

Pre-placement Functional Capacity Evaluations

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and

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Historical Perspective

Our interest in the measurement of physical strength probably dates to the first humans.



Life was truly a struggle in which the fittest survived.

Historical Perspective

Persons with limited strength are more likely to be injured in “hard” jobs.

“Hard” jobs can be redesigned to be within the physical strength capability of most people.

Since physical strength is important in these jobs, we must find ways to quantify it through testing.

Human Strength

Strength: The capacity to produce force or torque with voluntary muscle contraction.

Maximum Strength: The capacity to produce force or torque with a maximum voluntary muscle contraction.

“Maximum strength” is some value representing what he or she is comfortable expressing at the time with the existing equipment and environmental conditions.

Human Strength

A voluntary muscle contraction is “voluntary.” When a person’s physical strength is measured, only the effort the person willingly puts forth at the time is measured.

The test equipment and the tested person’s familiarity with the process also influence the “voluntary” strength output.

The interface between the tested person and the test equipment is particularly important.

Human Strength

We commonly use the terms “muscle force” and “muscle strength” to describe the strength phenomenon. Technically, this is incorrect.

In most human movements and force exertions, a functional muscle group works together to produce observable output.

In complicated exertions, functional groups work together to produce the measured output, (e.g. a squat lift).

Purpose of Strength Measurement in Ergonomics

Two primary purposes:

- 1) worker selection/placement and**
- 2) job design**

Heavy physical demands should not be performed by those lacking necessary strength capabilities.

Purpose of Strength Measurement in Ergonomics

Worker selection/placement can reduce harmful physical effects caused by job/worker mismatch given adherence to three principles:

- 1) Strength measured closely simulates actual high strength elements in a job.
- 2) Predictive Value: the measure of the test's ability to determine who is at risk of future work related musculoskeletal disorders (MSDs). Predictive value is applicable only when individuals are tested for jobs where high risk is known (i.e., for jobs known to possess high strength demands.
- 3) The training/skills of the ergonomist administering the test.

Strength measurement can also be used in fitness for duty exams.

Purpose of Strength Measurement in Ergonomics

Dr. Don Chaffin noted (in 1974) that strength testing had appropriate use in worker selection if the three principles were met.

Despite some initial legal challenges, several large companies have been using strength testing as a component of functional capacity evaluations (FCEs) for the past 15-20 years.

The Federal sector has been, as a whole, slower to accept FCEs.

Purpose of Strength Measurement in Ergonomics

MSDs account for 34% of all lost workdays and illnesses (www.OSHA.gov).



MSDs account for \$15-20 billion in worker's compensation costs, with total costs as much as \$60 billion.

Test Criteria

Sensitivity: A measure of a test's accuracy in identifying workers who will develop a disease or injury, expressed as:

$$\frac{\text{TP}}{\text{TP} + \text{FN}} \times 100$$

(TP = True Positives and FN = False Negatives)

Test Criteria

Specificity: A measure of a test's accuracy in correctly identifying persons who will not develop a future problem, expressed as:

$$\frac{\text{TN}}{\text{TN} + \text{FP}} \times 100$$

(TN = True Negatives and FP = False Positives)

Test Criteria

Positive Predictive Value: The measure of testing ability to predict who is at risk of a future injury or disease, expressed as:

$$\frac{TP}{TP + FP} \times 100$$

(TP = True Positives and FP = False Positives)

Study Overview

The Veterans Health Administration (VHA), a component of the Department of Veterans Affairs, is the largest Federal employer of health care workers in the USA.

VHA employs a wide spectrum of employees in both direct patient care and support roles, many of which require heavy lifting, in excess of 45 lbs, as a functional requirement.

Study Overview

To the best of our knowledge, no other VHA facility has evaluated the value added in reducing injuries through pre-placement FCEs.

Central Texas Veterans Health Care System (CTVHCS) is a VHA facility with some 3,000 employees, providing acute inpatient care, long term care, inpatient psychiatric and outpatient ambulatory services to veterans in the geographic center of the State of Texas.

Study Overview

Two specific questions were posed:

- 1) Were the workforce demographics sufficiently stable to properly evaluate pre-placement FCEs?**
 - 2) Did the introduction of FCEs for CTVHCS workforce applicants having 45 lb lifting/carrying functional requirements result in a reduction of job-related lifting/carrying injuries?**
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Materials and Methods

Subjects for this study were CTVHCS employees (N=643) with 45 lb minimum lifting/carrying functional requirements entering on duty (EOD) between Feb 1, 1994 and Jan 31, 2000.

