EVALUATION OF BACK PROBLEMS AMONG EMERGENCY MEDICAL SERVICES PROFESSIONALS

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By
Jonathan R. Studnek, MS, NREMT-P

***

The Ohio State University
2008

Dissertation Committee:
Professor J. Mac Crawford, Advisor
Professor Amy K. Ferketich
Professor Michael L. Pennell
Professor J. R. Wilkins III

Approved by

Advisor
Graduate Program in Public Health
ABSTRACT

The aims of this dissertation were to: 1) Describe the work-life and demographic characteristics, of Emergency Medical Services (EMS) professionals, associated with reporting recent back pain; 2) Estimate back pain severity and factors associated with changes in back pain severity among currently working EMS professionals; 3) Evaluate occupational injuries in an urban EMS system before and after implementation of mechanical stretchers.

In order to complete the above objectives two data sets were analyzed. The first two objectives utilized the Longitudinal EMT Attributes and Demographics Study (LEADS) Health and Wellness Follow-up Survey. Participant selection for this study was based on prior back problem status as indicated in past LEADS efforts. LEADS data from 2004-2006 were queried and all individuals reporting a back problem in any year (n=1,009) were selected as potential cases. A random sample of 1,050 non-injured participants was selected as the probable control population.

To complete the third objective, an epidemiologic assessment of an intervention to prevent occupational injury was performed. Occupational injury data for this study were obtained from Austin Travis County EMS (A/TCEMS) Record Management System (RMS). In December 2006, A/TCEMS purchased and placed into service battery operated hydraulic patient stretchers. The study period was from 01/01/1999-04/30/2008 with the pre-intervention period considered the time between 01/01/1999 – 12/31/2006,
and the post-intervention time period being any date after and including 01/01/2007. A list of 1,047 active and separated employees was used to derive the amount of person-time at risk during the pre and post intervention period.

Results from study one and two indicate that there were work-life, health, and demographic characteristics associated with reporting recent back pain and the severity of reported pain. Individuals who reported prior back problems or fair/poor health were more likely to report current pain, with odds ratios of 2.8 (95% CI 2.1-3.9) and 4.1 (95% CI 2.2-7.7), respectively. Self reported health was also found to be significantly associated with changes in Aberdeen Back Pain Scale (ABPS) scores. Individuals who reported fair/poor health had the largest unit change in ABPS at 10.1 (7.2 – 12.9).

Regarding the third objective there were 1,478 injuries reported during the observation period with an overall incidence rate of 52.9 injuries per 100 full time employees (FTE) per year. The incidence rates pre-intervention and post-intervention were 61.1 and 28.8 per 100 FTE, with a corresponding rate ratio (RR) of 0.47 (95% CI 0.41 - 0.55). The lowest rate ratio noted was among the sub-category of stretcher related injuries (RR 0.30; 95% CI 0.17 – 0.52).

The results of this dissertation indicated that work-life, health, and demographic characteristics may be associated with recent back pain. Also, potential ergonomic interventions may reduce the burden of back injury among EMS professionals. Future
studies should further investigate the impact of evidence–based ergonomic interventions, on occupational injuries, among EMS professionals utilizing more robust study designs, such as randomized trials.
Dedicated to Angela, Emma, and Abigail
I wish to thank my adviser, Mac Crawford, for taking the time to guide me through this process. Without his mentorship this work would not have been possible. I am deeply grateful. I would also like to thank Amy Ferchetich for her support; she has been a great teacher and mentor. Finally, I would like to thank Michael Pennell and Jay Wilkins for their insight and contributions to this dissertation process.

I am grateful to the National Registry of EMTs, specifically William E Brown Jr. and the board of directors, for deciding to support EMS research through the creation of a fellowship program. The education I have obtained through this fellowship is truly priceless. I also thank Gregg Margolis who has supported me and provided direction throughout this dissertation and the entire fellowship. I am also appreciative of the support from the rest of the staff at the National Registry, but most importantly from my friend Tony Fernandez, thanks for being there.

Most importantly I need to acknowledge the support I have received from my family, especially my wife Angela, without her support none of this would have been possible.
VITA

August 30, 1978 .........................................................Born – Anchorage, AK

2002 .................................................................B.S. Emergency Medical Services
University of New Mexico

2008 .................................................................M.S. Public Health
The Ohio State University

1999-2004 ..........................................................EMT/Paramedic
Albuquerque Ambulance Service
Albuquerque, NM

2004-present ......................................................EMS Research Fellow
The National Registry of EMTs
Columbus, OH

