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Moua, Chee Chia. ***The Impact of Federal Hiring Restriction on the Effectiveness of Pre-Employment Physical Capability Tests***

Abstract

The focus of this study was to examine the physical capability exams used by Company XYZ. Their transition from a non-validated test program to a validated program produced undesired results. The purpose of this study was to examine the influences federal hiring legislation may have on physical capability exams in the workplace.

The primary benefit of physical testing is to prevent or reduce the number of injuries in the workplace due to their large financial impact to the company. "The ability of management to select particular employees for the specific job is a major factor in promoting company efficiency, growth, and earnings." Physical ability tests are often subjected to a high standard of legal and administrative review due to their high rates of adverse impacts against females and individuals over the age of 40 years old. This study will compare the new validated testing program to the old non-validated testing program, through extensive literature review and statistical analyses.

Results showed that the fear of utilizing a non-validated testing program may have led to the development of an entirely new, overly cautious program, lacking important test aspects such as the use of work simulated tests.

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Chapter I: Introduction

Founded in 1979, Company XYZ is a leading manufacturer and distributor of quality meat products that serves grocery stores and food distributors throughout the Midwestern United States. They also service wholesale markets, provide branded products, custom food services cutting, cold storage and product transportation. As clearly stated in their occupational safety and health (OHS) policy statement, Company XYZ recognizes that the prevention of occupational illness and injury must be a core value of their business for humanitarian, economic, and legal reason, due the possible negative effects they pose on the safety and well being of their employees and the financial strength of the company. Company XYZ manages occupational safety and health efforts in the same manner as they manage other core values of their business, by giving them highest priority, using good management techniques, and by seeking continual improvement of their Occupational Safety and Health Management System (OSHMS).

Many jobs at Company XYZ are physically demanding. These physical tasks include extended periods of repetitive work and heavy lifting. As a result, the most frequent recordable occupational injuries are musculoskeletal disorders (MSDs) such as cumulative trauma disorders (CTD) and back strains and sprains. A recordable injury is defined by the Occupational Safety and Health Administration (OSHA) as is an occupational injury or illness that requires medical treatment more than simple first aid and must be reported. Studies show that 10-15 percent of the workforce is physically mismatched to the physical demands of the job. To help reduce the risk, Company XYZ utilizes a pre-employment physical capability test to screen applicants entering the work place. Though pre-employment physical capability tests are primarily conducted to assess the ability of new applicants to meet the physical demands of the jobs for

which they are applying for, employers are encouraged to also test employees returning from illness/injury leave or transferring between jobs which require higher demands (Anderson, 2006; Waite, 2010).

Physical capability testing provides information that attempt to determine an employee's susceptibility to injuries resulting from the physical demands of a job. Physical capability tests are designed utilizing a thorough job task analysis. A job task analysis is performed to address each physically demanding job within the workplace to identify and determine in detail the particular duties, their requirements, and the relative importance of these duties for a given job (*Job*, 2000). Employees must pass a series of work related movements and postures designed to mimic actual job demands. Pre-employment physical capability testing is important in that they may help employers reduce future costs by controlling the risks at the initial stage of employment. These costs may be associated with employee absenteeism, medical expenses, increased stress on other employees who must cover for them, recruitment, hiring, or training costs for replacements, and the legal costs associated with non-compliance with federal safety and health standards (Waite, 2010, p. 6).

Prior to 2007, Company XYZ's pre-employment physical capability testing protocols were developed in-house and were never validated in accordance to federal standards, thus they ran the risk of liability claims under the Employment Opportunity Commission (EEOC). Finally in 2007, Company XYZ contracted with Advanced Ergonomics, Inc (AEI) to develop a new testing program which would be in compliance to federal hiring standards. These federal standards include the Americans with Disability Act (ADA), the Equal Employment Opportunity Commission (EEOC), the Civil Rights Act of 1991, the Age Discrimination in Employment Act (ADEA) and the Uniform Guidelines on Employee Selection Procedures. The federal standards

state that pre-employment tests must not intentionally or disproportionately exclude specific applicants or applicants in a particular group by sex, national origin, religion, disability, or age, unless the employer can justify the test or procedure under the law (USDJ, 2009; *Employment,* 2010).

AEI provides comprehensive services which help maintain program quality control and data management. AEI tracks and monitors pass rates on a quarterly basis to detect problems in the quality of test administration or changes in the applicant pool. As a result, AEI helps to ensure program effectiveness and integrity. Due to the current pre-employment physical capability exam's inability to provide significant reduction in employee injuries at Company XYZ, the exam needs to be thoroughly reevaluated for validity and job relatedness. Upon examination, it was discovered that current physical capability exam has not been updated since it was first implemented in 2007, thus there was a great possibility that the exam may have been inaccurately reflecting the current job demands.

Despite the use of the new pre-employment physical capability testing protocols for several years, there was not a significant reduction in the employee injury rate. Upon examining the incident rates during the old and the new protocols, there was actually an increase in total number of recordable incidents. The safety director of Company XYZ's believed that the previous testing protocols were more stringent and provided a better reflection of the required physical job demands. As a result, it was proposed that the new pre-employment physical capability test may have been ineffectively screening out employees susceptible to injury due to the hiring restrictions established in the federal standards. This research study will examine and compare the pre-2007 testing protocols to the post-2007 testing protocols, and examine if the

federal standards may have had any significant negative impact on the effectiveness of pre-employment physical capability testing program.

Statement of the Problem

The efficacy of the current pre-employment physical capability test is unclearly providing the data it is intended to provide due to federal hiring restrictions.

Purpose of the Study

The purpose of this study was to analyze and compare the pre-2007 testing protocols developed by Company XYZ to the current testing protocols developed by Advanced Ergonomics, Inc. in 2007. In addition, this research will examine the federal standards regarding hiring procedures and determine if they have any adverse impact on the effectiveness of physical capability testing programs.

Assumptions of the Study

1. This study assumes that Company XYZ's current workplace environment has been ergonomically designed or modified, to the best of their ability, to sustain a workplace free of recognized hazards which may cause or are likely to cause death or serious physical harm to the employees, thus not contributing to the incident rates and influencing the effectiveness of the current pre-employment physical capability test.

Goals of the Study

1. Determine the expected outcomes of physical capability testing.
2. Identify the legal implications associated with conducting and developing pre-employment physical capability tests.
3. Compare the old testing procedures (2002-2006) to the new testing procedures (2007-2011).

Significance

The significance of this field problem was to assist Company XYZ in achieving their safety and health goals, as established in their Occupational Safety and Health Management System (OSHMS) policy statement, by removing or solving gaps in their management system to minimize employee exposures to hazards or risks in the workplace.

Definition of Terms

Adverse impact is defined by the EEOC in the Uniform Guidelines on Employee Selection Procedures as a "substantially different rate of selection in hiring, promotion, or other employment decision which works to the disadvantage of members of a race, sex, or ethnic group." (*Uniform*, 2011).

Best Practices as, defined by BusinessDictionary.com, are "industry-wide descriptions for approaches, processes, or procedures which have been proven to deliver exemplary results in areas critical to an organization's mission or purpose" (*Definition,* n.d.).

Disability is "a physical or mental impairment that substantially limits one or more of the major life activities" (USDJ, 2009).

Discrimination is "limiting, segregating, or classifying a job applicant or employee in a way that adversely affects the opportunities or status of such applicant or employee because of the disability of such applicant or employee" (USDJ, 2009)

Disparate Impact as defined by the Civil Rights Act of 1991 is the using neutral tests or selection procedures that have the effect of disproportionately excluding persons based on race, color, religion, sex, or national origin, where the tests or selection procedures are not job-related and consistent with business necessity.

Disparate Treatment as defined by the Civil Rights Act of 1991 is the intentional discrimination based on race, color, religion, sex, or national origin.

Job Task Analysis is a process to identify and determine in detail the particular duties and their requirements and the relative importance of these duties for a given job (*Job*, 2000).

Occupational Safety and Health (OHS) Policy Statement is a written statement which clearly outlines the general goals and objectives of the organization in establishing a safe and healthful work environment (*Guide,* 2000*).*

OSHA Recordable is an occupational injury or illness that requires medical treatment more than simple first aid and must be reported to the Occupational Safety and Health Administration (OSHA).

Physical Ability Test, as defined by the Equal Employment Opportunity Commission (EEOC), is any testing that purports to measure an individual's ability to perform the essential physical requirements of a job.

Limitations of the Study

The limitation of this study was a lack of a complete and thorough understanding of statistical measurements and calculations required for this study. Hours of self education was required to obtain a basic understanding of the necessary statistical calculations and methods.

Chapter II: Literature Review

The purpose of this study was to analyze and compare the old physical capability testing protocols developed by Company XYZ prior to 2007 to the current testing protocols developed by AEI to determine if federal hiring restrictions may have had any adverse impact on the effectiveness of the programs. This research study will examine if federal hiring restrictions would have allowed more individuals susceptible to injury to slip into the workplace or current employees to transfer to jobs they were not physically capable of safely performing.

The literature review covers the following areas: 1) an overview of the purpose of pre-employment physical capability testing, and 2) the legal implications associated with developing and conducting pre-employment physical capability tests.

Why Conduct Pre-Employment Physical Capability Testing?

The selection process for physically demanding jobs has always been and will continue to remain a challenge for future employers (Hogan & Quigley, 1994). As part of the hiring process, many companies have utilized a pre-employment physical capability test to determine a candidate's ability to safely perform the essential physical demands of the job without risk to injury (Hogan & Quigley, 1994; Gallagher, S., Moore, J. S., & Stobbe, T. J., 1998). Physical capability tests, in conjunction with job designs, have been shown to help further control, prevent, and minimize the risks of occupational injuries. Physical capability tests are either conducted prior to or after a conditional offer of employment has been given. The statutory constraints of the testing procedures will be affected by when the test is given; this will be discussed in detail later in this chapter under the section Legal Implications Associated with Developing and Conducting Pre-Employment Physical Capability Tests.

The use of pre-employment tests can be a very effective means of determining which applicants are most qualified for a particular job (*Employment,* 2002). Physical ability testing ensures a higher level of safety for the employees and members of the public, thus increasing productivity and reducing workers' compensation costs. Failure to maintain a safe and healthful work environment at all times may contribute to increased sunk costs for the employer. Sunk costs are paid fees in which there are no returns on investment. Examples of such costs include employee absenteeism, medical expenses, increased stress on other employees who must cover for them, and recruitment, hiring, or training costs for new hires, as well as legal costs associated with non-compliance with federal safety and health standards (Waite, 2010, p. 6). "The ability of management to select particular employees for the specific job is a major factor in promoting company efficiency, growth, and earnings. An employer has a duty to use due care in the selection and retention of employees, and that the duty is owed to those people that employees will come in contact as a result of the employment" (McKendrick, 2001, p. 14).

Typical physical ability tests examine the strength, endurance, and postural demands of the particular job (Anderson, 2006). Determining the physical demands associated with a job requires conducting a thorough analysis of all tasks associated with the job. A job analysis "is a process to identify and determine in detail the particular job duties and requirements and the relative importance of these duties for a given job" (*Job,* 2000). An effective job analysis requires gathering and documenting all information about the tools, equipment, materials used, the work environment, how often the job is performed, how far objects are moved, postures exerted, etc. Several job analysis techniques include interviewing, observation, and use of questionnaires or surveys. Interviews are used to directly question employees about the work they perform. This provides the opportunity to obtain firsthand accounts from individuals who

are regularly exposed to the physical demands of the various tasks associated with the job. The disadvantage to interviews is that the responses may be biased, and the various issues associated with question interpretation and subjectivity. Observations help to gather information regarding adverse postures and motions performed to accomplish the task. Questionnaires have an advantage over both interviews and observation in that they are very cost effective in studies involving large sample sizes, and they help to reduce biased responses. Once all the necessary data is obtained, management can examine the data and determine which work areas need improvement. Improvements include re-engineering a machine for safer use, incorporating job rotation, or requiring the use of personal protective equipment while performing the job.

Though technology has provided the opportunity for job automation, there remain many tasks which are impracticable to automate and still require manual labor. As technology continues to advance, the quality of current physical assessments must be periodically reviewed to maintain their effectiveness and ensure that the program protocols continue to be of direct relatedness to the current job tasks (Hogan & Quigley, 1994). In conjunction with regular job task analysis, the AEI Physical Ability Testing Program provides two methods to test for program effectiveness. The first method presented by AEI is the criterion-related predictive validation design (Anderson, 2006). In this method, the test is administered to the applicants prior to becoming hired; it is important to keep note that the results of the test cannot be used in determining employee hiring ability, but rather as a benchmark to compare the incident rates of those who failed the test to those who have passed. If the incident rate for those who passed the test is significantly lower than those who have failed the test, this suggests that the physical capability test is effectively identifying individuals more susceptible to injury for the particular job. The disadvantage to this method is that the test results cannot be used to determine

employability of the applicant, thus individuals who failed the physical capability exam may still be hired. As a result, the applicant may still have a significant impact on employer incident rates for the company. Another disadvantage to this method is that the effectiveness of the physical capability exam cannot be measured right away due to the lack of sample size readily available. As a result, it may take several years to collect a large enough sample before the program's effectiveness can be measured.

The second method presented by AEI is the Pre/Post-Implementation Analysis. The results of the test are used to compare the injury rate of new-hires who began work prior to the implementation of the test to those who were hired after. The advantage to this method is that the physical capability test can be measured for effectiveness much sooner than the predictive validation method. This method also provides the opportunity to use the testing results for determining hiring ability. The disadvantage is that it involves comparing incident rates from two different time periods, which may impact the ability to properly determine the effectiveness of the screening program due to changes in specific tasks from one time period to the next.

Legal Implications Associated with Developing and Conducting Pre-Employment Physical Capability Tests

Physical ability tests are often subjected to a high standard of legal and administrative review. Because most strength tests present adverse impacts against females and individuals over the age of 40 years old, a thorough job analysis of each task within the organization is necessary to determine the composition of the test battery to accurately reflect the physical demands of a particular job for a standard 8-hour work shift (*Overview*, 2011; *Uniform*, 2011). Adverse impact is defined by the Equal Employment Opportunity Commission (EEOC) as a "substantially different rate of selection in hiring, promotion, or other employment decision

which works to the disadvantage of members of a race, sex, or ethnic group." Thus, documented empirical evidence is necessary to show that the protocols of the test are of direct job-relatedness (U.S., 2009; *Employment,* 2010). Due to the range in physical demands of various jobs, the test battery should reflect only the positions for which the applicant will be applying for. Because the physical demands of a fork lift driver will vary greatly from that of a custodian, the testing protocols for each position should differ as well.

When developing a physical ability testing program, Jocelyn K. Waite (2010, p.3) explains that there are many important factors to consider. Developing a physical ability testing policy requires determining whether to test job applicants, incumbent employees, or both; which positions to include under the testing policy; which abilities to test in covered positions; whether to utilize work sample tests or tests that measure the ability to perform required physical movements, based on job analysis of required movements; whether to test broadly for the physical ability to carry out essential functions of the job or to focus on the physical ability to perform particular essential maneuvers that have been tied to workplace injuries; whether to test general physical fitness; and/or whether to set standards that exceed those that are required under federal regulations or to extend required standards to employees not covered by federal regulations. By thoroughly considering all of these factors, your physical capability testing protocols will be able to help management safely determine the most qualified person for the particular physical job.

Employers who implement pre-employment testing must be familiar with regulatory requirements associated with testing content and implementation methodology. "Any tests conducted to assess physical ability —as well as inquiries related to physical ability—are subject to limitations under federal and state law; violations of those requirements may result in liability

under civil rights and nondiscrimination statutes" (Waite, 2010, p.3). Pre-employment testing programs must adhere to the Title VII of the Civil Rights Act (CRA) of 1964, the Age Discrimination in Employment Act (ADEA), the Equal Employment Opportunity Commission (EEOC), Uniform Guidelines on Employee Selection Procedures, Title I of the Civil Rights Act (CRA) of 1991, and the Americans with Disability Act (ADA). Essentially, regulation state that pre-employment tests must not intentionally or disproportionately exclude specific applicants or applicants in a particular group by sex, national origin, religion, disability, or age, unless the employer can justify the test or procedure under the law (USDJ, 2009; *Employment,* 2010; *Understanding*, 1999). The following will briefly discuss each employment laws and their affect on pre-employment physical capability testing.

Title VII of the Civil Rights Act (CRA) of 1964. Title VII prohibits unfair discrimination in all terms and conditions of employment based on race, color, religion, sex, or national origin (U.S. Equal Employment Opportunity Commission, 2012d; *Understanding*, 1999). Employers with 15 or more employees, all employment agencies, and labor unions are subject to CRA of 1964. Under CRA of 1964, it is unlawful to discriminate against a person based on race, color, religion, sex, or national origin with respect to any term, condition, or privilege of employment, including hiring, firing, promotion, layoff, compensation, benefits, job assignments, and training**.**

The Age Discrimination in Employment Act (ADEA). The ADEA protects against employees age 40 or older during the employment process (U.S. EEOC, 2012b; *Understanding*, 1999). Under the ADEA, it is unlawful to discriminate against a person because of his/her age with respect to any term, condition, or privilege of employment, including hiring, firing, promotion, layoff, compensation, benefits, job assignments, and training. Employers with 20 or

more employees, all employment agencies, and labor unions are subject to ADEA. Exempt from ADEA include law enforcement and military personnel.

The Equal Employment Opportunity Commission (EEOC). The EEOC is responsible for enforcing federal laws that make it illegal to discriminate against a job applicant or an employee because of the person's race, color, religion, sex (including pregnancy), national origin, age (40 or older), disability or genetic information (U.S. EEOC, 2012a; *Understanding*, 1999). The laws apply to all types of work situation including hiring, firing, promotion, layoff, compensation, benefits, job assignments, and training**.** The EEOC has the authority to investigate any charges of discrimination against employers.

The Uniform Guidelines on Employee Selection Procedures. Established by the EEOC, the Civil Service Commission, and the Labor and Justice Department, the Uniform Guidelines on Employee Selection Procedures are an established set of principles governing the use of employee selection procedures according to applicable laws (*Uniform*, 2011; *Understanding*, 1999). The Guidelines provide a framework for employers and other organizations for determining the proper use of tests and other selection procedures. Employers with 15 or more employees, all employment agencies, and labor unions are subject to the Guidelines. The Guidelines also cover contractors and subcontractors to the federal government and organizations receiving federal assistance. The laws apply to all types of work situation including hiring, firing, promotion, layoff, compensation, benefits, job assignments, and training**.**

Title I of the Civil Rights Act (CRA) of 1991. Title I of the CRA of 1991 includes all of the principles of the CRA of 1964 but include several significant amendments (U.S. EEOC, 2012c; *Understanding*, 1999). The CRA of 1991 requires demonstration of both the job-relatedness and business necessity of assessment instruments or procedures that may cause

adverse impact. The regulation also prohibits adjusting scores or use of different cut-off scores for different groups of test takers, or alterations of employment-related test results based on the demographics of the test takers. In addition, the regulation makes compensatory and punitive damages available and allows jury trials when intentional employment discrimination can be shown.

Physical ability testing has a tendency to proportionally screen out more females, some ethnic group members more than white males, and individuals over forty years old (Musculoskeletal, n.d.; Hogan & Quigley, 1994). When there is an adverse impact for females or other groups, employers must provide evidence that the pre-employment testing procedures meet the requirements laid out by the EEOC in the Uniform Guidelines on Employee Selection Procedures and that the discrimination is an uncontrollable side effect of important safety measures (*Uniform*, 2011). Under the Uniform Guidelines, adverse impact is defined as a "substantially different rate of selection in hiring, promotion, or other employment decision which works to the disadvantage of members of a race, sex, or ethnic group." The Uniform Guidelines require that three points are needed to demonstrate that a test battery is a valid instrument for selection:

1.There has been a thorough job analysis;

2.The tests in the battery are highly related to the job requirements; and

3.There is clear evidence that the tests are predictive of job performance.

For physical ability testing, it is often difficult to avoid an adverse impact on females where the requirement for the job is lifting a very heavy amount of weight (Roseblum, 2002). If there are less discriminatory ways to test physical capabilities, the employer should explore those options.

The EEOC has a four-fifths rule for predicting adverse impact against any race, sex, or ethnic group. The four-fifths rule states that if the selection rate for a protected class is less than 80 percent of the selection rate for the group with the highest selection rate, the procedure is deemed to have an adverse impact (Waite, 2010; *Uniform,* 2011). It is recommended that adverse impact determinations should be made for each group constituting 2 percent or more of either the employer's workforce or the workforce in the relevant labor market. For example, if the hiring rate for whites other than Hispanics is 60%, for American Indians 45%, for Hispanics 48%, and for Blacks 51%, and each of these groups constitutes more than 2% of the labor force in the relevant labor area, a comparison should be made of the selection rate for each group with that of the highest group (whites). These comparisons show the following impact ratios: American Indians 45/60 or 75%; Hispanics 48/60 or 80%; and Blacks 51/60 or 85%. Applying the four-fifths or 80% rule of thumb, on the basis of the above information alone, adverse impact is indicated for American Indians but not for Hispanics or Blacks (*Uniform,* 2011).

If the hiring procedures have been deemed to not to be job related, the employer should provide evidence of the procedure's validity (Waite, 2010; U.S. EEOC, 2012a). The EEOC provides three validation strategies:

1. Criterion-related validity—a statistical demonstration of a relationship between scores on a selection procedure and job performance of a sample of workers.
2. Content validity—a demonstration that the content of a selection procedure is representative of important aspects of performance on the job.
3. Construct validity—a demonstration that (a) a selection procedure measures a construct (something believed to be an underlying human trait or characteristic, such as honesty) and (b) the construct is important for successful job performance.

Of the three, criterion-related and content validity are the most appropriate for physical capability exams. Criterion-related validity is useful for situations when "there is a substantial number of individuals for inclusion in the study, a considerable range of performance on the selection and criterion measures, and reliable and valid measures of job performance either available or capable of being developed" (Waite, 2012, p. 30)". Content validity is used when "work samples or other operational measures of prerequisite skills can be developed, but not for skills or abilities that are expected to be learned on the job" (Waite, 2012, p.30).

The Americans with Disability Act (ADA). The ADA states that qualified individuals with disabilities must be given equal opportunity in all aspects of any term, condition, or privilege of employment, including hiring, firing, promotion, layoff, compensation, benefits, job assignments, and training (U.S. EEOC, 2008; *Understanding*, 1999; U.S. Department, 2009). Employers with 15 or more employees, private employers, state and local governments, employment agencies and labor unions are subject to ADA.

Under the ADA, before an offer of employment is made, all disability-related inquiries and medical examinations are prohibited, even if they are job related (Waite, 2010). Employers may not ask job applicants about the existence, nature, or severity of a disability. Applicants may only be asked about their ability to perform specific job functions. Medical examinations of employees must be job related and consistent with the employer's business needs. What ADA does allow is for the employer to inquire about the capability to physically perform a job related task and for demonstration, but is not allowed to perform any measurements such as pulse or blood pressure, which would then constitute the testing to be a medical examination (USDJ, 2009). Inquiries about job related capabilities are allowed as long as the employer does so for all individuals applying for the same position. Once a conditional job offer has been made,

disability-related inquiries and medical exams are permitted regardless of relation to the job, provided that the employer makes inquiries and conducts exams for all employees in the same job category (Waite, 2010; USDJ, 2009). An employer may request medical information when there is a reasonable belief that a particular employee will be unable to perform essential job functions or will pose a direct threat because of a medical condition, or when an employer receives a request for a reasonable accommodation and the person's desire for accommodation is not obvious (USDJ, 2009; *Employment*, 2010).

ADA requires that if during a physical test, a reasonable accommodation is requested, the employer must grant this request if they individual has a disability. ADA defines disability as "a physical or mental impairment that substantially limits one or more major life activities of such individual" (USDJ, 2009). "Temporary injuries or medical conditions that do not affect day-to-day activities, but only restrain an employee from performing a required job function, are not be considered disabilities" (Rosenblum, 2002, p.7). Reasonable accommodations under the ADA may include job restructuring, part-time or modified work schedules, reassignment to a vacant position, modification of equipment or devices, appropriate adjustment or modifications of examinations, training materials or policies, or the provision of qualified readers or interpreters. Because ADA states that it is unlawful to discriminate against qualified individuals with a disability by using qualification standards such as employment tests or other selection criteria that tend to screen out an individual or class of individuals with disabilities, the individual can only be denied employment if the candidate posed a "direct threat" (*Employment,* 2010; Rosenblum, 2002; USDJ 2009). The ADA Guidance states that a direct threat is when "the individual poses a significant risk of substantial harm to him/herself or others, and that the risk cannot be reduced below the direct threat level through reasonable accommodation." The factors

to be considered in evaluating the existence of a direct threat include duration of the risk, nature and severity of the potential harm, likelihood that the potential harm will occur, and imminence of the potential harm (Waite, 2010).

In addition, pre-employment test must measure important job functions directly related to the task. Utilizing height and weight as a determination for failure of a pre-employment test is illegal unless they are proven to be job related factors (*Musculoskeletal*, n.d.). In the Supreme Court case, Dothard vs. Rawlinson, to be considered for an applicant for an Alabama prison guard, there was a 120 pound minimum weight standard and 5 foot 2 inch minimum height standard, as well as regulatory requirements establishing gender criteria for assigning counselors to maximum security institutions for positions with close physical proximity to inmates (as cited in Waite, 2010). Statistics showed that the combined height and weight minimums would exclude 41.13 percent of the female population while excluding less than one percent of the male population. The verdict concluded that the use of gender to assign counselors in close contact was not based on stereotypes, but on the real need not to have women put in danger of assault, as for example from sex offenders scattered throughout the maximum-security prisons. Though there was indeed a valid case of the testing procedure being discriminatory, the state as employer showed that discriminatory employment practice was necessary for safe and efficient job performance. As a result, Alabama passed a regulation requiring that all guards be the same sex as the inmates.

Workers compensation liability for injuries suffered during physical ability testing. One of the risks of conducting physical ability testing is that an applicant or employee may be injured during the test. The applicant's qualifications for workers' compensation reparations are dependent on the state in which the claim occurred (Rosenblum, 1992; Waite, 2010). There are

no federal standards for the courts are divided on this issue. On one side, because the person is not an employee when taking the physical test, they are not covered under the organizations workers' compensation laws. On the other hand, because the person submitted to testing for the benefit of the employer, a constructive employer/employee relationship exists. It is important when reviewing workers' compensation issues to evaluate the law of the state in which the pre-employment testing will take place.

Chapter III: Methodology

The purpose of this study was to determine if federal hiring restrictions may have an impact on the effectiveness of physical capability testing programs. This research study will examine if federal hiring restrictions would have allowed more individuals susceptible to injury to enter the workplace or current employees to transfer to jobs they were not physically capable of safely performing.

To properly assess the effectiveness of the current physical capability testing protocols, the following goals were established:

1. Determine the expected outcomes of physical capability screening
2. Discuss the legal implications associated with conducting and developing pre-employment physical capability tests.
3. Compare the pre-2007 testing procedures to the post-2007 testing procedures

The methods and procedures used to accomplish the goals of the study will be outlined in the following areas: methodology of study, subject selection and description, instrumentation, data collection procedures, data analysis, and the limitations of the study.

Methodology of Study

To answer the first two goals, literature review was conducted to obtain a better understanding of the components and purpose of physical capability testing and the legal implications associated with its development and implementation. Literature review also provided detailed description of various methods to test for program effectiveness.

As a client of Advanced Ergonomics, Inc. (AEI), their Physical Ability Testing Review Program provided two methods for determining the effectiveness of their physical capability exam, as was described in detail in Chapter II. The two methods are the Prospective Validation

and the Pre/Post-Implementation Analysis. Both methods are dependent upon when the sample population and the time period in which the test was implemented. The Prospective Validation method requires all applicants to complete the pre-employment physical capability exam, but rather than use the results for determining hiring ability, they are used as a benchmark to compare the injury rates between those who failed and passed the exam. As a result, it takes several years to collect a large enough sample before the program's effectiveness can be measured. On the other hand, the Pre/Post-Implementation Analysis does use the pre-employment physical capability exam results to determine hiring ability. The results are again used as a benchmark, but are now used to compare injury rates among the employees who were hired prior to and after the implementation of the physical capability test. Thus, measuring the effectiveness of the testing program can be conducted much sooner than with the Prospective Validation method. Since the current test used by Company XYZ has been used for several years in determining the hiring ability of applicants since 2007, this research study will focus on utilizing the Pre/Post-Implementation Analysis method to verify if the current physical capability exam was ineffectively screening out employees susceptible to injury.

Upon verifying that the current physical capability exam was ineffectively decreasing injury rates, a thorough analysis and comparison between the pre-2007 and post-2007 physical capability test protocols will be performed. Specific information that will be looked for will be changes between the testing methods which would reflect compliance to the federal legislation that may have lead to the current physical capability testing program to be ineffective.

Subject Selection and Description

There were be no human subjects required to utilize the Pre/Post-Implementation Analysis method nor in the comparison of the two testing programs. The Pre/Post-

Implementation Analysis required examining the OSHA 300 logs from 2002 to 2012. Comparing the two physical capability exams required examining a detailed description of steps for implementing the programs.

Instrumentation

To analyze all the injury rates of Company XYZ, the instrument that will be used to conduct this research were the company's OSHA 300 logs from 2002 to 2012. The OSHA 300 logs provide information such as the name of the employee, employee's job title, date of injury, location of incident, type of injury or illness, and the severity of the injury or illness. This data will help with developing injury trend analyses necessary to determine if changes in injury rates are a result of the changes in physical testing protocols.

Statistical analysis was conducted on the OSHA 300 log data utilizing the Data Analysis tool in Microsoft Excel. The following statistical methods were used: Descriptive Statistics, Correlation, and t-Test: Paired Two Sample for Means (alpha = 0.05). The following are the hypotheses for this study:

1. Null hypothesis (H_0): The mean number of injuries from 2002-2006 is equal to the mean number injuries from 2007 to 2011.
2. Alternate hypothesis (H_1): The mean number of injuries from 2002-2006 is NOT equal to the mean number injuries from 2007 to 2011).

Descriptive Statistics provides information on a set of data to determine statistical information about its central tendency and variability such as sum, mean, median, mode, standard deviation, skewness, etc.

A correlation analysis measures the relationship between two or more variables; in this case, the number of physical injuries experienced as time progressed. Correlation analysis

provides a Pearson's correlation value between -1 and +1, representing a statistical relationship among dependent data points sensitive to a linear relationship. As it approaches zero there is less of a relationship (closer to uncorrelated). The closer the coefficient is to either −1 or 1, the stronger the correlation between the variables. In conjunction with the Pearson's correlation value, the graph developed will provide a regression-line. The regression line is given a coefficient of determination value (R^2) from 0 to 1, representing how well the regression line approximates the real data points. The closer the value to 1, the greater the regression line fits the data.

The t-Test is a statistical hypothesis test used to compare whether the mean difference between two groups is really significant or if it is due instead to random chance. There are two types of t-Tests, unpaired and paired. The unpaired t-Test uses two sample sets that are independent of each other, where knowing about one sample does not affect the outcome of the other. In a paired t-Test, the two sample sets are not independent of each other, thus knowing about one sample does affect the outcome of the other. Often paired t-Tests are performed on the same sample twice, once before an application of a treatment and then once again after the treatment.

The type of t-Test used for this study is a t-Test: Paired Two Sample for Means. A paired t-Test is used due to the assumption that between the two time periods, there remains a large number of the same employees, thus the same employees would have been exposed to both physical testing programs (the treatment). Statistical analyses are tested against a confidence level to determine the significance of the samples. Confidence intervals are typically measured against a 95% confidence level, suggesting that the values from both samples but lie within a 95% window between a lower and upper control limit. The t-Test for this study will be tested

against the 95% confidence level, or alpha level 0.05. Determined from the test will be a t-Stat and p-Value. To accept the null hypothesis, the t-Stat must lie within the t-Critical value (a ±value), which represents where 95% of each sample value should lie within. The p-Value calculated represents the percentage value for which the actual t-Stat value lies. If the p-Value is less than 0.05, this means that the t-Stat value has fallen outside the t-Critical value, thus rejecting the null hypothesis and suggesting that the sample means are significantly different.

After performing statistical analyses, the testing procedures from both programs must be examined to determine key differences which coincide with federal hiring restrictions. This is performed by looking at the actual testing procedures obtained by Company XYZ.

Data Collection Procedures

The following procedures were carried out to obtain information required to perform the statistical analyses:

1. All recordable injuries on the OSHA logs were categorized into the following:
    a. Type of recordable injury (by year only):
        i. Sprains/Strains: back, chest/abdomen, neck/shoulder, elbow/forearm, hand/wrist, knee/thigh, foot/ankle
        ii. Repetitive: shoulder, back, elbow, hand/wrist
        iii. Non-physical: foot fracture, hand fracture, eye injury, laceration, contusion, hearing loss
    b. Physical and non-physical injuries by employee job title (by year only)
        i. Job titles: warehouse, driver, production, maintenance, garage, customer, custodian, office worker
    c. Total number of physical injury incidents (by both year and month)

d. Total number of non-physical injury incidents (by both year and month})

2. Developed scatter graphs in Microsoft Excel of each category previously described:
    a. Old pre-employment physical capability exam (2002-2006)
    b. New pre-employment physical capability exam (2007-2011)
    c. Entire time period (2002-2011)
3. Performed statistical analyses in Microsoft Excel for each category previously described:
    a. Descriptive Statistics
    b. Correlation
    c. t-Test: Paired Two Sample for Means (alpha = 0.05)

Data Analysis

Utilizing the information recorded within the OSHA 300 logs, a comparison of various categories of injuries can be conducted for each the old and new pre-employment physical exam time periods and the entire time period. From the statistical computations, the p-values and correlation data can be analyzed to determine if there were any significant changes in employee injury prior to and after the implementation of the current physical capability exam.

Upon verifying that the current physical capability exam is ineffective, a thorough analysis and comparison between the old and new physical capability test protocols can be conducted. Specific information that will be looked for will be relationships between significant statistical correlation data and changes between the testing methods. Ultimately, the goal is to determine what the impacts of compliance to the federal hiring legislation may have on the physical capability testing program.

Limitations

The limitation of this study was a lack of a complete and thorough understanding of statistical measurements and calculations required for this study. Hours of self education was required to obtain a basic understanding of the necessary statistical calculations and methods.

Chapter IV: Results

The purpose of this study was to examine the potential influence federal hiring legislation may have on physical capability exams in the workplace. The primary goal of this study was to determine if the stringent hiring legislation has been allowing individuals susceptible to injury into the workplace or current employees to transfer to jobs they were unqualified to perform safely, thus contributing to higher incidents of recordable injuries.

To properly achieve this goal, the following areas were examined:

1. The expected outcomes of physical capability screening
2. The legal implications associated with conducting and developing pre-employment physical capability tests.
3. A comparison of the pre-2007 testing protocols to the post-2007 testing protocols.

The following will describe in detail the results obtained for each goal.

Goal One

The first goal of the study was to analyze the expected outcomes of physical capability screening. This was accomplished through extensive literature review. The purpose of physical capability testing is to assist management's decision in selecting the most qualified individuals for a physically demanding job. The testing protocols test for strength, endurance, and postural demands associated with the particular job. The primary benefit of physical testing is to prevent or reduce the number of injuries in the workplace due to their large financial impact to the company. As McKendrick stated, "the ability of management to select particular employees for the specific job is a major factor in promoting company efficiency, growth, and earnings." Not only are there direct financial losses as a result of workplace injuries but indirect costs as well. Examples of such costs include employee absenteeism, medical expenses, increased stress on

other employees who must cover for them, and recruitment, hiring, or training costs for new hires, as well as legal costs associated with non-compliance with federal safety and health standards. Unfortunately, a major impediment to developing effective physical capability tests are the strict hiring legislation which companies must overcome.

