FINAL PERFORMANCE REPORT

Functional Limitations and Recovery From At-Work Injuries
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LIST OF ABBREVIATIONS

CI	Confidence Interval
HAQ	Stanford University Health Assessment Questionnaire
HR	Hazard Ratio
LE	Lower Extremity
SD	Standard Deviation
SF-36	Medical Outcomes Short Form-36
UE	Upper Extremity
VAS	Visual Analog Scale

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ABSTRACT

Problem: Occupational injuries can induce functional limitations in workers both at home and in work settings. In this study, two instruments, the Stanford Health Assessment Questionnaire (HAQ) and the Short-Form 36 (SF-36) were used to document both the immediate and short-term effects of injuries in municipal workers who suffered mainly from strains and sprains.

Methods: Telephone interviews were conducted with injured workers approximately one week, two weeks, one month, and three months following their injuries. One hundred and fourteen subjects agreed to participate in the study; 90 workers completed at least one useable interview; 78 completed all four interviews. Cox hazards proportional models were used to predict lost time from work, and to test the sensitivity of the instruments to within-subject change and return to work.

Results: The mean HAQ scores indicated moderate disability during the first week of recovery. At one-month following the injuries, workers still demonstrated moderate functional limitations in ability to complete errands and household chores. Moderate disability, as indicated by self-report of pain, decreased sense of well being, fatigue, and sleep problems, also persisted up to one-month. Except for measurement of general health and mental health, the mean SF-36 scores on the six remaining subscales were well below the population mean scores up to one-month following the injuries. Scores for physical functioning, role-physical, and bodily pain continued to differ significantly from population mean scores three-months following the onset of injury. HAQ scores and subscales of the SF-36, physical functioning, role physical, and bodily pain were highly correlated at each time period ($r = >.59$ for all, $p = <.001$). Hazard ratios for lost days were calculated for the physical health component summary score of the SF-36, as well as the following subscales: bodily pain, physical functioning, and role physical. Each measure demonstrated a significantly elevated risk of lost time for scores indicating poorer functioning. For example, using the physical component summary scale of the SF-36, subjects whose scores were one standard deviation lower were more than twice as likely to experience an extended lost time episode than those with higher scores (hazard ratio = 2.36, 95% C.I. = 1.73 – 3.22, $p = <.001$).

Conclusions: Limitations in physical functioning, physical role, and bodily pain persisted in workers after relatively minor workplace injuries despite a 91% return to work rate. Both the HAQ and the physical functioning subscale of the SF-36 are sensitive to change in function related to acute occupational injuries and both are moderately correlated with work days lost.

Significant Findings

Purpose of Study: This longitudinal study was undertaken to describe the immediate and short-term effects of minor to moderate occupational injuries on affected municipal workers. Two measures, the Health Assessment Questionnaire [HAQ] (Fries, Spitz, Kraines, & Holman, 1980; Ramey, Fries, & Singh, 1995) and the Acute Version, Medical Outcomes Short Form-36 [SF-36] (Ware, Snow, Kosinski, & Gandek, 1993) were prospectively administered to injured workers to ascertain their injury-related functional limitations and general health perceptions. In addition, injured workers were interviewed about lost work-time, health utilization, job performance, job worries, and effects of the injury on family life.

The specific aims of the study were to:

1) Test the sensitivity of the HAQ and SF-36 over time to changes in function, fatigue, pain, and other symptoms by administering it to a diverse sample of injured municipal employees, as a measure of the non-economic costs of work-related injury;
2) Determine the relationship between the HAQ and SF-36 scores, health care costs, and lost days as a measure of the economic impact of work-related injuries.

Methods: In this study, information was obtained through structured telephone interviews, visual analog scales, and from medical records. Injured workers were recruited through one occupational health clinic for municipal workers. Participants were interviewed by telephone one week (Time 1), two weeks (Time 2), one month (Time 3), and three months (Time 4) following their injury. There were no differences between those who participated and those lost to follow-up with regard to age, the only variable for which comparisons could be made. Those lost to follow-up were more likely to have suffered an assault compared with subjects, but this difference was not significant.

Study Sample: Ninety injured municipal workers participated in this study. The mean age of subjects was 46.6 years (S.D. = 10.1) and 56% were male. Overall, the ethnic/racial distribution was similar to the ethnic representation of workers employed in the municipality, as was the job classification (Table 1). The most frequently represented occupation was transportation workers (22%), followed by public safety workers (18%), nurses and nursing aides (15%), crafts workers, operatives and laborers (10%), park and zoo workers (10%), administrative and technical employees (9%), other (9%), and teachers and school workers (6%). Ninety-one percent of the workers had returned to work by the conclusion of the study.