PUBLICATIONS

Research Publications


**FIELDS OF STUDY**

Major Field: Public Health
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>ii</td>
</tr>
<tr>
<td>Dedication</td>
<td>v</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>vi</td>
</tr>
<tr>
<td>Vita</td>
<td>vii</td>
</tr>
<tr>
<td>List of Tables</td>
<td>xi</td>
</tr>
<tr>
<td>List of Figures</td>
<td>xiii</td>
</tr>
<tr>
<td>Chapters:</td>
<td></td>
</tr>
<tr>
<td>1. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>2. Back Problems among Emergency Medical Services Professionals:</td>
<td>5</td>
</tr>
<tr>
<td>The LEADS Health and Wellness Follow-Up Study</td>
<td></td>
</tr>
<tr>
<td>2.1 Introduction</td>
<td>5</td>
</tr>
<tr>
<td>2.2 Methods</td>
<td>7</td>
</tr>
<tr>
<td>2.2.1 Variable Description</td>
<td>8</td>
</tr>
<tr>
<td>2.2.2 Data Analysis</td>
<td>12</td>
</tr>
<tr>
<td>2.3 Results</td>
<td>13</td>
</tr>
<tr>
<td>2.4 Discussion</td>
<td>23</td>
</tr>
<tr>
<td>2.5 Strengths and Limitations</td>
<td>25</td>
</tr>
<tr>
<td>2.6 Conclusions</td>
<td>28</td>
</tr>
<tr>
<td>3. Quantifying the Severity of Back Pain among</td>
<td>29</td>
</tr>
<tr>
<td>Among Emergency Medical Services Professionals</td>
<td></td>
</tr>
<tr>
<td>3.1 Introduction</td>
<td>29</td>
</tr>
<tr>
<td>3.2 Methods</td>
<td>30</td>
</tr>
<tr>
<td>3.2.1 Variable Description</td>
<td>31</td>
</tr>
<tr>
<td>3.2.2 Data Analysis</td>
<td>32</td>
</tr>
<tr>
<td>3.3 Results</td>
<td>33</td>
</tr>
<tr>
<td>3.4 Discussion</td>
<td>41</td>
</tr>
<tr>
<td>3.5 Limitations</td>
<td>43</td>
</tr>
</tbody>
</table>

4.1 Introduction .................................................................................................................. 46
4.2 Methods ....................................................................................................................... 49
  4.2.1 Setting ................................................................................................................... 49
  4.2.2 Intervention .......................................................................................................... 50
  4.2.3 Data Collection .................................................................................................... 50
  4.2.4 Data Analysis ....................................................................................................... 52
4.3 Results ........................................................................................................................ 52
4.4 Discussion ................................................................................................................... 57
4.5 Limitations ................................................................................................................ 60
4.6 Conclusions ............................................................................................................... 62

5. Concluding Remarks .................................................................................................... 63

List of References .............................................................................................................. 68

Appendix A ....................................................................................................................... 76

Appendix B ....................................................................................................................... 83
LIST OF TABLES

Table				Page

1. Descriptive Statistics, Univariate Odds Ratios, and 95% Confidence Intervals for Independent Variables Related to Individual Health ........................................ 15

2. Descriptive Statistics, Univariate Odds Ratios, and 95% Confidence Intervals for Independent Variables Related to Work-Life Characteristics ........................................ 16

3. Descriptive Statistics, Univariate Odds Ratios, and 95% Confidence Intervals for Independent Variables Related to Demographic Characteristics ........................................ 18

4. Odds Ratios and 95% Confidence Intervals of the Final Model .......................... 20

5. Investigator Controlled Stepwise Model Building Process (paper 1) ................ 21

6. Assessment of Confounding of Effects of Past Injury ........................................ 22

7. Sample Description and Average ALBPS by Independent Variables Related to Individual Health .......................................................... 35

8. Sample Description and Average ALBPS by Independent Variables Related to Work-Life Characteristics .......................................................... 36

9. Sample Description and Average ALBPS by Independent Variables Related to Demographic Characteristics .......................................................... 38

10. Investigator Driven Stepwise Model Building Process (paper 2) ...................... 40

11. Final Multivariable Linear Regression Model ............................................... 41

12. Overall and Subcategory Incidence Rates and Rate Ratios for Occupational Injury ........................................................................................................... 54

13. Overall and Subcategory Incidence Rates and Rate Ratios for Injuries with Lost Work Days ........................................................................................................... 56
Table

14. Overall and Subcategory Worker Compensation Bureau Costs Pre and Post intervention .......................................................... 57
LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Diagram of Participant Selection for Papers One and Two</td>
<td>9</td>
</tr>
<tr>
<td>2. Injury Rate per 100 FTE per Year</td>
<td>53</td>
</tr>
<tr>
<td>3. Rate of Lost Workday Injuries per 100 FTE</td>
<td>55</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

Current evidence suggests that Emergency Medical Services (EMS) professionals are at high risk of occupational illness and injury. However, the epidemiology of occupational injury among this profession has remained relatively unexplored. Most current occupational health studies have been descriptive in nature, only a few have attempted to describe the rates of injury in the workforce, and currently no known studies have attempted to assess the impact of occupational health interventions.

Each year millions of calls for service are answered by EMS professionals. EMS is comprised of unique and diverse professionals who are asked to treat and transport sick and injured patients in times of great need. These medical professionals can be found working in rural or urban environments, in private or municipal systems, and as career or volunteer providers. The delivery of EMS is unique to each community. Regardless of the delivery methods for this care, by fire departments or private ambulances, EMS professionals, of all training and skill levels, often work in austere environments. EMS professionals are called upon to provide patient care in unusual and often dangerous locations such as cramped quarters or busy highways.
EMS is a relatively young profession having its start in 1966 after the publication of a white paper entitled *Accidental Death and Disability*.\textsuperscript{10} Since that time it has been documented that the profession is lacking in sound scientific research,\textsuperscript{11, 12} especially in regards to workforce-related issues such as occupational health. Two documents specifically call for occupational health research in EMS. They are the *EMS Agenda for the Future*\textsuperscript{13} and the Institute of Medicine report *Emergency Medical Services at the Crossroads*.\textsuperscript{14} The *EMS Agenda for the Future* states that “Studies must be designed to yield an improved understanding of occupational hazards and strategies for minimizing them.”\textsuperscript{13} These sentiments are echoed in the IOM report as well.