Goal Two

The second goal of the study was to evaluate the legal implications associated with conducting and developing pre-employment physical capability tests. This was also accomplished through extensive literature review.

Physical ability tests are often subjected to a high standard of legal and administrative review. Because most strength tests often result in adverse impacts against females and individuals over the age of 40 years old, physical capability tests must provide empirical evidence to show that the test protocols are of direct job-relatedness. Due to the range in physical demands of various jobs, the test battery should reflect only the positions for which the applicant will be applying for. "Any tests conducted to assess physical ability —as well as inquiries related to physical ability—are subject to limitations under federal and state law; violations of those requirements may result in liability under civil rights and nondiscrimination statutes" (Waite, 2010, p.3). Pre-employment testing programs must adhere to the Title VII of the Civil Rights Act (CRA) of 1964, the Age Discrimination in Employment Act (ADEA), the Equal Employment Opportunity Commission (EEOC), Uniform Guidelines on Employee Selection Procedures, Title I of the Civil Rights Act (CRA) of 1991, and the Americans with Disability Act (ADA). Essentially, pre-employment tests must not intentionally or disproportionately exclude specific applicants or applicants in a particular group by sex, national

origin, religion, disability, or age, unless the employer can justify the test or procedure under the law (USDJ, 2009; *Employment,* 2010; *Understanding*, 1999).

Goal Three

The third goal of the study was to perform a thorough comparison and analysis between the old (pre-2007) and new (post-2007) pre-employment physical capability testing protocols. This analysis required comparing the injury rates from both time periods, and then to compare the protocols of each physical testing program.

Comparing the Injury Rates. Data about the injury rates were obtained from the OSHA 300 logs from 2002 to 2011. The injuries were organized into various categories based on type of recordable injury, and job title of the injured employee. Statistical analytical methods were performed on each category including Descriptive Statistic, Correlation, and t-Test: Paired Two Sample for Means (alpha = 0.05). Also provided are bar graphs comparing the mean, maximum, and minimum number of injuries from each category experienced during each testing time period. Utilizing a 95% confidence level, p-values highlighted in green show values within 5%, yellow values between 5% and 10%, and red values greater than 10% significance. Table 4.0 Statistical Analyses Results show a compilation of all the statistical calculation results.

Table 4.0 Statistical Analyses Results

Table	Category	Type	Year	Mean	Correlation	t Stat	P (T<=0) Two-Tail	t-Critical Two-Tail
4.1	Back	Sprain	02-'06	12	-0.1861	-	-	-
	Back	Sprain	07-'11	14.6	0.7559	-	-	-
	Back	Sprain	02-'11	13.3	0.5613	-2.0180	0.1138	2.7764
4.2	Chest/Abdomen	Sprain	02-'06	0.6	-0.2887	-	-	-
	Chest/Abdomen	Sprain	07-'11	1.4	0.5547	-	-	-
	Chest/Abdomen	Sprain	02-'11	1	0.5060	-1.0887	0.3375	2.7764
4.3	Neck/Shoulder	Sprain	02-'06	3.2	-0.3780	-	-	-
	Neck/Shoulder	Sprain	07-'11	4.6	0.5574	-	-	-
	Neck/Shoulder	Sprain	02-'11	3.9	0.6458	-3.5000	0.0249	2.7764
4.4	Elbow/Forearm	Sprain	02-'06	2	-0.2236	-	-	-
	Elbow/Forearm	Sprain	07-'11	3	-0.8944	-	-	-
	Elbow/Forearm	Sprain	02-'11	2.5	0.1090	-1.4142	0.2302	2.7764

4.5	Hand/Wrist	Sprain	02-'06	2.2	-0.1768	-	-	-
	Hand/Wrist	Sprain	07-'11	3	-0.5164	-	-	-
	Hand/Wrist	Sprain	02-'11	2.6	0.0975	-0.8251	0.4557	2.7764
4.6	Knee/Thigh	Sprain	02-'06	1.8	0.8489	-	-	-
	Knee/Thigh	Sprain	07-'11	2.4	-0.8660	-	-	-
	Knee/Thigh	Sprain	02-'11	2.1	0.4244	-0.7385	0.5012	2.7764
4.7	Foot/Ankle	Sprain	02-'06	1	-0.8944	-	-	-
	Foot/Ankle	Sprain	07-'11	0.8	-0.7071	-	-	-
	Foot/Ankle	Sprain	02-'11	0.9	-0.5495	1.0000	0.3739	2.7764
4.8	Shoulder	Repetitive	02-'06	0.2	0.7071	-	-	-
	Shoulder	Repetitive	07-'11	2.2	-0.3198	-	-	-
	Shoulder	Repetitive	02-'11	1.2	0.5968	-2.8284	0.0474	2.7764
4.9	Back	Repetitive	02-'06	0.2	0.7071	-	-	-
	Back	Repetitive	07-'11	0.6	0.3536	-	-	-
	Back	Repetitive	02-'11	0.4	0.4724	-1.0000	0.3739	2.7764
4.10	Elbow/Forearm	Repetitive	02-'06	0.8	0.4851	-	-	-
	Elbow/Forearm	Repetitive	07-'11	0.8	0.5669	-	-	-
	Elbow/Forearm	Repetitive	02-'11	0.8	0.2487	0.0000	1.0000	2.7764
4.11	Hand/Wrist	Repetitive	02-'06	4.6	-0.1890	-	-	-
	Hand/Wrist	Repetitive	07-'11	2.4	-0.7071	-	-	-
	Hand/Wrist	Repetitive	02-'11	3.5	-0.7077	2.1573	0.0972	2.7764
4.12	Warehouse	Job Title	02-'06	9	-0.0894	-	-	-
	Warehouse	Job Title	07-'11	12.6	-0.2626	-	-	-
	Warehouse	Job Title	02-'11	10.8	0.4178	-1.6677	0.1707	2.7764
4.13	Driver	Job Title	02-'06	5.8	0.2466	-	-	-
	Driver	Job Title	07-'11	8.8	0.1213	-	-	-
	Driver	Job Title	02-'11	7.3	0.6880	-3.0000	0.0399	2.7764
4.14	Production	Job Title	02-'06	12.4	-0.1213	-	-	-
	Production	Job Title	07-'11	14.2	-0.2188	-	-	-
	Production	Job Title	02-'11	13.3	0.2619	-1.2923	0.2658	2.7764
4.15	All	Year	02-'06	28.6	0.0000	-	-	-
	All	Year	07-'11	35.8	-0.4636	-	-	-
	All	Year	02-'11	32.2	0.6567	-4.1991	0.0137	2.7764
4.16	All	Month	02-'06	2.3833	-0.0651	-	-	-
	All	Month	07-'11	2.9833	-0.0748	-	-	-
	All	Month	02-'11	2.6833	0.1322	-2.2470	0.0284	2.0010

Tables 4.1 Back Sprains (2002-2011)

Back Sprains (2002-2011)	
Year	Incidents
2002	10
2003	15
2004	12
2005	14
2006	9
2007	13
2008	13
2009	15
2010	17
2011	15

Descriptive Statistics ('02-'06)	
Sum	60
Mean	12
Max	15
Min	9
Range	6
Mode	#N/A

Correlation ('02-'06)		
	Year	*Incidents*
Year	1	
Incidents	-0.1861	1

Descriptive Statistics ('07-'11)	
Sum	73
Mean	14.6
Max	17
Min	13
Range	4
Mode	13

Correlation ('07-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.7559	1

Descriptive Statistics ('02-'11)	
Sum	133
Mean	13.3
Max	17
Min	9
Range	8
Mode	15

Correlation ('02-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.5613	1

t-Test: Paired Two Sample for Means		
	2002-2006	*2007-2011*
Mean	12	14.6
Variance	6.5	2.8
Observations	5	5
Pearson Correlation	0.1172	
Hypothesized Mean Difference	0	
df	4	
t Stat	-2.0180	
P(T<=t) one-tail	0.0569	
t Critical one-tail	2.1318	
P(T<=t) two-tail	0.1138	
t Critical two-tail	2.7764	

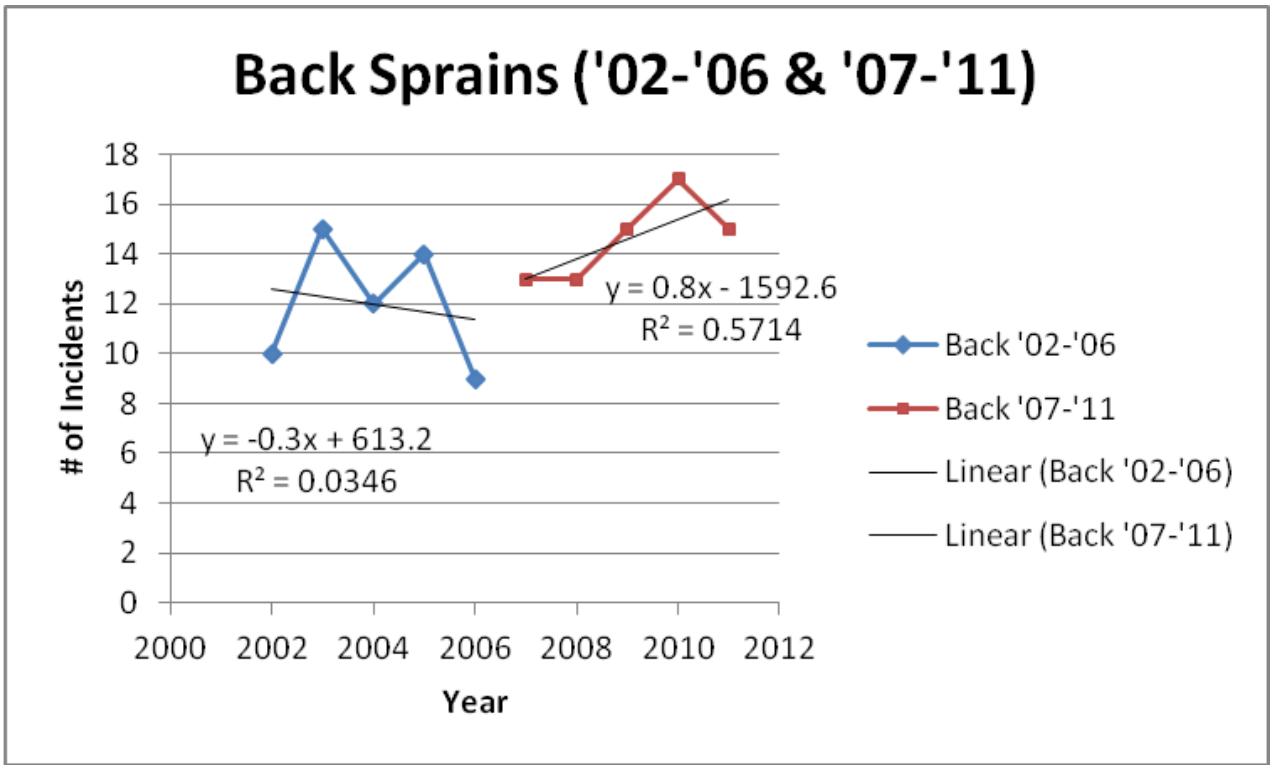

Fig. 4.1a Back Sprains ('02-'06 & '07-'11)

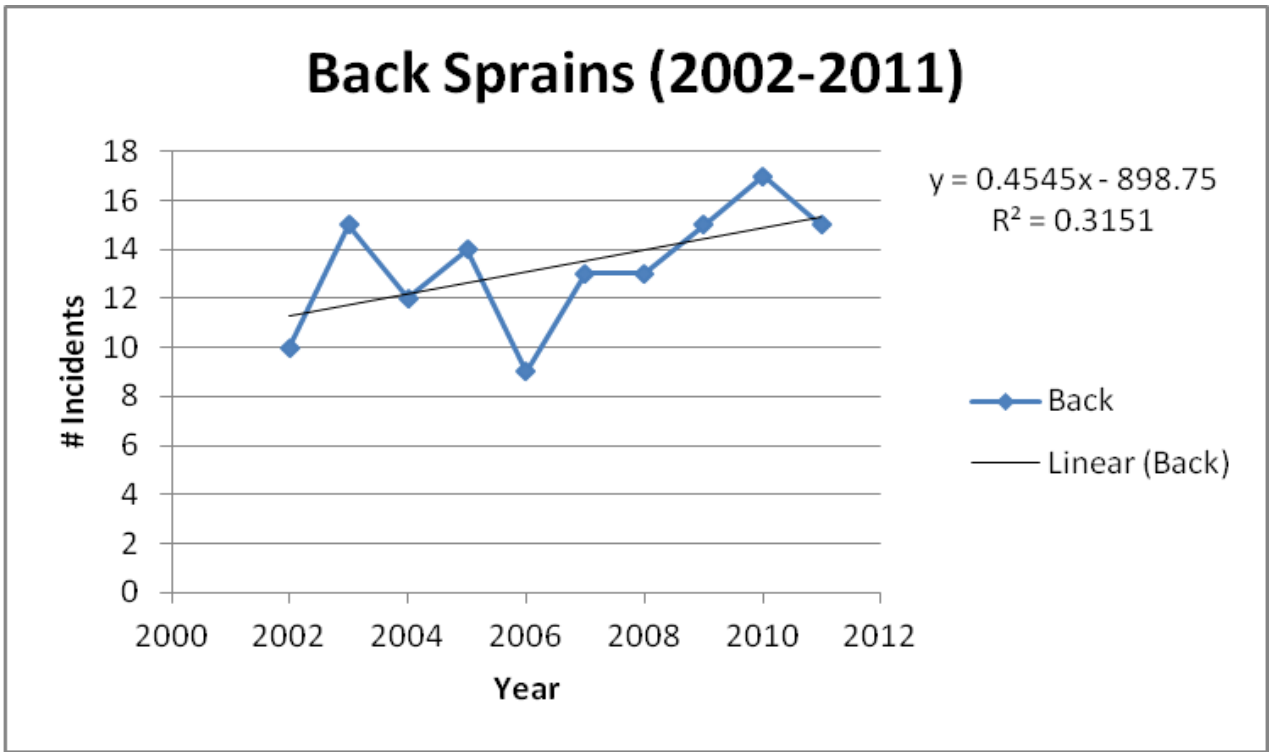

Fig. 4.1b Back Sprains (2002-2011)

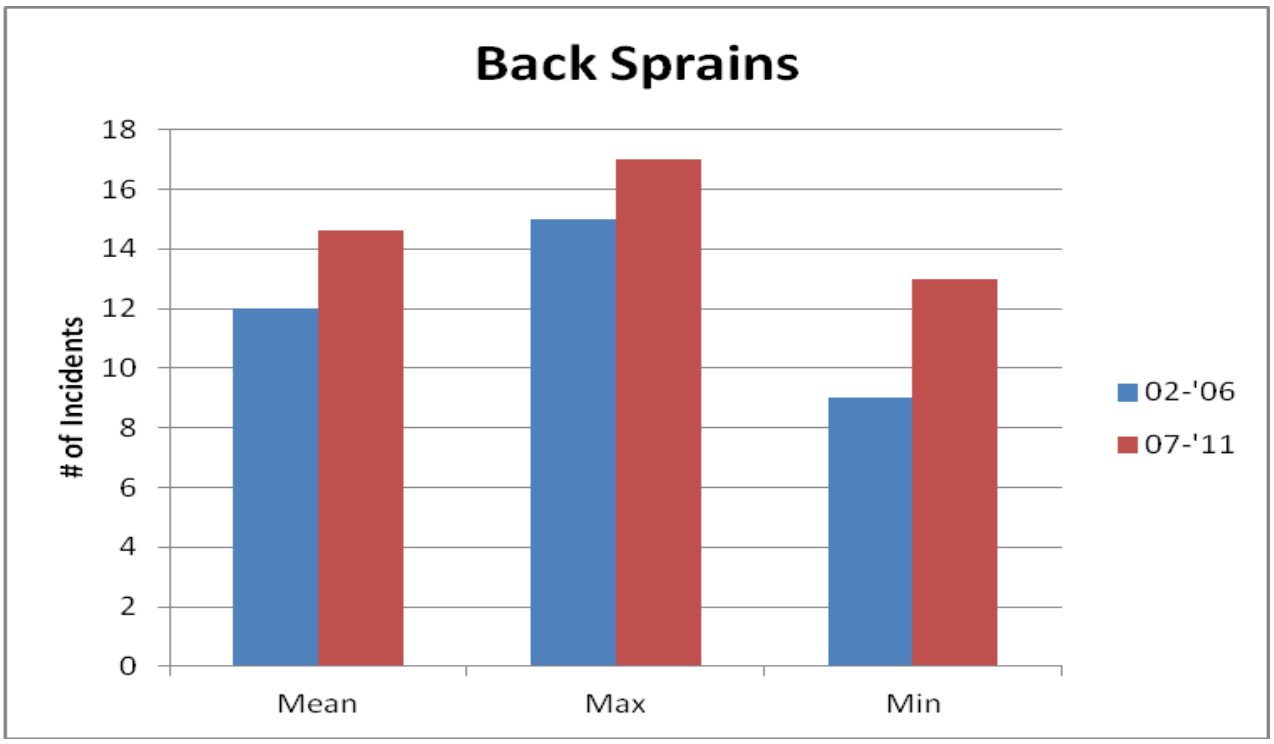

Fig. 4.1c Back Sprains Rates (2002-2011)

Tables 4.1 Back Sprains (2002-2011) display all back sprains that were recorded on the OSHA 300 logs from 2002 to 2011. Each *Correlation* table provides a Pearson's value, a positive or negative number suggesting an increase or decrease of incidents over time. The Pearson's value for '02-'06 of -0.1861 suggests a weak negative correlation, '07-'11 of 0.7559 suggests a strong positive correlation, and '02-'11 of 0.5613 suggests an overall medium positive correlation. These relationships can be seen graphically in Fig. 4.1a & Fig. 4.1b.

To confirm the significance of the strong positive relationship from '02-'11 and that the positive correlation did not occur by chance, a t-Test is performed. The t-Test examines the mean number of injuries from both samples (time periods) and determines if the mean injury rates are significantly different at a confidence level. At the 95% confidence level, the *t-Test: Paired Sample for Means* table shows that the P (T<=t) two-tail value is 0.1138.

After comparing the means, maximum, and minimum injuries from '02-'06 to '07-'11, it can be seen that all values have increased from one time period to the next.

Tables 4.2 Chest/Abdomen Sprains (2002-2011)

Chest/Abdomen Sprains (2002-2011)	
Year	Incidents
2002	1
2003	1
2004	0
2005	0
2006	1
2007	0
2008	1
2009	2
2010	3
2011	1

Descriptive Statistics ('02-'06)	
Sum	3
Mean	0.6
Max	1
Min	0
Range	1
Mode	1

Correlation ('02-'06)		
	Year	*Incidents*
Year	1	
Incidents	-0.2887	1

Descriptive Statistics ('07-'11)	
Sum	7
Mean	1.4
Max	3
Min	0
Range	3
Mode	1

Correlation ('07-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.5547	1

Descriptive Statistics ('02-'11)	
Sum	10
Mean	1
Max	3
Min	0
Range	3
Mode	1

Correlation ('02-'-11)		
	Year	*Incidents*
Year	1	
Incidents	0.5060	1

t-Test: Paired Two Sample for Means		
	2002-2006	*2007-2011*
Mean	0.6	1.4
Variance	0.3	1.3
Observations	5	5
Pearson Correlation	-0.8807	
Hypothesized Mean Difference	0	
df	4	
t Stat	-1.0887	
P(T<=t) one-tail	0.1688	
t Critical one-tail	2.1318	
P(T<=t) two-tail	0.3375	
t Critical two-tail	2.7764	

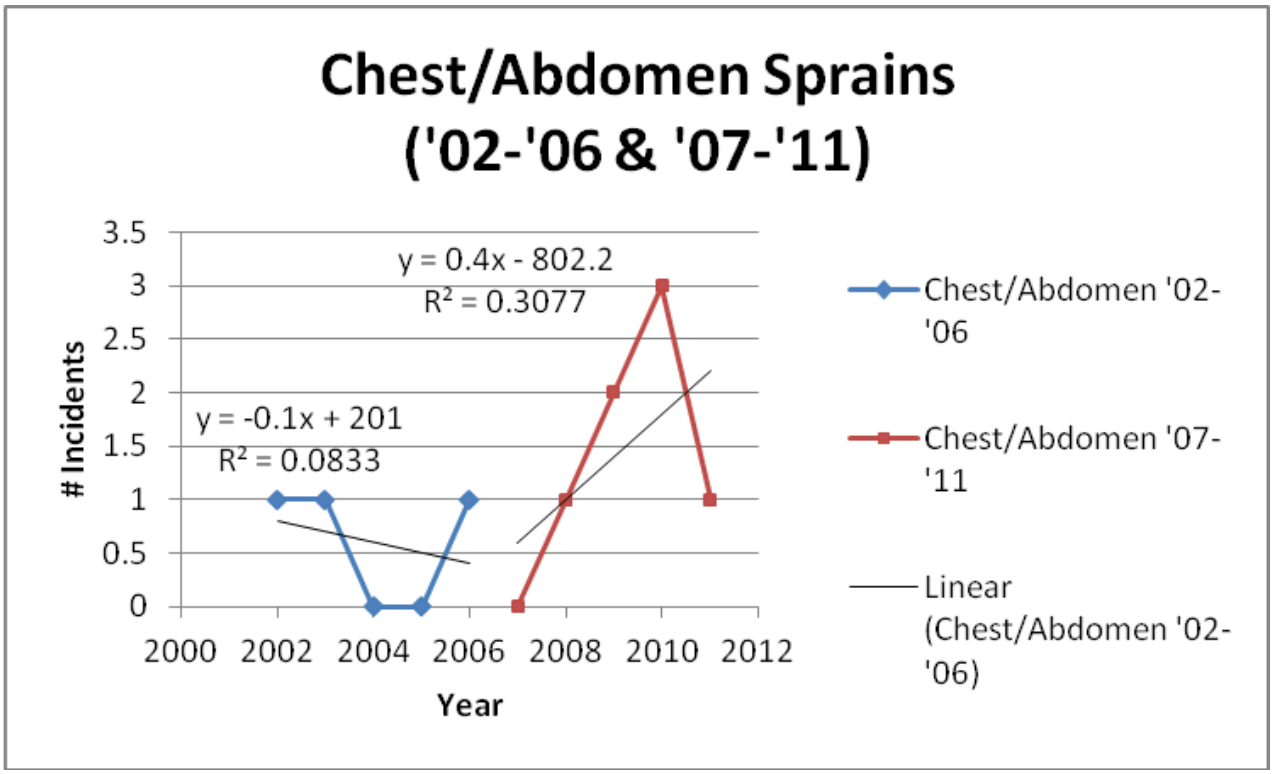

Fig. 4.2a Chest/Abdomen Sprains ('02-'06 & '07-'11)

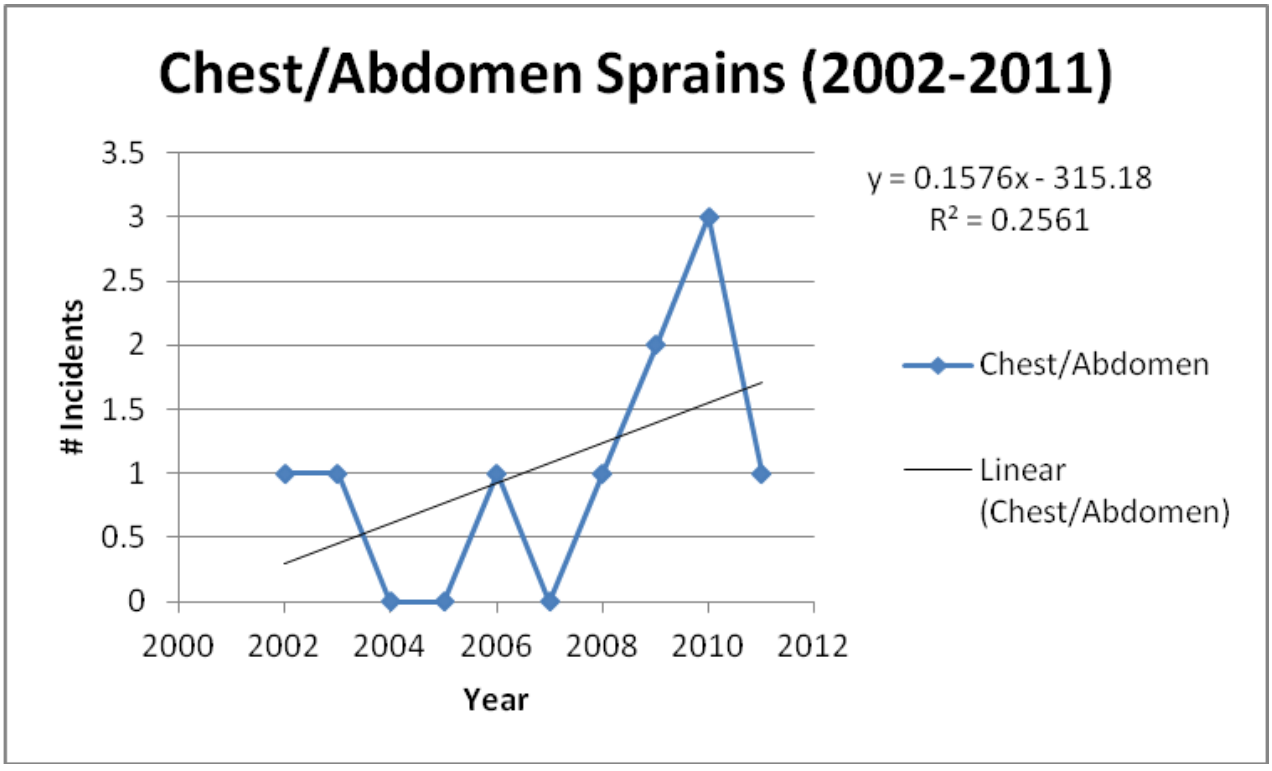

Fig. 4.2b Chest/Abdomen Sprains (2002-2011)

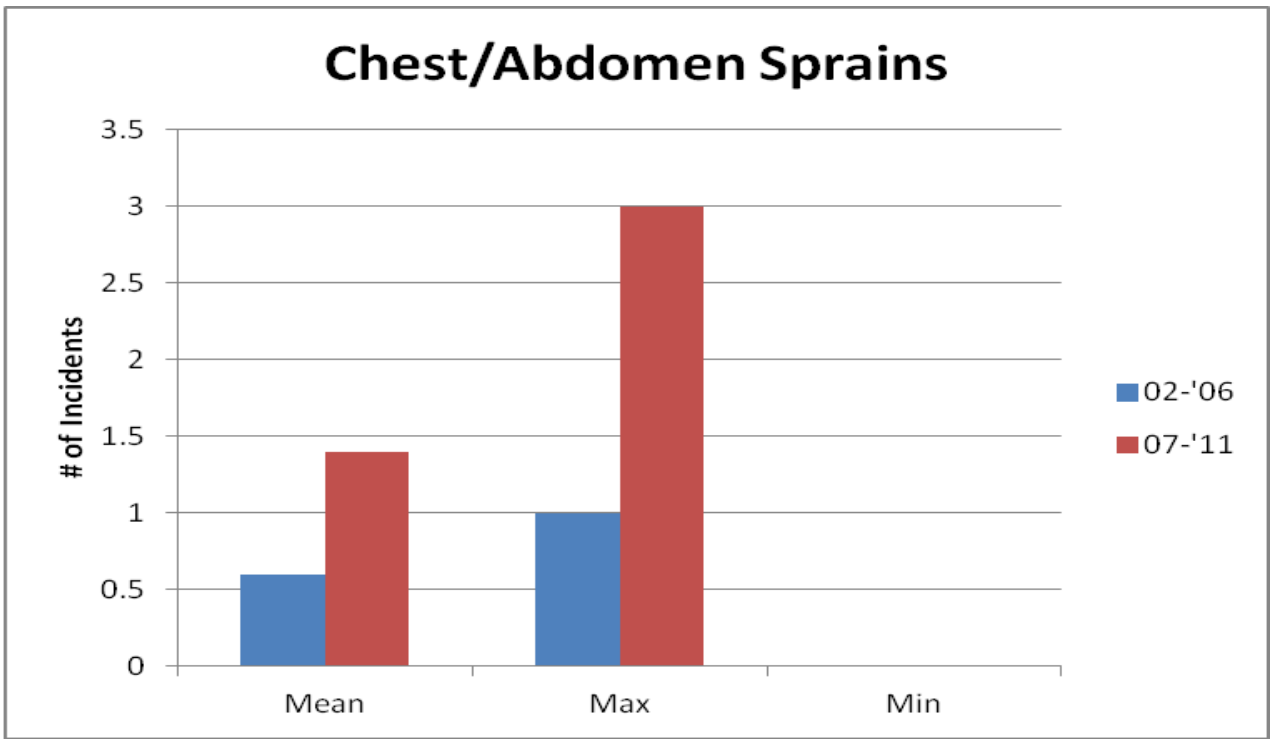

Fig. 4.2c Chest/Abdomen Sprains Rates (2002-2011)

Tables 4.2 Chest/Abdomen Sprains (2002-2011) display all chest and/or abdomen sprains that were recorded on the OSHA 300 logs from 2002 to 2011. Each *Correlation* table provides a Pearson's value, a positive or negative number suggesting an increase or decrease of incidents over time. The Pearson's value for '02-'06 of -0.2887 suggests a weak negative correlation, '07-'11 of 0.5547 suggests a medium positive correlation, and '02-'11 of 0.5060 suggests an overall medium positive correlation. These relationships can be seen graphically in Fig. 4.2a & Fig. 4.2b.

To confirm the significance of the medium positive relationship from '02-'11 and that the positive correlation did not occur by chance, a t-Test is performed. The t-Test examines the mean number of injuries from both samples (time periods) and determines if the mean injury rates are significantly different at a confidence level. At the 95% confidence level, the *t-Test: Paired Sample for Means* table shows that the P (T<=t) two-tail value is 0.3375.

After comparing the means, maximum, and minimum injuries from '02-'06 to '07-'11, it can be seen that all values have increased or unchanged from one time period to the next.