Personnel with an EOD between Feb 1, 1994 and Jan 31, 1997(N=291) received only a pre-placement physical exam(no FCE testing).

Materials and Methods

All employees covered in this study underwent a pre- placement physical examination.

Functional requirements for these positions are specified by the U.S. Office of Personnel Management (OPM).

Job Classifications at CTVHCS Requiring 45 Lb Minimum Lift / Carry

RN

LPN

Nurse Aide

Health Aide

Housekeeping Tech.

Food Service Tech.

Supply Tech.

Dental Tech.

Engineering Tech.

Information Management Tech.

Medical Lab Tech.

Physical/Occupational Therapist

Pharmacy Tech

Security/Police

Veterans Canteen Service Tech.

Radiology Tech.

Safety/IH Tech.

Respiratory Tech.

Recreation Tech.

Boiler Plant Operator

Painter

Blind Rehab Tech.

Prosthetic Tech.

Laundry Tech.

Materials and Methods

The functional capacity evaluation (FCE) was added to the pre-placement physical exam process in Feb 1, 1997.

Employees (N=352) with 45 lb lifting/carrying requirements hired between Feb 1, 1997 and Jan 31, 2000 received an FCE along with clinical exam. All exams were accomplished by one physician who is board certified in Occupational Medicine.

Materials and Methods

Applicants undergoing an FCE were required to sign and date a memo explaining the procedures in non-medical terms.

Department of Veterans Affairs Memorandum

To: _____

From: Chief, Occupational and Environmental Medicine Section (0120E)

Subject: Pre-Employment Physical Examinations

Re: Applicants for Employment at Central Texas Veterans Health Care System (CTVHCS)

1. As an applicant for employment at CTVHCS, you are required to meet certain functional requirements for that position. These requirements are spelled out by the U.S. Office of Personnel Management for a variety of position classifications. The functional requirements are listed on the front of the SF-78 physical exam form or may be obtained from my secretary for applicants requiring a SF-88 form.
2. Many of the positions require heavy lifting or carrying (45 pounds or greater), as one of the functional requirements. At CTVHCS, we employ a work capacity evaluation to assist in measuring an applicant's ability to safely perform such functional requirements. This evaluation, which is conducted in Occupational Therapy, is usually accomplished after your physical examination by a physician or physician extender.
3. After the completion of your complete physical examination, we render a professional recommendation to Human Resources Management Service regarding the results of your exam. In order to medically recommend you for employment at CTVHCS, you must meet the functional requirements measured in this physical examination, including the work capacity evaluation.
4. With your signature below, you have indicated that you have read this letter and that you understand the physical examination process at CTVHCS.

Charles D. Ridgley, Jr., M.D., M.S.
Charles D. Ridgley, Jr., M.D., M.S.

I have read the above letter and I understand the physical examination process at CTVHCS.