Currently, the majority of occupational injury research conducted in EMS has focused on describing common types of injuries and the prevalence at which they occur. Schwartz et al.\textsuperscript{15} utilized a cross-sectional survey of EMS professionals from six New England states to estimate the prevalence and describe injury patterns. The questionnaire estimated the prevalence of back, eye, and extremity injuries, as well as injuries due to assault, ambulance crashes, and stress. The estimated rates were as follows: stress (27.2/100 Full Time Equivalents(FTE)/yr), back injury (25.4), extremity (23.7), assault (20.3), ear (6.0) and eye (3.4). In 1994 Tortella\textsuperscript{16} applied survey methods to obtain a rate of severe disabling injuries requiring hospitalization (SDIH). According to the authors, SDIH correlated with the total number of system responses (emergency calls for service), and therefore responses were used to define the injury rate. It was estimated that one injury would occur per year, for every 31,616 calls for EMS service. Finally, Gershon et al.\textsuperscript{3} utilized a retrospective review of accident, incident and exposure reports for 197
EMS workers in Baltimore, MD. Record review included documentation of demographics, injury type, site of injury, and outcome. There were 226 injury report forms analyzed and as stated by the author; this indicated the generation of more than one report per worker per year.

In 2005, Maguire et al. used the Department of Labor’s standard injury definitions to estimate the incident rate of injury among two EMS systems. One of the main objectives of the Maguire et al. paper was to compare their findings with other occupational groups. The overall rate of injury among EMS professionals in this study was estimated at 34.6 injuries per 100 FTE per year. This rate was determined to be higher than that of fire fighters and other health services workers. In the conclusion of their paper Maguire et al. called for the evaluation of interventions to reduce the injury rate among EMS professionals.6

It is relatively well known that musculoskeletal injuries such as back injuries are prevalently reported among EMS professionals.8,17 This is similar to other healthcare professions, specifically nursing.18-20 Much like nursing, EMS professionals perform many tasks that place strain on the back.21-23 However, unlike nursing there have not been any formal studies conducted to assess the impact of interventions on back injuries.24-26

EMS professionals are required to perform many job tasks that place localized strain on the back and other joints.21-23 The frequency of which these strenuous tasks are performed may vary. However there are several strenuous activities that are performed on a regular basis. These tasks center on the movement of the patient to a stretcher and the subsequent lifting of the stretcher into an ambulance. In a majority of EMS systems,
once a patient has been placed on a stretcher two EMS professionals must lift the stretcher to a loading height and again lift the stretcher into the back of an ambulance. It is hypothesized that a device used to limit the effort EMS professionals use to lift patients may reduce the occurrence of back injuries. While there are currently no known studies in EMS that have examined the use of mechanical lifting devices, several have been conducted in the nursing profession.

A clearer picture of occupational injury among EMS professionals is beginning to emerge. However, it is important that the epidemiologic research of injuries in this profession continue. As back injuries are prevalently reported within EMS, this dissertation focused on describing back injuries in the EMS workforce. Specifically, this dissertation had three aims: 1) Describe the work-life and demographic characteristics, of EMS professionals, associated with reporting recent back pain; 2) Estimate back pain severity and factors associated with changes in back pain severity among currently working EMS professionals; and 3) Evaluate occupational injuries in an urban EMS system before and after implementation of mechanical stretchers.
CHAPTER 2

BACK PROBLEMS AMONG EMERGENCY MEDICAL SERVICES PROFESSIONALS: THE LEADS HEALTH AND WELLNESS FOLLOW-UP STUDY

2.1 Introduction

Recently, there have been several attempts to describe and quantify occupational injuries among Emergency Medical Services (EMS) professionals.\textsuperscript{6, 17, 27} It has been shown that musculoskeletal injuries, especially back injuries, are a common problem among EMS professionals.\textsuperscript{3, 15, 21, 28, 29} As part of their job, EMS professionals perform many tasks that put localized strain on the back.\textsuperscript{21-23} Examples of such tasks include moving patients from a bed to a stretcher, transporting patients down stairs, and performing cardiopulmonary resuscitation (CPR).

EMS professionals are an important part of the healthcare delivery system. Emergency health care is provided by these professionals at any hour of the day, on any day of the year, almost anywhere in the United States. It has recently been estimated that about 900,000 EMS professionals respond to more than 17 million calls for service per year.\textsuperscript{30, 31} Regardless of the place or time, EMS professionals are expected to treat and
transport sick or injured patients. These medical professionals can be found working in rural or urban environments, in private or municipal systems, and as paid or volunteer providers.\(^8,9\)

Limited research has been conducted regarding non-mechanical factors associated with back pain among EMS professionals.\(^3,15,21,28,29\) One earlier study indicated that work-life and health characteristics were associated with the probability of reporting back problems.\(^17\) However, this study was limited by the lack of specificity of the outcome variable, the number of explanatory variables available for analysis, and the size of the study sample.

Predictors of low back pain in other health professions have been well documented\(^18-20\); however, EMS is unique in that medical care is often provided in varying and often dangerous locations.\(^32-35\) These varying working conditions may impact the susceptibility of EMS professionals to injury.