Tables 4.3 Neck/Shoulder Sprains (2002-2011)

Neck/ShoulderSprains (2002-2011)	
Year	Incidents
2002	3
2003	4
2004	3
2005	4
2006	2
2007	4
2008	5
2009	4
2010	5
2011	5

Descriptive Statistics ('02-'06)	
Sum	16
Mean	3.2
Max	4
Min	2
Range	2
Mode	3

Correlation ('02-'06)		
	Year	*Incidents*
Year	1	
Incidents	-0.3780	1

Descriptive Statistics ('07-'11)	
Sum	23
Mean	4.6
Max	5
Min	4
Range	1
Mode	5

Correlation ('07-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.5774	1

Descriptive Statistics ('02-'11)	
Sum	39
Mean	3.9
Max	5
Min	2
Range	3
Mode	4

Correlation ('02-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.6458	1

t-Test: Paired Two Sample for Means		
	2002-2006	*2007-2011*
Mean	3.2	4.6
Variance	0.7	0.3
Observations	5	5
Pearson Correlation	0.2182	
Hypothesized Mean Difference	0	
df	4	
t Stat	-3.5	
P(T<=t) one-tail	0.0124	
t Critical one-tail	2.1318	
P(T<=t) two-tail	0.0249	
t Critical two-tail	2.7764	

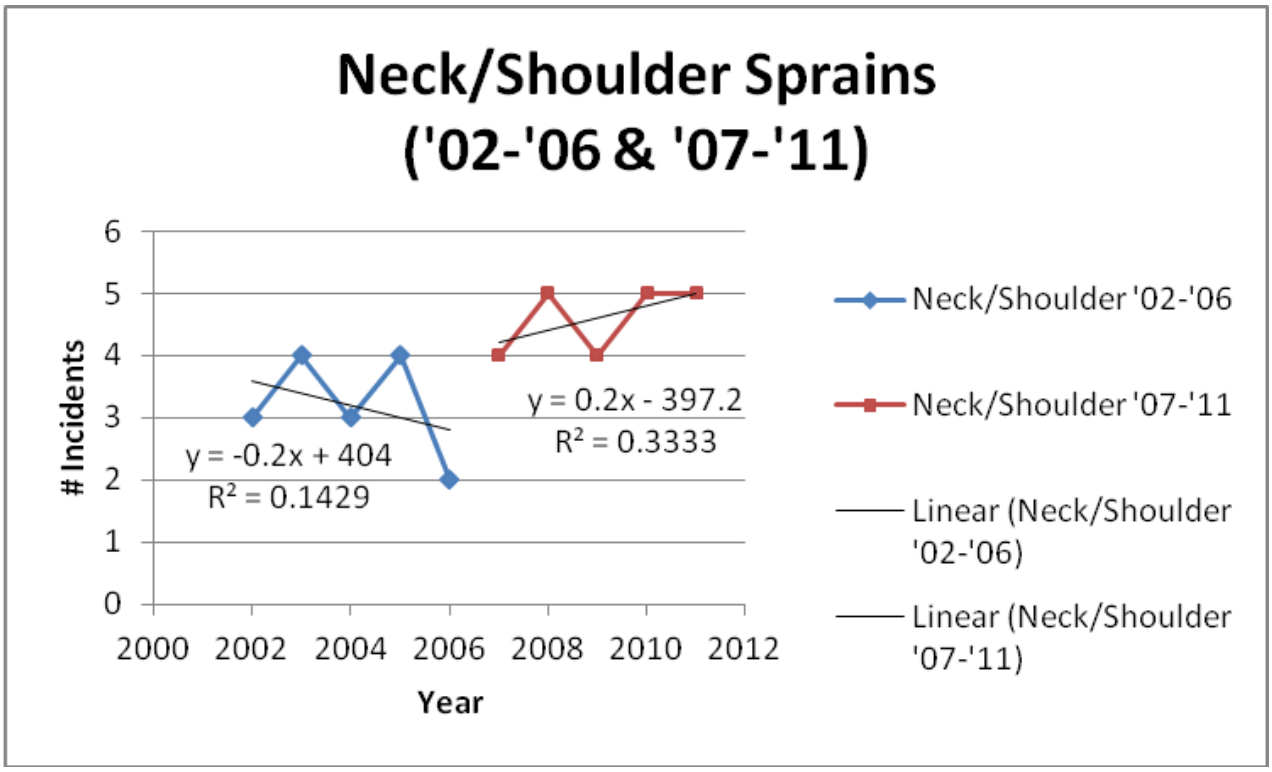

Fig. 4.3a Neck/Shoulder Sprains ('02-'06 & '07-'11)

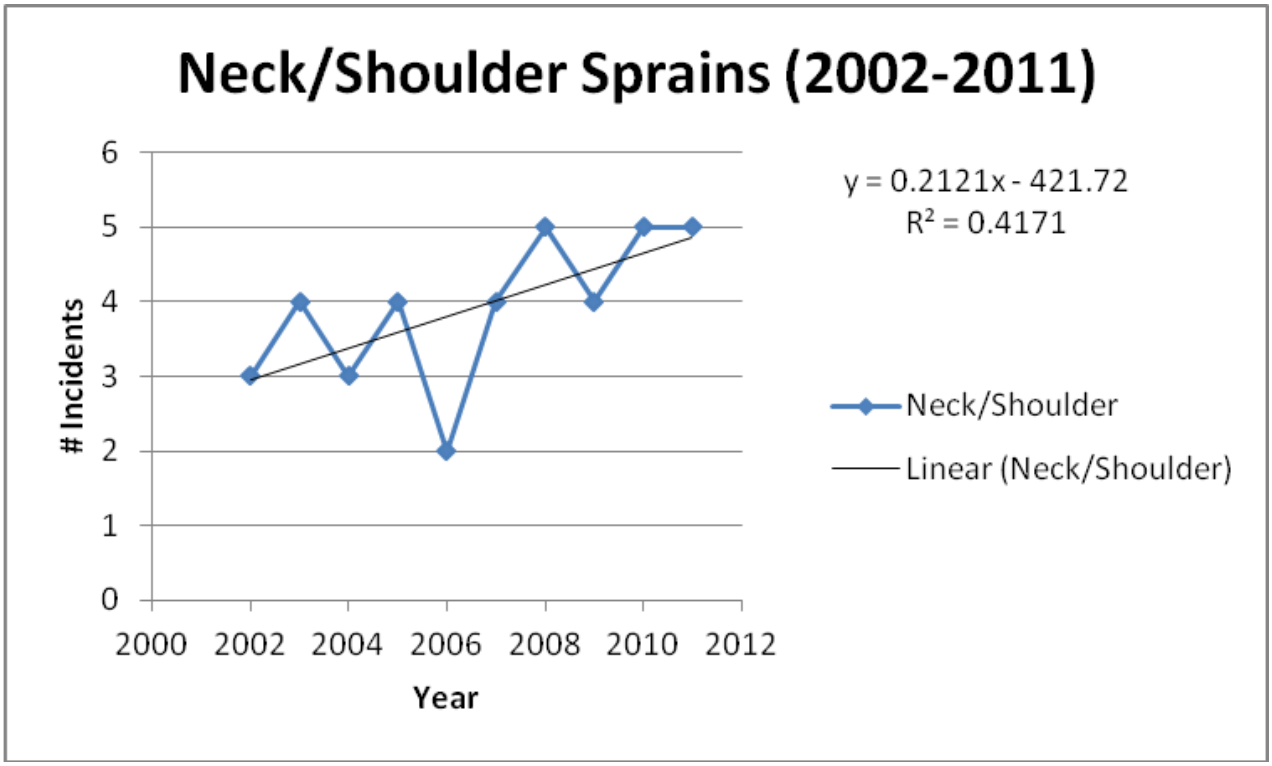

Fig. 4.3b Neck/Shoulder Sprains (2002-2011)

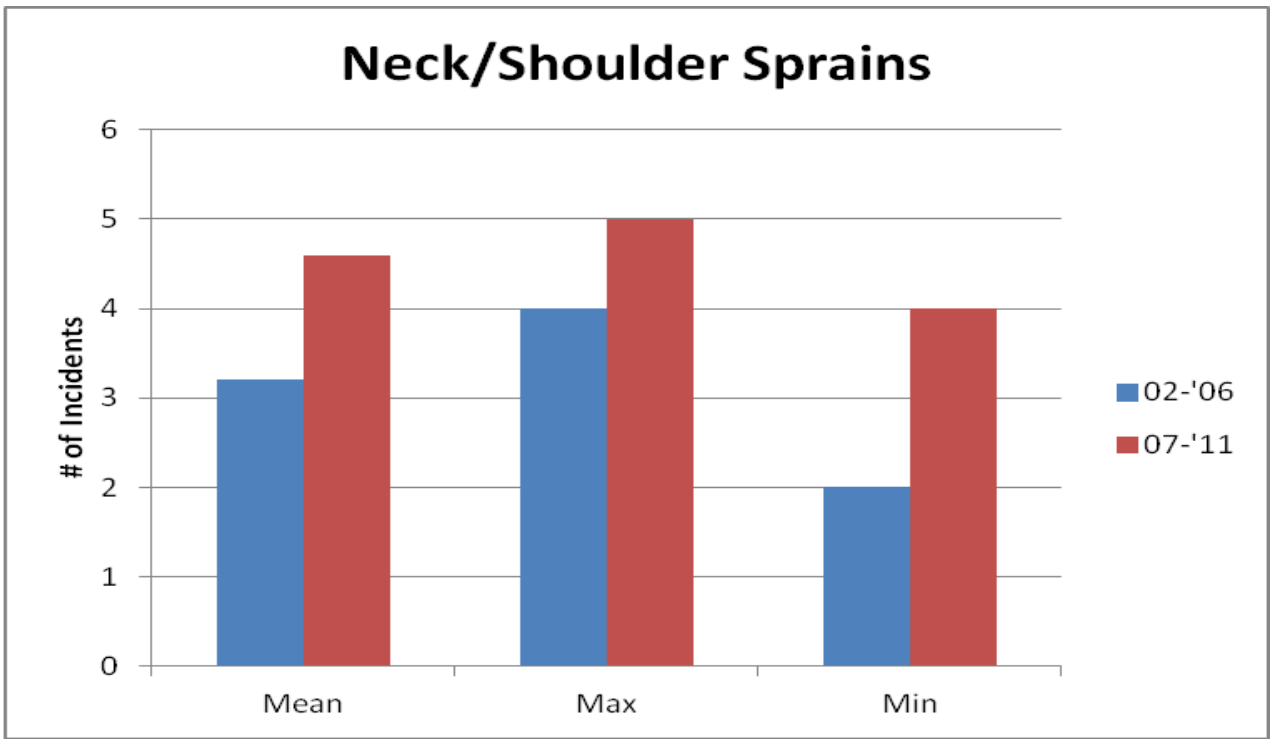

Fig. 4.3c Neck/Shoulder Sprains Rates (2002-2011)

Tables 4.3 Neck/Shoulder Sprains (2002-2011) display all neck and/or shoulder sprains that were recorded on the OSHA 300 logs from 2002 to 2011. Each *Correlation* table provides a Pearson's value, a positive or negative number suggesting an increase or decrease of incidents over time. The Pearson's value for '02-'06 of -0.3787 suggests a weak negative correlation, '07-'11 of 0.5771 suggests a medium positive correlation, and '02-'11 of 0.6458 suggests an overall medium positive correlation. These relationships can be seen graphically in Fig. 4.3a & Fig. 4.3b.

To confirm the significance of the medium positive relationship from '02-'11 and that the positive correlation did not occur by chance, a t-Test is performed. The t-Test examines the mean number of injuries from both samples (time periods) and determines if the mean injury rates are significantly different at a confidence level. At the 95% confidence level, the *t-Test: Paired Sample for Means* table shows that the P (T<=t) two-tail value is 0.0249.

After comparing the means, maximum, and minimum injuries from '02-'06 to '07-'11, it can be seen that all values have increased from one time period to the next.

Tables 4.4 Elbow/Forearm Sprains (2002-2011)

Elbow/Forearm Sprains (2002-2011)	
Year	Incidents
2002	2
2003	2
2004	3
2005	1
2006	2
2007	5
2008	4
2009	2
2010	2
2011	2

Descriptive Statistics ('02-'06)	
Sum	10
Mean	2
Max	3
Min	1
Range	2
Mode	2

Correlation ('02-'06)		
	Year	*Incidents*
Year	1	
Incidents	-0.2236	1

Descriptive Statistics ('07-'11)	
Sum	15
Mean	3
Max	5
Min	2
Range	3
Mode	2

Correlation ('07-'11)		
	Year	*Incidents*
Year	1	
Incidents	-0.8944	1

Descriptive Statistics ('02-'11)	
Sum	25
Mean	2.5
Max	5
Min	1
Range	4
Mode	2

Correlation ('02-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.1090	1

t-Test: Paired Two Sample for Means		
	2002-2006	*2007-2011*
Mean	2	3
Variance	0.5	2
Observations	5	5
Pearson Correlation	0	
Hypothesized Mean Difference	0	
df	4	
t Stat	-1.4142	
P(T<=t) one-tail	0.1151	
t Critical one-tail	2.1318	
P(T<=t) two-tail	0.2302	
t Critical two-tail	2.7764	

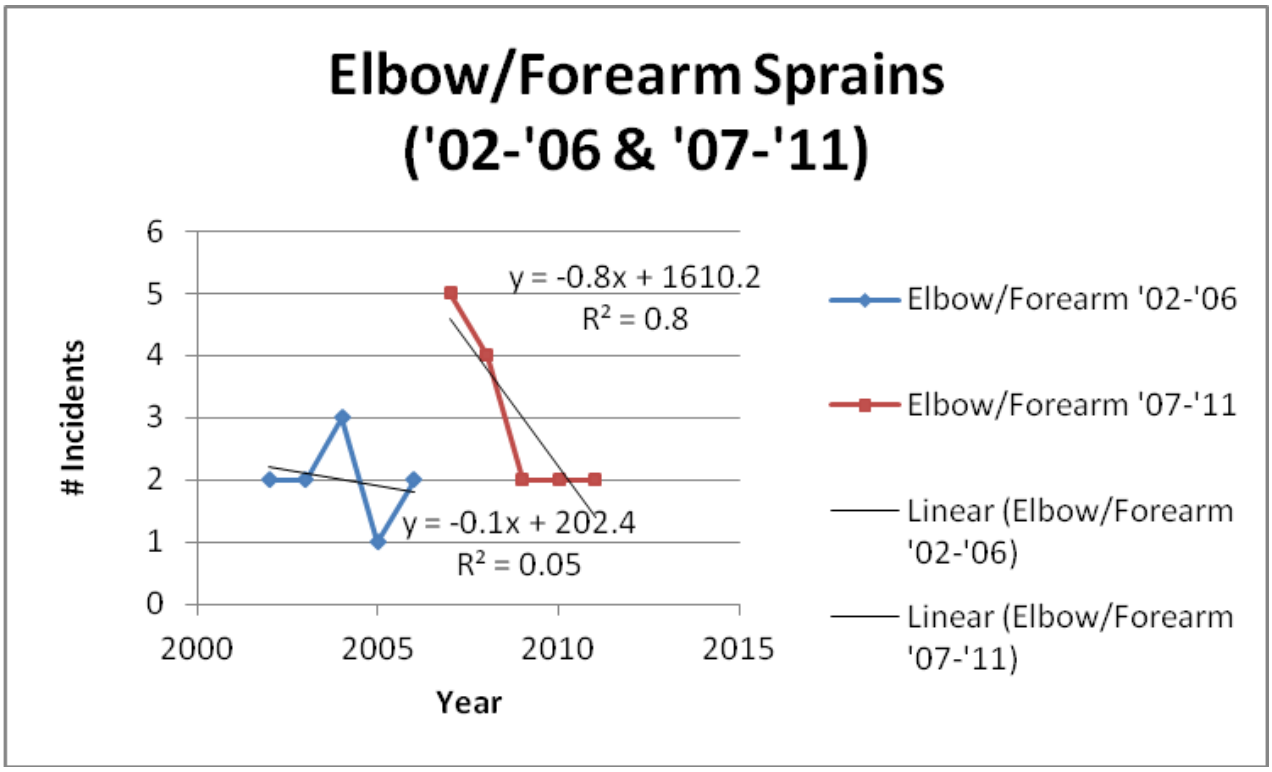

Fig. 4.4a Elbow/Forearm Sprains (’02-’06 & ’07-‘11)

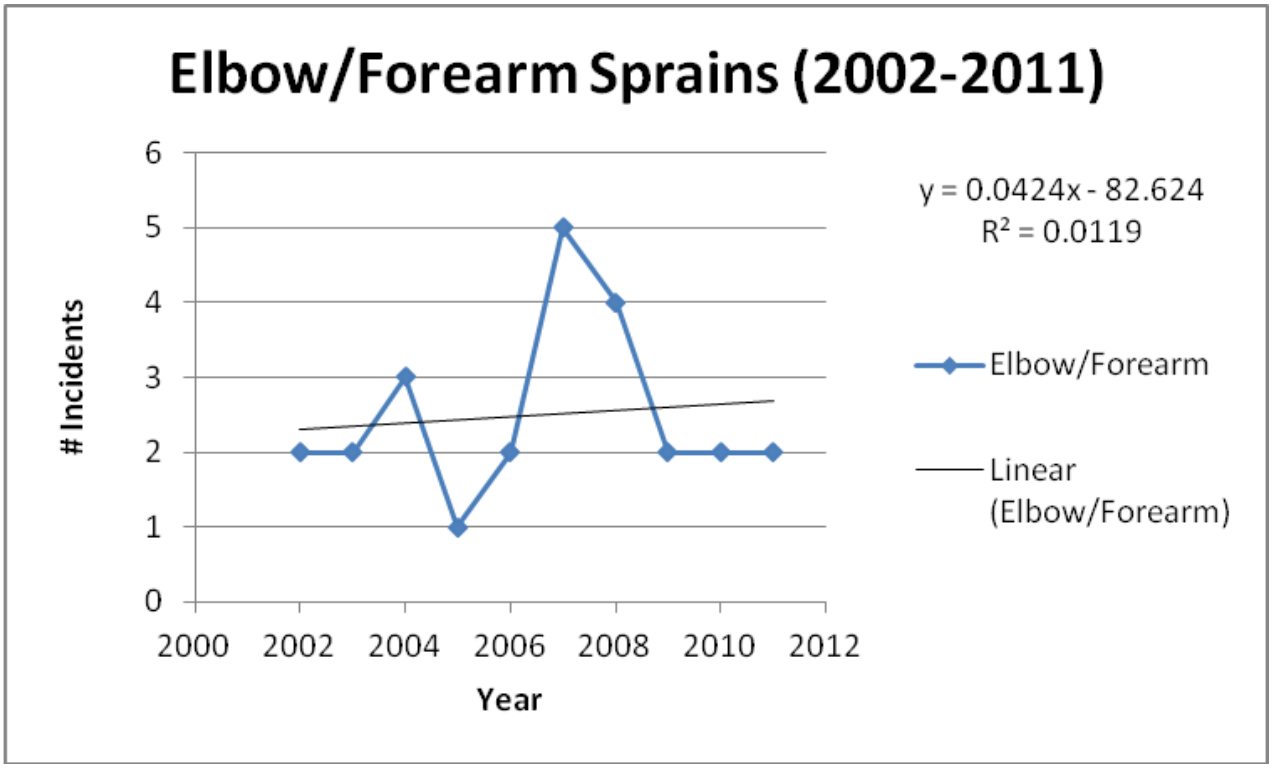

Fig. 4.4b Elbow/Forearm Sprains (2002-2011)

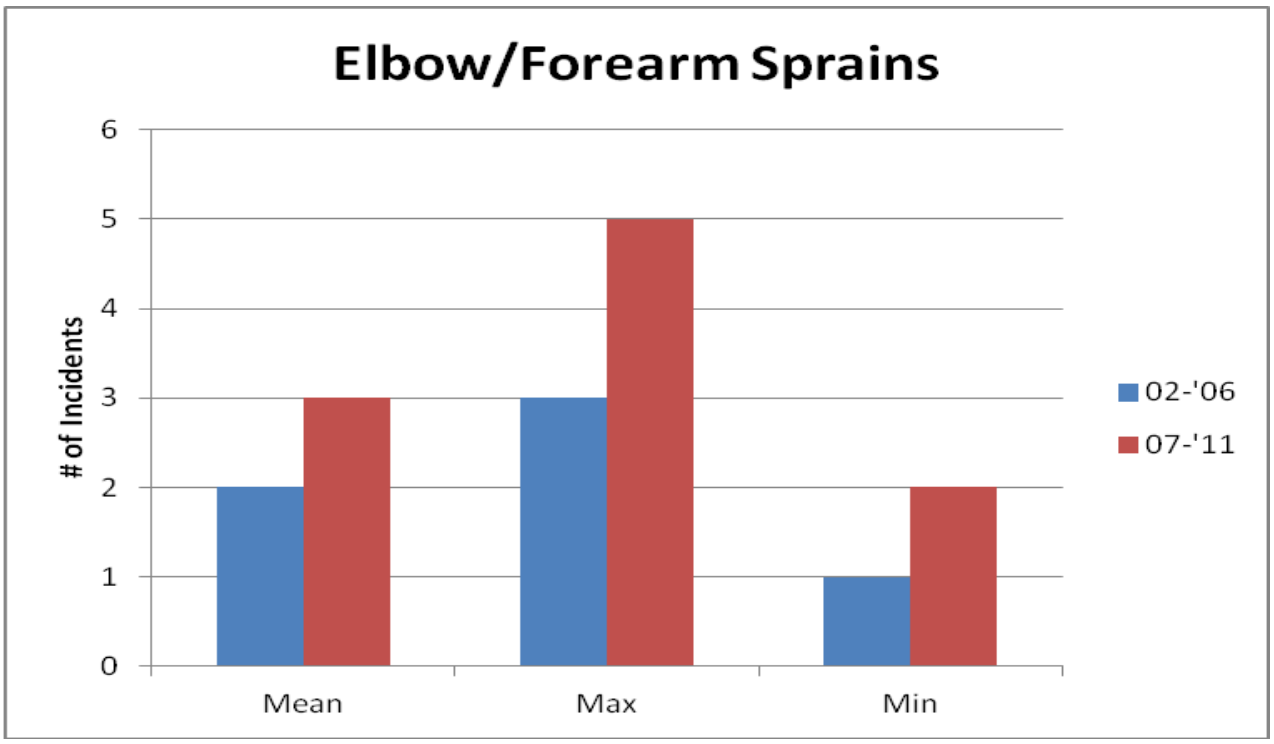

Fig. 4.4c Elbow/Forearm Sprains Rates (2002-2011)

Tables 4.4 Elbow/Forearm Sprains (2002-2011) display all elbow and/or forearm sprains that were recorded on the OSHA 300 logs from 2002 to 2011. Each *Correlation* table provides a Pearson's value, a positive or negative number suggesting an increase or decrease of incidents over time. The Pearson's value for '02-'06 of -0.2236 suggests a weak negative correlation, '07-'11 of -0.8944 suggests a strong negative correlation, and '02-'11 of 0.1090 suggests an overall weak positive correlation. These relationships can be seen graphically in Fig. 4.4a & Fig. 4.4b.

To confirm the significance of the medium positive relationship from '02-'11 and that the positive correlation did not occur by chance, a t-Test is performed. The t-Test examines the mean number of injuries from both samples (time periods) and determines if the mean injury rates are significantly different at a confidence level. At the 95% confidence level, the *t-Test: Paired Sample for Means* table shows that the P (T<=t) two-tail value is 0.2302.

After comparing the means, maximum, and minimum injuries from '02-'06 to '07-'11, it can be seen that all values have increased from one time period to the next.

Tables 4.5 Hand/Wrist Sprains (2002-2011)

Hand/Wrist Sprains (2002-2011)	
Year	Incidents
2002	1
2003	4
2004	4
2005	0
2006	2
2007	3
2008	4
2009	3
2010	4
2011	1

Descriptive Statistics ('02-'06)	
Sum	11
Mean	2.2
Max	4
Min	0
Range	4
Mode	4

Correlation ('02-'06)		
	Year	*Incidents*
Year	1	
Incidents	-0.1768	1

Descriptive Statistics ('07-'11)	
Sum	15
Mean	3
Max	4
Min	1
Range	3
Mode	3

Correlation ('07-'11)		
	Year	*Incidents*
Year	1	
Incidents	-0.5164	1

Descriptive Statistics ('02-'11)	
Sum	26
Mean	2.6
Max	4
Min	0
Range	4
Mode	4

Correlation ('02-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.0975	1

t-Test: Paired Two Sample for Means		
	2002-2006	*2007-2011*
Mean	2.2	3
Variance	3.2	1.5
Observations	5	5
Pearson Correlation	0	
Hypothesized Mean Difference	0	
df	4	
t Stat	-0.8251	
P(T<=t) one-tail	0.2278	
t Critical one-tail	2.1318	
P(T<=t) two-tail	0.4557	
t Critical two-tail	2.7764	

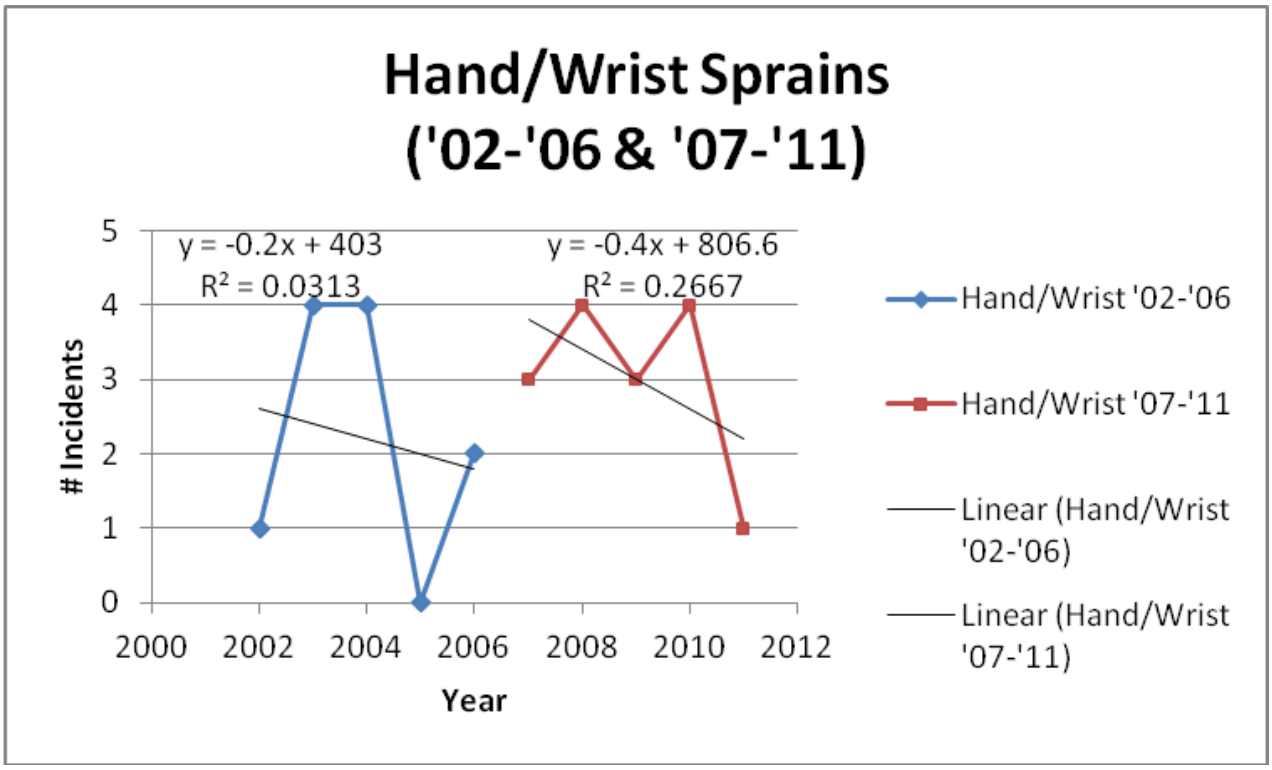

Fig. 4.5a Hand/Wrist Sprains (’02-’06 & ’07-‘11)

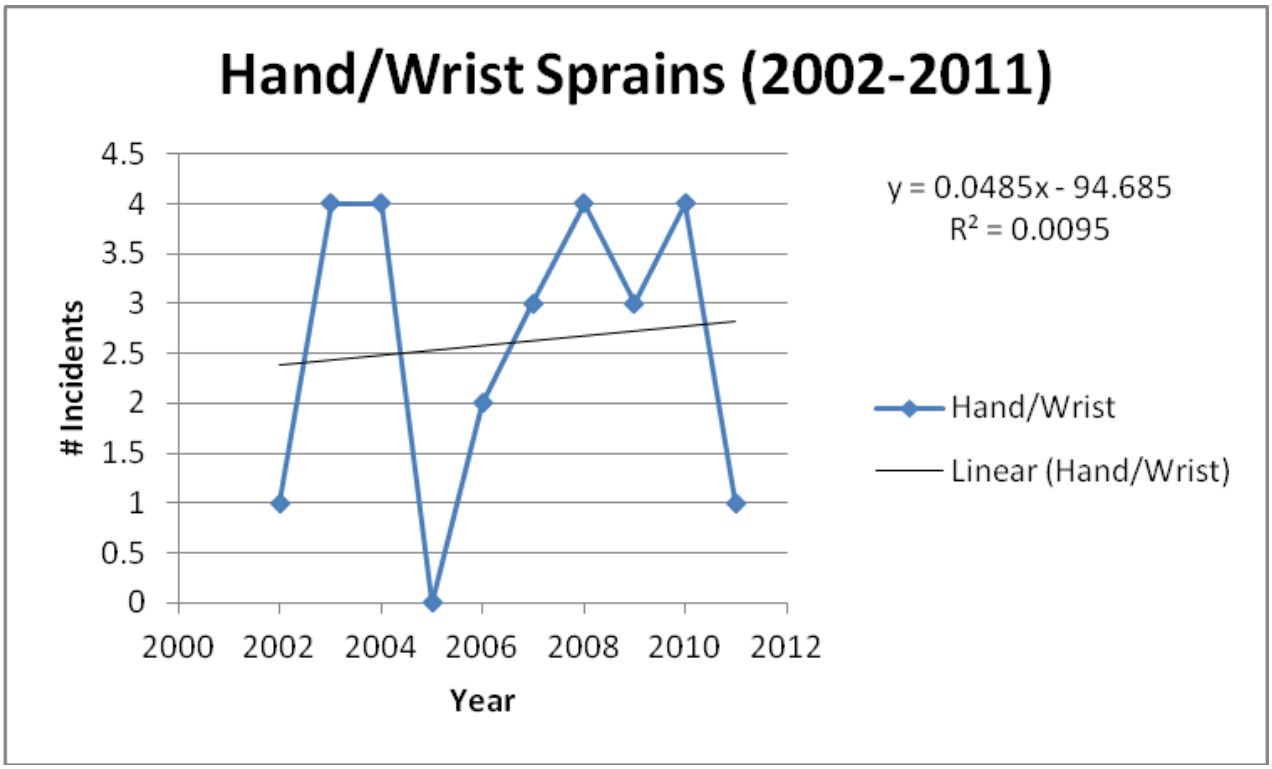

Fig. 4.5b Hand/Wrist Sprains (2002-2011)

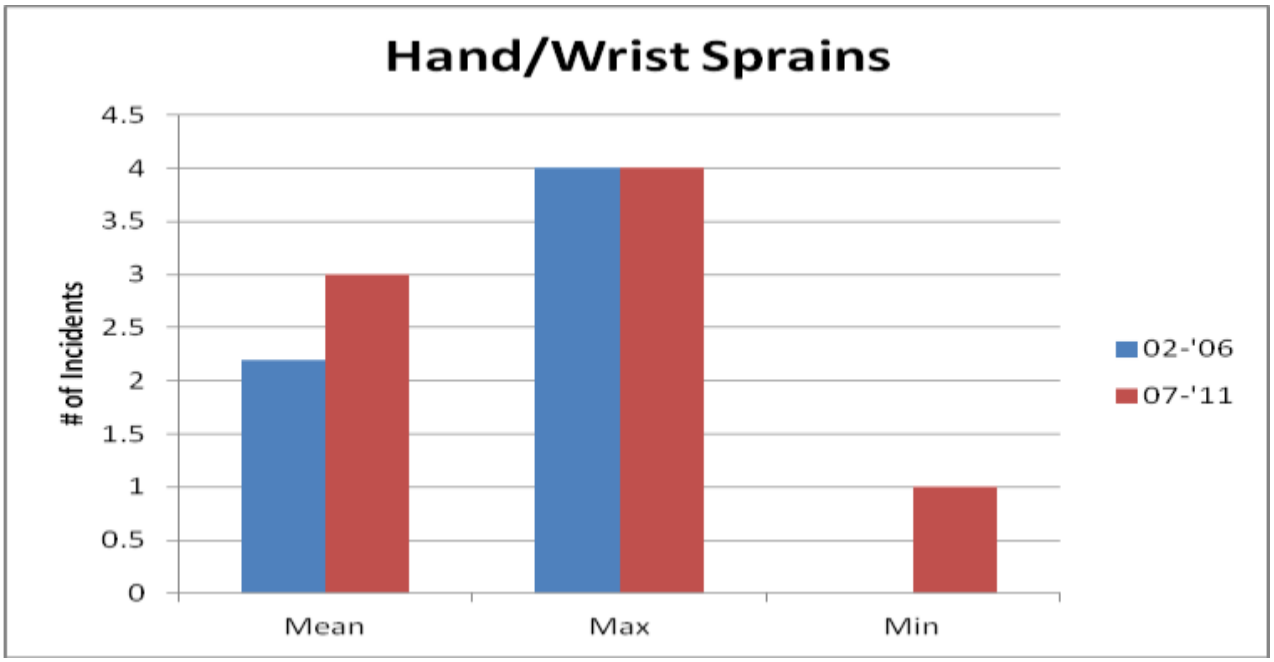

Fig. 4.5c Hand/Wrist Sprains Rates (2002-2011)

Tables 4.5 Hand/Wrist Sprains (2002-2011) display all hand and/or wrist sprains that were recorded on the OSHA 300 logs from 2002 to 2011. Each *Correlation* table provides a Pearson's value, a positive or negative number suggesting an increase or decrease of incidents over time. The Pearson's value for '02-'06 of -0.1768 suggests a weak negative correlation, '07-'11 of -0.5164 suggests a medium negative correlation, and '02-'11 of 0.0975 suggests an overall weak positive correlation. These relationships can be seen graphically in Fig. 4.5a & Fig. 4.5b.

To confirm the significance of the medium positive relationship from '02-'11 and that the positive correlation did not occur by chance, a t-Test is performed. The t-Test examines the mean number of injuries from both samples (time periods) and determines if the mean injury rates are significantly different at a confidence level. At the 95% confidence level, the *t-Test: Paired Sample for Means* table shows that the P (T<=t) two-tail value is 0.4557.

After comparing the means, maximum, and minimum injuries from '02-'06 to '07-'11, it can be seen that all values have increased or unchanged from one time period to the next.

Tables 4.6 Knee/Thigh Sprains (2002-2011)

Knee/Thigh Sprains (2002-2011)	
Year	Incidents
2002	1
2003	0
2004	2
2005	3
2006	3
2007	3
2008	3
2009	2
2010	2
2011	2

Descriptive Statistics ('02-'06)	
Sum	9
Mean	1.8
Max	3
Min	0
Range	3
Mode	3

Correlation ('02-'06)		
	Year	*Incidents*
Year	1	
Incidents	0.8489	1

Descriptive Statistics ('07-'11)	
Sum	12
Mean	2.4
Max	3
Min	2
Range	1
Mode	2

Correlation ('07-'11)		
	Year	*Incidents*
Year	1	
Incidents	-0.8660	1

Descriptive Statistics ('02-'11)	
Sum	21
Mean	2.1
Max	3
Min	0
Range	3
Mode	2

Correlation ('02-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.4244	1

t-Test: Paired Two Sample for Means		
	2002-2006	*2007-2011*
Mean	1.8	2.4
Variance	1.7	0.3
Observations	5	5
Pearson Correlation	-0.9102	
Hypothesized Mean Difference	0	
df	4	
t Stat	-0.7385	
P(T<=t) one-tail	0.2506	
t Critical one-tail	2.1318	
P(T<=t) two-tail	0.5012	
t Critical two-tail	2.7764	

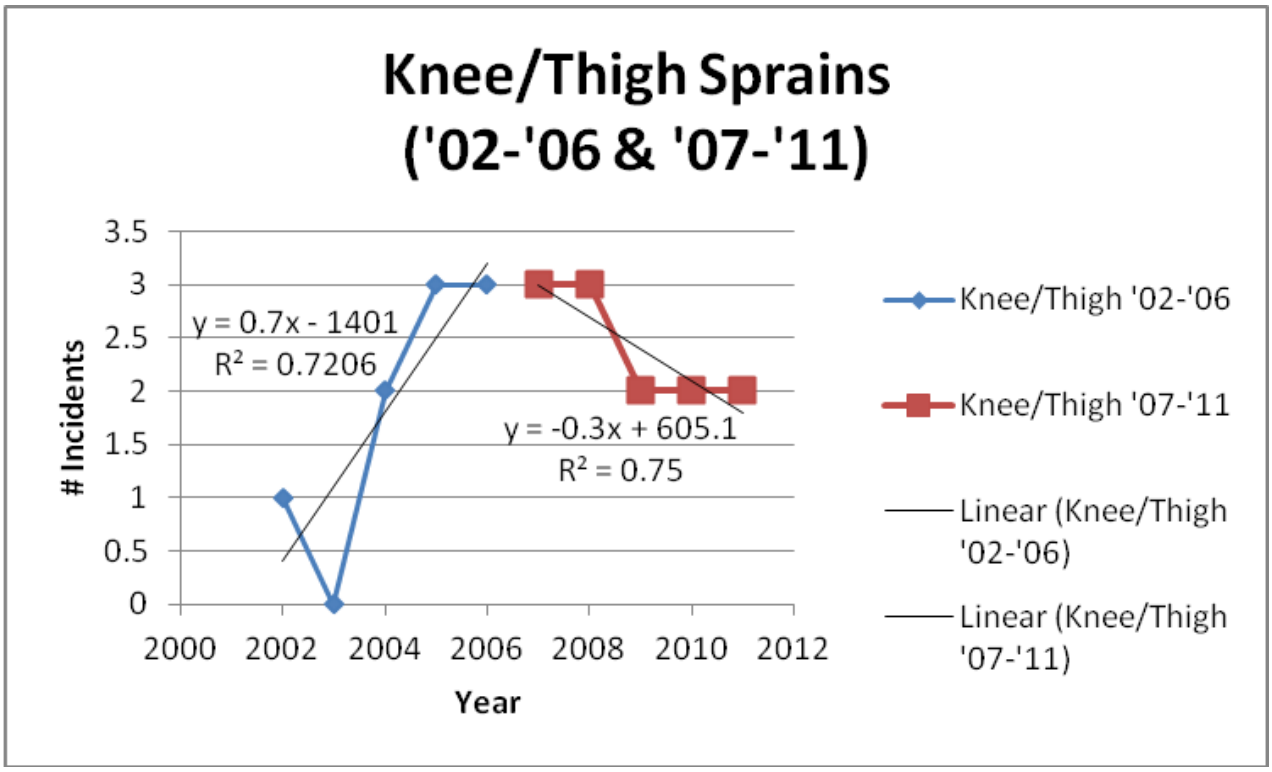

Fig. 4.6a Knee/Thigh Sprains (’02-’06 & ’07-‘11)