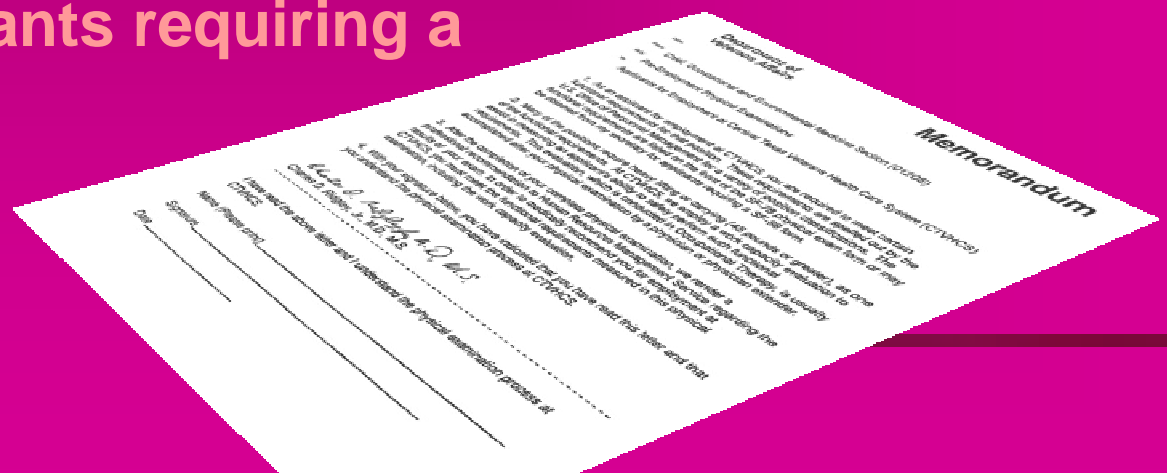
Name (Please print) _____

Signature _____

Date _____

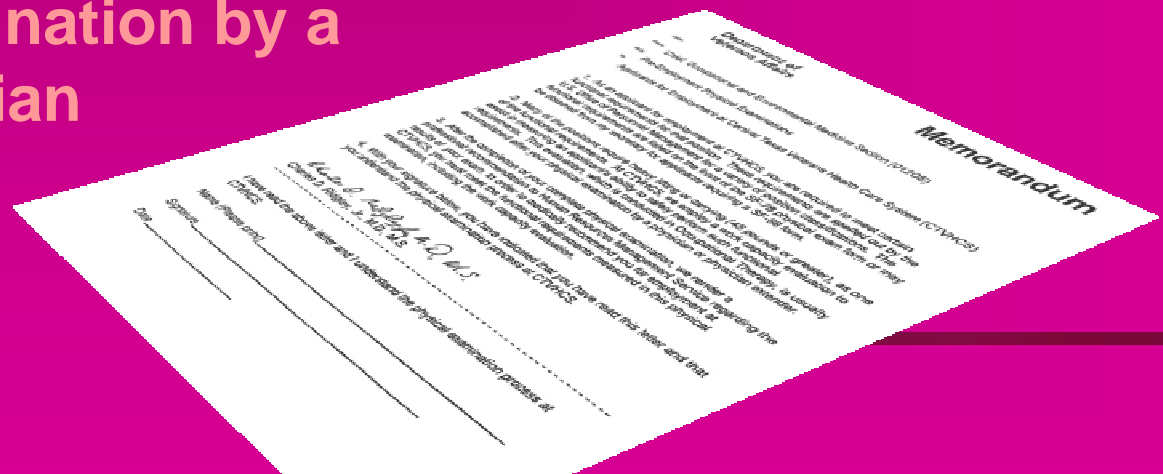
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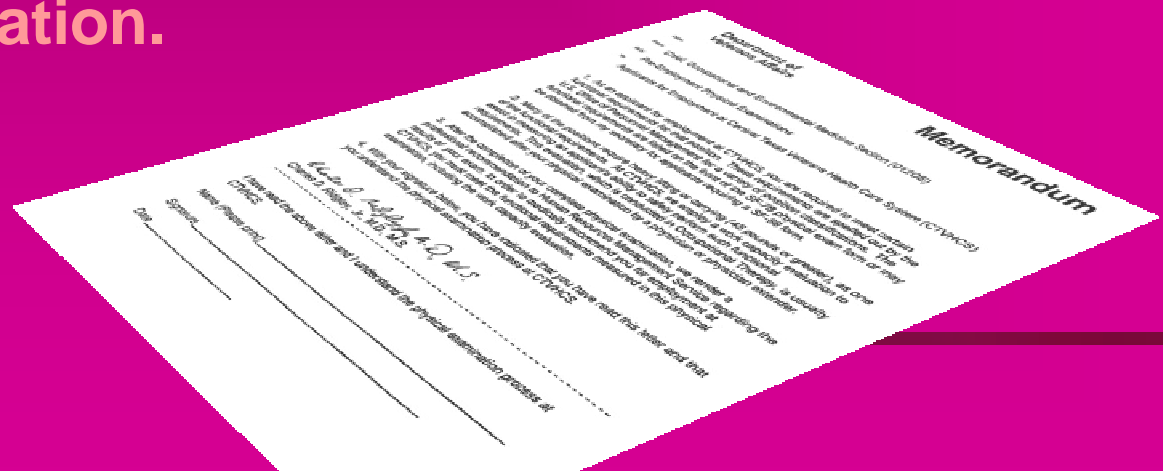
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Materials and Methods

3. After the completion of your complete physical examination, we render a professional recommendation to Human Resources Management Service regarding the results of your exam. In order to medically recommend you for employment at CTVHCS, you must meet the functional requirements measured in this physical examination, including the work capacity evaluation.



Materials and Methods

To receive a medical recommendation for hiring, all applicants must have a general medical exam with no evidence of significant clinical problems relative to the functional requirements.

In addition, applicants who were FCE tested must satisfactorily lift a 45 lb minimum load with adequate endurance and possess bilateral grip strength within functional limits, along with meeting other measured parameters.