Overexertion (31%) and slips, trips and falls (22%) were the primary mode of exposure. Sprains and strains of the upper and lower extremities (27%) and spinal sprains and strains (24%) comprised over 50% of the injuries (Table 2). On average, workers sustained 2.33 injuries per event.

Functional Limitations: The mean disability index score of the HAQ one week following the onset of injury (Time 1) was 1.12 (S.D. = .65) and at three months after the injury (Time 1) was 0.36 (S.D. = .52). Higher numbers indicate more limited function (Table 3). Pain, well being,

fatigue, and problems with sleep, measured by use of visual analog scales, demonstrated statistically significant negative linear trends over time (all p values <. 001) [Figures 1 and 2].

Except for "General Health," the injured workers' mean scores for the SF-36 subscales (physical functioning, physical role, bodily pain, vitality, social functioning, emotional role, and mental health) were below the mean population scores until one month (Time 3) following their injury. Three of the subscale scores, physical health, physical role, and bodily pain, demonstrated a statistically significant difference from the population mean scores up to three months following the onset of injury (Table 4).

Lost Time and Relationship to SF-36 and HAQ Scores: Hazard ratios (HR) for lost days were calculated for the physical health component summary score of the SF-36, three SF-35 subscales (bodily pain, physical functioning, and role physical), as well as the HAQ and the HAQ fatigue score, measured by a visual analog scale (VAS). Each measure demonstrated a significantly elevated risk of lost time for scores indicating poorer functioning (Table 5). In the second set of models where both the absolute values and change in scores were tested, all predictor variables remained statistically significant for the absolute values. For both HAQ variables (disability and fatigue), however, both the absolute score and the change in score were independently predictive of return to work. When the SF-36 physical function measure and the HAQ were tested simultaneously, each independently predicted lost time suggesting that they measure different constructs.

The summary physical health component scale, the physical functioning subscale and the disability index of the HAQ were all moderately correlated with lost days. General health, emotional role functioning, and mental health did not demonstrate any relationship with lost time at any time period. Visual analog pain, fatigue, and overall sense of well being scores were also statistically significantly correlated with lost days at some to all of the time periods studied

Age, years of education, marital status and gender were not correlated with lost days. Age and education were not associated with any HAQ scores, and education was not correlated with any of the SF-36 subscales at any time period. At Time 4, however, age demonstrated low but statistically significant negative correlations with role physical (r = -.26, p = .02), and vitality (r = -.26, p = .02).

Correlations between disability HAQ scores and the SF-36 subscales, physical functioning, physical role functioning, and bodily pain demonstrated a moderate to high degree of correlation at each measurement (r = ≥ -.59, p = <.001 at each time period). The bodily pain scale of the SF-36 was also moderately to highly correlated with the VAS for pain of the HAQ (r = > -.64, p = <.001 at each time period).

The HAQ VAS pain and fatigue measurements were highly correlated at Time 2 - 4 (r = > .65, p = <.001 at each time). Pain and sleep followed a similar pattern with moderate associations at Time 1 and 4, and high correlations at Time 2 and 3 (r = >.70, p = <.001 at each time). Pain was also moderately to highly correlated with overall sense of well being (r = .58 to .81, p = <.001 at each time period). Fatigue and well being, and sleep and well being were also highly correlated (r = >.60, p = <.001).

Family and Work Effects: During the first week of injury, almost 70% of the injured workers needed or wanted help with personal care, household duties, or other tasks. At Time 4, approximately 20% continued to need or want assistance in these areas, and 14% reported that their injury caused family members to miss social activities and feel more stressed during that

week. At Time 2, one-half of the workers reported that family members had changed the amount of time they spent on household duties and one-quarter reported this at Time 4. At Time 2 and 3, those workers who required help reported that their family members were spending approximately 5 hours more per week performing household duties than usual. In addition at Time 2, friends or family members who lived outside the home reportedly spent approximately 8 hours more per week assisting them than usual.

At Time 4, 16% of the workers reported that they sometimes or often felt they couldn't support their family, 25% were sometimes or often afraid that they would be unable to earn a living, and 38% experienced some worry that their injury would get worse if they continued to work. At Time 2, approximately 25% of the workers reported that their motivation to work and that the quality of their work was less than usual. Approximately one-third reported that their job satisfaction has decreased and that they felt they were unable to pull their own weight at work. At Time 4, approximately 17% continued to report experiencing less job satisfaction.