This current effort was intended to improve upon past occupational injury research through utilization of an outcome variable that was specifically related to back pain instead of the more general outcome, “back problems,” which was used in the prior effort.\(^17\) Also, explanatory variables (self-reported) that were not included in the initial effort such as EMS call volume, body mass index (BMI), level of physical activity, prior back problems, and smoking status were explored. It was hypothesized that a common theme of work-life, health, and demographic characteristics would emerge as being associated with reporting recent back pain among EMS professionals.
2.2 Methods

The data for this analysis were obtained from a sample of 2,059 participants originally enrolled in the Longitudinal EMT Attributes and Demographics Study (LEADS). LEADS was created in 1999 to describe the individuals providing emergency medical services throughout the United States.\textsuperscript{8,9} This project was developed and is managed by the National Registry of Emergency Medical Technicians (NREMT) and the National Highway Traffic Safety Administration (NHTSA).

The present study, the LEADS Health and Wellness Follow-up Survey, based participant selection on the self-report of prior back problems as indicated in past LEADS efforts. LEADS data from 2004-2006 were queried and all individuals reporting a back problem in any year (n=1,009) were selected. There were 2,350 individuals who had never reported a back problem during that time and a random sample of 1,050 non-injured participants was selected. This project received IRB approval from The Ohio State University.

A 58-item postal questionnaire was used to collect relevant health and wellness information from the selected participants. This questionnaire was developed in the spring of 2007 and was composed of validated questions from prior LEADS efforts\textsuperscript{8,9}, the Behavioral Risk Factor Surveillance System\textsuperscript{36}, and the Aberdeen Back Pain Scale.\textsuperscript{37} The survey was pilot tested on EMS professionals using cognitive debriefing techniques. Survey questions not part of previously validated instruments were modified based on pilot test results.

Data collection began in August 2007 and was completed in December of 2007. The questionnaire was mailed to participants on three separate occasions. A postcard
reminder was delivered to participants between the first and second mailing. Completed questionnaires were returned to the NREMT where they were optically scanned and placed into an Access database. Certain demographic data such as age and sex were obtained from participants’ prior LEADS responses.

2.2.1 Variable Description

The outcome variable for this cross-sectional cohort study was self-reported pain in the back or legs. Participants were asked to report if they had suffered pain in the back or legs within the last two weeks. Those indicating that they had experienced one or more days of pain in the last two weeks were classified as having the outcome, recent pain. Individuals who did not report pain in the last two weeks were classified as not having the outcome. Figure 1 displays how individuals were selected into the study.
Figure 1: Participant Selection
Independent variables were selected based on the literature and their plausibility of being associated with recent back pain. Variables were grouped as they related to EMS professionals’ health, work-life, and demographics. Five variables related to subjects’ health, ten related to their work-life, and five related to demographics.

The five independent variables related to health were past back problem, body mass index (BMI), overall health, physical activity, and current smoking status. Individuals were categorized as having a past back problem dependent upon how they were selected into the study. The 1,009 prevalent cases sampled were classified as having prior back problem and the 1,050 sampled potential controls were deemed to have no prior back problem. Using self-reported height and weight, BMI was calculated. Individuals were categorized as normal (<25 kg/m²), overweight (25-29.9 kg/m²), or obese (≥30 kg/m²). Participants self-reported their overall health using a four-point scale (excellent, good, fair, and poor). Due to small cell sizes the fair and poor categories were collapsed. Individuals were categorized as currently meeting or not meeting the Centers for Disease Control and Prevention (CDC) physical activity guidelines by analyzing three survey questions. Those who reported participating in moderate physical activity for 30 minutes a day five days a week or vigorous physical activity for 20 minutes a day three days a week were categorized as meeting recommendations. Finally, current smoking status was obtained through questions based on the Behavioral Risk Factor Surveillance System (BRFSS) and individuals were categorized as current smokers or current non-smokers (including never smokers).

The ten variables related to work-life were: certification level, call volume, satisfaction with job assignment, satisfaction with the EMS profession, intention to leave
the EMS profession, community size where EMS duties are performed, EMS service type, proportion of emergency and non-emergency calls, involvement in patient transportation, and number of years worked as an EMS professional. Only those EMS personnel certified at the Emergency Medical Technician-Basic or paramedic levels were included in this study. Call volume indicated the number of calls for service an EMS professional responded to in a typical week. Number of calls were categorized as low (0-9), moderate (10-39), and high (≥40). The two job satisfaction variables were categorized as very satisfied, satisfied, and not satisfied (dissatisfied or very dissatisfied).

A three-category variable was created to represent a participant’s intent to leave the profession (definitely stay, probably stay, and leaving). Those stating that they would probably leave, definitely leave or already left were included in the leaving category. Community size defined the area in which an EMS provider worked and was dichotomized as small town/city (≤24,999 people) or urban area (≥25,000 people). In order to define the type of EMS organization for which a participant worked, individuals were placed into one of three categories; fire department-based, private, or other (including hospital-based, US federal government, military, or county/municipal).

Proportion of emergency and non-emergency calls was dichotomized from a five-level categorical variable resulting in individuals being categorized as performing mostly emergency transports or mostly scheduled transports. A participant was classified as performing patient transports if they reported that their EMS service transported patients. Patient transport is an integral part of EMS; however not all EMS professionals transport
patients. Finally, participants reported their years of experience in 9 different categories. In order to obtain adequate cell sizes four categories were created; less than one year, 1-4 years, 5-10 years, or greater than 10 years.