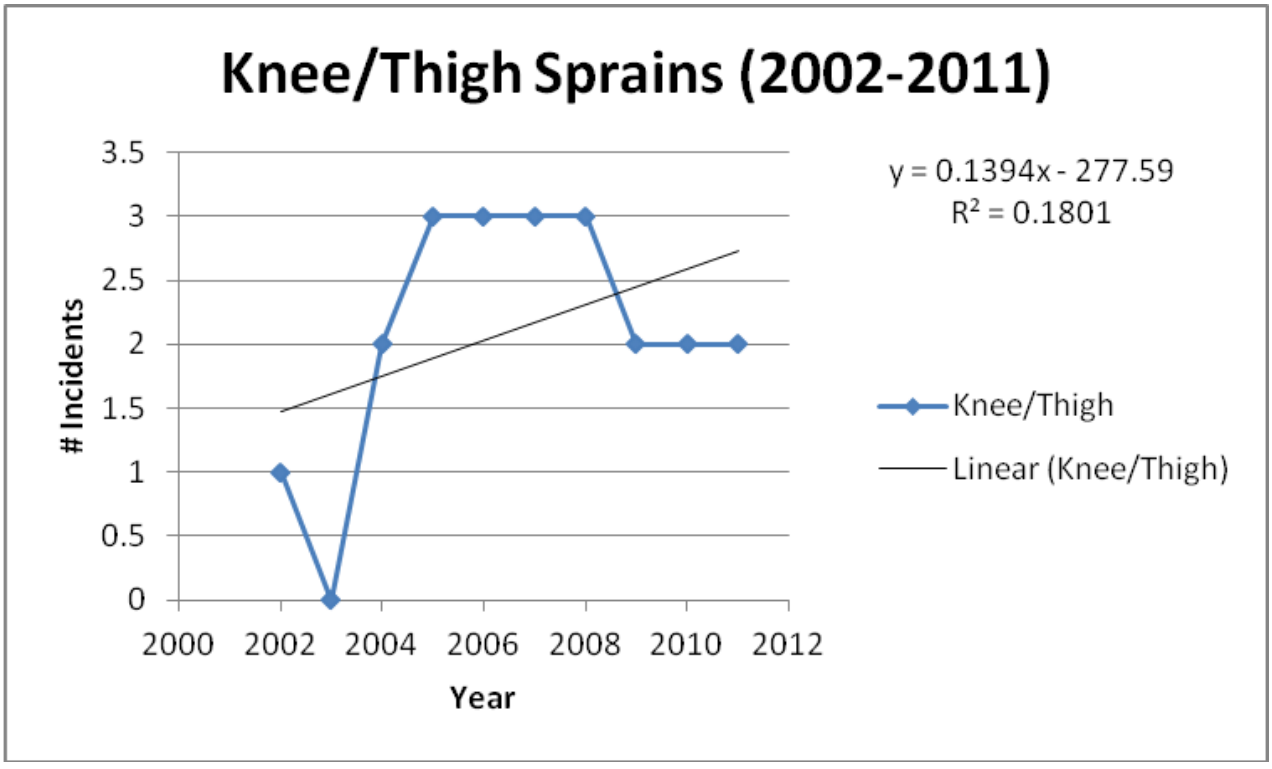

Fig. 4.6b Knee/Thigh Sprains (2002-2011)

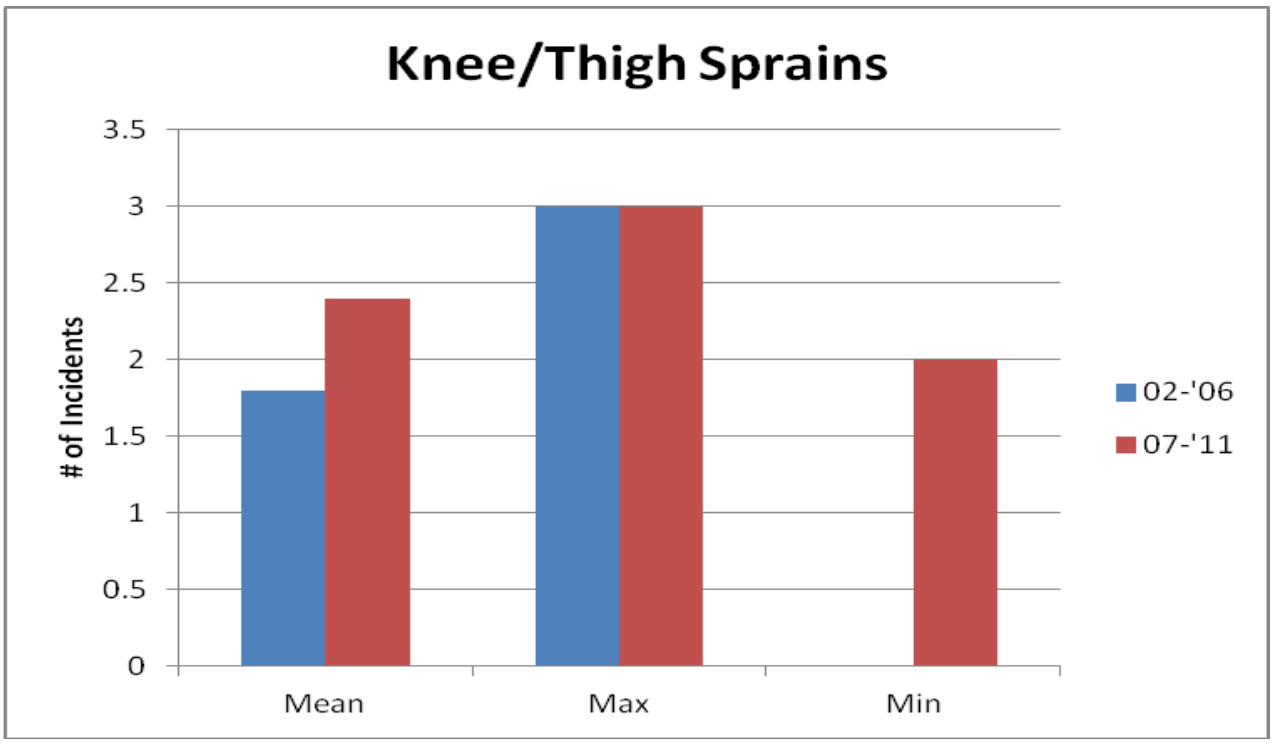

Fig. 4.6c Knee/Thigh Sprains Rates (2002-2011)

Tables 4.6 Knee/Thigh Sprains (2002-2011) display all knee and/or thigh sprains that were recorded on the OSHA 300 logs from 2002 to 2011. Each *Correlation* table provides a Pearson's value, a positive or negative number suggesting an increase or decrease of incidents over time. The Pearson's value for '02-'06 of 0.8489 suggests a strong positive correlation, '07-'11 of -0.8660 suggests a strong negative correlation, and '02-'11 of 0.4244 suggests an overall medium positive correlation. These relationships can be seen graphically in Fig. 4.6a & Fig. 4.6b.

To confirm the significance of the medium positive relationship from '02-'11 and that the positive correlation did not occur by chance, a t-Test is performed. The t-Test examines the mean number of injuries from both samples (time periods) and determines if the mean injury rates are significantly different at a confidence level. At the 95% confidence level, the *t-Test: Paired Sample for Means* table shows that the P (T<=t) two-tail value is 0.5012.

After comparing the means, maximum, and minimum injuries from '02-'06 to '07-'11, it can be seen that all values have increased or unchanged from one time period to the next.

Tables 4.7 Foot/Ankle Sprains (2002-2011)

Foot/Ankle Sprains (2002-2011)	
Year	Incidents
2002	2
2003	1
2004	1
2005	1
2006	0
2007	1
2008	1
2009	1
2010	1
2011	0

Descriptive Statistics ('02-'06)	
Sum	5
Mean	1
Max	2
Min	0
Range	2
Mode	1

Correlation ('02-'06)		
	Year	*Incidents*
Year	1	
Incidents	-0.8944	1

Descriptive Statistics ('07-'11)	
Sum	4
Mean	0.8
Max	1
Min	0
Range	1
Mode	1

Correlation ('07-'11)		
	Year	*Incidents*
Year	1	
Incidents	-0.7071	1

Descriptive Statistics ('02-'11)	
Sum	9
Mean	0.9
Max	2
Min	0
Range	2
Mode	1

Correlation ('02-'11)		
	Year	*Incidents*
Year	1	
Incidents	-0.5495	1

t-Test: Paired Two Sample for Means		
	2002-2006	*2007-2011*
Mean	1	0.8
Variance	0.5	0.2
Observations	5	5
Pearson Correlation	0.7906	
Hypothesized Mean Difference	0	
df	4	
t Stat	1.0000	
P(T<=t) one-tail	0.1870	
t Critical one-tail	2.1318	
P(T<=t) two-tail	0.3739	
t Critical two-tail	2.7764	

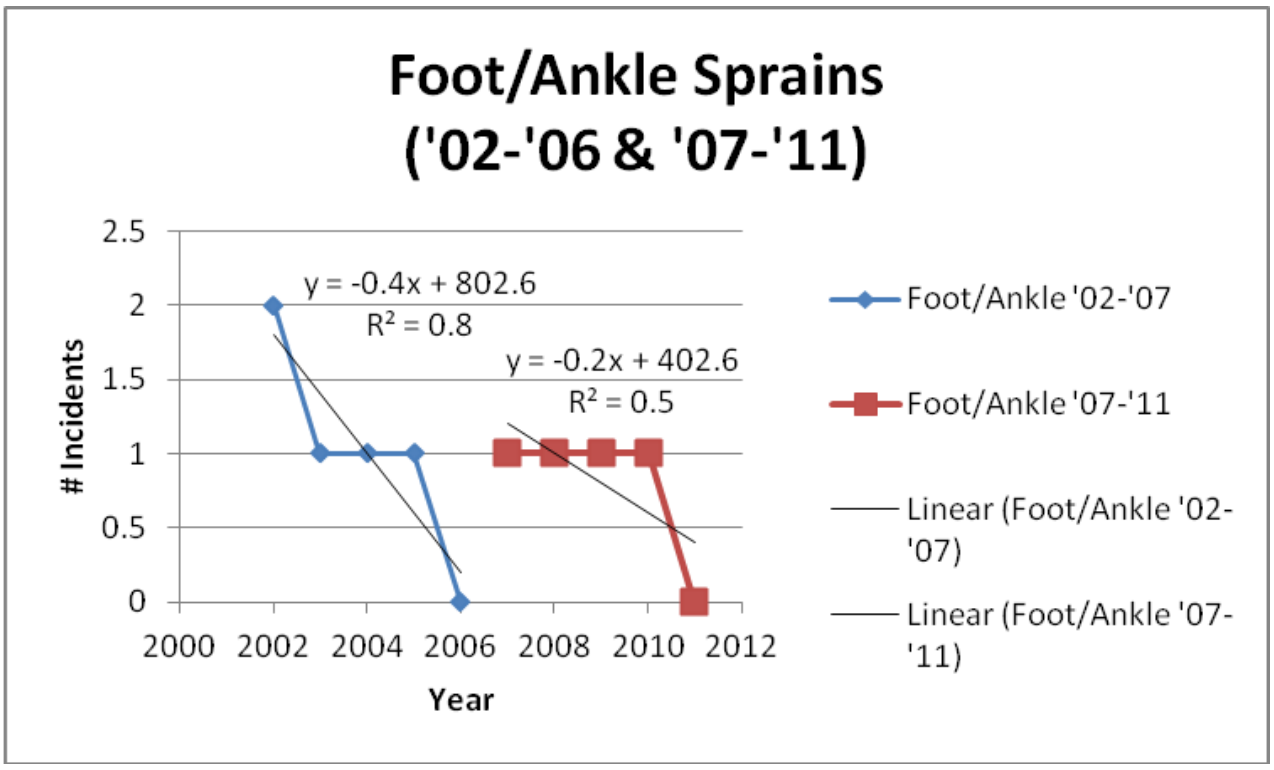

Fig. 4.7a Foot/Ankle Sprains ('02-'06 & '07-'11)

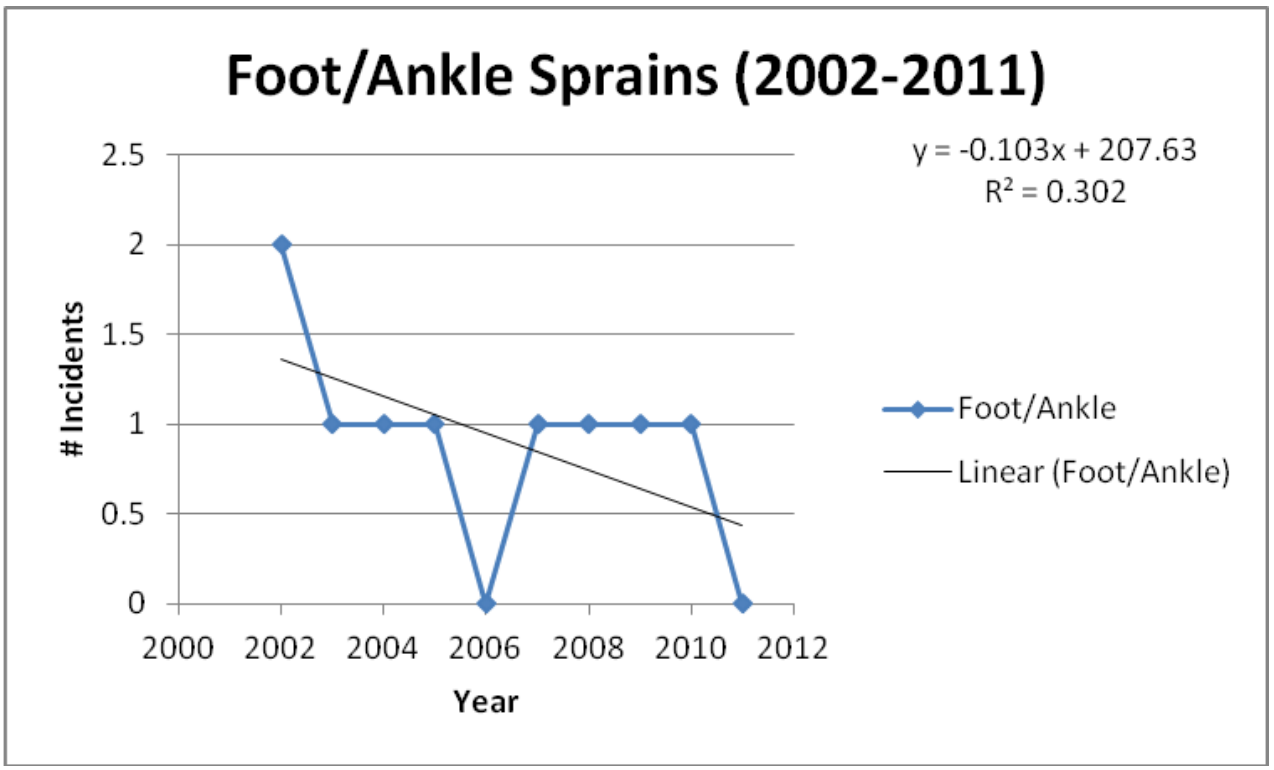

Fig. 4.7b Foot/Ankle Sprains (2002-2011)

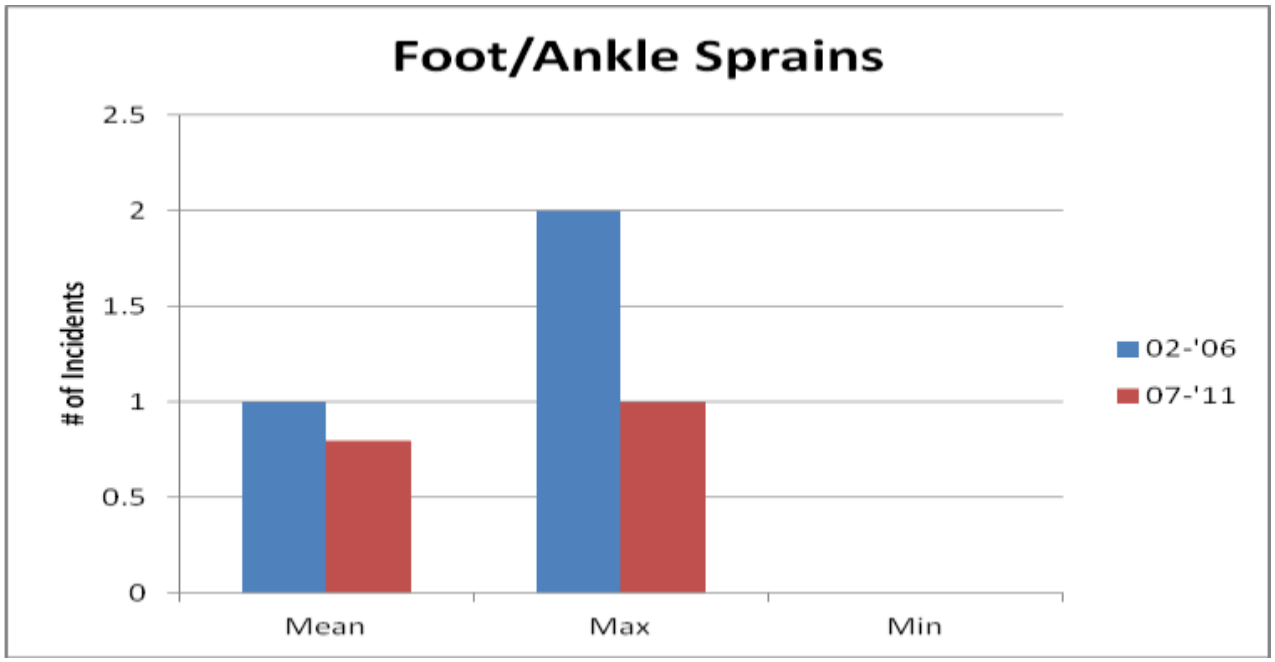

Fig. 4.7c Foot/Ankle Sprains Rates (2002-2011)

Tables 4.7 Foot/Ankle Sprains (2002-2011) display all foot and/or ankle sprains that were recorded on the OSHA 300 logs from 2002 to 2011. Each *Correlation* table provides a Pearson's value, a positive or negative number suggesting an increase or decrease of incidents over time. The Pearson's value for '02-'06 of -0.8944 suggests a strong negative correlation, '07-'11 of -0.7071 suggests a strong negative correlation, and '02-'11 of -0.5495 suggests an overall medium negative correlation. These relationships can be seen graphically in Fig. 4.7a & Fig. 4.7b.

To confirm the significance of the medium positive relationship from '02-'11 and that the positive correlation did not occur by chance, a t-Test is performed. The t-Test examines the mean number of injuries from both samples (time periods) and determines if the mean injury rates are significantly different at a confidence level. At the 95% confidence level, the *t-Test: Paired Sample for Means* table shows that the P (T<=t) two-tail value is 0.3739.

After comparing the means, maximum, and minimum injuries from '02-'06 to '07-'11, it can be seen that all values have decreased or unchanged from one time period to the next.

Tables 4.8 Shoulder Repetitive Injuries (2002-2011)

Shoulder Repetitive (2002-2011)	
Year	Incidents
2002	0
2003	0
2004	0
2005	0
2006	1
2007	2
2008	3
2009	4
2010	0
2011	2

Descriptive Statistics ('02-'06)	
Sum	1
Mean	0.2
Max	1
Min	0
Range	1
Mode	0

Correlation ('02-'06)		
	Year	*Incidents*
Year	1	
Incidents	0.7071	1

Descriptive Statistics ('07-'11)	
Sum	11
Mean	2.2
Max	4
Min	0
Range	4
Mode	2

Correlation ('07-'11)		
	Year	*Incidents*
Year	1	
Incidents	-0.3198	1

Descriptive Statistics ('02-'11)	
Sum	12
Mean	1.2
Max	4
Min	0
Range	4
Mode	0

Correlation ('02-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.5968	1

t-Test: Paired Two Sample for Means		
	2002-2006	*2007-2011*
Mean	0.2	2.2
Variance	0.2	2.2
Observations	5	5
Pearson Correlation	-0.0754	
Hypothesized Mean Difference	0	
df	4	
t Stat	-2.8284	
P(T<=t) one-tail	0.0237	
t Critical one-tail	2.1318	
P(T<=t) two-tail	0.0474	
t Critical two-tail	2.7764	

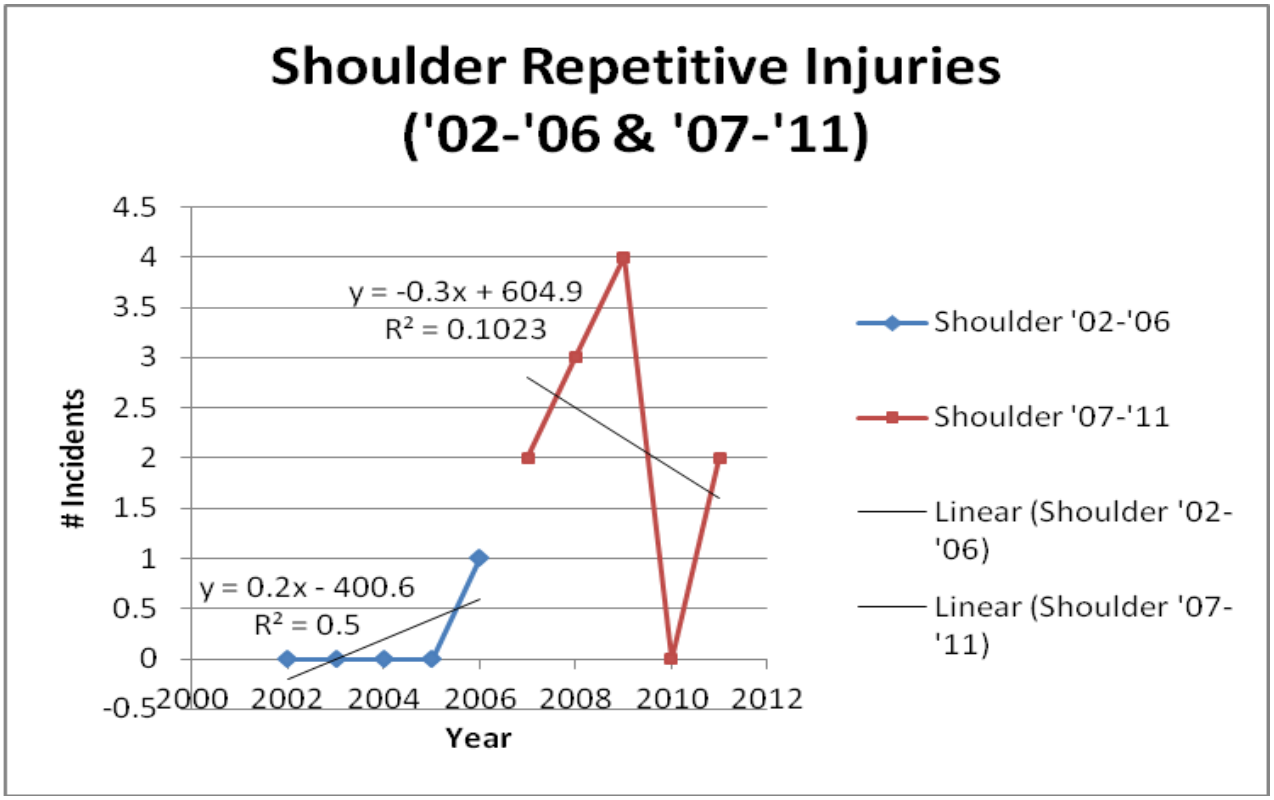

Fig. 4.8a Shoulder Repetitive Injuries (’02-’06 & ’07-‘11)

Fig. 4.8b Shoulder Repetitive Injuries (2002-2011)

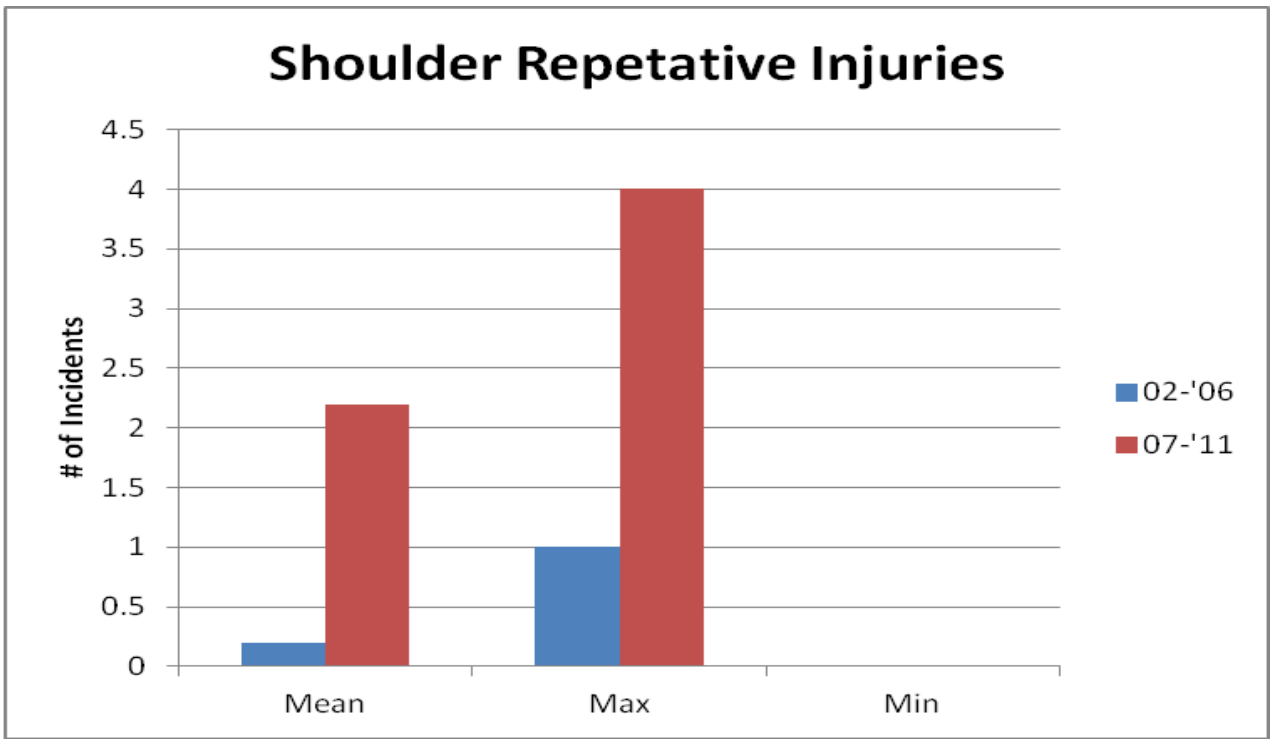

Fig. 4.8c Shoulder Repetitive Injuries Rates (2002-2011)

Tables 4.8 Shoulder Repetitive Injuries (2002-2011) display all repetitive shoulder injuries that were recorded on the OSHA 300 logs from 2002 to 2011. Each *Correlation* table provides a Pearson's value, a positive or negative number suggesting an increase or decrease of incidents over time. The Pearson's value for '02-'06 of 0.7071 suggests a strong positive correlation, '07-'11 of -0.3198 suggests a medium negative correlation, and '02-'11 of 0.5968 suggests an overall medium positive correlation. These relationships can be seen graphically in Fig. 4.8a & Fig. 4.8b.

To confirm the significance of the medium positive relationship from '02-'11 and that the positive correlation did not occur by chance, a t-Test is performed. The t-Test examines the mean number of injuries from both samples (time periods) and determines if the mean injury rates are significantly different at a confidence level. At the 95% confidence level, the *t-Test: Paired Sample for Means* table shows that the P (T<=t) two-tail value is 0.0474.

After comparing the means, maximum, and minimum injuries from '02-'06 to '07-'11, it can be seen that all values have increased or unchanged from one time period to the next.

Tables 4.9 Back Repetitive Injuries (2002-2011)

Back Repetitive (2002-2011)	
Year	Incidents
2002	0
2003	0
2004	0
2005	0
2006	1
2007	0
2008	0
2009	2
2010	0
2011	1

Descriptive Statistics ('02-'06)	
Sum	1
Mean	0.2
Max	1
Min	0
Range	1
Mode	0

Correlation ('02-'06)		
	Year	*Incidents*
Year	1	
Incidents	0.7071	1

Descriptive Statistics ('07-'11)	
Sum	3
Mean	0.6
Max	2
Min	0
Range	2
Mode	0

Correlation ('07-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.3536	1

Descriptive Statistics ('02-'11)	
Sum	4
Mean	0.4
Max	2
Min	0
Range	2
Mode	0

Correlation ('02-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.4724	1

t-Test: Paired Two Sample for Means		
	2002-2006	*2007-2011*
Mean	0.2	0.6
Variance	0.2	0.8
Observations	5	5
Pearson Correlation	0.25	
Hypothesized Mean Difference	0	
df	4	
t Stat	-1	
P(T<=t) one-tail	0.1870	
t Critical one-tail	2.1318	
P(T<=t) two-tail	0.3739	
t Critical two-tail	2.7764	

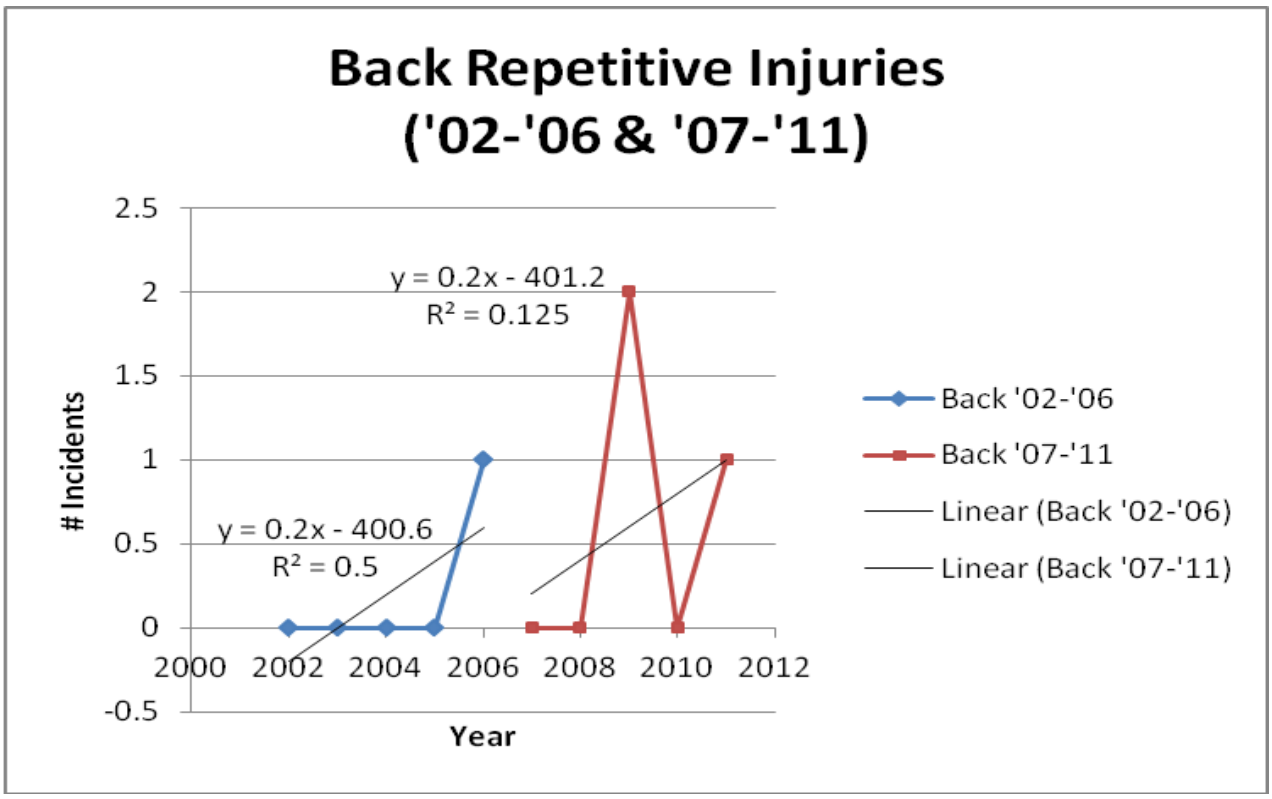

Fig. 4.9a Back Repetitive Injuries (’02-’06 & ’07-‘11)

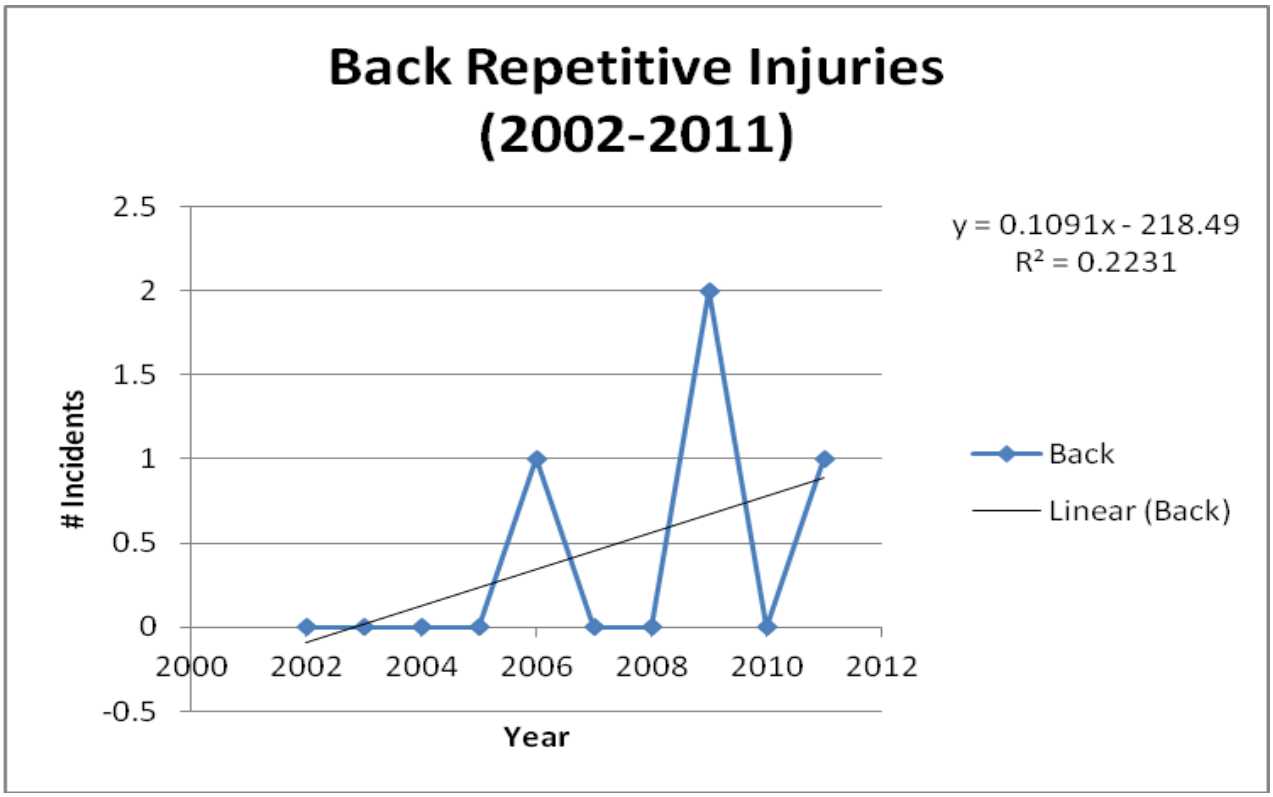

Fig. 4.9b Back Repetitive Injuries (2002-2011)

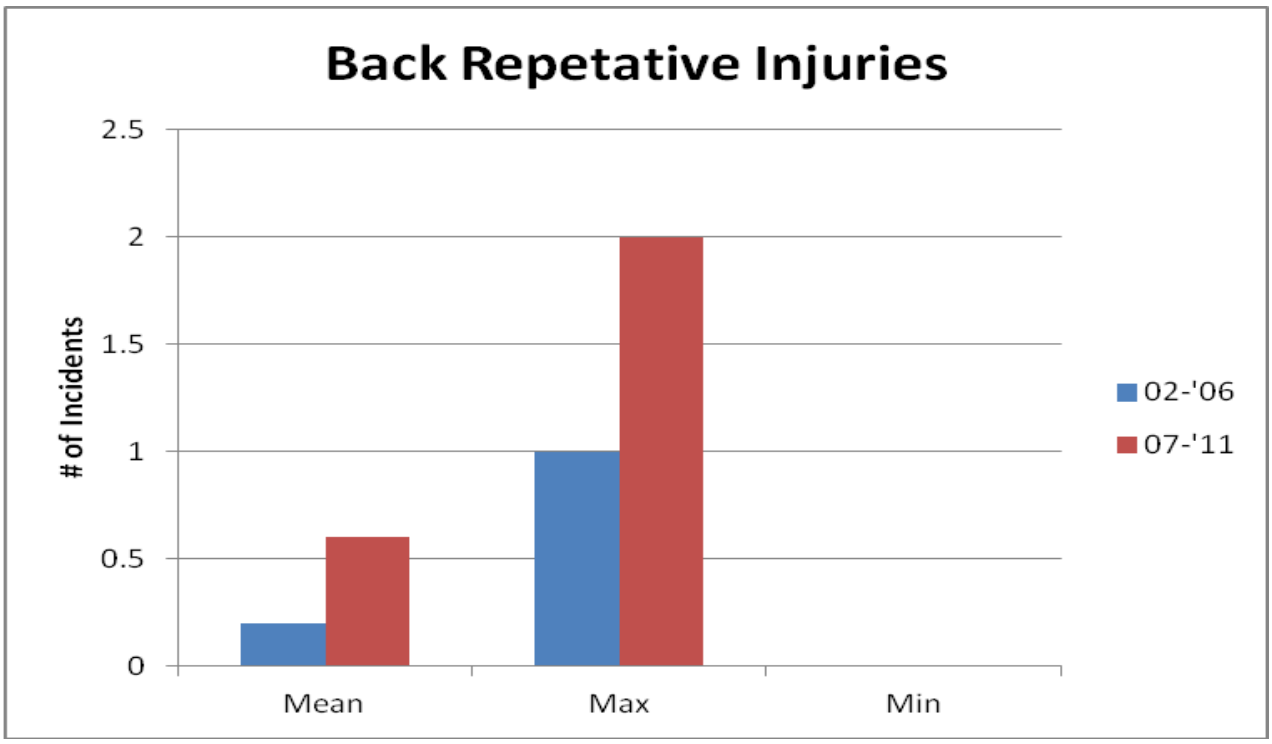

Fig. 4.9c Back Repetitive Injuries Rates (2002-2011)

Tables 4.9 Shoulder Repetitive Injuries (2002-2011) display all repetitive back injuries that were recorded on the OSHA 300 logs from 2002 to 2011. Each *Correlation* table provides a Pearson's value, a positive or negative number suggesting an increase or decrease of incidents over time. The Pearson's value for '02-'06 of 0.7071 suggests a strong positive correlation, '07-'11 of 0.3536 suggests a medium positive correlation, and '02-'11 of 0.4724 suggests an overall medium positive correlation. These relationships can be seen graphically in Fig. 4.9a & Fig. 4.9b.

