. Using this study as a base, it could be studied over a number of universities to obtain a larger population, data could be more easily analyzed, and increase the response to the reporting of injuries. Expanding the research to different populations outside the university could also be assessed.

Revisions of the survey format to include combining the exercise portions could improve the efficiency of the survey. This will make it more user friendly, easier to complete, and may increase response rate. A clearer definition of what is classified as an injury and what constitutes regular exercise could also be included.

Additional research could include the use of longitudinal studies comparing the injury rates between people who exercise and those who do not. The time frame to which the injuries occurred could be expanded. The amount of days off work due to injury and compliance to exercise programs could be

assessed. In addition, a comprehensive cost analysis could be accomplished between exercise groups and non-exercise groups, including direct costs related to injury (days off work and medical costs), indirect costs related to injury, costs of absenteeism that are non-injury related, and the cost of insurance premium rates. These factors would provide valuable information for employers when determining various program implementation and cost containment measures.

The effectiveness of exercise protocols vs. individualizing exercise programs could be assessed to see if it is cost effective and decreases injury rates. Also, the contents of the specific exercise program could be investigated to see what would make a cost effective and beneficial program.

Studies could be expanded to include what activities in a specific job could lead to injury and whether education and prevention programs could lead to a decrease in injury and whether it is cost effective. Another issue to be addressed is "What is healthy exercise?" and establishing what amount of exercise can affect the injury level, whether it be under-training or over-training. Due to the rising cost of occupational injuries and illnesses, a better understanding of cost effective preventative measures is imperative.

APPENDIX A

REPORT OF ACTION: EXEMPT/EXPEDITED REVIEW

University of North Dakota Institutional Review Board

Date: 3/24/2003 **Project Number:** IRB-200303-215

Principal Investigator: Kaiser, Stephen; Kuhn, Chris; Steckler, Jay

Department: Physical Therapy

Project Title: The Relationship Between Work Related Injury and Participation in Exercise and Recreational Activities

The above referenced project was reviewed by a designated member for the University's Institutional Review Board on March 31, 2003 and the following action was taken:

☐ Project approved. **Expedited Review** Category No. _____
Next scheduled review must be before _____

☐ **Copies of the attached consent form with the IRB approval stamp dated _____ must be used in obtaining consent for this study.**

☒ Project approved. **Exempt Review** Category No. 2
This approval is valid until March 20, 2004 as long as approved procedures are followed.
No periodic review scheduled unless so stated in the Remarks Section.

☐ **Copies of the attached consent form with the IRB approval stamp dated _____ must be used in obtaining consent for this study.**

☐ Minor modifications required. The required corrections/additions must be submitted to ORPD for review and approval. **This study may NOT be started UNTIL final IRB approval has been received.**
(See Remarks Section for further information.)

☐ Project approval **deferred. This study may not be started until final IRB approval has been received.**
(See Remarks Section for further information.)

REMARKS: Any adverse occurrences in the course of the research project must be reported immediately to the IRB Chairperson or ORPD.

Any changes in protocol or Consent Forms must receive IRB approval prior to being implemented. You must submit a memo with a copy of the Consent Form and a revised Human Subjects Review Form, with the appropriate signatures, to the Office of Research and Program Development for review and approval.

PLEASE NOTE: Requested revisions for student proposals MUST include adviser's signature. All revisions MUST be highlighted.

☑ Education Requirements Completed. (Project cannot be started until IRB education requirements are met.

Put Page Numbers on Survey!

Typo on pg. 2 of survey

cc: Bev Johnson

R D Landy 3-31-03
Signature of Designated IRB Member Date
UND's Institutional Review Board

If the proposed project (clinical medical) is to be part of a research activity funded by a Federal Agency, a special assurance statement or a completed 310 Form may be required. Contact ORPD to obtain the required documents.

(Revised 10/2002)

APPENDIX B

University of North Dakota Faculty and Staff:

We are conducting a project in partial fulfillment of the requirements for our Master of Physical Therapy degree at the University of North Dakota. The purpose of this survey is to compare the relationship between work injury and exercise history. The results of this project will allow us to achieve a better understanding of how exercise may or may not influence the prevention of work related injuries.