The five demographic variables analyzed were marital status, race, gender, age, and level of education. Marital status was categorized as being married/a member of an unmarried couple, divorced/widowed/separated, or never married. Race was categorized as minority or white. Finally, participants were placed into five categories based on their highest level of education completed: high school, some college, Associate’s degree, Bachelor’s degree, and Master’s degree or higher.

### 2.2.2 Data Analysis

The focus of this study was to analyze recent back pain among currently working EMS professionals. Therefore, those individuals who indicated that they were permanently or temporarily not practicing, were currently not performing EMS work for any organization, or could not be defined as practicing were excluded from analysis (n = 128).

Preliminary data analysis included the use of descriptive statistics and univariate odds ratios (ORs). Initially, descriptive analyses of the data were performed to examine possible associations between independent variables and the outcome. Univariate ORs were then calculated for each independent variable to assess its magnitude of effect on the outcome. Data were analyzed using STATA version 9 (College Station, TX).

In order to further explore the relationships among independent variables and the outcome, unconditional multivariable logistic regression was performed. It has been well documented that past back problems are associated with recurrent injury and pain.\(^{40-42}\)
Therefore, logistic regression model building began with past back problem as the initial independent variable in the model. An investigator-driven stepwise approach was then undertaken where other independent variables were added to the model one at a time. The variable with the lowest Wald p-value was then added. This process continued until all remaining independent variables were no statistically significant at the 0.05 level. To avoid possible multi-collinearity problems, only satisfaction with profession, the more global indicator of level of satisfaction, was used in the model building process.

To fully explore the associations between recent back pain and the independent variables confounding was investigated. Confounding was assessed by observing the effects of initially insignificant independent variables on the variable past back problem. This variable was selected as previous work has indicated that an individual’s past back injury status is strongly associated with recurrent back pain. A change in the odds ratio of 10% in the past back problem variable was considered sufficient evidence to conclude confounding and the variable, regardless of its statistical significance would remain in the model. In addition possible confounding effects of other variables were considered. Upon completion of the main effects model plausible interaction terms were created and effect modification was assessed. Only those interaction terms with a Wald p-value ≤ 0.01 were added to the model. Model fit was assessed using the Hosmer-Lemeshow goodness of fit test and area under the ROC.

### 2.3 Results

The initial response rate for the survey was 1058/2059 (51.4%). Of the 1,009 prevalent cases that were sent surveys, 48.0% returned a completed survey. Of the 1,050 non-injured participants selected as controls, 54.6% returned a completed survey.
final response rate was calculated using the American Association of Public Opinion Research Outcome Rate Calculator. There were 210 individuals with addresses that led to returned mail and 124 individuals who were ineligible because they were currently not practicing. This left 934 individuals available for analysis producing a final response rate of 54.2%. A final 4 observations were excluded because outcome information was missing.

In the sample population there were 470 (50.5%) participants who reported one or more days of pain in the back or legs over a two week period. Among those participants with recent pain 141 of them were initially sampled as controls, having never reported back problems on past LEADS surveys. There were 182 individuals who had previously reported back problems but currently reported no recent back pain. Thus, the cases and controls used in these analyses were a mixture of subjects from the originally targeted groups; those with previous back problems and those without. Ultimately cases included individuals whose status had crossed over with reports of recent back or leg pain among those who had no previous back problems. Controls also include individuals with current lack of pain among those originally targeted as having past back problems. Tables 1-3 present descriptive statistics of the overall sample and by those reporting recent pain. Also, the unadjusted associations between the dependent and independent variables were presented as ORs. The tables were grouped in relation to EMS professional’s health (Table 1), work-life (Table 2), and demographics (Table 3).
<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Total Sample</th>
<th>Recent Pain n (column%)</th>
<th>No Pain n (column%)</th>
<th>Univariate OR*</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Past Back Problem</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>419</td>
<td>141</td>
<td>278</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td></td>
<td>45.0%</td>
<td>30.0%</td>
<td>60.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>511</td>
<td>329</td>
<td>182</td>
<td>3.56</td>
<td>2.72 - 4.89</td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal &lt;25</td>
<td>307</td>
<td>136</td>
<td>171</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td></td>
<td>33.0%</td>
<td>28.9%</td>
<td>37.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight &gt;25-29.9</td>
<td>399</td>
<td>192</td>
<td>197</td>
<td>1.23</td>
<td>0.91 - 1.65</td>
</tr>
<tr>
<td></td>
<td>41.8%</td>
<td>40.9%</td>
<td>42.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese &gt;30</td>
<td>223</td>
<td>137</td>
<td>86</td>
<td>2.00</td>
<td>1.41 - 2.85</td>
</tr>
<tr>
<td></td>
<td>24.0%</td>
<td>29.1%</td>
<td>18.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>11</td>
<td>5</td>
<td>6</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>1.2%</td>
<td>1.1%</td>
<td>1.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>265</td>
<td>97</td>
<td>178</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td></td>
<td>28.5%</td>
<td>18.5%</td>
<td>38.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>561</td>
<td>309</td>
<td>252</td>
<td>2.51</td>
<td>1.85 - 3.41</td>
</tr>
<tr>
<td></td>
<td>60.3%</td>
<td>65.7%</td>
<td>54.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fair/Poor</td>
<td>103</td>
<td>74</td>
<td>29</td>
<td>5.22</td>
<td>3.17 - 8.81</td>
</tr>
<tr>
<td></td>
<td>11.1%</td>
<td>15.7%</td>
<td>8.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>0.1%</td>
<td>0%</td>
<td>0.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Met Recommendations</td>
<td>458</td>
<td>206</td>
<td>252</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td></td>
<td>49.25%</td>
<td>43.8%</td>
<td>54.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did Not Meet</td>
<td>437</td>
<td>245</td>
<td>192</td>
<td>1.56</td>
<td>1.20 - 2.03</td>
</tr>
<tr>
<td>Recommendations</td>
<td>46.99%</td>
<td>52.1%</td>
<td>41.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>35</td>
<td>19</td>
<td>16</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>3.75%</td>
<td>4.0%</td>
<td>3.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Smoker</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>900</td>
<td>396</td>
<td>404</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td></td>
<td>86.02%</td>
<td>84.3%</td>
<td>87.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>130</td>
<td>74</td>
<td>56</td>
<td>1.35</td>
<td>0.93 - 1.96</td>
</tr>
<tr>
<td></td>
<td>13.98%</td>
<td>15.7%</td>
<td>12.2%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* OR=Odds Ratio and CI=Confidence Interval