Usefulness of Findings: This study adds to the body of knowledge about the economic and non-economic effects of work-related injuries by prospectively evaluating functional limitations and their effect on the family and in the work setting. This study evaluated these effects immediately following the event and during the short-term recovery period. Despite a 91% return to work rate, injured workers scores on three of the subscales of the SF-36 were well below the population norms at three-months after the injury event. Injured workers with one standard deviation of change were almost twice as likely to experience an extended absence from work when compared with workers with fewer functional limitations for every variable of the SF-36 tested.

This study used previously validated questionnaires to quantify patient-centered outcomes after relatively minor occupational injuries. The SF-36 and HAQ have been demonstrated to be responsive to clinical changes in varying conditions, and the SF-36 has been shown to demonstrate positive clinical improvement in musculoskeletal disorders (Beaton, Hogg-Johnson, & Bombardier, 1997). In this study, both were effective measures of functional limitations, though the SF-36 seemed to provide a better overall view of subjects' perceived health. On the other hand, the HAQ provided better within-subject sensitivity when predicting lost days.

It is important to study municipal workers since they are employed in a wide variety of occupations and high-risk work settings including transportation, protective services, and health care. Injuries seen in municipal workers range from minor cuts and abrasions to more serious injuries such as burns and fractures. The primary aims of occupational health services for municipal workers are to provide appropriate care and to facilitate the return to work of healthy, productive employees (Higgins, Ezike, & Orris, 2001). An understanding of the risks associated with these occupations is critical to the development of job-specific injury and illness prevention programs aimed at decreasing occupational injuries.

Information regarding the effects of occupational injuries on symptoms and functional status is sorely needed (Atlas, Singer, Keller, Patrick, & Deyo, 1996; Pransky & Himmelstein, 1996). This information is important since decreases in function may assist in the early identification of disability. The personal, employer, and community costs associated with prolonged work-related injuries and disability are high (Leigh, Markowitz, Fahs, Shin, & Landrigan, 1997; Robinson, Fulton-Kehoe, Martin, & Franklin, 2001).

In this study, functional limitations following minor to moderate occupational injuries were found to be disruptive and to decrease the quality of life of injured workers and their families. Prospective studies with a longer follow-up period should be conducted to assess the long-term recovery period from occupational injuries. Patient-relevant outcomes such as those measured in this study should be collected to better help clinicians develop treatment plans that accommodate their limitations and maximize self-care. Both the HAQ and the SF-36 are brief health status measures that are practical for use in clinical settings. The HAQ offers ease of scoring and contains questions about upper extremity function. The SF-36 provides a more complete overview of health status but scores must be computer-generated. Assessment of functional limitations at home and in the work setting has an important, but not yet thoroughly explicated role in health care. Further more thoughtful research will help to clarify the role of functional evaluation in clinical settings and in constructing and implementing more effective treatment plans (Baker & Johnston, 2000).

Scientific Report: A manuscript describing the overall conduct of this study is attached for your records. This manuscript has been submitted for publication in a peer-reviewed journal. This manuscript contains an analysis of the non-economic costs of workplace injuries as evaluated by this study. The article also addresses the strengths and limitations of using two well-tested standardized instruments, in occupational health settings for the purpose of evaluating functional limitations and developing work rehabilitation plans of care. A second article regarding family and work effects is in progress and is expected to be completed soon.

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Publications:

In Review:

Gillen, M., Jewell, S., Faucett, J., Leigh, J.P., & Yelin, E. (2001). Functional limitations and well being in injured workers: A longitudinal study (In review: Journal of Occupational and Environmental Medicine).

In Preparation:

Gillen, M., Leigh P., & Jewell, S. Work limitations and family caregiving in injured workers: A longitudinal study.

Scientific Presentations

2001 Occupational and Environmental Medicine Grand Rounds, University of California, San Francisco, "Functional Limitations, Well Being and Family Caregiving in Injured Workers: A Three-Month Follow Up Study."

2001 American Public Health Association, Atlanta, GA. "Functional Limitations and Well Being in Injured Workers: A Three Month Follow Up Study."