Materials and Methods

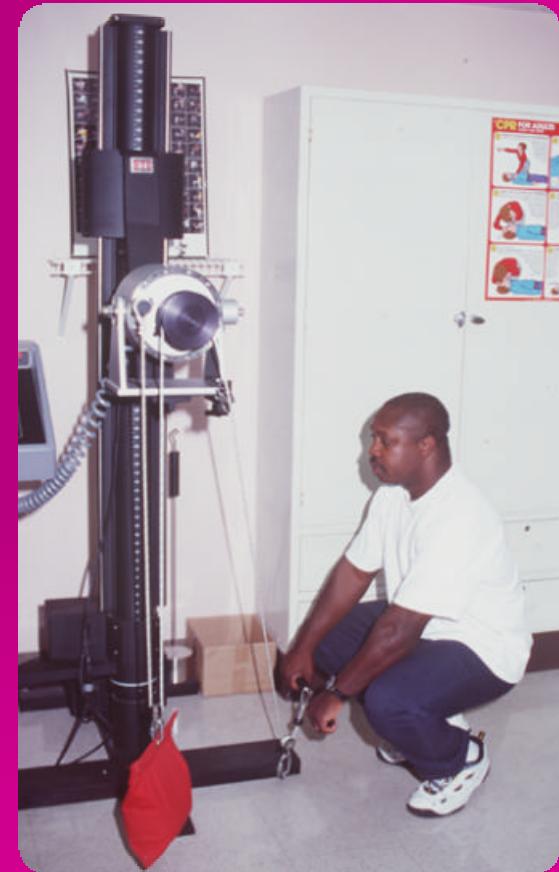
Grip strength testing was done with a Jamar dynamometer.



Materials and Methods

Lifting/carrying was measured on a BTE (Baltimore Therapeutic Equipment) work simulator.

The weight lifting requirement is the single most important measurement in the FCE.



Functional Capacity Test Instrument

Age: 41 Sex: M



Hand Dominance: Right

Height: 72 Inches Weight: 230 lbs.

Position Applied For: Housekeeping Aide

Mental Status: Alert, Ambulatory and Oriented X3

AROM: UE AROM Was WNL BILAT

Hand Coordination: (R) = 0:30 Sec. (L) = 0:30 Sec.

Norm = 0:25-0.35 Sec.

Grip Strength: (R) = 98 lbs (L) = 84 lbs Norm = 102-117 lbs

Stair Climbing: Successful 5/5 Trials

Squatting: Successful 5/5 Trials

Balance: Two Successful 30 Sec. Unilateral Stances (R) And (L)

Bending (Toe Touch): Successful 5/5 Trials

Reaching: Successful 5/5 Trials

Endurance: Good

Functional Capacity Test Instrument

Age: 41 Sex: M

Impression: UE ROM and Coordination were WNL (B). Grip strength was slightly below normal but WFL Bilaterally. No difficulty with balance, endurance, flexibility or lifting were observed. Applicant used proper body mechanics during the testing.

Lifting: Maximum knuckle to shoulder lift = 81 lbs.

Recommendation: Regular Duty.



Materials and Methods

Injury case definition: Employees with a 45 lb lifting/carrying requirement with an EOD between Feb 1, 1994-Jan 31, 2000 sustaining a lifting/carrying injury in the performance of official job duties, medically evaluated and/or treated for that injury and filing a CA-1.

The study included employees who were hired in the respective time frames but separated (retirement, resignation, termination) prior to the Jan 31, 1997 and Jan 31, 2000) dates.

Data were collected from Occupational Health records and Human Resource Management Service (HRMS).

Data Obtained From Occupational Health Records and HRMS:

- 1) Functional capacity tested (yes or no)
- 2) Date of birth
- 3) Gender
- 4) Height
- 5) Weight
- 6) EOD
- 7) Job category
- 8) Full or part time duty status
- 9) Injury (yes or no) with a maximum of 4 injuries in this time frame
- 10) Time of injuries in 24-hour time
- 11) Lost time (in days)
- 12) Type of treatment
- 13) Light duty (in days)
- 14) Physical or occupational therapy sessions
- 15) Date(s) of injuries
- 16) Date of completion of study (unless separated)
- 17) Number of lbs lifted (if an FCE tested employee)
- 18) Grip Strength (lbs)
- 19) Functional range of grip strength (lbs)
- 20) Hand Dominance

Two New Categories Created:

Med Other:

Health Aide

Blind Rehab Tech.

Medical Lab Tech.