To confirm the significance of the medium positive relationship from '02-'11 and that the positive correlation did not occur by chance, a t-Test is performed. The t-Test examines the mean number of injuries from both samples (time periods) and determines if the mean injury rates are significantly different at a confidence level. At the 95% confidence level, the *t-Test: Paired Sample for Means* table shows that the P (T<=t) two-tail value is 0.3739.

After comparing the means, maximum, and minimum injuries from '02-'06 to '07-'11, it can be seen that all values have increased or unchanged from one time period to the next.

Tables 4.10 Elbow/Forearm Repetitive Injuries (2002-2011)

Elbow/Forearm Repetitive (2002-2011)	
Year	Incidents
2002	1
2003	0
2004	0
2005	0
2006	3
2007	0
2008	1
2009	1
2010	0
2011	2

Descriptive Statistics ('02-'06)	
Sum	4
Mean	0.8
Max	3
Min	0
Range	3
Mode	0

Correlation ('02-'06)		
	Year	*Incidents*
Year	1	
Incidents	0.4851	1

Descriptive Statistics ('07-'11)	
Sum	4
Mean	0.8
Max	2
Min	0
Range	2
Mode	0

Correlation ('07-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.5669	1

Descriptive Statistics ('02-'11)	
Sum	8
Mean	0.8
Max	3
Min	0
Range	3
Mode	0

Correlation ('02-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.2487	1

t-Test: Paired Two Sample for Means		
	2002-2006	*2007-2011*
Mean	0.8	0.8
Variance	1.7	0.7
Observations	5	5
Pearson Correlation	0.6417	
Hypothesized Mean Difference	0	
df	4	
t Stat	0	
P(T<=t) one-tail	0.5	
t Critical one-tail	2.1318	
P(T<=t) two-tail	1	
t Critical two-tail	2.7764	

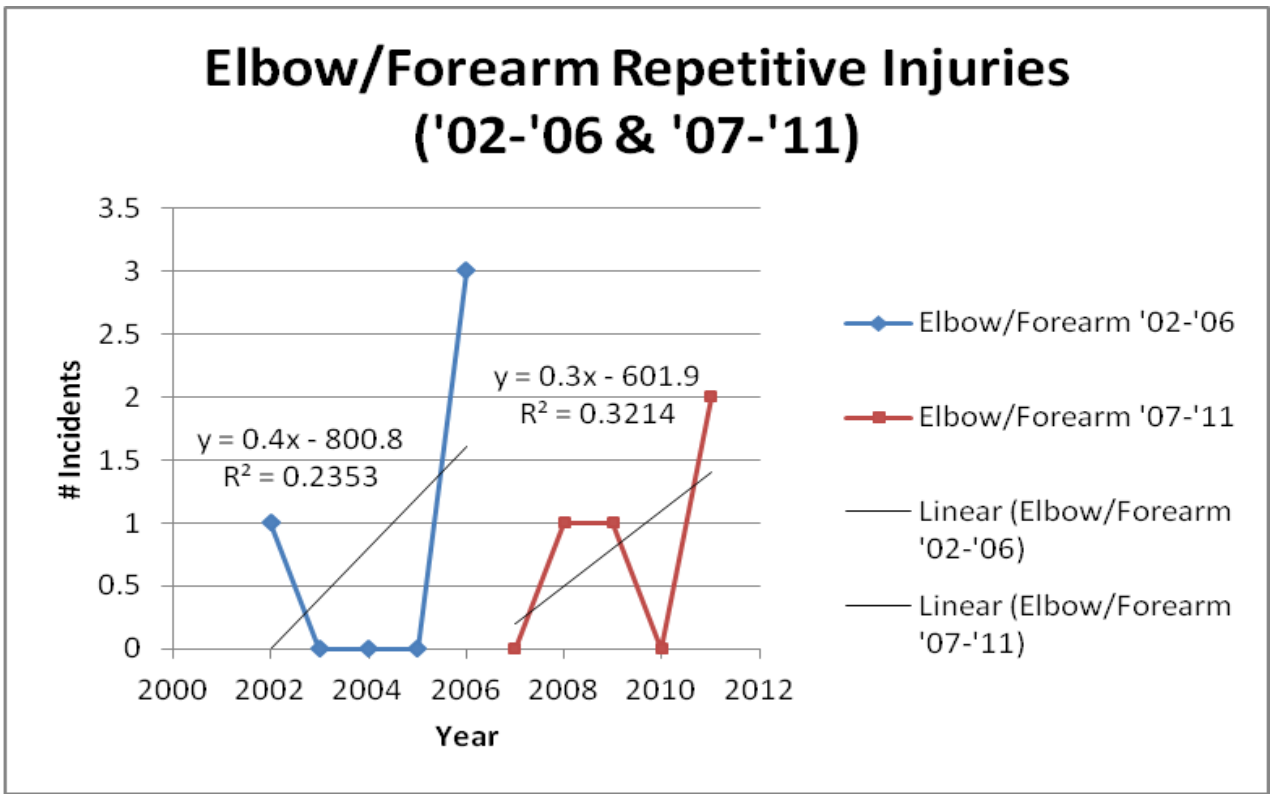

Fig. 4.10a Elbow/Forearm Repetitive Injuries (’02-’06 & ’07-‘11)

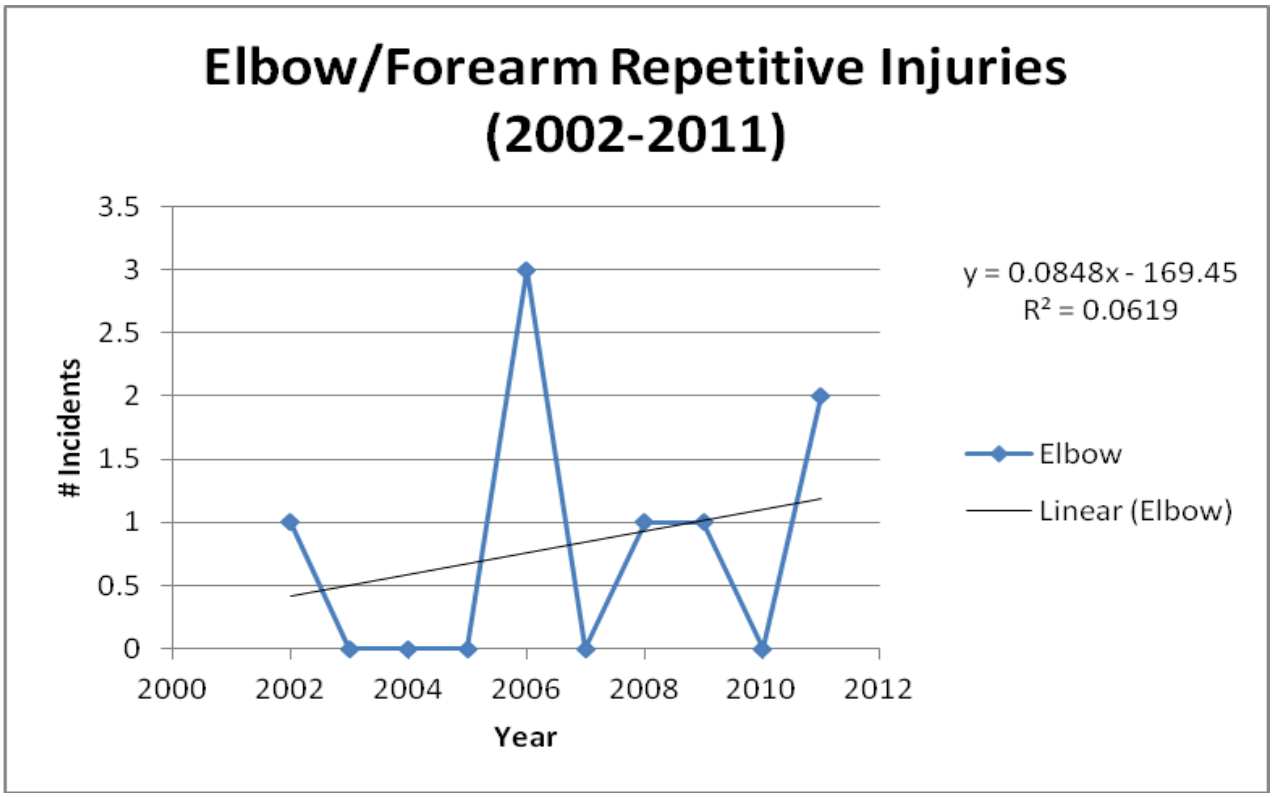

Fig. 4.10b Elbow/Forearm Repetitive Injuries (2002-2011)

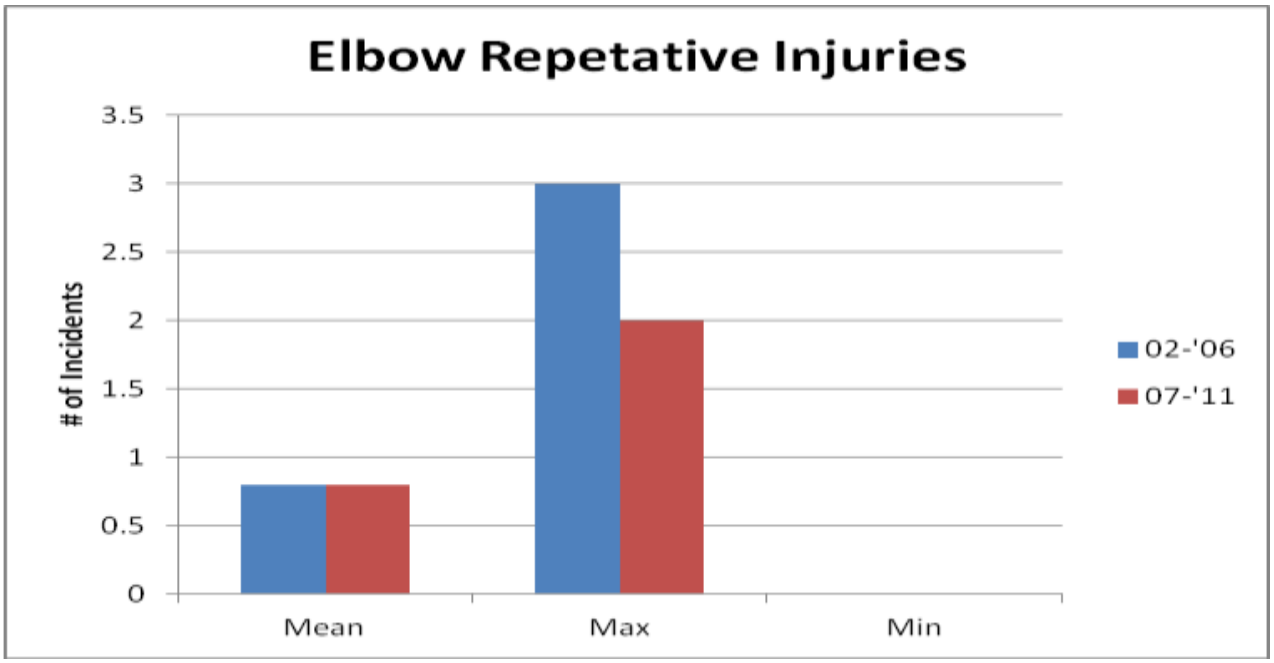

Fig. 4.10c Elbow/Forearm Repetitive Injuries Rates (2002-2011)

Tables 4.10 Elbow/Forearm Repetitive Injuries (2002-2011) display all repetitive elbow and/or forearm injuries that were recorded on the OSHA 300 logs from 2002 to 2011. Each *Correlation* table provides a Pearson's value, a positive or negative number suggesting an increase or decrease of incidents over time. The Pearson's value for '02-'06 of 0.4851 suggests a medium positive correlation, '07-'11 of 0.5669 suggests a medium positive correlation, and '02-'11 of 0.2487 suggests an overall weak positive correlation. These relationships can be seen graphically in Fig. 4.10a & Fig. 4.10b.

To confirm the significance of the medium positive relationship from '02-'11 and that the positive correlation did not occur by chance, a t-Test is performed. The t-Test examines the mean number of injuries from both samples (time periods) and determines if the mean injury rates are significantly different at a confidence level. At the 95% confidence level, the *t-Test: Paired Sample for Means* table shows that the P (T<=t) two-tail value is 1.

After comparing the means, maximum, and minimum injuries from '02-'06 to '07-'11, it can be seen that all values have decreased or unchanged from one time period to the next.

Tables 4.11 Hand/Wrist Repetitive Injuries (2002-2011)

Hand/Wrist Repetitive (2002-2011)	
Year	Incidents
2002	5
2003	6
2004	4
2005	2
2006	6
2007	4
2008	3
2009	1
2010	3
2011	1

Descriptive Statistics ('02-'06)	
Sum	23
Mean	4.6
Max	6
Min	2
Range	4
Mode	6

Correlation ('02-'06)		
	Year	*Incidents*
Year	1	
Incidents	-0.1890	1

Descriptive Statistics ('07-'11)	
Sum	12
Mean	2.4
Max	4
Min	1
Range	3
Mode	3

Correlation ('07-'11)		
	Year	*Incidents*
Year	1	
Incidents	-0.7071	1

Descriptive Statistics ('02-'11)	
Sum	35
Mean	3.5
Max	6
Min	1
Range	5
Mode	6

Correlation ('02-'11)		
	Year	*Incidents*
Year	1	
Incidents	-0.7077	1

t-Test: Paired Two Sample for Means		
	2002-2006	*2007-2011*
Mean	4.6	2.4
Variance	2.8	1.8
Observations	5	5
Pearson Correlation	-0.1336	
Hypothesized Mean Difference	0	
df	4	
t Stat	2.1573	
P(T<=t) one-tail	0.0486	
t Critical one-tail	2.1318	
P(T<=t) two-tail	0.0972	
t Critical two-tail	2.7764	

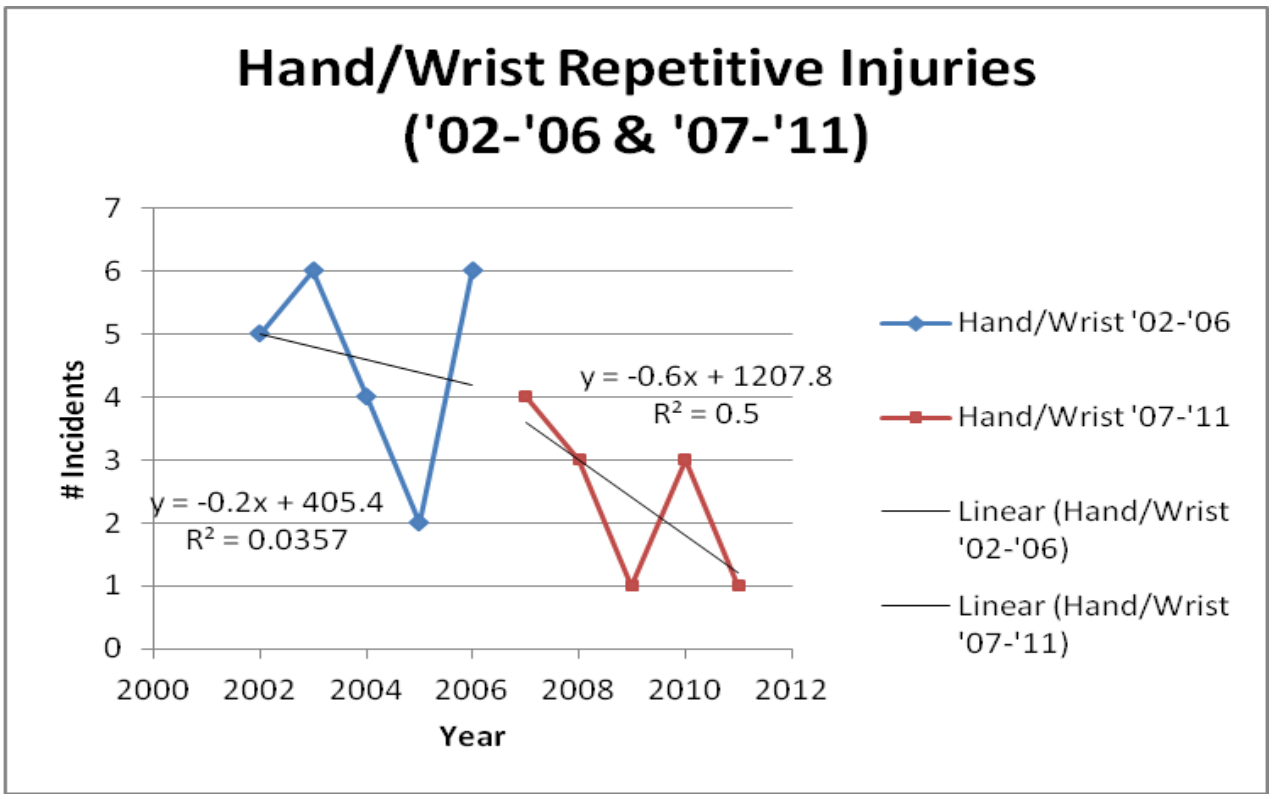

Fig. 4.11a Hand/Wrist Repetitive (’02-’06 & ’07-‘11)

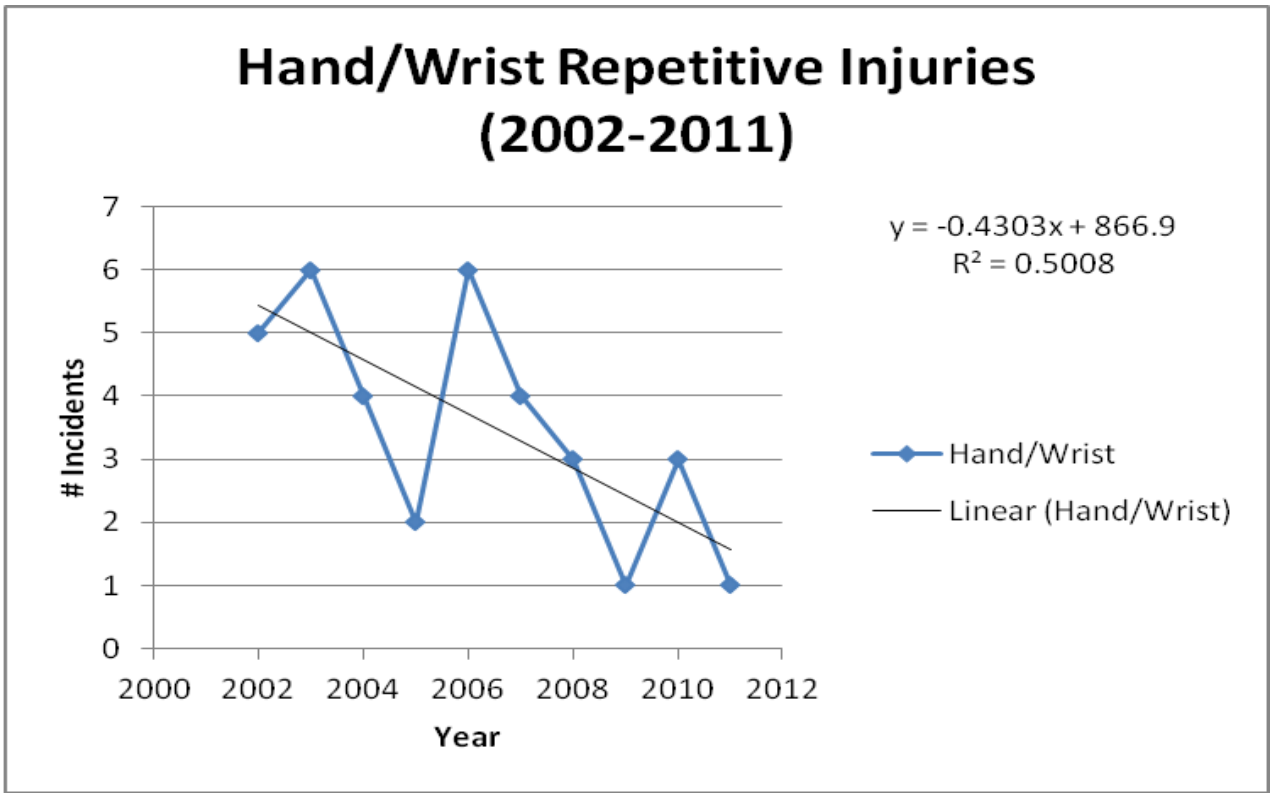

Fig. 4.11b Hand/Wrist Repetitive Injuries (2002-2011)

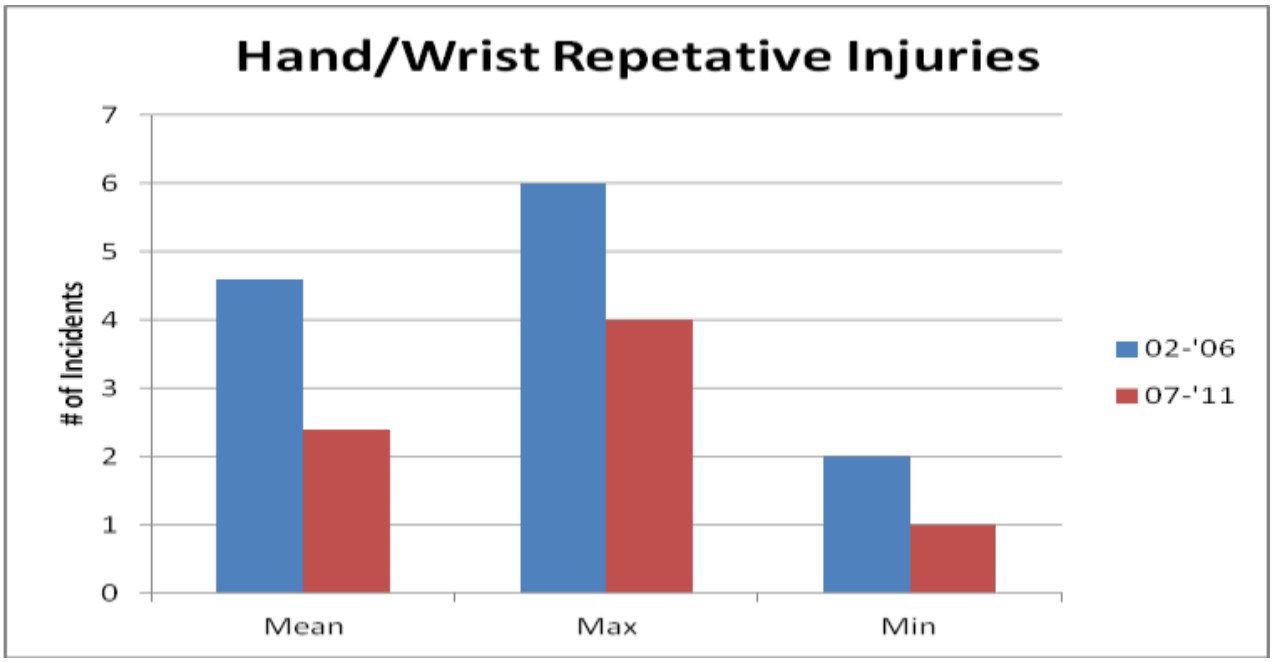

Fig. 4.11c Hand/Wrist Repetitive Injuries Rates (2002-2011)

Tables 4.11 Hand/Wrist Repetitive Injuries (2002-2011) display all repetitive hand and/or wrist injuries that were recorded on the OSHA 300 logs from 2002 to 2011. Each *Correlation* table provides a Pearson's value, a positive or negative number suggesting an increase or decrease of incidents over time. The Pearson's value for '02-'06 of -0.1890 suggests a weak negative correlation, '07-'11 of -0.7071 suggests a strong negative correlation, and '02-'11 of -0.7077 suggests an overall strong negative correlation. These relationships can be seen graphically in Fig. 4.11a & Fig. 4.11b.

To confirm the significance of the medium positive relationship from '02-'11 and that the positive correlation did not occur by chance, a t-Test is performed. The t-Test examines the mean number of injuries from both samples (time periods) and determines if the mean injury rates are significantly different at a confidence level. At the 95% confidence level, the *t-Test: Paired Sample for Means* table shows that the P (T<=t) two-tail value is 0.0972.

After comparing the means, maximum, and minimum injuries from '02-'06 to '07-'11, it can be seen that all values have decreased from one time period to the next.

Tables 4.12 Warehouse Employees Physical Injuries (2002-2011)

Warehouse Employee (2002-2011)	
Year	Incidents
2002	5
2003	14
2004	11
2005	8
2006	7
2007	14
2008	10
2009	15
2010	14
2011	10

Descriptive Statistics ('02-'06)	
Sum	45
Mean	9
Max	14
Min	5
Range	9
Mode	#N/A

Correlation ('02-'06)		
	Year	*Incidents*
Year	1	
Incidents	-0.0894	1

Descriptive Statistics ('07-'11)	
Sum	63
Mean	12.6
Max	15
Min	10
Range	5
Mode	14

Correlation ('07-'11)		
	Year	*Incidents*
Year	1	
Incidents	-0.2626	1

Descriptive Statistics ('02-'11)	
Sum	108
Mean	10.8
Max	15
Min	5
Range	10
Mode	14

Correlation ('02-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.4178	1

t-Test: Paired Two Sample for Means		
	2002-2006	*2007-2011*
Mean	9	12.6
Variance	12.5	5.8
Observations	5	5
Pearson Correlation	-0.2936	
Hypothesized Mean Difference	0	
df	4	
t Stat	-1.6677	
P(T<=t) one-tail	0.0854	
t Critical one-tail	2.1318	
P(T<=t) two-tail	0.1707	
t Critical two-tail	2.7764	

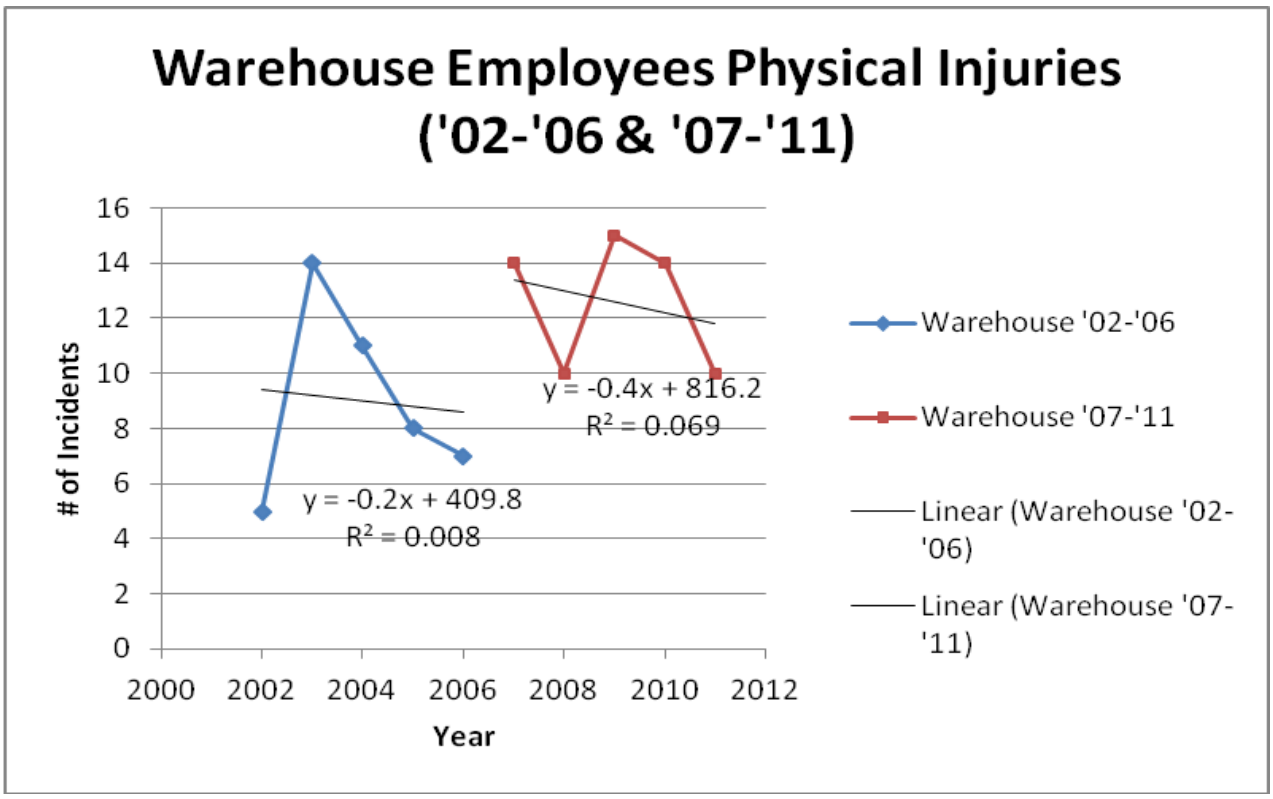

Fig. 4.12a Warehouse Employees Physical Injuries (’02-’06 & ’07-‘11)

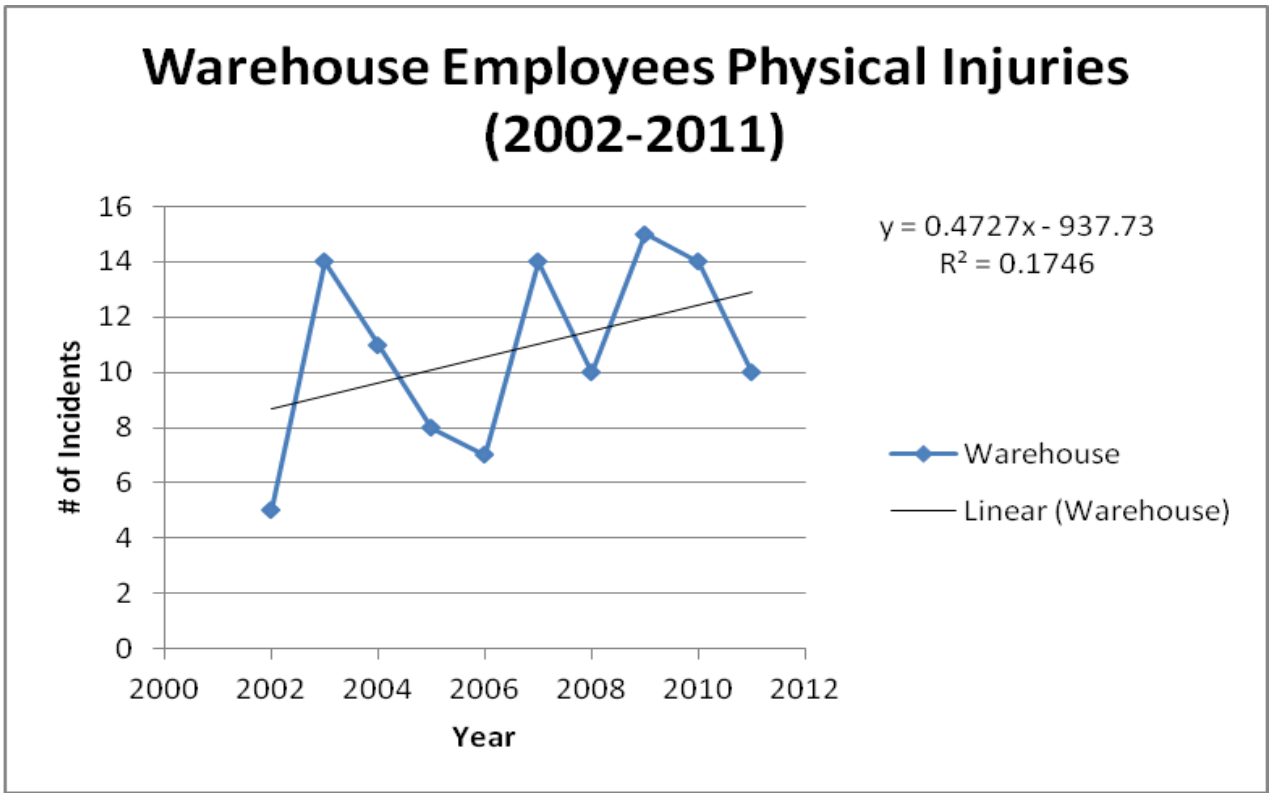

Fig. 4.12b Warehouse Employees Physical Injuries (2002-2011)

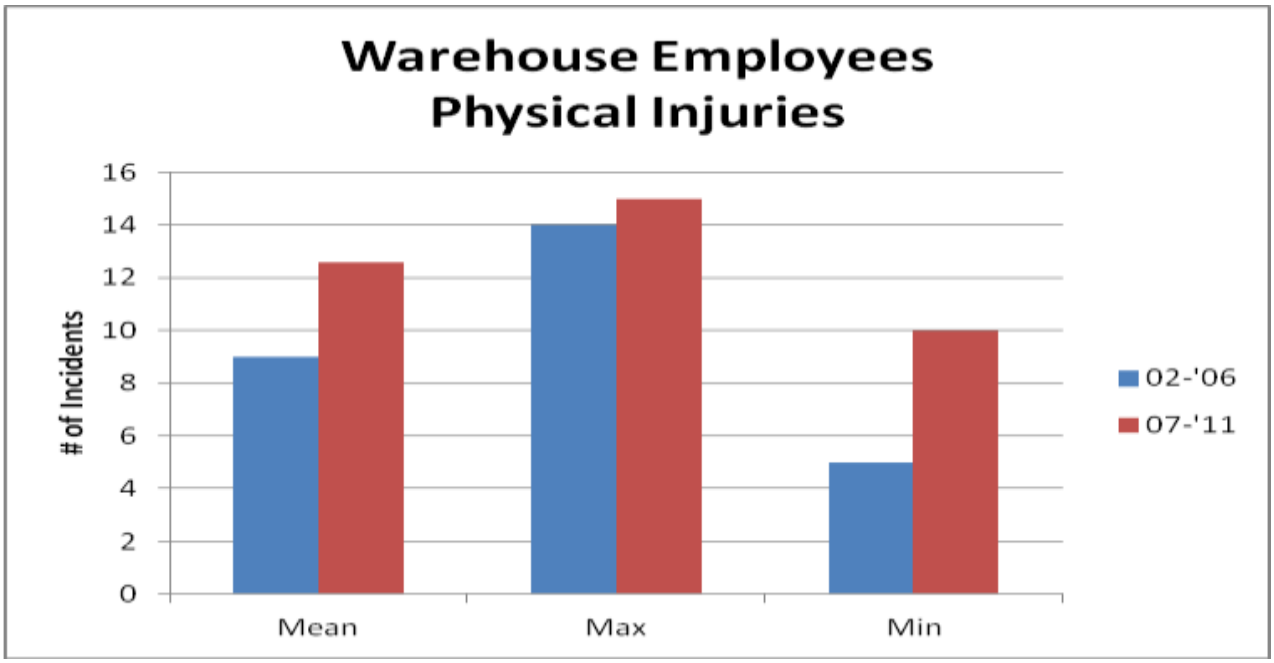

Fig. 4.12c Warehouse Employees Physical Injuries Rates (2002-2011)

Tables 4.12 Warehouse Employee Physical Injuries (2002-2011) display all warehouse employee injuries that were recorded on the OSHA 300 logs from 2002 to 2011. Each *Correlation* table provides a Pearson's value, a positive or negative number suggesting an increase or decrease of incidents over time. The Pearson's value for '02-'06 of -0.0894 suggests a weak negative correlation, '07-'11 of -0.2626 suggests a weak negative correlation, and '02-'11 of 0.4178 suggests an overall medium positive correlation. These relationships can be seen graphically in Fig. 4.12a & Fig. 4.12b.