Appendices – Tables and Figures

Table 1. Occupation of participants (n = 90) compared with race/ethnicity and occupation of municipal employees (N = 29,914)

Occupation	Study participants (%)	Municipal employees (%)
Professional/Technicians	24	36
Protective Services	18	16
Paraprofessional	9	7
Office/clerical	6	11
Skilled craft	12	8
Service/maintenance	31	17
Other/unknown/elected/exempt	0	5
Total	100%	100%

Table 2. Description of Injuries (n = 166 injuries in 71 subjects)*

Description of Injuries	Number	Percent
UE and LE strains/sprains**	42	25
Spinal strains/sprains and back pain	41	25
Contusions (face, trunk, UE, LE) and open wounds	36	22
Other	19	11
Bursitis, tenosynovitis	15	9
Fractures, dislocations	13	8

* Some subjects experienced more than one injury

** UE = upper extremity, LE = lower extremity

Table 3. Mean HAQ Summary Scores and Subscale Scores (SD) at One-Week, Two-Weeks, One-Month, and Three-Months Following Occupational Injury (n = 78)

HAQ Scores	One-week Time 1	Two-Weeks Time 2	One-Month Time 3	Three-Months Time 4
Summary Score	**1.12 (.65)**	**.86 (.64)**	**.56 (.57)**	**.36 (.52)**
Dressing and grooming	1.22 (.89)	.88 (.84)	.40 (.67)	.28 (.60)
Arising	1.10 (.80)	.79 (.73)	.49 (.64)	.32 (.59)
Eating	.51 (.92)	.36 (.66)	.27 (.55)	.14 (.42)
Walking	1.03 (.94)	.72 (.85)	.49 (.75)	.32 (.63)
Hygiene	1.12 (.94)	.90 (1.01)	.58 (.88)	.31 (.71)
Reach	1.51 (.98)	1.19 (.91)	.81 (.87)	.41 (76)
Gripping	.78 (.99)	.65 (.89)	.44 (.78)	.29 (.71)
Activities and errands	1.65 (.95)	1.37 (1.05)	1.03 (1.02)	.82 (98)

Table 4. SF-36 Scores at One-Week, Two-Weeks, One-Month, and Three-Months Following Occupational Injury (n = 78) Compared with General Population Mean Scores (N = 2,474)

SF-36 Subscale	Population Mean Scores	One-Week (Time 1)	Two-Weeks (Time 2)	One-Month (Time 3)	Three-Months (Time 4)
Physical function	84.2 ± 23.3	49.5± 30.9*	58.2 ± 29.3*	68.1 ± 27.1*	76.4 ± 25.3**
Role physical	81.0 ± 34.0	18.0 ± 34.4*	29.9 ± 40.3*	44.9 ± 42.9*	63.6 ± 41.3*
Bodily pain	75.2 ± 23.7	42.0 ± 22.6*	50.8 ± 24.8*	61.1 ± 24.8*	69.2 ± 23.1***
General health	72.0 ± 20.3	73.9 ± 18.5	72.7 ± 18.2	73.5 ± 17.4	75.3 ± 16.2
Vitality	60.9 ± 21.0	48.5 ± 23.2*	53.9 ± 22.2**	58.2 ± 22.2	62.6 ± 20.2
Social function	83.3 ± 22.7	62.0 ± 30.1*	68.3 ± 29.5*	77.4 ± 25.8***	84.5 ± 22 1
Role emotional	81.3 ± 33.0	63.7 ±43.7*	62.4 ±45.4*	71.8 ± 39.1***	85.0 ± 32.1
Mental health	74.7 ± 18.1	70.6 ±18.7	71.2 ±21.3	74.3 ± 18.5	79.3 ± 16.8***

*$p = \leq 001$; ** $p = \leq .01$; *** $p = <.05$ (One-sample t-test compared to population means scores)

Table 5. Hazard Ratios For Lost Time From Work Associated With SF-36 and HAQ† Functional Limitation Scores Using One Standard Deviation of Change‡ (n = 59)

	Most Recent Value (Model 1)	Most Recent Value (Model 2)	Most Recent Change (Model 2)
Measure	Hazard Ratio (95% C.I.§ §)	Hazard Ratio (95% C.I. §)	Hazard Ratio (95% C.I. §)
Physical Component Summary	2.36*** (1.73 – 3.22)	2.16*** (1.54 – 3.03)	1.01 (0.47 – 2.16)
Physical Function	1.85*** (1.44 – 2.38)	1.70 *** (1.32 – 2.21)	1.44 (0.80 – 2.58)
Bodily Pain	2.32*** (1.68 – 3.19)	1.78*** (1.29 – 2.46)	2.03 (0.95 – 4.36)
Role Physical	2.08 *** (1.54 – 2.81)	1.82*** (1.32 – 2.49)	0.96 (0.51 – 1.83)
HAQ Disability	0.52*** (0.37 – 0.72)	0.85 **(0.75 – 0.96)	0.79* (0.65 – 0.96)
VAS Fatigue¶	0.64** (0.47 – 0.87)	0.91* (0.84 – 0.99)	0.85* (0.75 – 0.97)