Table 1. Descriptive Statistics, Univariate Odds Ratios, and 95% Confidence Intervals for Independent Variables Related to Individual Health
<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Certification Level</th>
<th>Call Volume</th>
<th>Satisfied With Assignment</th>
<th>Satisfied With Profession</th>
<th>Intent to Leave</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0-9 calls</td>
<td>10-39 calls</td>
<td>40-50 calls</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>375</td>
<td>481</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>363</td>
<td>567</td>
<td>58</td>
<td>162</td>
</tr>
<tr>
<td></td>
<td></td>
<td>39.0%</td>
<td>61.0%</td>
<td>9.6%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>162</td>
<td>309</td>
<td>58</td>
<td>60.6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>34.5%</td>
<td>65.5%</td>
<td>12.3%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>204</td>
<td>250</td>
<td>31</td>
<td>54.3%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>43.7%</td>
<td>56.3%</td>
<td>6.7%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reference</td>
<td>1.48</td>
<td>1.81</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>***</td>
<td>1.13 - 1.92</td>
<td>1.09 - 3.02</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reference</td>
<td>1.35</td>
<td>1.81</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>***</td>
<td>1.03 - 1.76</td>
<td>1.54 - 3.84</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reference</td>
<td>1.73</td>
<td>2.43</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>***</td>
<td>1.30 - 2.31</td>
<td>1.54 - 3.84</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Real</td>
<td>1.28 - 2.25</td>
<td>2.00 - 5.22</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>NaN</td>
<td>3.23</td>
<td>NaN</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>NaN</td>
<td>2.00 - 5.22</td>
<td>NaN</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>NaN</td>
<td>1.59</td>
<td>NaN</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>NaN</td>
<td>1.19 - 2.12</td>
<td>NaN</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reference</td>
<td>1.42 - 3.61</td>
<td>NaN</td>
<td></td>
</tr>
</tbody>
</table>

* OR=Odds Ratio and CI=Confidence Interval

Table 2. Descriptive Statistics, Univariate Odds Ratios, and 95% Confidence Intervals for Independent Variables Related to Work-Life Characteristics
### Table 2 continued

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Total Sample</th>
<th>Recent Pain n (column%)</th>
<th>No Pain n (column%)</th>
<th>Univariate OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Community Size</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>336</td>
<td>169 (36.0%)</td>
<td>167 (36.3%)</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td>Urban</td>
<td>590</td>
<td>285 (40.6%)</td>
<td>275 (50.9%)</td>
<td>1.02</td>
<td>0.78 - 1.34</td>
</tr>
<tr>
<td>Missing</td>
<td>34</td>
<td>16 (3.4%)</td>
<td>18 (3.9%)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td><strong>Service Type</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire Based</td>
<td>308</td>
<td>130 (32.7%)</td>
<td>178 (38.7%)</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td>Private</td>
<td>213</td>
<td>125 (22.9%)</td>
<td>98 (19.1%)</td>
<td>1.94</td>
<td>1.96 - 2.77</td>
</tr>
<tr>
<td>Other</td>
<td>297</td>
<td>164 (31.9%)</td>
<td>133 (28.9%)</td>
<td>1.69</td>
<td>1.22 - 2.33</td>
</tr>
<tr>
<td>Missing</td>
<td>112</td>
<td>51 (12.0%)</td>
<td>61 (13.3%)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td><strong>Transport Type</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mostly Emergency</td>
<td>733</td>
<td>355 (47.5%)</td>
<td>378 (51.2%)</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td>Mostly Scheduled</td>
<td>185</td>
<td>100 (21.3%)</td>
<td>85 (14.1%)</td>
<td>1.64</td>
<td>1.16 - 2.31</td>
</tr>
<tr>
<td>Transports</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>32</td>
<td>15 (3.4%)</td>
<td>17 (3.7%)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td><strong>Transport Patients</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>157</td>
<td>63 (16.9%)</td>
<td>94 (20.4%)</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td>Yes</td>
<td>745</td>
<td>395 (90.1%)</td>
<td>350 (76.1%)</td>
<td>1.69</td>
<td>1.10 - 2.39</td>
</tr>
<tr>
<td>Missing</td>
<td>28</td>
<td>12 (3.0%)</td>
<td>16 (3.5%)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td><strong>Years Worked</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 1 year</td>
<td>95</td>
<td>44 (10.2%)</td>
<td>51 (11.1%)</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td>1-4 years</td>
<td>291</td>
<td>141 (31.3%)</td>
<td>150 (32.6%)</td>
<td>1.09</td>
<td>0.68 - 1.73</td>
</tr>
<tr>
<td>5-10 years</td>
<td>313</td>
<td>164 (33.7%)</td>
<td>149 (22.4%)</td>
<td>1.29</td>
<td>0.90 - 2.02</td>
</tr>
<tr>
<td>≥ 11 years</td>
<td>228</td>
<td>120 (24.5%)</td>
<td>108 (23.5%)</td>
<td>1.28</td>
<td>0.80 - 2.08</td>
</tr>
<tr>
<td>Missing</td>
<td>3</td>
<td>1 (0.3%)</td>
<td>2 (0.4%)</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>
Table 3. Descriptive Statistics, Univariate Odds Ratios, and 95% Confidence Intervals for Independent Variables Related to Demographic Characteristics