To confirm the significance of the medium positive relationship from '02-'11 and that the positive correlation did not occur by chance, a t-Test is performed. The t-Test examines the mean number of injuries from both samples (time periods) and determines if the mean injury rates are significantly different at a confidence level. At the 95% confidence level, the *t-Test: Paired Sample for Means* table shows that the P (T<=t) two-tail value is 0.1707.

After comparing the means, maximum, and minimum injuries from '02-'06 to '07-'11, it can be seen that all values have increased from one time period to the next.

Tables 4.13 Driver Employees Physical Injuries (2002-2011)

Driver Employee (2002-2011)	
Year	Incidents
2002	5
2003	4
2004	9
2005	5
2006	6
2007	8
2008	10
2009	9
2010	7
2011	10

Descriptive Statistics ('02-'06)	
Sum	29
Mean	5.8
Max	9
Min	4
Range	5
Mode	5

Correlation ('02-'06)		
	Year	*Incidents*
Year	1	
Incidents	0.2466	1

Descriptive Statistics ('07-'11)	
Sum	44
Mean	8.8
Max	10
Min	7
Range	3
Mode	10

Correlation ('07-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.1213	1

Descriptive Statistics ('02-'11)	
Sum	73
Mean	7.3
Max	10
Min	4
Range	6
Mode	5

Correlation ('02-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.6880	1

t-Test: Paired Two Sample for Means		
	2002-2006	*2007-2011*
Mean	5.8	8.8
Variance	3.7	1.7
Observations	5	5
Pearson Correlation	0.0797	
Hypothesized Mean Difference	0	
df	4	
t Stat	-3	
P(T<=t) one-tail	0.0200	
t Critical one-tail	2.1318	
P(T<=t) two-tail	0.0399	
t Critical two-tail	2.7764	

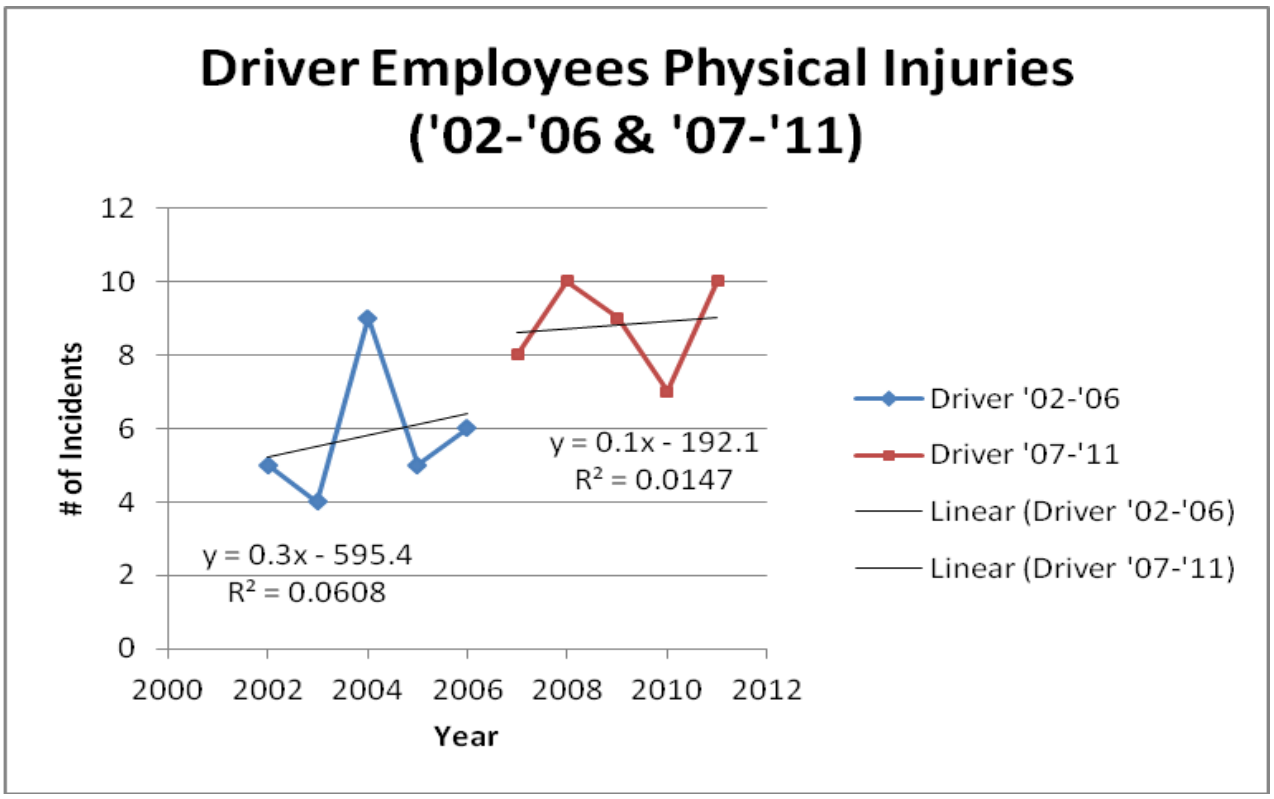

Fig. 4.13a Driver Employee Physical Injuries (’02-’06 & ’07-‘11)

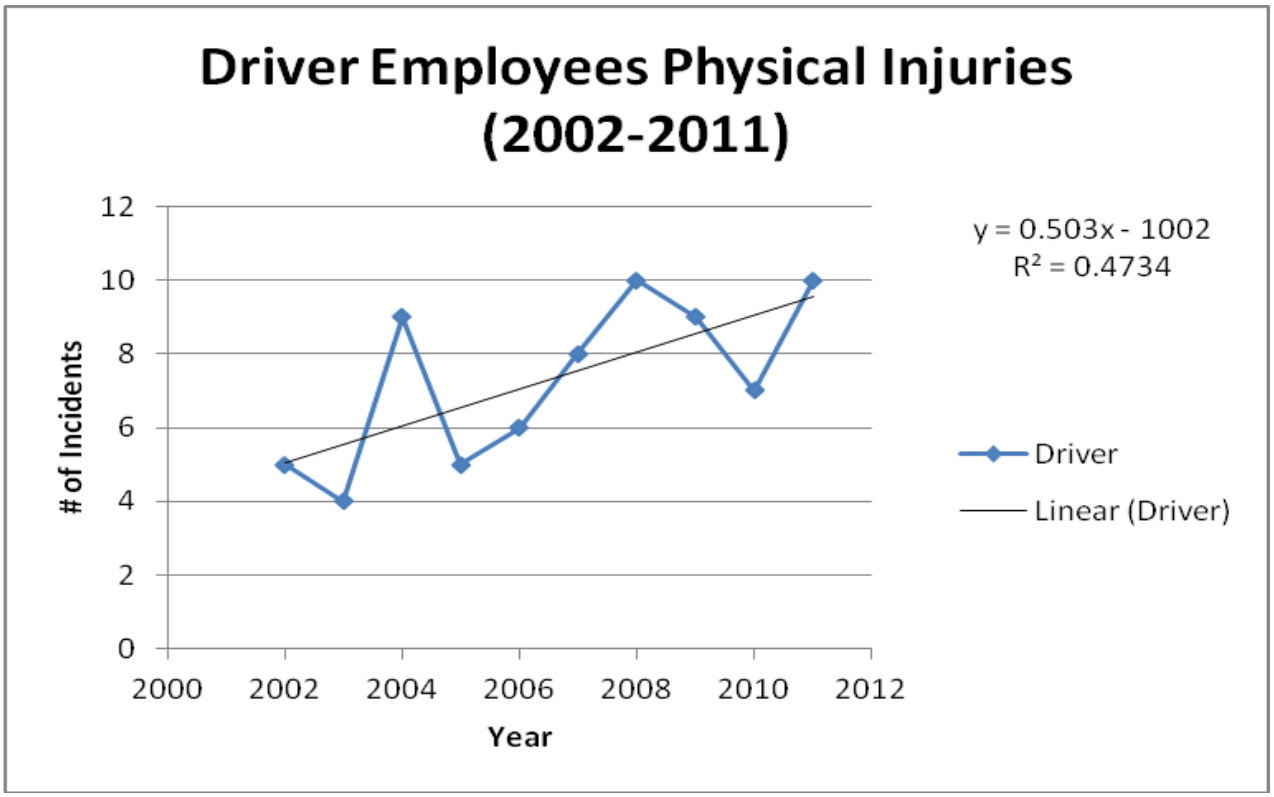

Fig. 4.13b Driver Employees Physical Injuries (2002-2011)

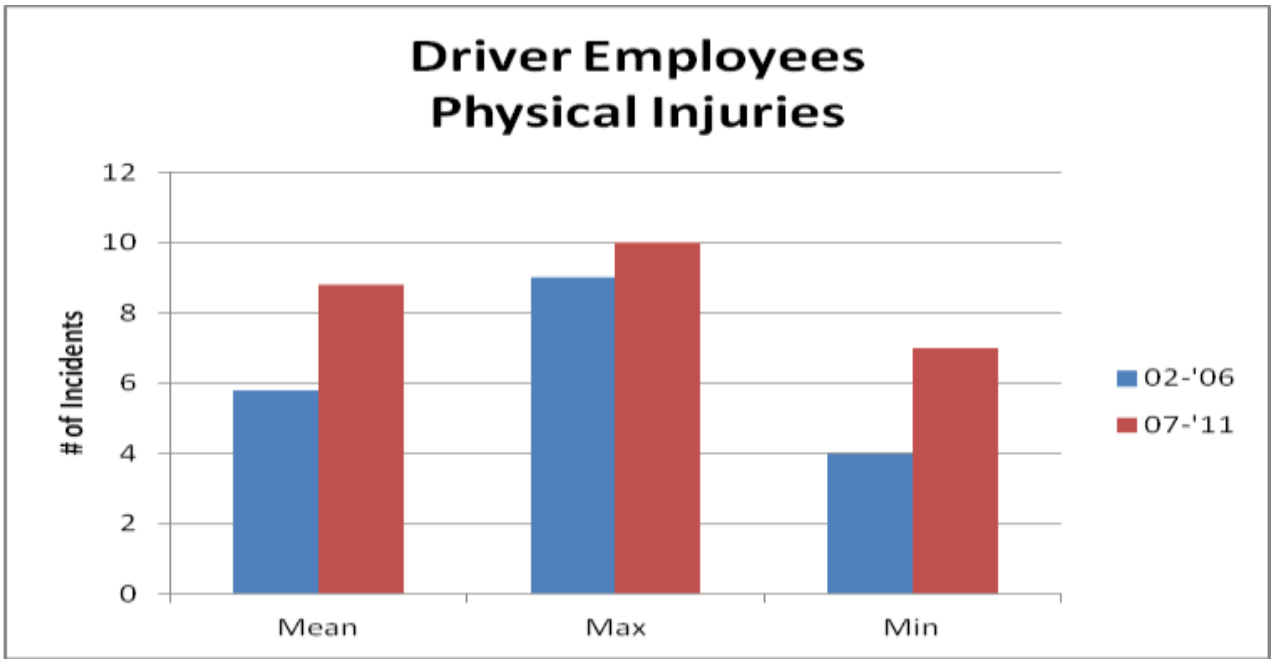

Fig. 4.13c Driver Employees Physical Injuries Rates (2002-2011)

Tables 4.13 Driver Employee Physical Injuries (2002-2011) display all driver employee injuries that were recorded on the OSHA 300 logs from 2002 to 2011. Each *Correlation* table provides a Pearson's value, a positive or negative number suggesting an increase or decrease of incidents over time. The Pearson's value for '02-'06 of 0.2466 suggests a weak positive correlation, '07-'11 of 0.1213 suggests a weak positive correlation, and '02-'11 of 0.6880 suggests an overall medium positive correlation. These relationships can be seen graphically in Fig. 4.13a & Fig. 4.13b.

To confirm the significance of the medium positive relationship from '02-'11 and that the positive correlation did not occur by chance, a t-Test is performed. The t-Test examines the mean number of injuries from both samples (time periods) and determines if the mean injury rates are significantly different at a confidence level. At the 95% confidence level, the *t-Test: Paired Sample for Means* table shows that the P (T<=t) two-tail value is 0.0399.

After comparing the means, maximum, and minimum injuries from '02-'06 to '07-'11, it can be seen that all values have increased from one time period to the next.

Tables 4.14 Production Employees Physical Injuries (2002-2011)

Production Employee (2002-2011)	
Year	Incidents
2002	14
2003	14
2004	8
2005	12
2006	14
2007	13
2008	17
2009	13
2010	16
2011	12

Descriptive Statistics ('02-'06)	
Sum	62
Mean	12.4
Max	14
Min	8
Range	6
Mode	14

Correlation ('02-'06)		
	Year	*Incidents*
Year	1	
Incidents	-0.1213	1

Descriptive Statistics ('07-'11)	
Sum	71
Mean	14.2
Max	17
Min	12
Range	5
Mode	13

Correlation ('07-'11)		
	Year	*Incidents*
Year	1	
Incidents	-0.2188	1

Descriptive Statistics ('02-'11)	
Sum	133
Mean	13.3
Max	17
Min	8
Range	9
Mode	14

Correlation ('02-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.2619	1

t-Test: Paired Two Sample for Means		
	2002-2006	*2007-2011*
Mean	12.4	14.2
Variance	6.8	4.7
Observations	5	5
Pearson Correlation	0.1592	
Hypothesized Mean Difference	0	
df	4	
t Stat	-1.2923	
P(T<=t) one-tail	0.1329	
t Critical one-tail	2.1318	
P(T<=t) two-tail	0.2658	
t Critical two-tail	2.7764	

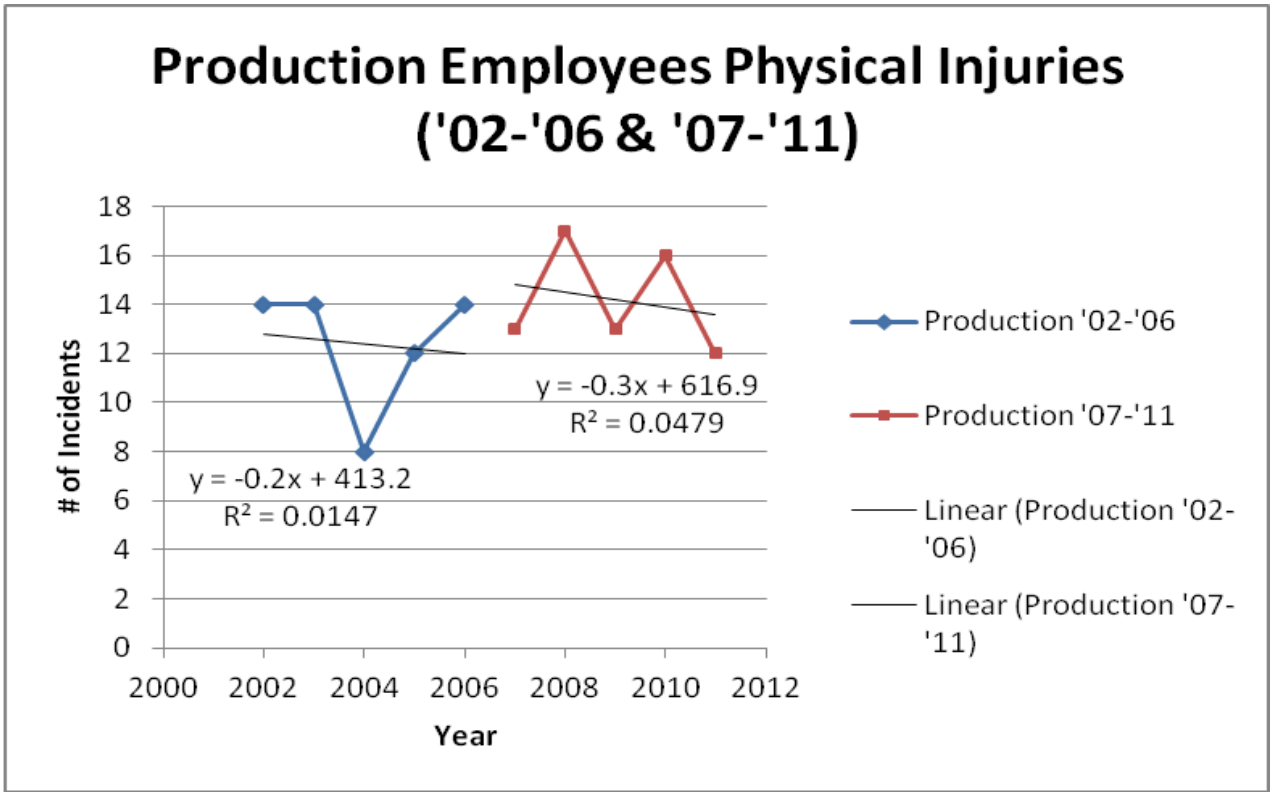

Fig. 4.14a Production Employees Physical Injuries (’02-’06 & ’07-‘11)

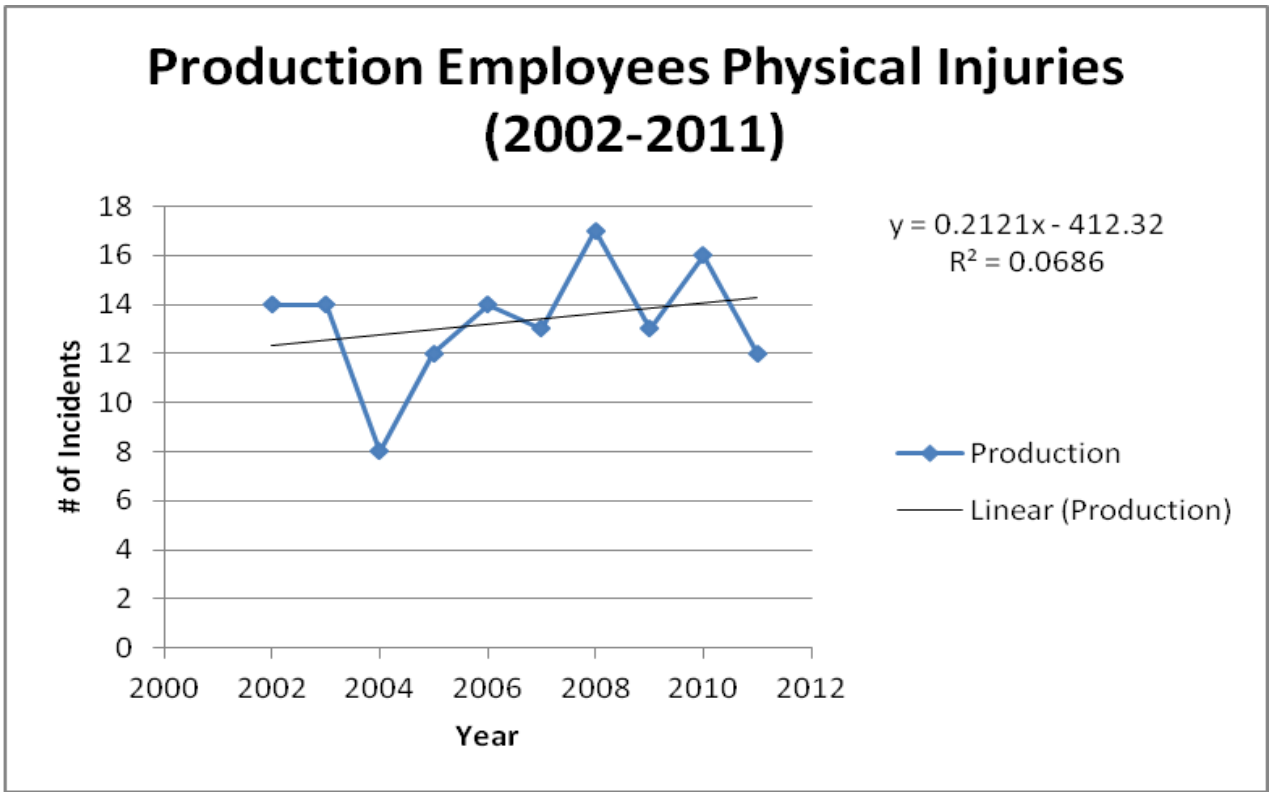

Fig. 4.14b Production Employees Physical Injuries (2002-2011)

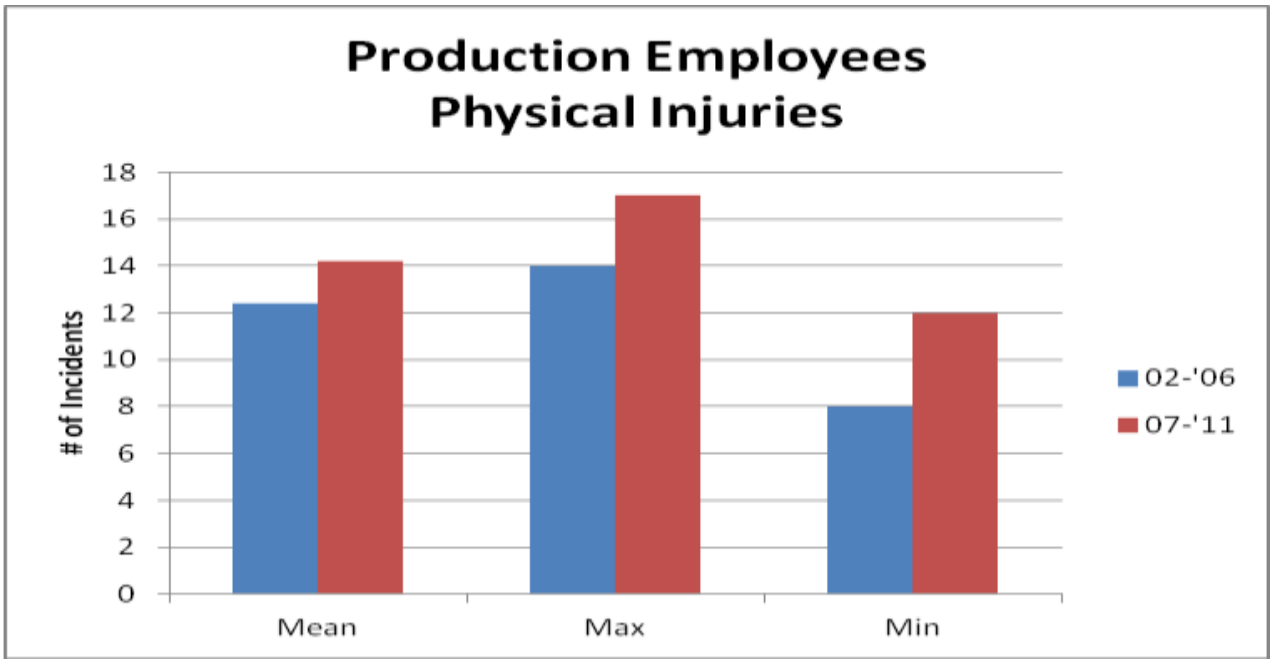

Fig. 4.14c Production Employees Physical Injuries Rates (2002-2011)

Tables 4.14 Production Employee Physical Injuries (2002-2011) display all production employee injuries that were recorded on the OSHA 300 logs from 2002 to 2011. Each *Correlation* table provides a Pearson's value, a positive or negative number suggesting an increase or decrease of incidents over time. The Pearson's value for '02-'06 of -0.1213 suggests a weak negative correlation, '07-'11 of -0.2188 suggests a weak negative correlation, and '02-'11 of 0.2619 suggests an overall weak positive correlation. These relationships can be seen graphically in Fig. 4.14a & Fig. 4.14b.

To confirm the significance of the medium positive relationship from '02-'11 and that the positive correlation did not occur by chance, a t-Test is performed. The t-Test examines the mean number of injuries from both samples (time periods) and determines if the mean injury rates are significantly different at a confidence level. At the 95% confidence level, the *t-Test: Paired Sample for Means* table shows that the P (T<=t) two-tail value is 0.2658.

After comparing the means, maximum, and minimum injuries from '02-'06 to '07-'11, it can be seen that all values have increased from one time period to the next.

Tables 4.15 All Physical Injuries (2002-2011: Yearly)

All Physical Injuries (2002-2011: Yearly)	
Year	Incidents
2002	26
2003	33
2004	29
2005	25
2006	30
2007	35
2008	38
2009	37
2010	37
2011	32

Descriptive Statistics ('02-'06)	
Sum	143
Mean	28.6
Max	33
Min	25
Range	8
Mode	#N/A

Correlation ('02-'06)		
	Year	*Incidents*
Year	1	
Incidents	0	1

Descriptive Statistics ('07-'11)	
Sum	179
Mean	35.8
Max	38
Min	32
Range	6
Mode	37

Correlation ('07-'11)		
	Year	*Incidents*
Year	1	
Incidents	-0.4636	1

Descriptive Statistics ('02-'11)	
Sum	322
Mean	32.2
Max	38
Min	25
Range	13
Mode	37

Correlation ('02-'11)		
	Year	*Incidents*
Year	1	
Incidents	0.6567	1

t-Test: Paired Two Sample for Means		
	2002-2006	*2007-2011*
Mean	28.6	35.8
Variance	10.3	5.7
Observations	5	5
Pearson Correlation	0.0848	
Hypothesized Mean Difference	0	
df	4	
t Stat	-4.1991	
P(T<=t) one-tail	0.0069	
t Critical one-tail	2.1318	
P(T<=t) two-tail	0.0137	
t Critical two-tail	2.7764	

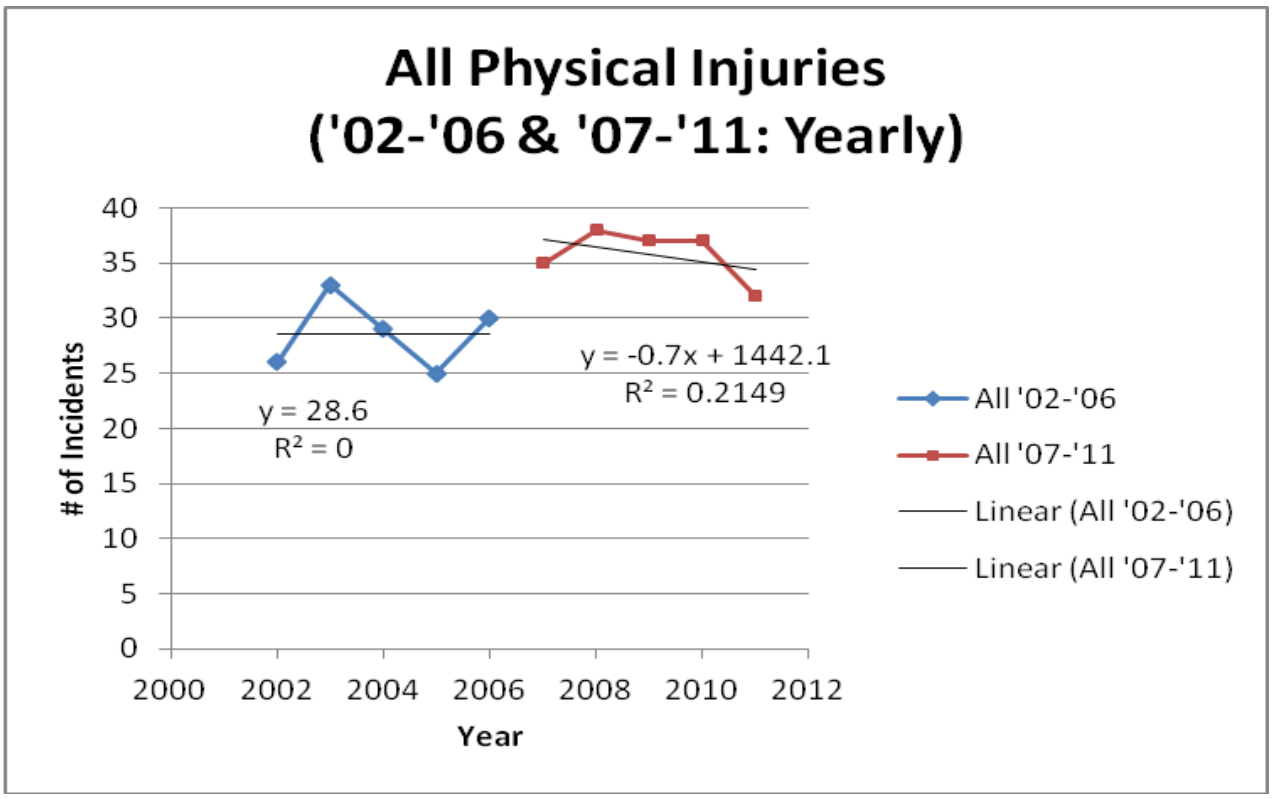

Fig. 4.15a All Physical Injuries (’02-’06 & ’07-‘11: Yearly)

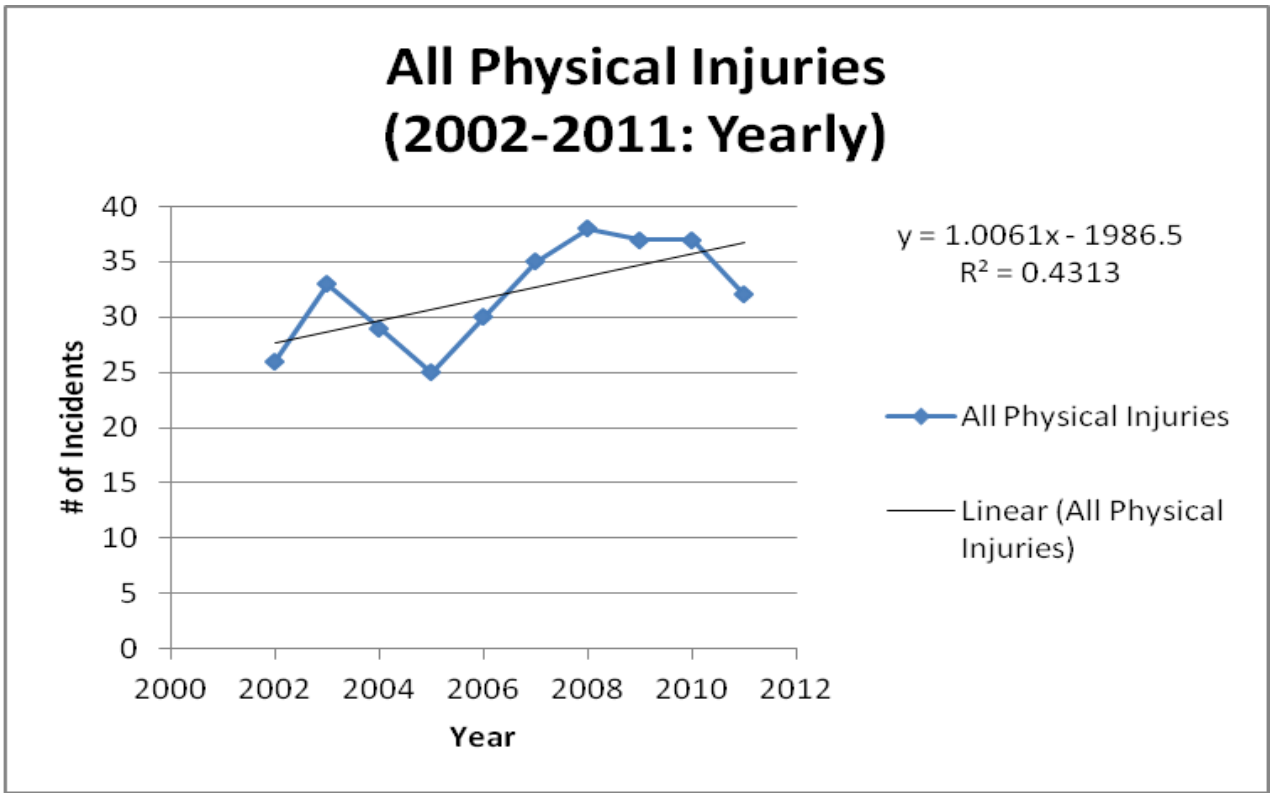

Fig. 4.15b All Physical Injuries (2002-2011: Yearly)

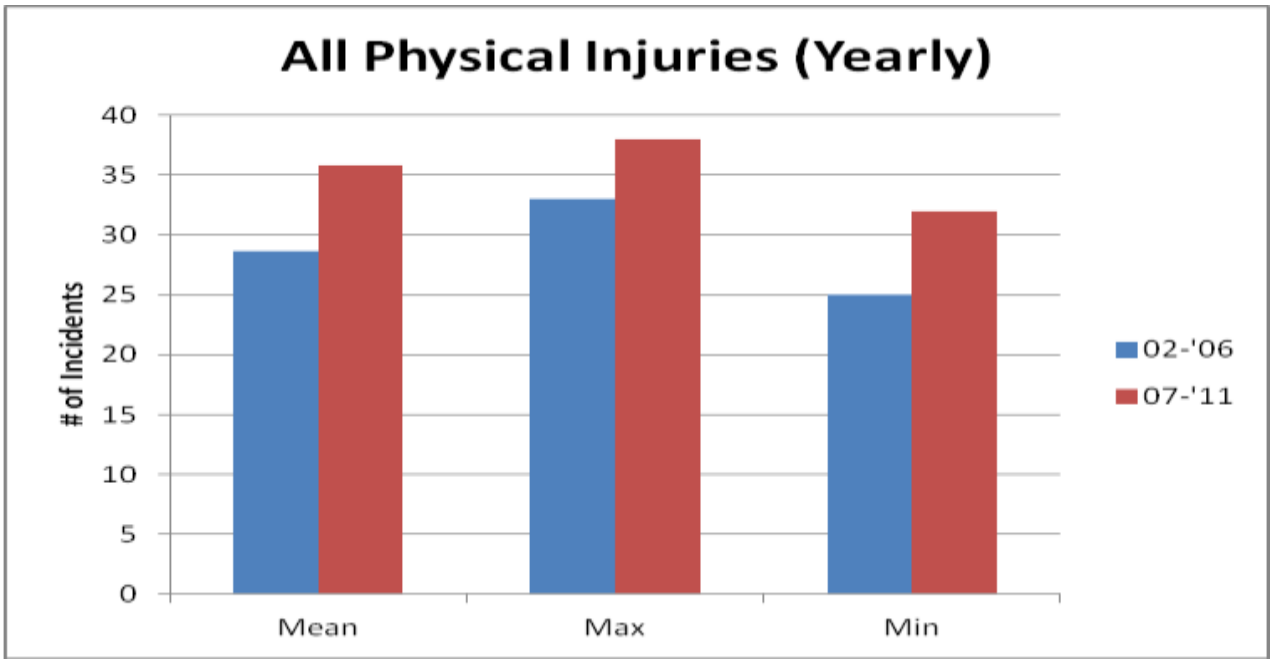

Fig. 4.15c All Physical Injuries Rates (2002-2011: Yearly)

Tables 4.15 All Physical Injuries (2002-2011: Yearly) display all physical injuries that were recorded on the OSHA 300 logs from 2002 to 2011 organized by year. Each *Correlation* table provides a Pearson's value, a positive or negative number suggesting an increase or decrease of incidents over time. The Pearson's value for '02-'06 of 0 suggests no correlation, '07-'11 of -0.4636 suggests a medium negative correlation, and '02-'11 of 0.6567 suggests an overall medium positive correlation. These relationships can be seen graphically in Fig. 4.15a & Fig. 4.15b.