We would appreciate you completing the enclosed survey. Your results are confidential and your identity will remain anonymous. We are interested in your honest opinions. Please answer the questions to the best of your ability. Completion and submission of this survey implies your consent to participate in this project. If you prefer to not answer a question please leave it blank. Data will be stored in a locked file in the Physical Therapy department for at least three years following completion of this study. At that time the data will be shredded

The survey should take approximately 5-10 minutes of your time to complete. **Please return the survey in the enclosed envelope via inter-campus mail to box 9037 by April 25.**

Thank you in advance for your cooperation with this endeavor. The results of this project will allow us to determine if people who participate in exercise or recreational activities have a decreased risk of work related injury. This will allow us to educate our colleagues and future patients in the area of prevention and wellness. If you have any questions about the research or if you would like information about the results please, contact Beverly Johnson at 777-2831 or Stephen Kaiser at 777-9183. If you have any other questions or concerns please call the Office or Research and Program Development at 777-4279.

Sincerely,

Stephen Kaiser, BS, SPT
Physical Therapy Student

Chris Kuhn, SPT
Physical Therapy Student

Jay Steckler, SPT
Physical Therapy Student

Enclosure

UND Department of Physical Therapy
A Survey: Work Injury and Exercise History

Demographics:

Age _____ Sex: M F

Job Description:

_____ Faculty
_____ Executive/Administrative
_____ Technical Support (support associate)
_____ Clerical and Administrative Support (e.g., secretary, billing clerk, office supervisor)
_____ Service Occupation (e.g., security, food service, janitor, maintenance)
_____ Operator of Laborer (e.g., truck driver, construction worker)
_____ Sales (e.g., retail sales, sales representatives)
_____ Precision Production and Crafts Worker (e.g., mechanic, carpenter, machinist)

How long have you been working at your present position (years)? _____

Work Injury Information:

Have you been injured at your present job in the past 2 years? Y N

If you answered "N", please go to page 3 for the exercise portion of the survey.

If "Y", please complete work injury chart located on page 2.

Work Injury Information: This section looks at your work injury history. Please complete the table below as accurately and completely as possible.

1. Mark the location of the injury (1st most recent, 2nd second most recent, etc)
2. Mark the cause of each injury
3. Classify each injury (mild, moderate, severe)
4. Report the number of days missed from work for each injury.

	1st Injury	2nd Injury	3rd Injury
Location:			
Neck			
Upper Back			
Low Back			
Hip			
Pelvis (SI)			
Knee			
Foot			
Ankle			
Shoulder			
Elbow			
Wrist			
Hand			
Head			
Cause:			
Slip, trip, fall			
Strain from lifting, pulling, etc.			
Repetitive activities (lifting overhead, sitting for long periods)			
Cut/puncture/scrape			
Electrical			
Caught between or struck by object(s)			
Classification:			
Mild			
Moderate			
Severe			
Days of Work missed due to injury:			

Please continue to page 3 for the exercise portion of the survey →

Exercise Information: This section looks at your history of participation in exercise and recreational activities outside of work. Please mark on the chart the average of what your exercise and activities have been in the past two years. It should not include activities that were prescribed due to work injury.

For each activity section, please fill in the following:

1. The days per week that you do these type of activities
2. Amount of time in minutes you spend per episode of activity
3. Average rate of perceived exertion (RPE) during each episode of activity using the ratings at the bottom of the page

	Days per week	Minutes per episode	RPE (see chart below)
Cardiovascular (e.g. biking, running, walking, treadmill)			
Weight Training			
Aerobics Classes			
Yoga/Tai Chi			
Pilates			
Recreational Sports (e.g. basketball, tennis, volleyball, softball)			
Swimming			
Golf			
Martial Arts			
Leisure Activities (e.g. gardening, yard work, dancing)			
Other (Please Specify): _____ _____			

RPE Scale

6	
7	Very, Very light
8	
9	Very light
10	
11	Fairly light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very Hard
18	
19	Very, very, hard
20	

Please continue to next page ➔

What has been your exercise level in the past two years compared to the rest of your adult life?

____ More in the past 2 years
____ Less in the past 2 years
____ About the same in the past 2 years (previous years an adult)

Thank you for completing this survey. Please return in the envelope that has been provided for you to the UND Department of Physical Therapy.