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Total Sample</th>
<th>Recent Pain</th>
<th>No Pain</th>
<th>Univariate OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/Unmarried Couple</td>
<td>691</td>
<td>318</td>
<td>343</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td>Divorced/Widowed/Separated</td>
<td>98</td>
<td>59</td>
<td>39</td>
<td>1.63</td>
<td>1.06 - 2.51</td>
</tr>
<tr>
<td>Never Married</td>
<td>188</td>
<td>92</td>
<td>76</td>
<td>1.31</td>
<td>0.93 - 1.83</td>
</tr>
<tr>
<td>Missing</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>718</td>
<td>373</td>
<td>345</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td>Minority</td>
<td>194</td>
<td>86</td>
<td>108</td>
<td>0.74</td>
<td>0.54 - 1.01</td>
</tr>
<tr>
<td>Missing</td>
<td>18</td>
<td>11</td>
<td>7</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>251</td>
<td>140</td>
<td>102</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td>Male</td>
<td>593</td>
<td>279</td>
<td>314</td>
<td>0.61</td>
<td>0.45 - 0.82</td>
</tr>
<tr>
<td>Missing</td>
<td>86</td>
<td>42</td>
<td>44</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Level of Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>71</td>
<td>38</td>
<td>33</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td>Some College</td>
<td>369</td>
<td>200</td>
<td>169</td>
<td>1.03</td>
<td>0.62 - 1.71</td>
</tr>
<tr>
<td>Associate’s Degree</td>
<td>209</td>
<td>99</td>
<td>110</td>
<td>0.78</td>
<td>0.46 - 1.34</td>
</tr>
<tr>
<td>Bachelor’s Degree</td>
<td>210</td>
<td>110</td>
<td>106</td>
<td>0.9</td>
<td>0.53 - 1.54</td>
</tr>
<tr>
<td>Master’s Degree or Greater</td>
<td>59</td>
<td>19</td>
<td>40</td>
<td>0.41</td>
<td>0.20 - 0.85</td>
</tr>
<tr>
<td>Missing</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

* OR=Odds Ratio and CI=Confidence Interval
Descriptive statistics (Tables 1-3) indicate that 65.8% of the individuals in this study were classified as overweight or obese and 49.3% of the population met CDC physical activity recommendations. Job satisfaction among participants appeared high with 89.3% reporting that they were satisfied or very satisfied with the EMS profession. Individuals appeared to work for a variety of EMS organizations with fire-based EMS the most common service type (33.1%). Service type also had the most missing data with 12.0% of respondents not indicating a service type. Finally, there were considerably more males than females in the total sample (63.8% vs. 27.0%), however this was consistent with data collected from prior EMS workforce analyses.8,9

Univariate analyses indicated that 15 out of 20 independent variables were significantly associated with recent back pain (p \( \leq 0.05 \)). There were several variables with notably large univariate ORs. Individuals with a prior back problem had an OR of 3.56 (95% CI 2.72-4.68) when compared to those with no past back problem. With excellent health as the referent group, individuals reporting fair or poor health were significantly associated with having recent back pain with an OR of 5.22 (95% CI 3.17-8.61). Individuals who reported being dissatisfied or very dissatisfied when compared to those very satisfied had an OR of recent back pain of 3.23 (95% CI 2.00-5.22). Finally, when compared to individuals working for fire departments, those working for private EMS agencies had a significant OR of 1.94 (95% CI 1.36-2.77) for reporting recent back pain.

The final logistic regression model is displayed in Table 4. Table 5 reports the stepwise model building process and Table 6 shows the assessment of confounding after the main effects model was constructed. No independent variables outside those included
in the main effects model met criteria for confounding. Finally, plausible interaction terms were considered; however none were significant and included in the final model.