To confirm the significance of the medium positive relationship from '02-'11 and that the positive correlation did not occur by chance, a t-Test is performed. The t-Test examines the mean number of injuries from both samples (time periods) and determines if the mean injury rates are significantly different at a confidence level. At the 95% confidence level, the *t-Test: Paired Sample for Means* table shows that the P (T<=t) two-tail value is 0.0137.

After comparing the means, maximum, and minimum injuries from '02-'06 to '07-'11, it can be seen that all values have increased from one time period to the next.

Tables 4.16 All Physical Injuries (2002-2011: Monthly)

All Physical Injuries (2002-2011: Monthly)

Yr.	Mos #	Mo.	Incidents	Yr.	Mos #	Mo.	Incidents	Yr.	Mos #	Mo.	Incidents	Yr.	Mos #	Mo.	Incidents
`02	1	Jan	3	`04	31	July	3	`07	61	Jan	4	`09	91	July	4
`02	2	Feb	5	`04	32	Aug	2	`07	62	Feb	1	`09	92	Aug	3
`02	3	Mar	3	`04	33	Sep	3	`07	63	Mar	5	`09	93	Sep	3
`02	4	Apr	2	`04	34	Oct	3	`07	64	Apr	1	`09	94	Oct	1
`02	5	May	2	`04	35	Nov	1	`07	65	May	4	`09	95	Nov	3
`02	6	Jun	1	`04	36	Dec	6	`07	66	Jun	1	`09	96	Dec	3
`02	7	July	2	`05	37	Jan	5	`07	67	July	3	`10	97	Jan	4
`02	8	Aug	0	`05	38	Feb	5	`07	68	Aug	3	`10	98	Feb	4
`02	9	Sep	1	`05	39	Mar	4	`07	69	Sep	3	`10	99	Mar	2
`02	10	Oct	3	`05	40	Apr	2	`07	70	Oct	6	`10	100	Apr	5
`02	11	Nov	2	`05	41	May	1	`07	71	Nov	1	`10	101	May	2
`02	12	Dec	2	`05	42	Jun	2	`07	72	Dec	3	`10	102	Jun	0
`03	13	Jan	4	`05	43	July	1	`08	73	Jan	7	`10	103	July	2
`03	14	Feb	5	`05	44	Aug	3	`08	74	Feb	5	`10	104	Aug	6
`03	15	Mar	3	`05	45	Sep	0	`08	75	Mar	3	`10	105	Sep	1
`03	16	Apr	1	`05	46	Oct	1	`08	76	Apr	2	`10	106	Oct	3
`03	17	May	3	`05	47	Nov	0	`08	77	May	2	`10	107	Nov	2
`03	18	Jun	1	`05	48	Dec	1	`08	78	Jun	4	`10	108	Dec	6
`03	19	July	4	`06	49	Jan	4	`08	79	July	2	`11	109	Jan	3
`03	20	Aug	1	`06	50	Feb	3	`08	80	Aug	0	`11	110	Feb	3
`03	21	Sep	4	`06	51	Mar	3	`08	81	Sep	0	`11	111	Mar	2
`03	22	Oct	1	`06	52	Apr	4	`08	82	Oct	6	`11	112	Apr	5
`03	23	Nov	3	`06	53	May	1	`08	83	Nov	4	`11	113	May	3
`03	24	Dec	3	`06	54	Jun	3	`08	84	Dec	3	`11	114	Jun	2
`04	25	Jan	1	`06	55	July	2	`09	85	Jan	5	`11	115	July	2
`04	26	Feb	3	`06	56	Aug	2	`09	86	Feb	2	`11	116	Aug	4
`04	27	Mar	2	`06	57	Sep	2	`09	87	Mar	0	`11	117	Sep	4
`04	28	Apr	1	`06	58	Oct	3	`09	88	Apr	4	`11	118	Oct	0
`04	29	May	1	`06	59	Nov	1	`09	89	May	5	`11	119	Nov	2
`04	30	Jun	3	`06	60	Dec	2	`09	90	Jun	4	`11	120	Dec	2

Tables 4.16 All Physical Injuries (2002-2011: Monthly)

Descriptive Statistics ('02-'06)	
Sum	143
Mean	2.3833
Max	6
Min	0
Range	6
Mode	3

Correlation ('02-'06)		
	Month #	*Incidents*
Month #	1	
Incidents	-0.0651	1

Descriptive Statistics ('07-'11)	
Sum	179
Mean	2.9833
Max	7
Min	0
Range	7
Mode	3

Correlation ('07-'11)		
	Month #	*Incidents*
Month #	1	
Incidents	-0.0748	1

Descriptive Statistics ('02-'11)	
Sum	322
Mean	2.6833
Max	7
Min	0
Range	7
Mode	3

Correlation ('02-'11)		
	Month #	*Incidents*
Month #	1	
Incidents	0.1322	1

t-Test: Paired Two Sample for Means		
	2002-2006	*2007-2011*
Mean	2.3833	2.9833
Variance	1.9014	2.8641
Observations	60	60
Pearson Correlation	0.1045	
Hypothesized Mean Difference	0	
df	59	
t Stat	-2.2470	
P(T<=t) one-tail	0.0142	
t Critical one-tail	1.6711	
P(T<=t) two-tail	0.0284	
t Critical two-tail	2.0010	

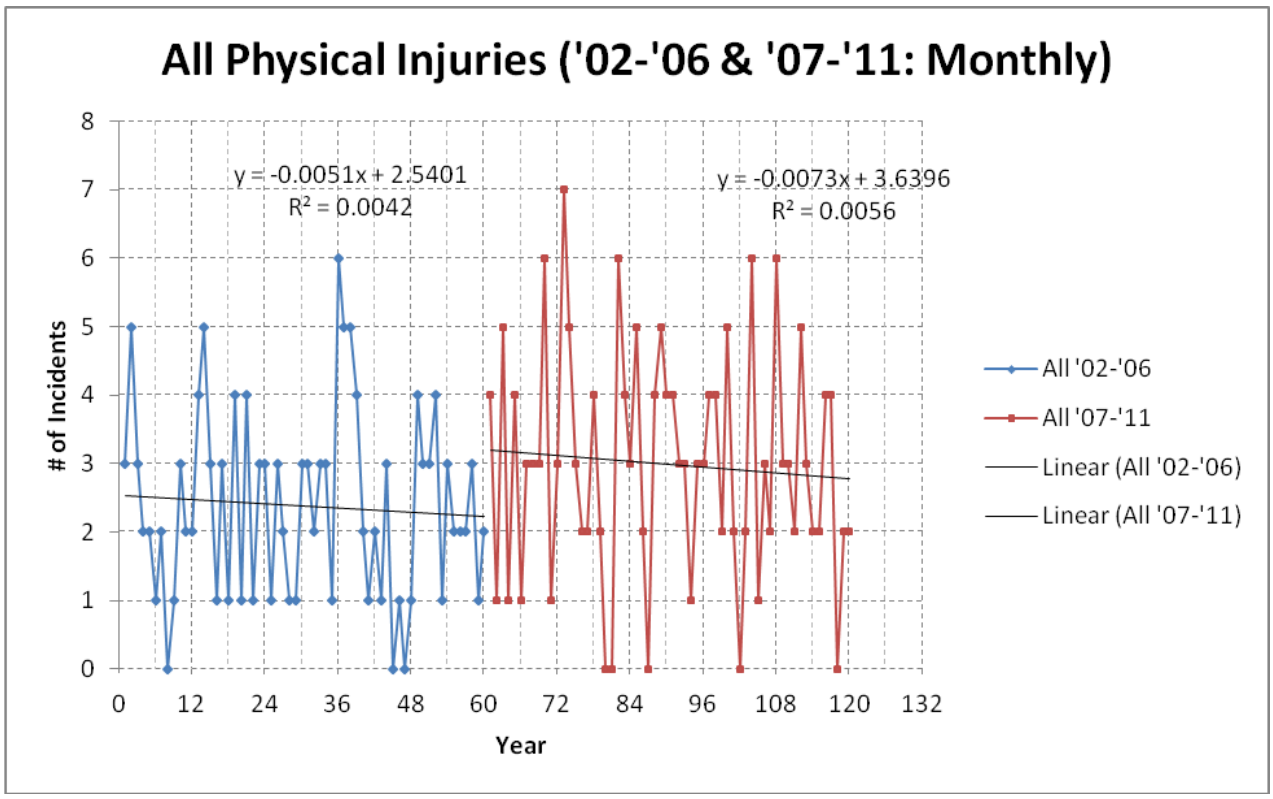

Fig. 4.16a All Physical Injuries (’02-’06 & ’07-‘11: Monthly)

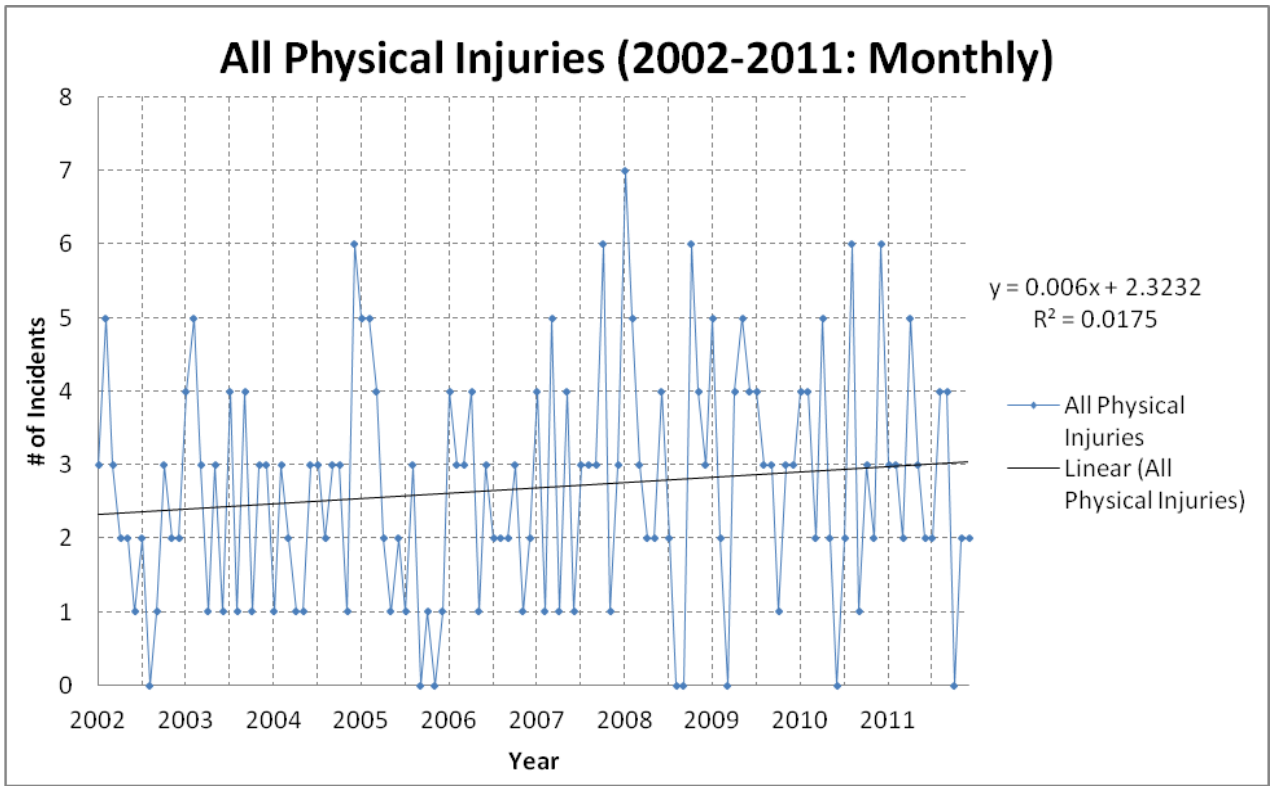

Fig. 4.16b All Physical Injuries (2002-2011: Monthly)

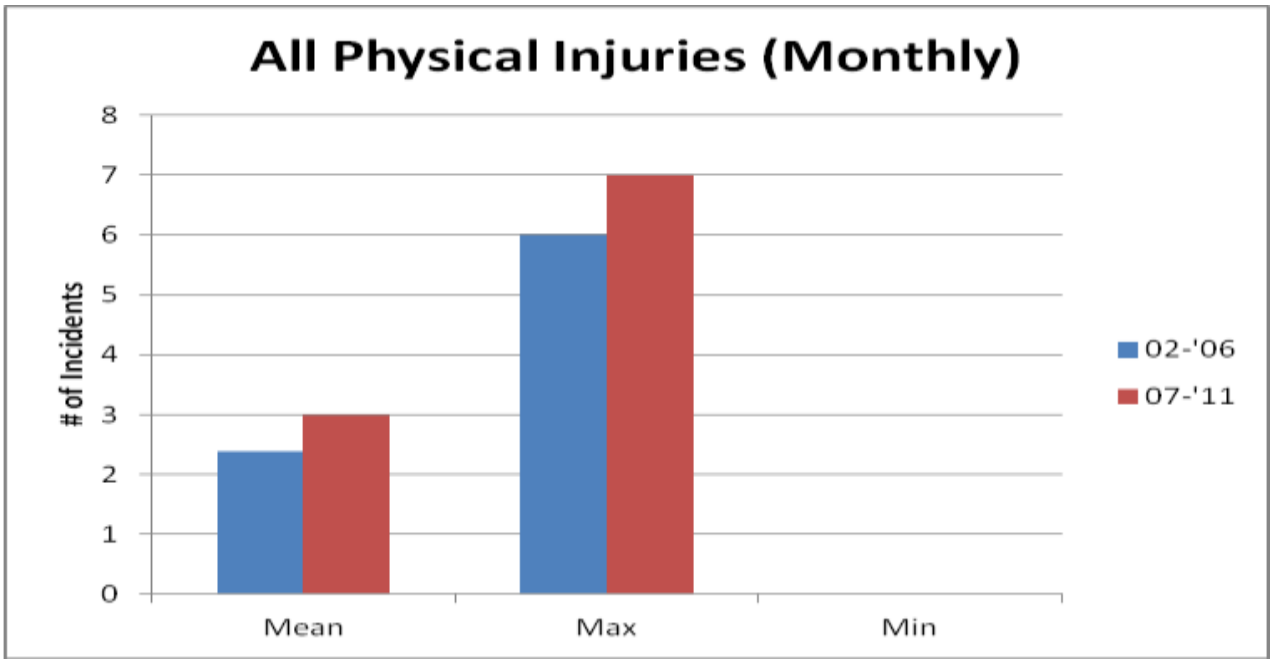

Fig. 4.16c All Physical Injuries Rates (2002-2011: Monthly)

Tables 4.16 All Physical Injuries (2002-2011: Monthly) display all physical injuries that were recorded on the OSHA 300 logs from 2002 to 2011 organized by month. Each *Correlation* table provides a Pearson's value, a positive or negative number suggesting an increase or decrease of incidents over time. The Pearson's value for '02-'06 of -0.0651 suggests a weak negative correlation, '07-'11 of -0.0748 suggests a weak negative correlation, and '02-'11 of 0.1322 suggests an overall weak positive correlation. These relationships can be seen graphically in Fig. 4.16a & Fig. 4.16b.

To confirm the significance of the medium positive relationship from '02-'11 and that the positive correlation did not occur by chance, a t-Test is performed. The t-Test examines the mean number of injuries from both samples (time periods) and determines if the mean injury rates are significantly different at a confidence level. At the 95% confidence level, the results show that the P (T<=t) two-tail value is 0.0284.

After comparing the means, maximum, and minimum injuries from '02-'06 to '07-'11, it can be seen that all values have increased or remained the same from one time period to the next.

Comparing Testing Procedures. There were key differences in the old testing program to the new testing program. Key differences discovered were: where the test was developed, who can conduct the test, requirements for employee test participation, job positions tested for, and the methods for testing the critical demands associated with the particular job. Both physical testing programs were administered at a clinic by a qualified physician. Both testing procedures can be found in the Appendix.

Old Testing Program (Pre-2007). The specific instructions and details for conducting the old test program were not written down but verbally given by the physician to the applicant. Thus, there were no written requirements for ensuring formality each time the test was implemented. Because the tests were developed in-house, the results of the entire testing program are reported directly to the Safety Director.

The old test procedures did not require the passing of any health questionnaires prior to administering the test. Though all employee were administered the flexibility and strength test, this was simply a test used to identify potential problems in one or more of the test areas so the physician could give the employee advice on how to improve their "score." The flexibility and strength test procedures used can be found in Appendix E. Regardless how the employee performed in the flexibility and strength tests, the determination if the employee would be able to safely perform the physical capability test was left up to the discretion of the physician implementing the test.

Once approved to take the test, the employee would be administered only the portion which related to the particular job they were applying for. The old test protocols can be found in Appendices A-D. The old test program tested for the following job positions: 1) Warehouse, 2) Truck Driver, 3) Packers, and 4) Skinners/Meat Cutters. Warehouse employees performed

various back and lifting tests. Truck Drivers performed various back and lifting tests, balance tests, and work simulation tasks. Packers performed wrist and hand dexterity tests, back and lifting tests, and work simulation tasks. Skinners and meat cutters performed wrist and hand dexterity tests, back and lifting tests, and work simulation tasks. Incorporated into the Wrist and Hand Dexterity tests are the Tinel's Sign Test and the Phalen's Test. Both tests are performed to detect irritated nerves, especially important for detecting carpal tunnel syndrome (CTS).

As mentioned earlier, the old test incorporates lifting and carrying demonstrations. According to the 2012 Liberty Mutual Manual Materials Handling Guide (See Appendices G-M for the specific guides used), the following are the female and male work populations which the tasks can accommodate:

- Warehouse/Truck Driver:
    - Pallet to Waist: Ending between knuckle and shoulder height (≥28"/31" and ≤ 53"/57"), a lift distance of 30" from floor to waist, hands 7" out, and at a frequency of once every 8 hours:
        - 60 lbs accommodates less than 10% of females and 68% for males.
        - 100 lbs exceeds the lifting limits for both males and females.
    - Pallet to Shoulder: Ending above shoulder height (≥53"/57"), a lift distance 30" from floor to shoulder, hands 7" out, and at a frequency of once every 8 hrs:
        - 60 lbs accommodates less than 10% of females (60 lbs exceeds the limits, maxes out at 40 lbs) and 62% for males.
        - 100 lbs exceeds the limits for both female and male employees.
    - Horizontal Carry (6ft): With hand height at 40", a travel distance of 7 feet, and at a frequency of once every 8 hrs:

        - 60 lbs accommodates 30% of females and 87% for males.
        - 100 lbs exceeds the limits for females, but accommodates 50% of males.

- Truck Driver only:
    - Lifting a bag of rice onto shoulders off 36" table: 120 lbs object, ending above shoulder height (≥53"/57"), a lift distance of 20" from table to shoulder, at a frequency of once every 8 hrs accommodates less than 10% of both females and males.

- Packers and Skinners/Meat Cutters:
    - Lifting Meat Tubs from 24" high stand to 36" high table: Ending between knuckle and shoulder height (≥28"/31" and ≤ 53"/57"), a lift distance of 20", and at a frequency of once every 8 hrs:
        - 50 lbs accommodates 17% of females and 88% of males.
        - 65 lbs accommodates less than 10% of females and 73% of males.
    - Lifting boxes from pallet to table: Ending between knuckle and shoulder height (≥28"/31" and ≤ 53"/57"), a lift distance of 30", and at a frequency of once every 8 hrs:
        - 50 lbs accommodates less than 10% of females and 80% of males.
        - 65 lbs accommodates less than 10% of females and 61% of males.
    - Horizontal Carry (6ft): Hand height at 40", a distance of 7 feet, and at a frequency of once every 8 hrs:
        - 50 lbs accommodates 70% of females and greater than 90% of males
        - 65 lbs accommodates 22% of females and 84% of males

New Testing Program (2007-Present). The new testing procedure is documented based, requiring written signature approval from the applicant performing each test, ensuring they agree and are aware of the risks associated with each test. A key difference of the new test to the old test is that AEI requires only AEI certified test administrators to implement the test, specifically stating that they "will not stand behind any tests results from uncertified trainers." Because the testing program was developed by AEI, the results from the test must be recorded on a special Teleform Pre-Placement Data Sheet, with specific requirements for documenting the results. The Data Sheet is then faxed back to AEI. Within 24 hours, AEI will report back with the results if the employee passed or failed the physical capability test.

The new physical test requires the applicant to first pass a health questionnaire prior to taking the physical capability test. Employees who responded "yes" to any questions must obtain approval from the physician and complete the Physician Release Form. The Physician Release Form will note any restrictions the employee may need to perform the test safely.

Once approved to be administered the test, blood pressure and heart rates will be measured as a baseline for the various tests. The general procedure for implementing each test is as followed: 1) the physician will read a written set of instructions for each test, 2) demonstrate the test, 3) ask if the employee has any questions, 4) require the employee to sign the written instructions document, stating that they understand the risks and procedures required to safely perform the specific test, 5) have the employee perform the test, and 6) then the physician records the results. The new physical testing program is comprised of an endurance test, floor lift, mid-chest lift, pull test, push test, ceiling crawl test, and a pipe crawl test; which tests will be administered is dependent on the job position applying for. The new test program tests for the

following job positions: 1) Warehouse, 2) Drivers, 3) Maintenance, 4) Packager, 5) Cutter, and Custodian.

As mentioned, the new test incorporates various lifting demonstrations. According to the 2012 Liberty Mutual Manual Materials Handling Guide (See Appendix for the specific guides used), the following are the female and male work populations which the tasks can accommodate:

- Floor Lift: Ending below knuckle height (≤ 28”/31”), a lift distance of 30” from floor to waist, and a frequency of once every 8 hours.
    - Warehouse/Drivers: 100 lbs accommodates less than 10% of females and 49% of males.
    - Packager: 50 lbs accommodates 43% of females and 89% of males.
    - Cutter/Custodian: 40/42 lbs accommodates 66% of females and greater than 90% of males.
- Mid-Chest Lift: Ending between knuckle and shoulder height (≥28”/31” and ≤ 53”/57”), a lift distance of 30” from floor to chest, and a frequency of once every 8 hours.
    - Warehouse/Drivers: 100 lbs accommodates less than 10% of females and 12% for males.
    - Packager: 50 lbs accommodates less than 10% of females and 80% for males.
    - Cutter: 60 lbs accommodates less than 10% of females and 68% of males.
    - Custodian: 42 lbs accommodates 29% of females and greater than 90% for males.

Chapter V: Summary, Conclusion, and Recommendations

The purpose of this study was to examine the potential influence federal hiring legislation may have on physical capability exams in the workplace. The primary goal of this study was to determine if the stringent hiring legislation has been allowing individuals susceptible to injury into the workplace or allow current employees to transfer to jobs they were unfit to safely perform, thus contributing to higher incidents of recordable injuries. To properly achieve this goal, the following areas were examined:

1. The expected outcomes of physical capability screening
2. The legal implications associated with conducting and developing pre-employment physical capability tests.
3. A comparison of the pre-2007 testing protocols to the post-2007 testing protocols.

Extensive literature review was performed to achieve the first and second goals mentioned above. The purpose of physical capability testing is to assist management's decision in selecting the most qualified individuals for a physically demanding job. The testing protocols test for strength, endurance, and postural demands associated with the particular job. The primary benefit of physical testing is to prevent or reduce the number of injuries in the workplace due to their large financial impact to the company. As McKendrick stated, "the ability of management to select particular employees for the specific job is a major factor in promoting company efficiency, growth, and earnings." Unfortunately, developing effective physical capability tests requires overcoming strict hiring legislation impediments.

The second goal of the study was to evaluate the legal implications associated with conducting and developing pre-employment physical capability tests. Physical ability tests are often subjected to a high standard of legal and administrative review. Because most strength

tests often result in adverse impacts against females and individuals over the age of 40 years old, physical capability tests must provide empirical evidence to show that the test protocols are of direct job-relatedness. Due to the range in physical demands of various jobs, the test battery should reflect only the positions for which the applicant will be applying for. "Any tests conducted to assess physical ability —as well as inquiries related to physical ability—are subject to limitations under federal and state law; violations of those requirements may result in liability under civil rights and nondiscrimination statutes" (Waite, 2010, p.3). Pre-employment testing programs must adhere to the Title VII of the Civil Rights Act (CRA) of 1964, the Age Discrimination in Employment Act (ADEA), the Equal Employment Opportunity Commission (EEOC), Uniform Guidelines on Employee Selection Procedures, Title I of the Civil Rights Act (CRA) of 1991, and the Americans with Disability Act (ADA). Essentially, pre-employment tests must not intentionally or disproportionately exclude specific applicants or applicants in a particular group by sex, national origin, religion, disability, or age, unless the employer can justify the test or procedure under the law (USDJ, 2009; *Employment,* 2010; *Understanding*, 1999).

The third goals required comparing the incident rates and physical capability testing protocols from both time periods, 2002-2006 compared to 2007-2011. Statistical analyses were calculated to determine any significant differences between the average numbers of incidents from each testing protocol time period. To perform the calculations, data was gathered by examining OSHA 300 logs from 2002 to 2011. The data was organized into various categories based on type of recordable injury, whether the injury was a result of a physical or non-physical activity, and job title of the injured employee. Statistical analytical methods were performed on

each category. The statistical methods performed were 1) Descriptive Statistic, 2) Correlation, and 3) t-Test: Paired Two Sample for Means (alpha = 0.05).

Upon comparing both testing protocols, there were both similarities and significant differences. Unfortunately, neither testing programs appeared to have been greatly influenced by federal hiring restrictions. Results appear that the fear of obtaining a non-validated testing program may have led to developing an overly cautious program, leading to the increase in incidents.

Conclusions

Based on the data collected from this study, the following conclusions can be made about the physical capability exam used at Company XYZ:

Comparing the Injury Rates.

1. Upon a thorough examination of the OSHA 300 logs, there were many interesting findings. As can be seen in Table 4.17 Percent (%) Changes in means, the mean number of recordable injuries for each category, except Foot/Ankle Sprains and Repetitive Hand/Wrist Injuries, increased anywhere from 14.52% to 1000% from the old to the new testing program; an effective testing program should have resulted in a reduced average number of injuries. This can also be seen graphically from each graph which compares the injury rates (Fig. 4a graphs), where the ’07-’11 regression line starts and ends higher on the graph than the ’02-’06 regression line.

Table 4.17 Percent (%) Changes in Means					
Tables #	**Category**	**Type**	**Mean ('02-'06)**	**Mean ('07-'11)**	**% Change**
4.1	Back	Sprain	12	14.6	21.67%
4.2	Chest/Abdomen	Sprain	0.6	1.4	133.33%
4.3	Neck/Shoulder	Sprain	3.2	4.6	43.75%
4.4	Elbow/Forearm	Sprain	2	3	50.00%
4.5	Hand/Wrist	Sprain	2.2	3	36.36%
4.6	Knee/Thigh	Sprain	1.8	2.4	33.33%
4.7	Foot/Ankle	Sprain	1	0.8	-20.00%
4.8	Shoulder	Repetitive	0.2	2.2	1000.00%
4.9	Back	Repetitive	0.2	0.6	200.00%
4.10	Elbow/Forearm	Repetitive	0.8	0.8	0.00%
4.11	Hand/Wrist	Repetitive	4.6	2.4	-47.83%
4.12	Warehouse	Employee	9	12.6	40.00%
4.13	Driver	Employee	5.8	8.8	51.72%
4.14	Production	Employee	12.4	14.2	14.52%
4.15	All	Year	28.6	35.8	25.17%
4.16	All	Month	2.3833	2.9833	25.18%

2. To confirm that the increased injury rates were significant and not due to random chance, a t-Test needed to be conducted. From Table 4.0 Statistical Analyses Results, all the P (T<=0) Two-Tail values highlighted in green show values within 5%, yellow values between 5% and 10%, and red values greater than 10% significance. In order for the increase or decrease in injury rates to be significant at the 95% confidence level, p-values must be less than 0.05. As seen in Table 4.0, the majority of the categories were not significant (p-values greater than 0.05), thus had a greater probability of occurring by chance than by as a result of the change in testing protocols. The categories which did produce significant correlations were (all were positive correlations): Neck/Shoulder Sprains, Repetitive Shoulder Injuries, Driver Injuries, All Injuries (Year), and All Injuries (Month). Though the majority of the statistical findings were not significant, they produced enough results to conclude that the new testing procedures required

improvement in all areas except for Repetitive Hand/Wrist Injuries and Foot/Ankle Sprains.

3. When examining the correlation of mean injuries from both time periods in Table 4.0, it can be seen that 11 of the 16 categories already had negative correlation from 2002 to 2006, or decreasing incident rates over time. Of these 11 categories, 4 were reversed into positive correlations from 2007 to 2011. Overall, 6 of the 16 categories produced positive correlations with the new testing program.

4. By simply examining the means from each time period, it can be clearly seen which injuries produced the most recordables. Table 4.18 displays the mean number of injuries from both time periods, organized from the most to least mean number of injuries. The table shows that the majority of the injuries came from sprains, particularly upper body sprains. Aside from Repetitive Hand/Wrist Injuries and Foot/Ankle sprains, oddly enough, the results also show that the types of injuries which produced the highest mean injuries also contributed to the greatest increase in injuries since the change in physical testing programs.

Table 4.18 Category Rankings by Means

Table/Fig. #	Category	Type	Mean ('02-'06)	Mean ('07-'11)	Mean Difference
4.1	Back	Sprain	12	14.6	2.6
4.3	Neck/Shoulder	Sprain	3.2	4.6	1.4
4.4	Elbow/Forearm	Sprain	2	3	1
4.5	Hand/Wrist	Sprain	2.2	3	0.8
4.6	Knee/Thigh	Sprain	1.8	2.4	0.6
4.11	Hand/Wrist	Repetitive	4.6	2.4	-2.2
4.8	Shoulder	Repetitive	0.2	2.2	2
4.2	Chest/Abdomen	Sprain	0.6	1.4	0.8
4.7	Foot/Ankle	Sprain	1	0.8	-0.2
4.10	Elbow/Forearm	Repetitive	0.8	0.8	0
4.9	Back	Repetitive	0.2	0.6	0.4
4.14	Production	Job Title	12.4	14.2	1.8
4.12	Warehouse	Job Title	9	12.6	3.6
4.13	Driver	Job Title	5.8	8.8	3

Comparing Testing Procedures.

1. Upon examining both physical testing protocols, there were clearly distinct differences. As the Safety Director of Company XYZ states, he believed that old testing protocols provided a better reflection of the required physical demands; from my internship experience at Company XYZ, I would agree with the Safety Director. The best way to compare the two testing programs is with a Pros and Cons list:

    a. Pros (Old Test):

        i. Tests procedures include tasks which simulate the actual job, at the maximum critical demands experienced

        ii. Incorporates the Tinel's Sign Test and Phalen's Test (both used to detect CTS).

    b. Cons (Old Test):

        i. Lack of written instructions.

        ii. Does not include a written health questionnaire.

        iii. Did not measure heart rates during each test.

        iv. Some tests require demonstrating the task only once (i.e. back and lift tests).

        v. According to the 2012 Liberty Mutual Manual Materials Handling Guide, lifting and carrying tasks requirements significantly present adverse impacts against the female employees

    c. Pros (New Test):

        i. Very documented based (helps with potential liability issues)

ii. Includes tests for maintenance and custodian job positions

iii. Includes pull and crawl tests

d. Cons (New Test)

i. Crawl test demonstration requires the physician to construct the crawl devices.

ii. Does not incorporating simulating actual tasks performed on the job, particularly for the Driver employees who must unload their trucks on a daily basis.

iii. Lift tests procedures may fatigue the applicant as they have to demonstrate many lifts until they approach their "maximal limit." This fatigue will wear the applicant, thus limiting their ability to reach their actual maximal limits.

iv. According to the 2012 Liberty Mutual Manual Materials Handling Guide, lifting tasks requirements significantly present adverse impacts against the female employees.

Possible Federal Hiring Restrictions Impacts.

1. From examining the statistics and testing protocols from both programs, the most injuries continued to be upper body strains. Federal hiring legislation states that pre-employment tests must not intentionally or disproportionately exclude specific applicants or applicants in a particular group by sex, national origin, religion, disability, or age, unless the employer can justify the test or procedure under the law. After examining the both physical testing procedures, there appears to be no significant finding which would make Company XYZ vulnerable

to EEOC complaints due to hiring discrimination as long as they were able to prove that the testing components were critical to the operations of the actual job. As a company which provides many services such as wholesale markets, branded products, custom food services cutting, cold storage and product transportation, the nature of the job requires a lot of material handling.

2. My assumption is that the fear of obtaining a non-validated testing program may have led to developing an overly cautious program, leading to the increase in incidents due to the various gaps which were overlooked. When examining both testing programs, there are no shared similarities in the tests used. The old test is very job simulated based, whereas the new test is very representative based; both have their benefits and downfalls.

Recommendations

Based on the data collected from this study, the following recommendations can be made about the physical capability exam used at Company XYZ:

1. There were both significant pros and cons to both physical testing procedures. The key difference from the new procedures compared to the old procedures was the absence of actual job simulation incorporation into the testing program. I firmly believe that by developing a new physical testing program which incorporated concepts from both the old and new tests, particularly by modernizing the old test program, can significantly help improve the physical testing program at Company XYZ. I would recommend keeping the job simulation aspects, while continuing to test maintenance and custodian employees as well. Most importantly, the new testing program should incorporate the health

questionnaire, documented instructions, and agreement of understanding forms to protect against any liability claims.