REFERENCES

1. DiNuble MD, Sherman K. Exercise and the bottom line. *Phys Sports Med.* 1999;27(2):37-39.
2. Bureau of Labor Statistics. Number of non-fatal occupational injuries and illnesses involving days away from work and involving musculoskeletal disorders by selected worker and case characteristics. 1999. Available at: http://www.bls.gov. Accessed June 1, 2003.
3. National Safety Council. Report on injuries in accidents in America. 2001. Available at: http://www.nsc.org. Accessed May 1, 2003.
4. Reardon J. The history and impact of worksite wellness. *Nurs Econ.* 1998;16(3):117-121.
5. Dolliver M. Raising one's eyebrows at the gym isn't workout enough. *Adweek.* 2003;44:54-55.
6. Durrrett A. Survey reveals exercise habits. *IDEA Health and Fitness Source.* 1999;17:14.
7. Shepard R. Do worksite exercise and health programs work? *Phys Sport Med.* 1999;27(2):48-55.
8. Jacobson BH, Aldana SG. Relationship between frequency of aerobic activity and illness-related absenteeism in a large company sample. *J Occup Environ Med.* 2001;43(12):1019-1025.

9. Muto T, Sakurai H. Relation between exercise and absenteeism due to illness and injury in manufacturing companies in Japan. *J Occup Med.* 1993;35(10):995-999.
10. Boyce RW, Jones GR, Hiatt AR. Physical fitness capacity and absenteeism of police officers. *J Occup Med.* 1991;33(11):1137-1143.
11. Schulz AB, Lu C, Barnett TE, et al. Influence of participation in a worksite health promotion program on disability days. *J Occup Environ Med.* 2002;44(8):776-780.
12. Serxner S, Gold D, Anderson D, Williams D. The impact of a worksite health promotion program on short-term disability usage. *J Occup Environ Med.* 2001;43(1):25-29.
13. Berterra RL. The effects of behavioral risks on absenteeism and health care costs in the workplace. *J Occup Med.* 1991;33(11):1119-1124.
14. Bureau of Labor Statistics. Workplace injuries and illnesses in 2001. Washington DC: Bureau of Labor Statistics of the US Department of Labor; 2002.
15. Musculoskeletal conditions including arthritis, low back pain, and repetitive motion strain are the leading cause of absenteeism. Safety Directors Report. Institute of Health and Productivity Management. 2003;9-35.
16. Hoozeman MJ, Van Der Beek AJ, Frings-Dressen MH, Van Dijk FJ, Van Der Woude LH. Pushing and pulling in relation to musculoskeletal disorders: a review of risk factors. *Ergonomics.* 1998;41(6):757-781.

17. Hoozeman MJ, Van Der Beek AJ, Frings-Dressen MH, Van Dijk FJ, Van Der Woude LH. Pushing and pulling in association with low back and shoulder complaints. *Occup Environ Med.* 2002;59(10):696-702.

18. Feurstein M, Marshall L, Shaw WS, Burrell LM. Multicomponent intervention for work-related upper extremity disorders. *J Occup Rehab.* 2000;10(1):71-83.

19. Vuori I. Exercise and physical health: musculoskeletal health and functional capabilities. *Res Q Exerc Sport.* 1995;66(4):276-285.

20. Hass CJ, Feigenbaum MS, Franklin BA. Prescription of resistance training for healthy populations. *Sports Med.* 2001;31(14):953-964.

21. American College of Sports Medicine. ACSM's Guidelines for Exercise Testing and Prescription. PhiladelphiA, Pa: LippIncott Williams & Wilkens; 2000.

22. Feigenbaum MS, Pollock ML. Prescription for resistance training for health and disease. *Med Sci Sports Exerc.* 1999;31(1):38-45.

23. Vertinsky P. "Run Jane run": central tensions in the current debate about enhancing women's strength through exercise. *Women Health.* 1998;27:81-111.

24. Sallis JF, Haskell WL, Fortman SP, Wood PD, Vranizan KM. Moderate-intensity physical activity and cardiovascular risk factors: the standard five-city project. *Prev Med.* 1986;15:561-568.