Nursing (Not specified)

Dental Tech.

Security/Police Officer

X-Ray Tech.

Respiratory Tech.

Recreation Tech.

Prosthetic Tech.

Support:

Supply Tech.

Engineering Tech.

Laundry Tech.

Pharmacy Tech.

Safety/IH Tech.

Information Management

Vets. Canteen Service Tech.

Boiler Plant Operator

Painter

Seven Job Categories for Analytical Purposes:

- 1) Registered Nurse
 - 2) Nurse Aide
 - 3) Licensed Practical Nurse
 - 4) Housekeeping Aide
 - 5) Food Service Tech
 - 6) Med Other
 - 7) Support
-

Injury Classification (ICD-9 Codes)

724.2 = Back Strain

540.9 = Shoulder Strain

847.0 = Cervical Strain

842.01= Wrist Strain

550.9 = Abdominal Wall Strain

786.50= Pectoral/Intercostal Strain

Type of Treatment

1. No Treatment
 2. NSAIDS
 3. Muscle Relaxants
 4. Narcotics
 5. Heat/Ice
 6. Rest
 7. Personal Physician (Not Treated by VA)
-

Materials and Methods

Data were entered into an Excel spreadsheet. To ensure employee confidentiality, all identifying characteristics such as name and SSN were removed.

Besides descriptive statistics of the populations, analytical comparisons were accomplished using SPSS software.

Results - General Comments

This was a historical cohort study: outcomes have all occurred before the start of the investigation, cohorts have been established, and their experience assessed from existing records.

Rates of Injury

Raw (numerator) injury numbers do not give us an accurate assessment of injury (as a morbidity measurement).

It is imperative to know how long after EOD each employee was at risk for an injury (max of 3 years).

If the employee left the study because of routine separation (retirement, new job) or medical disability, this concept becomes especially important.

Rates of Injury

Rates of morbidity (or mortality) form the essential ingredients in vital statistics methodology.

$$\text{RATE} = \frac{\text{\# injuries}}{\text{time at risk as weeks of work}} \times 10,000$$

Rates of Injury

One of the main difficulties in the comparison of crude rates over time is that basic characteristics of the population may also differ substantially, particularly with regard to age.

Adjustment will decrease the potential confounding effect of age.

Rates of Injury

Confounding: variables whose effect is entangled with the effect of other variables.

For a variable to be a confounder, it must be related to the disease or condition of interest and to the risk factor being investigated.

Results

In this study, the first question concerned stability of the cohort over a 6-year period.

The five following tables give descriptive statistics, important to cohort stability.

The maximum number of injuries recorded for an employee was four (4).

Descriptive Statistics

TESTED

	Frequency	Percent
No	291	45.3
Yes	352	54.7
Total	643	100.0

GENDER

	Frequency	Percent
F	351	54.6
M	292	45.4
Total	643	100.0

Descriptive Statistics

		Tested?			
			N	Y	Total
Gender	F	Count	171	180	351
		% within Tested?	58.8%	51.1%	54.6%
	M	Count	120	172	292
		% within Tested?	41.2%	48.9%	45.4%
Total		Count	291	352	643
		% within Tested?	100.0%	100.0%	100.0%

Descriptive Statistics

Number of Workers by Decade of Birth

		Frequency	Percent
	1930s	10	1.6
	1940s	111	17.3
	1950s	215	33.4
	1960s	145	22.6
	1970s	43	8.2
	Total	534	83.0
Missing	Unknown	109	17.0
Total		643	100.0

Descriptive Statistics

First Injury Tabulation by ICD-9 Classification

	FCE Non-tested (291)	FCE Tested (352)
540.9	10 (3.4%)	1 (0.32)
550.9	1 (0.3%)	0 (0%)
724.2	32 (11.0%)	11 (3.1%)
786.5	0 (0%)	1 (0.3%)
842.0	2 (0.7%)	0 (0%)
847.0	3 (1.0%)	1 (0.3%)

Descriptive Statistics

Second Injury Tabulation By ICD-9 Classification

	FCE Non-tested (291)	FCE Tested (352)
540.9	1 (0.3%)	0 (0%)
724.2	5 (1.7%)	1 (0.3%)

(Re the third and fourth injuries: there was 1 (0.3%) injury each, respectively, in the FCE non-tested cohort and none in the FCE cohort)