2. When developing a new physical capability exam, Company XYZ should incorporate input from employees who have worked there for several years, who are very familiar with the required qualities to safely accomplish the tasks. This could be especially valuable when interviewing female employees. Particular questions to ask could be:

   a. How have you been able to manage with the strength requirements of the job?

   b. Any suggestions on how the pre-employment physical capability exam can be improved?

3. In addition to physical capability testing during the pre-employment phase, there could be some form of required annual or periodic testing for all employees. This will ensure that all employees are still physically capable to safely perform the required tasks of the job. This is especially important when there are significant task changes or additions required of the particular position.

4. The assumption of this study stated that "Company XYZ's current workplace environment has been ergonomically designed or modified, to the best of their ability, to sustain a workplace free of recognized hazards which may cause or are likely to cause death or serious physical harm to the employees, thus not contributing to the incident rates and influencing the effectiveness of the current pre-employment physical capability test." With this in mind, perhaps Company XYZ's workplace environment is NOT ergonomically designed to the best it

could be. This is one area which could easily be further examined and compared with the current pre-employment physical capability exam protocols. This could be beneficial to the development of the new physical capability exam, since its last update to ensure direct job relatedness to the current job demands was last performed in 2007.

5. Due to the material handling nature of the work at Company XYZ, females will almost always be adversely impacted during the hiring process. The percentage of the female population which would be excluded from jobs requiring the ability to lift the minimum of 40 lbs will be at least 70% or greater; this rate significantly increases as the physical strength requirements increase. As discovered during the literature review, physical accommodations during the physical capability testing procedure can only be provided if the applicant has a disability. Additional research is required on how to address such a controversial issue.

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Appendix A

Old Warehouse Physical Testing Procedures

Warehouse	Task Description	Critical Demands	Testing	Met	Not Met
Back and Lifting Education	1. Lift boxes of various sizes (5 reps)	60-100 lbs	60 lbs	_____	_____
			100 lbs	_____	_____
	2. Pallet to waist	60-100 lbs	60 lbs	_____	_____
			100 lbs	_____	_____
	3. Pallet to shoulder	60-100 lbs	60 lbs	_____	_____
			100 lbs	_____	_____
	4. Horizontal carry (6 ft.)	60-100 lbs	60 lbs	_____	_____
			100 lbs	_____	_____
	5. Follow through of proper body mechanics during all above activities			_____	_____

Appendix B

Old Truck Driver Physical Testing Procedures

Truck Driver	Task Description	Critical Demands	Testing	Met	Not Met
Back and Lifting Education	1. Lift boxes of various sizes (5 reps)	60-100 lbs	60 lbs	_____	_____
			100 lbs	_____	_____
	2. Pallet to waist	60-100 lbs	60 lbs	_____	_____
			100 lbs	_____	_____
	3. Pallet to shoulder	60-100 lbs	60 lbs	_____	_____
			100 lbs	_____	_____
	4. Horizontal carry (6 ft.)	60-100 lbs	60 lbs	_____	_____
			100 lbs	_____	_____
Balance	5. Single leg stance (10 sec)	Daily	10 sec	_____	_____
	6. 10ft balance beam				
	a. Forward/backward walking (2 reps)	Daily	10ft	_____	_____
	b. Side stepping (2 reps)		10ft	_____	_____
Work Simulation Tasks	1. Lift bag of rice from 36" table, place on shoulder and carry 10ft, then return bag to table (Repeat 2 times).	2-3 times/week	120 lbs	_____	_____
	2. Load boxes from pallet to two wheel cart. Push outside & wheel up and down inclined driveway and return cart inside: unload boxes onto pallet (Total distance: 500ft) (Repeat 3 times)	Throughout the day	350 lbs	_____	_____
	3. Push loaded two wheel cart up and down 5 stairs (3 reps)	Periodically	200 lbs	_____	_____
	4. Follow through of proper body mechanics during all above activities			_____	_____

Appendix C

Old Packers Physical Testing Procedures

Packers					
Wrist and Hand Dexterity	1. Three point pinch test: Average: Right: _____ lbs. Left: _____ lbs. Low/High Range: Right: _____ lbs. Left: _____ lbs. 2. Lateral pinch test: Average: Right: _____ lbs. Left: _____ lbs. Low/High Range: Right: _____ lbs. Left: _____ lbs. 3. Special Tests: a. Tinel's Sign: Positive: _____ Negative: _____ b. Phalen's Test: Positive: _____ Negative: _____				
	Task Description	**Critical Deman**	**Testing**	**Met**	**Not Met**
Back and Lifting Education	1. Lifting Meat Tub (5 reps): from 24" stand to 37" table	50-60 lbs	50 lbs	_____	_____
			65 lbs	_____	_____
	2. Lifting Boxes (5 reps): from pallet to 37" table	50-60 lbs	50 lbs	_____	_____
			65 lbs	_____	_____
	3. Horizontal Carry (5 reps): meat tubs 5 ft.	50-60 lbs	50 lbs	_____	_____
			65 lbs	_____	_____
Work Simulation Tasks	1. Flipping 2 lbs weights continuously while sitting at a 28" table (5 minutes)	Daily	5 minutes	_____	_____
	2. Follow through of proper body mechanics during all above activities			_____	_____

Appendix D

Old Skinners and Meat Cutters Physical Testing Procedures

Skinners & Meat Cutters					
Wrist and Hand Dexterity	1. Three point pinch test: Average: Right: _____ lbs. Left: _____ lbs. Low/High Range: Right: _____ lbs. Left: _____ lbs. 2. Lateral pinch test: Average: Right: _____ lbs. Left: _____ lbs. Low/High Range: Right: _____ lbs. Left: _____ lbs. 3. Special Tests: a. Tinel's Sign: Positive: _____ Negative: _____ b. Phalen's Test: Positive: _____ Negative: _____				
	Task Description	**Critical Deman**	**Testing**	**Met**	**Not Met**
Back and Lifting Education	1. Lifting Meat Tub (5 reps): from 24" stand to 37" table	50-60 lbs	50 lbs	_____	_____
			65 lbs	_____	_____
	2. Lifting Boxes (5 reps): from pallet to 37" table	50-60 lbs	50 lbs	_____	_____
			65 lbs	_____	_____
	3. Horizontal Carry (5 reps): meat tubs 5 ft.	50-60 lbs	50 lbs	_____	_____
			65 lbs	_____	_____
Work Simulation Tasks	1. Cutting putty with simulated knife continuously for 5 mins. Standing at 37" working height	Daily	5 minutes	_____	_____
	2. Follow through of proper body mechanics during all above activities			_____	_____

Appendix E

Old Flexibility and Strength Physical Testing Procedures

	Flexibility					Strength				
	Normal		Tight	Very Tight		Normal		Good	Fair	Poor
	1	2	3	4	5	5	4	3	2	
Neck	**Right**			**Left**						
Rotation	_____			_____						
Side Bend	_____			_____						
Flexion			_____							
Extension			_____							
Shoulder	**Right**			**Left**		**Right**				**Left**
Abduction	_____			_____		_____				_____
Adduction	_____			_____		_____				_____
Flexion	_____			_____		_____				_____
Extenstion	_____			_____		_____				_____
Int. Rotation	_____			_____		_____				_____
Ext. Rotation	_____			_____		_____				_____
H-Adduction	_____			_____		_____				_____
H-Abduction	_____			_____		_____				_____
Elbow	**Right**			**Left**		**Right**				**Left**
Flextion	_____			_____		_____				_____
Extension	_____			_____		_____				_____
Pronation	_____			_____		_____				_____
Supination	_____			_____		_____				_____
						Grip Strength				**Avg.**
Wrist	_____			_____		_____ lbs.				_____ lbs.
						Low/High Range				
Hand	_____			_____		_____ lbs.				_____ lbs.
Trunk/Back	**Right**			**Left**						
Rotation	_____			_____						
Side Bend	_____			_____						
Flexion			_____							
Extension			_____							
Lower Extremities	**Right**			**Left**		**Right**				**Left**
Quadriceps	_____			_____		_____				_____
Hamstrings	_____			_____		_____				_____
Dorsiflexion	_____			_____		_____				_____
Planterflexion	_____			_____		_____				_____

Appendix F

New Physical Testing Procedures Summary

Test	Description
Endurance Test	Standard 10" step test. Listen to the beat of the metronome and step at that rhythm for 3 mins. After stepping, stand and measure heart rate. If heart rate is below a specific amount, you will be allowed to sit for 1 min. and continue to stages 2 and 3. If heart rate exceeds the specific amount after any stage, this is the end of your test.
Floor Lift	Lift a box/tote from 6" to 30" and back to 6". Adjust weight in box/tote to demostrate maximal acceptable weight. After lifting the box/tote, ask yourself if you can lift more weight without experiencing undue strain, or pain and/or extreme discomfort. If yes, put one or two more weights into the box/tote and repeat lift. Continue procedure until you feel you have reached your maximum lift weight without undue strain.
Mid-Chest Lift	Lift a box/tote from 30" to 39" and back to 30". Adjust weight in box/tote to demostrate maximal acceptable weight. After lifting the box/tote, ask yourself if you can lift more weight without experiencing undue strain, or pain and/or extreme discomfort. If yes, put one or two more weights into the box/tote and repeat lift. Continue procedure until you feel you have reached your maximum lift weight without undue strain.
Pull Test	Pull a force monitor attached to a wall at a height of 35". Pull slowly until maximum force is reached. The applicant is allowed to pull in any posture as long as the force monitor is kept level to the floor. Up to 3 trials are allowed to demonstrate maximum effort.
Push Test	Push on a force monitor attached to the wall at applicant's waist level with forearms horizontal to the floor and elbows at the side. Push slowly until maximum force is reached. The applicant is allowed to push in any posture as long as the force monitor is kept level to the floor. Up to 3 trials are allowed to demonstrate maximum effort.
Ceiling Crawl Test	Crawl up out of a 24" by 24" opening and return to starting position unassisted. The opening should be 4 feet above the floor. This simulates crawling through ceiling tiles.
Pipe Crawl Test	Crawl or climb between two horizontal bars, the lower bar 8.5" above the floor and the upper bar 24" above the floor; this leaves a space 15.5". Ensure a minimum space of 48" wide.

Appendix G

New Testing Procedures Physical Ability Testing Guide

Job Title	Endurance (ml/kg)^(2/3)	Training Factor	Floor Lift	Mid-Chest Lift	Pull Test	Push Test
Warehouse	161.00		100 lbs	100 lbs		
Drivers	134.76	10%	100 lbs	100 lbs		
Maintenane					130 lbs	
Packager			50 lbs	50 lbs		
Cutter			40 lbs	60 lbs		92 lbs
Custodian			42 lbs	42 lbs		

Appendix H

Liberty Mutual Manual Materials Handling Guidelines

TABLE 2F - FEMALE POPULATION PERCENTAGES FOR LIFTING TASKS

ENDING BETWEEN KNUCKLE AND SHOULDER HEIGHT (≥28" AND ≤ 53")

OBJECT WEIGHT (POUNDS)	LIFTING DISTANCE (INCHES)	HAND DISTANCE	FREQUENCY ONE LIFT EVERY	7 INCHES					10 INCHES					15 INCHES				
				15s	30 s	1m	5m	8h	15s	30 s	1m	5m	8h	15s	30 s	1m	5m	8h
		59	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		56	30	-	-	-	-	-		-	-	-	-	-	-	-	-	-
			20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			10	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-
		53	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			20	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-
			10	-	-	-	-	21	-	-	-	-	-	-	-	-	-	-
		50	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			20	-	-	-	-	17	-	-	-	-	-	-	-	-	-	-
			10	-	-	-	-	29	-	-	-	-	14	-	-	-	-	-
		47	30	-	-	-	-	12	-	-	-	-	-	-	-	-	-	-
			20	-	-	-	-	24	-	-	-	-	11	-	-	-	-	-
			10	-	-	-	-	38	-	-	-	-	21	-	-	-	-	-
		44	30	-	-	-	-	19	-	-	-	-	-	-	-	-	-	-
			20	-	-	-	-	34	-	-	-	-	17	-	-	-	-	-
			10	-	-	-	15	48	-	-	-	-	30	-	-	-	-	-
		41	30	-	-	-	-	29	-	-	-	-	14	-	-	-	-	-
			20		-	-	12	44	-	-	-	-	26	-	-	-	-	-
			10	-	-	14	23	58	-	-	-	-	41	-	-	-	-	-
		38	30	-	-	-	-	40	-	-	-	-	22	-	-	-	-	-
			20	-	-	12	21	56	-	-	-	-	38	-	-	-	-	-
			10	-	-	23	34	68	-	-	-	18	52	-	-	-	-	17
		35	30	-	-	-	18	52	-	-	-	-	34	-	-	-	-	-
			20	-	14	22	32	66	-	-	-	16	50	-	-	-	-	16
			10	11	18	35	47	76	-	-	18	29	63	-	-	-	-	28
		32	30	-	-	20	30	64	-	-	-	15	48	-	-	-	-	14
			20	20	25	34	46	76	-	11	18	28	62	-	-	-	-	28
			10	20	30	49	60	83	-	14	31	42	73	-	-	-	11	42
		29	30	12	18	33	45	75	-	-	17	27	61	-	-	-	-	27
			20	34	39	49	60	83	18	22	31	43	74	-	-	-	11	42
			10	34	45	62	71	89	18	27	45	56	82	-	-	13	22	56
		26	30	25	33	50	60	84	11	17	32	43	74	-	-	-	11	43
			20	50	55	64	73	89	32	38	47	58	83	-	-	14	23	58
			10	50	60	75	81	+	33	43	61	70	88	-	12	26	37	70
		23	30	43	52	66	74	+	25	34	50	61	84	-	-	16	26	60
			20	66	70	77	83	+	51	56	64	73	89	17	21	30	41	73
			10	67	74	84	88	+	51	61	75	81	+	18	26	44	55	81
		20	30	62	70	80	85	+	46	54	68	76	+	14	20	35	46	76
			20	80	83	87	+	+	69	73	79	84	+	37	41	51	61	84
			10	80	85	+	+	+	69	76	85	89	+	37	47	64	72	89
		17	30	79	84	+	+	+	68	74	83	88	+	35	44	59	68	87
			20	+	+	+	+	+	83	86	89	+	+	60	64	71	79	+
			10	+	+	+	+	+	84	88	+	+	+	61	69	80	85	+
		14	30	+	+	+	+	+	85	88	+	+	+	63	70	80	85	+
			20	+	+	+	+	+	+	+	+	+	+	80	83	87	+	+
			10	+	+	+	+	+	+	+	+	+	+	81	85	+	+	+
		11	30	+	+	+	+	+	+	+	+	+	+	85	88	+	+	+
			20	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
			10	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		8	30	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
			20	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
			10	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

+ = GREATER THAN 90% - = LESS THAN 10%

Appendix I

Liberty Mutual Manual Materials Handling Guidelines

TABLE 2M - MALE POPULATION PERCENTAGES FOR LIFTING TASKS

ENDING BETWEEN KNUCKLE AND SHOULDER HEIGHT (≥31" AND ≤57")

OBJECT WEIGHT (POUNDS)	HAND DISTANCE	LIFTING DISTANCE (INCHES)	FREQUENCY ONE LIFT EVERY	7 INCHES					10 INCHES					15 INCHES				
				15s	30 s	1m	5m	8h	15s	30 s	1m	5m	8h	15s	30 s	1m	5m	8h
	96		30	-	-	-	-	12	-	-	-	-	-	-	-	-	-	-
			20	-	-	-	-	25	-	-	-	-	12	-	-	-	-	-
			10	-	-	16	21	46	-	-	-	-	30	-	-	-	-	-
	92		30	-	-	-	-	16		-	-	-	-	-	-	-	-	-
			20	-	-	-	-	30	-	-	-	-	16	-	-	-	-	-
			10	-	-	20	26	52	-	-	-	13	36	-	-	-	-	-
	88		30	-	-	-	-	21	-	-	-	-	-	-	-	-	-	-
			20	-	-	-	13	36	-	-	-	-	21	-	-	-	-	-
			10	-	11	25	32	57	-	-	12	17	42	-	-	-	-	13
	84		30	-	-	-	-	27	-	-	-	-	13	-	-	-	-	-
			20	-	-	12	17	42	-	-	-	-	26	-	-	-	-	-
			10	-	15	31	38	63	-	-	17	22	48	-	-	-	-	17
	80		30	-	-	-	11	33	-	-	-	-	18	-	-	-	-	-
			20	-	-	17	23	49	-	-	-	11	32	-	-	-	-	-
			10	12	20	38	44	68	-	-	22	28	54	-	-	-	-	23
	76		30	-	-	11	16	40	-	-	-	-	24	-	-	-	-	-
			20	-	-	23	29	55	-	-	11	15	39	-	-	-	-	11
			10	17	26	45	51	72	-	13	29	35	60	-	-	-	-	29
	72		30	-	-	16	21	47	-	-	-	-	31	-	-	-	-	-
			20	-	14	30	36	61	-	-	16	21	47	-	-	-	-	16
			10	23	33	52	58	77	11	19	36	42	66	-	-	-	13	36
	68		30	-	11	22	28	54	-	-	-	15	39	-	-	-	-	11
			20	12	20	37	44	67	-	-	22	28	54	-	-	-	-	23
			10	30	41	59	64	81	16	25	43	50	72	-	-	14	19	44
	64		30	12	17	30	36	61	-	-	16	21	47	-	-	-	-	16
			20	18	27	45	52	73	-	14	29	36	61	-	-	-	-	30
			10	38	49	65	70	84	23	33	51	57	77	-	-	20	26	52
	60		30	18	25	38	45	68	-	12	23	29	55	-	-	-	-	24
			20	25	35	54	60	78	13	20	38	44	68	-	-	-	15	39
			10	47	57	72	76	87	31	42	59	64	81	-	13	28	34	60
	56		30	26	33	48	54	74	13	19	32	38	63	-	-	-	-	32
			20	34	45	62	67	83	20	29	47	53	74	-	-	17	22	48
			10	56	65	77	81	+	41	51	67	71	85	13	20	37	44	67
	52		30	36	43	57	63	80	21	28	41	48	70	-	-	13	17	42
			20	44	54	69	74	86	28	39	56	62	80	-	11	25	31	57
			10	64	72	82	85	+	50	60	73	77	88	20	29	47	53	74
	48		30	46	54	66	71	85	31	38	52	58	77	-	11	21	27	53
			20	54	63	76	80	+	39	49	65	70	84	12	19	36	42	66
			10	72	78	86	88	+	60	68	80	83	+	30	40	57	63	80
	44		30	57	64	74	78	88	42	50	62	67	83	14	19	32	38	63
			20	64	72	82	85	+	51	60	74	77	88	20	29	47	53	74
			10	79	84	+	+	+	69	76	85	87	+	42	51	67	71	85
	40		30	68	73	81	84	+	55	61	72	76	87	24	31	44	51	72
			20	73	79	87	89	+	62	70	81	84	+	32	42	59	64	81
			10	85	88	+	+	+	77	82	89	+	+	54	63	75	79	89
	36		30	77	81	87	89	+	66	72	80	83	+	38	45	58	63	80
			20	81	85	+	+	+	72	78	86	88	+	46	56	70	74	87
			10	89	+	+	+	+	84	88	+	+	+	66	73	82	85	+
	32		30	84	87	+	+	+	77	81	86	88	+	53	60	70	74	87
			20	87	+	+	+	+	81	85	+	+	+	61	69	79	83	+
			10	+	+	+	+	+	89	+	+	+	+	76	82	88	+	+
	28		30	+	+	+	+	+	85	88	+	+	+	68	73	81	84	+
			20	+	+	+	+	+	86	+	+	+	+	74	79	87	89	+
			10	+	+	+	+	+	+	+	+	+	+	85	88	+	+	+

+ = GREATER THAN 90% - = LESS THAN 10%

Appendix J

Liberty Mutual Manual Materials Handling Guidelines

TABLE 3F - FEMALE POPULATION PERCENTAGES FOR LIFTING TASKS
ENDING ABOVE SHOULDER HEIGHT (>53")

OBJECT WEIGHT (POUNDS)	LIFTING DISTANCE (INCHES)	HAND DISTANCE	FREQUENCY ONE LIFT EVERY	7 INCHES					10 INCHES					15 INCHES				
				15s	30 s	1m	5m	8h	15s	30 s	1m	5m	8h	15s	30 s	1m	5m	8h
		40	30	-	-	-	-	13	-	-	-	-	-	-	-	-	-	-
			20	-	-	-	-	26	-	-	-	-	12	-	-	-	-	-
			10	-	-	-	-	40	-	-	-	-	22	-	-	-	-	-
		38	30	-	-	-	-	19		-	-	-	-	-	-	-	-	-
			20	-	-	-	-	33	-	-	-	-	17	-	-	-	-	-
			10	-	-	-	15	48	-	-	-	-	30	-	-	-	-	-
		36	30	-	-	-	-	26	-	-	-	-	12	-	-	-	-	-
			20	-	-	-	11	41	-	-	-	-	24	-	-	-	-	-
			10	-	-	12	21	55	-	-	-	-	38	-	-	-	-	-
		34	30	-	-	-	-	34	-	-	-	-	18	-	-	-	-	-
			20	-	-	-	18	50	-	-	-	-	32	-	-	-	-	-
			10	-	-	18	29	63	-	-	-	14	46	-	-	-	-	13
		32	30	-	-	-	12	43	-	-	-	-	26	-	-	-	-	-
			20	-	-	15	24	59	-	-	-	-	41	-	-	-	-	-
			10	-	11	26	38	70	-	-	12	21	55	-	-	-	-	20
		30	30	-	-	11	19	53	-	-	-	-	35	-	-	-	-	-
			20	11	14	22	33	67	-	-	-	17	51	-	-	-	-	17
			10	11	18	36	47	77	-	-	19	29	64	-	-	-	-	29
		28	30	-	-	18	28	62	-	-	-	13	45	-	-	-	-	13
			20	18	22	32	44	74	-	-	16	26	60	-	-	-	-	25
			10	18	27	45	57	82	-	13	28	40	72	-	-	-	-	39
		26	30	-	14	27	39	71	-	-	13	21	56	-	-	-	-	21
			20	28	33	43	54	81	13	17	25	37	69	-	-	-	-	36
			10	28	38	57	67	87	13	21	39	51	79	-	-	-	17	50
		24	30	16	23	39	51	79	-	-	22	33	66	-	-	-	-	32
			20	40	45	55	65	86	23	27	37	49	77	-	-	-	15	48
			10	40	50	67	75	+	23	33	51	62	84	-	-	17	27	61
		22	30	27	36	52	63	85	13	19	34	46	76	-	-	-	13	45
			20	53	58	66	74	+	35	40	50	61	84	-	-	16	26	60
			10	53	62	76	82	+	35	46	63	72	89	-	13	28	40	72
		20	30	41	50	65	73	+	24	32	49	59	83	-	-	15	24	59
			20	65	69	76	82	+	49	54	63	72	89	16	20	28	40	72
			10	66	73	84	88	+	50	59	74	81	+	16	25	43	54	80
		18	30	57	64	76	82	+	39	48	63	72	89	-	15	28	40	72
			20	76	79	84	88	+	64	68	75	81	+	30	35	44	55	81
			10	77	82	89	+	+	64	72	83	87	+	30	40	58	68	87
		16	30	71	77	85	89	+	57	64	76	82	+	22	30	46	57	82
			20	85	87	+	+	+	76	79	84	88	+	48	52	61	70	88
			10	85	89	+	+	+	77	82	89	+	+	48	57	72	79	+
		14	30	83	86	+	+	+	73	78	86	+	+	42	50	64	73	+
			20	+	+	+	+	+	86	88	+	+	+	66	70	76	82	+
			10	+	+	+	+	+	86	+	+	+	+	66	73	83	88	+
		12	30	+	+	+	+	+	85	88	+	+	+	64	70	80	85	+
			20	+	+	+	+	+	+	+	+	+	+	81	83	87	+	+
			10	+	+	+	+	+	+	+	+	+	+	81	85	+	+	+
		10	30	+	+	+	+	+	+	+	+	+	+	82	85	+	+	+
			20	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
			10	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		8	30	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
			20	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
			10	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
		6	30	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
			20	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
			10	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

+ = GREATER THAN 90% - = LESS THAN 10%

Appendix K

Liberty Mutual Manual Materials Handling Guidelines

TABLE 3M - MALE POPULATION PERCENTAGES FOR LIFTING TASKS
ENDING ABOVE SHOULDER HEIGHT (>57")

OBJECT WEIGHT (POUNDS)	HAND DISTANCE	LIFTING DISTANCE (INCHES)	FREQUENCY ONE LIFT EVERY	7 INCHES					10 INCHES					15 INCHES				
				15s	30 s	1m	5m	8h	15s	30 s	1m	5m	8h	15s	30 s	1m	5m	8h
	77		30	-	-	-	-	28	-	-	-	-	14	-	-	-	-	-
			20	-	-	14	18	44	-	-	-	-	28	-	-	-	-	-
			10	-	16	33	39	64	-	-	18	24	49	-	-	-	-	19
	74		30	-	-	-	11	33		-	-	-	18	-	-	-	-	-
			20	-	-	17	23	49	-	-	-	11	33	-	-	-	-	-
			10	12	20	38	45	68	-	-	22	29	54	-	-	-	-	23
	71		30	-	-	-	15	39	-	-	-	-	23	-	-	-	-	-
			20	-	-	22	28	54	-	-	-	14	38	-	-	-	-	11
			10	16	25	44	50	72	-	12	28	34	59	-	-	-	-	28
	68		30	-	-	14	19	45	-	-	-	-	29	-	-	-	-	-
			20	-	12	27	34	59	-	-	14	19	44	-	-	-	-	14
			10	21	31	49	55	75	-	17	33	40	64	-	-	-	11	34
	65		30	-	-	19	25	50	-	-	-	12	35	-	-	-	-	-
			20	-	16	33	40	64	-	-	18	24	50	-	-	-	-	19
			10	27	37	55	61	79	13	22	39	46	69	-	-	11	16	40
	62		30	-	13	24	31	56	-	-	12	16	41	-	-	-	-	12
			20	13	22	40	46	69	-	-	24	30	56	-	-	-	-	25
			10	33	43	60	66	82	18	27	46	52	73	-	-	16	21	46
	59		30	12	18	31	37	62	-	-	16	22	47	-	-	-	-	17
			20	18	28	46	52	73	-	14	30	37	62	-	-	-	-	31
			10	39	50	66	71	85	24	34	52	58	77	-	-	21	27	53
	56		30	17	24	38	44	68	-	11	22	28	54	-	-	-	-	23
			20	24	34	53	59	78	12	20	37	44	67	-	-	-	14	38
			10	46	56	71	75	87	30	41	58	64	81	-	12	27	33	59
	53		30	23	31	45	51	73	11	17	29	35	61	-	-	-	-	30
			20	31	42	59	65	81	17	26	44	51	72	-	-	15	20	45
			10	53	62	76	79	89	38	48	64	69	84	11	18	34	41	65
	50		30	31	38	52	58	77	17	23	37	43	67	-	-	-	14	37
			20	39	50	66	77	85	24	34	52	58	77	-	-	21	27	53
			10	60	68	80	83	+	46	55	70	74	87	16	25	42	49	71
	47		30	39	47	60	65	82	24	31	45	51	73	-	-	15	20	46
			20	47	57	72	76	87	32	42	59	65	81	-	13	28	35	60
			10	67	74	84	86	+	54	63	76	79	89	23	33	50	56	76
	44		30	48	55	67	72	85	32	40	53	59	78	-	12	22	28	54
			20	56	65	77	81	+	41	51	67	71	85	13	20	37	44	67
			10	73	79	87	89	+	61	69	80	83	+	31	41	58	64	81
	41		30	57	63	74	77	88	42	49	62	67	82	13	19	31	37	62
			20	64	72	82	85	+	50	59	73	77	88	20	29	46	53	74
			10	79	83	+	+	+	69	75	84	87	+	41	51	66	71	85
	38		30	65	71	79	82	+	51	58	70	74	86	21	28	41	48	70
			20	71	78	86	88	+	59	67	79	82	+	29	39	56	62	79
			10	83	87	+	+	+	75	81	88	+	+	51	60	73	77	88
	35		30	73	78	84	87	+	61	67	77	80	+	31	39	52	58	77
			20	78	83	89	+	+	68	75	84	86	+	40	50	65	70	84
			10	87	+	+	+	+	81	85	+	+	+	61	69	79	83	+
	32		30	80	83	88	+	+	70	75	83	85	+	43	50	62	68	83
			20	84	87	+	+	+	76	81	88	+	+	52	61	74	78	88
			10	+	+	+	+	+	86	89	+	+	+	70	76	85	87	+
	29		30	85	88	+	+	+	78	82	87	89	+	56	62	72	76	88
			20	88	+	+	+	+	83	86	+	+	+	63	71	81	84	+
			10	+	+	+	+	+	+	+	+	+	+	78	83	89	+	+
	26		30	+	+	+	+	+	85	88	+	+	+	68	73	81	83	+
			20	+	+	+	+	+	88	+	+	+	+	74	79	87	89	+
			10	+	+	+	+	+	+	+	+	+	+	85	88	+	+	+

+ = GREATER THAN 90% - = LESS THAN 10%

Appendix L

Liberty Mutual Manual Materials Handling Guidelines

TABLE 11F - FEMALE POPULATION PERCENTAGES FOR CARRYING TASKS

CARRYING DISTANCE				7 FEET					14 FEET					28 FEET				
FREQUENCY ONE CARRY EVERY				15s	30 s	1m	5m	8h	15s	30 s	1m	5m	8h	15s	30 s	1m	5m	8h
OBJECT WEIGHT (POUNDS)	73	HAND HEIGHT (INCHES)	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			31	-	-	-	-	21	-	-	-	-	-	-	-	-	-	-
	70		40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			31	-	-	-	-	28	-	-	-	-	70	-	-	-	-	12
	67		40	-	-	-	-	15	-	-	-	-	13	-	-	-	-	-
			31	-	-	-	-	36	-	-	-	-	21	-	-	-	-	18
	64		40	-	-	-	-	22	-	-	-	-	19	-	-	-	-	-
			31	-	-	-	-	45	-	-	-	-	29	-	-	-	-	25
	61		40	-	-	-	-	30	-	-	-	-	27	-	-	-	-	13
			31	-	-	-	-	54	-	-	-	-	38	-	-	-	-	34
	58		40	-	-	-	-	40	-	-	-	-	36	-	-	-	-	20
			31	-	-	-	11	63	-	-	-	-	47	-	-	-	-	43
	55		40	-	-	-	-	50	-	-	-	-	46	-	-	-	-	29
			31	-	-	14	18	71	-	-	-	-	57	-	-	-	-	54
	52		40	-	-	-	-	60	-	-	-	-	57	-	-	-	-	39
			31	-	14	22	27	79	-	-	11	14	67	-	-	-	12	63
	49		40	-	-	13	17	70	-	-	11	14	67	-	-	-	-	51
			31	18	22	33	39	85	-	-	18	23	75	-	15	15	20	73
	46		40	-	13	22	27	78	-	-	19	24	76	-	-	-	11	62
			31	28	34	45	51	89	-	-	29	34	82	12	25	25	30	80
	43		40	17	23	34	40	85	-	-	31	36	83	-	15	15	20	73
			31	41	47	58	63	+	-	13	42	47	88	22	37	37	43	86
	40		40	29	36	48	54	+	-	15	44	50	89	18	27	27	32	81
			31	55	60	70	74	+	-	23	55	61	+	35	51	51	57	+
	37		40	44	51	62	67	+	11	27	59	64	+	31	41	41	47	88
			31	68	72	80	83	+	19	38	69	73	+	50	65	65	70	+
	34		40	60	66	75	79	+	23	43	72	76	+	47	57	57	63	+
			31	79	82	87	89	+	34	54	80	83	+	65	77	77	81	+
	31		40	74	79	85	87	+	40	60	83	86	+	64	72	72	76	+
			31	88	+	+	+	+	51	70	88	+	+	78	86	86	88	+
	28		40	85	88	+	+	+	59	76	+	+	+	78	84	84	86	+
			31	+	+	+	+	+	69	82	+	+	+	87	+	+	+	+
	25		40	+	+	+	+	+	77	87	+	+	+	88	+	+	+	+
			31	+	+	+	+	+	83	+	+	+	+	+	+	+	+	+

+ = GREATER THAN 90% - = LESS THAN 10%

Appendix M

Liberty Mutual Manual Materials Handling Guidelines

TABLE 11M - MALE POPULATION PERCENTAGES FOR CARRYING TASKS

CARRYING DISTANCE			7 FEET					14 FEET					28 FEET				
FREQUENCY ONE CARRY EVERY			15s	30 s	1m	5m	8h	15s	30 s	1m	5m	8h	15s	30 s	1m	5m	8h
OBJECT WEIGHT (POUNDS)	99	HAND HEIGHT (INCHES) 43	-	-	-	18	50	-	-	-	-	36	-	-	-	-	22
		33	-	11	22	36	67	-	-	11	21	54	-	-	-	15	47
	94	43	-	-	12	23	56	-	-	-	12	42	-	-	-	-	28
		33	-	15	28	42	71	-	-	15	27	60	-	-	11	20	53
	89	43	-	-	17	29	62	-	-	-	17	49	-	-	-	-	34
		33	14	20	35	49	75	-	-	21	34	65	-	15	16	26	59
	85	43	-	-	22	35	66	-	-	11	21	54	-	-	-	-	40
		33	18	25	40	54	78	-	-	26	39	70	-	19	20	32	64
	81	43	-	14	27	41	70	-	-	15	27	60	-	-	-	14	46
		33	23	31	46	59	81	-	13	31	45	73	11	24	25	38	68
	77	43	13	19	33	47	74	-	-	20	33	65	-	-	-	19	52
		33	29	37	52	64	84	-	17	38	51	77	15	30	31	44	73
	73	43	18	25	40	53	78	-	-	26	39	69	-	13	14	25	58
		33	35	44	58	69	86	11	23	44	57	80	21	37	38	50	76
	69	43	24	32	46	59	81	-	13	32	46	74	-	18	19	31	63
		33	42	50	64	74	88	16	29	51	63	83	27	44	45	57	80
	65	43	31	39	53	65	84	-	19	40	53	78	-	25	26	38	69
		33	49	57	69	78	+	22	37	58	69	86	34	51	52	63	83
	61	43	39	47	60	71	87	13	26	47	60	82	16	32	34	46	74
		33	57	64	74	82	+	29	44	64	74	88	42	58	59	69	86
	57	43	47	55	67	76	89	19	34	55	67	85	23	41	42	54	79
		33	64	70	79	85	+	37	52	70	78	+	50	65	66	74	88
	53	43	56	62	73	80	+	27	43	63	73	88	31	50	51	62	83
		33	70	75	83	88	+	46	60	76	83	+	58	71	72	79	+
	49	43	64	70	78	84	+	37	52	70	78	+	41	58	59	69	86
		33	76	80	86	+	+	55	68	81	86	+	66	77	78	83	+
	45	43	71	76	83	88	+	47	61	76	83	+	51	67	68	76	89
		33	81	85	89	+	+	64	75	85	89	+	73	82	82	87	+
	41	43	78	82	87	+	+	58	70	82	87	+	61	74	75	82	+
		33	86	88	+	+	+	72	81	88	+	+	80	86	87	+	+
	36	43	85	87	+	+	+	70	79	88	+	+	73	82	83	87	+
		33	+	+	+	+	+	81	87	+	+	+	86	+	+	+	+
	31	43	+	+	+	+	+	81	87	+	+	+	82	89	89	+	+
		33	+	+	+	+	+	88	+	+	+	+	+	+	+	+	+

+ = GREATER THAN 90% - = LESS THAN 10%