25. Racette S, Deusinger S. Obesity: overview of prevalence, etiology and treatment. *Phys Ther.* 2003;83:1-21.

26. Moore TM. A workplace stretching program. Physiologic and perception measurements before and after participation. *AAOHN J.* 1998;46(12):563-568.

27. Brummett BH. Effect of smoking and sedentary behavior on the association between depressive symptoms and mortality from coronary heart disease. *Am J Cardiol.* 2003;92:529-532.

28. Kirshner HS. Medical prevention in stroke, 2003. *South Med J.* 2003;96:354-358.

29. Yoshimura N. Exercise and physical activities for the prevention of osteoporotic fractures: a review of the evidence. *Nippon Eiseigaku Zasshi.* 2003;58:328-337.

30. Ishii T, Yamakita T, Yamagami K, et al. Effect of exercise training on serum leptin levels in type 2 diabetic patients. *Metabolism.* 2001;50:1136-1140.

31. Ishii T, Yamakita T, Sato T, et al. Resistance training improves insulin sensitivity in NIDDM subjects without altering maximal oxygen uptake. *Diabetes Care.* 1998;21:1353-1355.

32. Slattery ML, Edwards S, Curtin K, et al. Physical activity and colorectal cancer. *Am J Epidemiol.* 2003;158:214-224.

33. Pollock ML, Gaesser GA, Butcher JD. The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. *Med Sci Sports Exerc.* 1998;30:975-991.

34. Dias RC, Dias JM, Ramos LR. Impact of an exercise and walking protocol on quality of life for elderly people with OA of the knee. *Physiother Res Int.* 2003; 8:121-130.

35. Smith D, McMurray N, Disler P. Early intervention for acute back injury: can we finally develop an evidence-based approach? *Clin Rehabil.* 2002;16:1-11.

36. Reijneveld SA, Westhoff MH, Hopman-Rock M. Promotion of health and physical health activity improves the mental health of elderly immigrants: results of group randomized controlled trial among Turkish immigrants in the Netherlands aged 45 and over. *J Epidemiol Community Health.* 2003;57:405-411.

37. Iversen MD, Fossel AH, Katz JN. Enhancing function in older adults with chronic low back pain: a pilot study of endurance training. *Arch Phys Med Rehabil.* 2003;84:1324-1331.

38. Winett RA, Carpinelli RN. Potential health-related benefits of resistance training. *Prev Med.* 2001;33:503-513.

39. Narin SO, Pinar L, Erbas D, Ozturk V, Idiman F. The effects of exercise and exercise-related changes in blood nitric oxide level on migraine headache. *Clin Rehabil.* 2003;17:624-630.

40. Hoff J, Gran A, Helgerud J. Maximal strength training improves aerobic endurance performance. *Scand J Med Sci Sports.* 2002;12:288-295.

41. Galloway MT, Jokl P. Aging successfully: the importance of physical activity in maintaining health and function. *J Am Acad Orthop Surg.* 2000;8(1):37-44.

42. Cruz CS. Fit to work. *Hawaii Business.* 2001;46(7):41-49.

43. Shephard RJ. Worksite fitness and exercise programs: a review of methodology and health impact. *Am J Health Promot.* 1996;10(6):436-452.

44. Ozminkowski R, et al. Long-term impact of Johnson and Johnson's health and wellness program on health care utilization and expenditures. *J Occup Environ Med.* 2002;44(1):21-29.

45. Gettman LR. Economic benefits of physical activity. *Phys Activity Fitness Res Digest*. 1996;2(7):1-6.

46. Messer J, Stone W. Worksite fitness and health promotion benefit/cost analysis: a tutorial, review of the literature, and assessment of the state of the art. *Assoc Worksite Health Promotion's Work Site Health*. 1995;2:34-43.

47. Baun WB, Bernacki EJ, Tsai SP. A preliminary investigation: effect of a corporate fitness program on absenteeism and health care cost. *J Occup Med.* 1986;28(1):18-22.

48. Human Resource Department Job Classification Categories. Available at: http://www.nodak.edu/broadbanding/descriptors/index.html. Accessed March 7, 2003.

49. Page S. IPEDS Racial/Ethnic Survey Report: For year 2002. Affirmitive Action Office. University of North Dakota, Grand Forks, ND. September 17, 2003.