Injury Rate Comparisons

Female Crude Injury Rates

	FCE Tested	FCE Non-tested
	Injuries/10,000 Weeks	Injuries/10,000 Weeks
ALL	6.7	11.1
RN	5.0	9.2
LPN	18.0	17.7
Nurse Aide	0.0	68.9
Med Other	4.0	17.3
Food Service	18.2	0.0
Housekeeping	0.0	0.0
Support	0.0	0.0

Injury Rate Comparisons

Female Age Adjusted Injury Rates

	FCE Tested Injuries/10,000 weeks	FCE Non-tested Injuries/10,000 weeks
ALL	5.6	11.2
RN	4.6	9.1
LPN	18.5	17.6
Nurse Aide	0.0	36.1
Med Other	2.8	17.0
Food Service	13.7	0.0
Housekeeping	0.0	0.0
Support	0.0	0.0

Injury Rate Comparisons

Female Age Adjusted Injury Rates Compared

Mantel Haenszel	All	RN	LPN	Nurse Aide	Med Other	Food Service	HSKG	Support
Rate Ratio	0.63	0.53	0.0	0.0	0.22	---	---	---
Lower 95% C.I.	0.25	0.15	---	---	0.02	---	---	---
Upper 95% C.I.	1.64	1.94	---	---	1.96	---	---	---

Injury Rate Comparisons

Male Crude Injury Rates

	FCE Tested Injuries/10,000 Weeks	FCE Non-tested Injuries/10,000 Weeks
ALL	4.8	7.0
RN	12.0	2.1
LPN	0.0	10.2
Nurse Aide	0.0	16.1
Med Other	0.0	9.8
Food Service	5.0	7.3
Housekeeping	2.5	6.7
Support	20.3	0.0

Injury Rate Comparisons

Male Age Adjusted Injury Rates

	FCE Tested Injuries/10,000 weeks	FCE Non-tested Injuries/10,000 weeks
ALL	5.1	6.2
RN	14.4	2.4
LPN	0.0	9.6
Nurse Aide	0.0	15.3
Med Other	0.0	10.9
Food Service	3.6	7.4
Housekeeping	3.0	6.0
Support	12.1	0.0

Injury Rate Comparisons

Male Age Adjusted Injury Rates Comparison

Mantel Haenszel	All	RN	LPN	Nurse Aide	Med Other	Food Service	HSKG	Support
Rate Ratio	0.77	4.35	0.0	0.0	0.0	0.63	0.51	---
Lower 95% C.I.	0.29	0.53	---	---	---	0.04	0.06	---
Upper 95% C.I.	2.10	35.21	---	---	---	10.27	4.59	---

Discussion

- ❖ Differing physicians (with multiple clinical backgrounds) performing pre placement exams (1994-97) vs. one physician (board certified in occupational medicine) performing exams (1997-2000).
- ❖ Rates of injury versus raw number of injuries.
- ❖ Missing data when employees leave Federal service (21 separated employees with no knowledge of job category).
- ❖ 643 medical records in 4 integrated care facilities and 3 communities based outpatient clinics.

Discussion

- ❖ Coding errors in the data base (57 variables x 643 employees).
- ❖ Classification errors if employee moves from a heavy lifting job to sedentary job without info provided to Occupational Health.
- ❖ This study demonstrated a reduction in the rate of lifting/carrying injuries for the FCE tested group compared to the FCE non-tested group when all job categories were considered.
- ❖ This rate reduction for employees working in positions at high risk for injury was consistent with the studies of Chaffin and others.

Discussion

- ❖ When a job category specifies comparisons of age adjusted injury were accomplished, the reductions - if any - in the rate of injuries were sometimes less obvious.
- ❖ Registered Nurses, the largest group in the study, demonstrated an injury rate reduction that was not statistically significant.
- ❖ The reduction in the Med Other must be carefully considered because this is a “lumping” of some job categories that have some heterogeneity.

Discussion

- ❖ **Small job categories have fewer employees and few if any injuries and may be statistically unstable.**
- ❖ **Age adjustment reduced any confounding effect from this variable.**
- ❖ **This is a study in progress. Many of the other variables listed previously have not been analyzed at this point.**
- ❖ **Multivariate analysis using Poisson regression will be done. Poisson regression is the appropriate regression tool to determine statistical modeling of rare events. In addition, an economic analysis of the injury data will be done**

Discussion

- ❖ **Our plan is to complete this study by August 2001**
 - ❖ **We believe that the overall injury rate decrease will result in a reduction in the injury compensation costs, even when the FCE cost is factored.**
 - ❖ **There should be additional decreases in the injury costs when we consider applicants not recommended for hiring (37).**
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