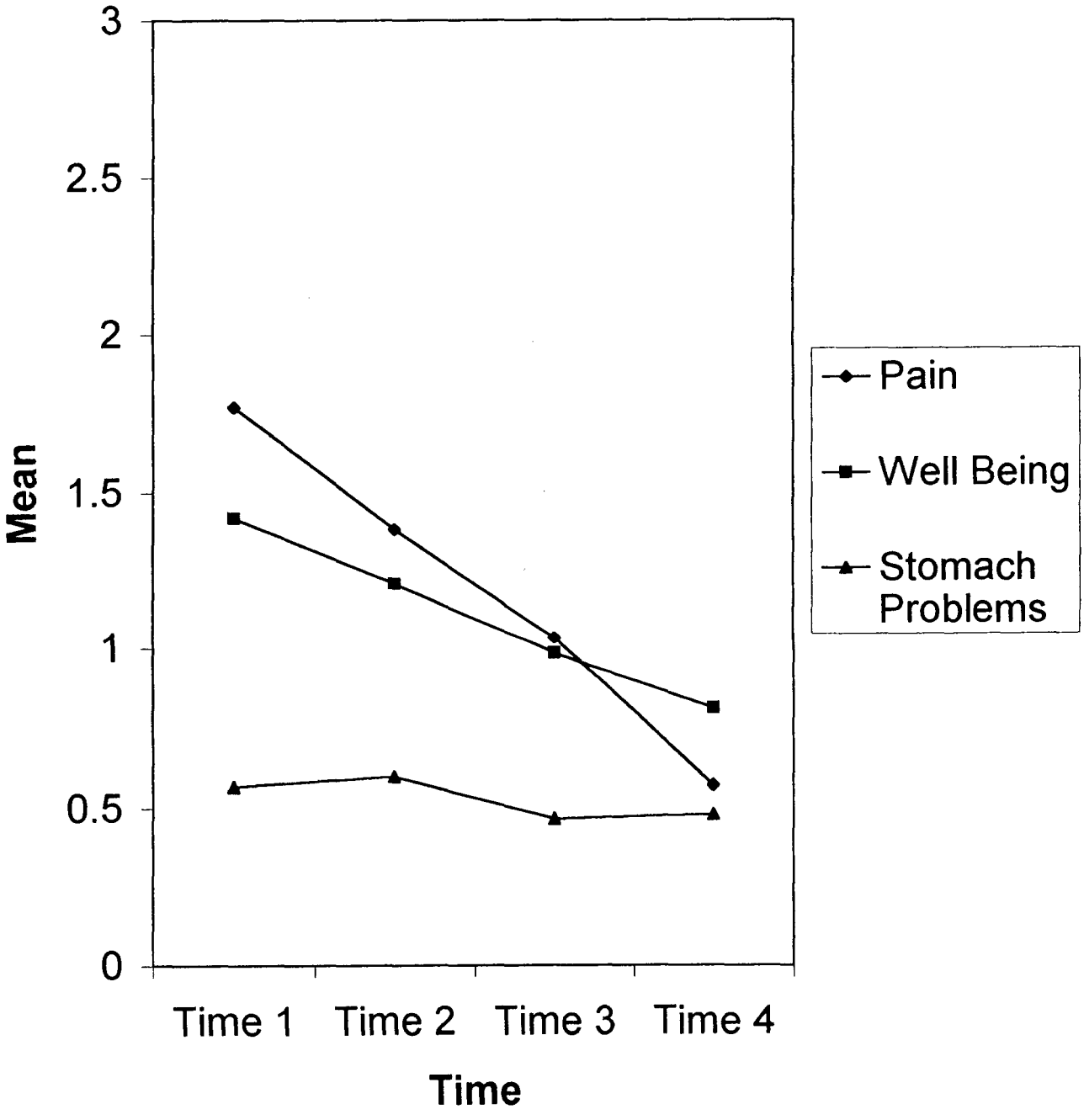
†SF-36 – Short Form-36; HAQ – Health Assessment Questionnaire

‡ Note: Calculated using Published Norms for the SF-36 (Ware et al., 1993), and observed baseline scores for the HAQ.

§ C.I. – Confidence Interval; ¶VAS – Visual Analog Scale

* $p = <.05$; ** $p = <.01$; *** $p = <.001$

Pain, Well Being and Stomach Problems Over Time (n=67)



Fatigue and Sleep Problems Over Time (n=67)