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>OR*</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Past Back Problem</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td>Yes</td>
<td>2.84</td>
<td>2.06 - 3.92</td>
</tr>
<tr>
<td>Health</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td>Good</td>
<td>2.29</td>
<td>1.58 - 3.32</td>
</tr>
<tr>
<td>Fair/Poor</td>
<td>4.11</td>
<td>2.20 - 7.69</td>
</tr>
<tr>
<td>Service Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire Department</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td>Private</td>
<td>1.72</td>
<td>1.13 - 2.63</td>
</tr>
<tr>
<td>Other</td>
<td>1.30</td>
<td>0.89 - 1.88</td>
</tr>
<tr>
<td>Satisfied With Profession</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very Satisfied</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td>Satisfied</td>
<td>1.50</td>
<td>1.06 - 2.13</td>
</tr>
<tr>
<td>Dissatisfied/Very Dissatisfied</td>
<td>1.86</td>
<td>1.03 - 3.38</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td>Male</td>
<td>0.67</td>
<td>0.47 - 0.97</td>
</tr>
<tr>
<td>Level of Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>Reference</td>
<td>***</td>
</tr>
<tr>
<td>Some College</td>
<td>1.29</td>
<td>0.69 - 2.44</td>
</tr>
<tr>
<td>Associates Degree</td>
<td>0.97</td>
<td>0.50 - 1.90</td>
</tr>
<tr>
<td>Bachelors Degree</td>
<td>1.09</td>
<td>0.56 - 2.14</td>
</tr>
<tr>
<td>Masters Degree or Greater</td>
<td>0.39</td>
<td>0.16 - 0.95</td>
</tr>
</tbody>
</table>

* OR=Odds Ratio and CI=Confidence Interval

Table 4. Odds Ratios and 95% Confidence Intervals of the Final Model

Many of the variables with high measures of effect in univariate analysis were present in the multivariable model with correspondingly high ORs. Though slightly attenuated, individuals with a reported past back problem or fair/poor health were more likely to report current pain, with ORs of 2.84 (95% CI 2.06-3.92) and 4.11 (95% CI
2.20-7.69) respectively. Males were less likely to report recent back pain than females (OR 0.67 95% CI 0.47-0.97). Individuals with the highest level of education were significantly less likely to report recent back pain than high school graduates. However, there was no other education level significantly associated with a decrease or increase in reporting back pain. Service type was also associated with recent back pain; with those working for private services having an OR of 1.72 (95% CI 1.13-2.63) when compared to those working for fire departments.

### Table 5

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3</th>
<th>Step 4</th>
<th>Step 5</th>
<th>Step 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>0.0005</td>
<td>0.0671</td>
<td>0.0906</td>
<td>0.0858</td>
<td>0.2371</td>
<td>0.2751</td>
</tr>
<tr>
<td>Health</td>
<td>0.0000</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Physical Activity</td>
<td>0.0030</td>
<td>0.1880</td>
<td>0.2570</td>
<td>0.2410</td>
<td>0.2350</td>
<td>0.3220</td>
</tr>
<tr>
<td>Current Smoker</td>
<td>0.1070</td>
<td>0.5280</td>
<td>0.6180</td>
<td>0.6170</td>
<td>0.8010</td>
<td>0.0303</td>
</tr>
<tr>
<td>Certification Level</td>
<td>0.0780</td>
<td>0.1140</td>
<td>0.1470</td>
<td>0.2060</td>
<td>0.1050</td>
<td>0.0760</td>
</tr>
<tr>
<td>Call Volume</td>
<td>0.1002</td>
<td>0.1121</td>
<td>0.0956</td>
<td>0.1218</td>
<td>0.0593</td>
<td>0.4630</td>
</tr>
<tr>
<td>Satisfied With Profession</td>
<td>0.0004</td>
<td>0.0070</td>
<td>0.0135</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Intent to Leave</td>
<td>0.0180</td>
<td>0.1314</td>
<td>0.5131</td>
<td>0.8437</td>
<td>0.6439</td>
<td>0.5381</td>
</tr>
<tr>
<td>Community Size</td>
<td>0.9500</td>
<td>0.8530</td>
<td>0.6070</td>
<td>0.4860</td>
<td>0.6730</td>
<td>0.7880</td>
</tr>
<tr>
<td>Service Type</td>
<td>0.0007</td>
<td>0.0017</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Transport Type</td>
<td>0.0080</td>
<td>0.0370</td>
<td>0.6820</td>
<td>0.8440</td>
<td>0.9310</td>
<td>0.8480</td>
</tr>
<tr>
<td>Transport Patients</td>
<td>0.0160</td>
<td>0.0190</td>
<td>0.1590</td>
<td>0.1970</td>
<td>0.1310</td>
<td>0.1670</td>
</tr>
<tr>
<td>Years Worked</td>
<td>0.9619</td>
<td>0.9663</td>
<td>0.8474</td>
<td>0.7726</td>
<td>0.9499</td>
<td>0.8780</td>
</tr>
<tr>
<td>Age</td>
<td>0.1560</td>
<td>0.0660</td>
<td>0.1020</td>
<td>0.1380</td>
<td>0.1860</td>
<td>0.4200</td>
</tr>
<tr>
<td>Marital Status</td>
<td>0.0111</td>
<td>0.0218</td>
<td>0.0861</td>
<td>0.0828</td>
<td>0.1893</td>
<td>0.1631</td>
</tr>
<tr>
<td>Race</td>
<td>0.1210</td>
<td>0.1620</td>
<td>0.2740</td>
<td>0.2710</td>
<td>0.2140</td>
<td>0.1430</td>
</tr>
<tr>
<td>Gender</td>
<td>0.0045</td>
<td>0.0021</td>
<td>0.0251</td>
<td>0.0224</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Level of Education</td>
<td>0.0148</td>
<td>0.0452</td>
<td>0.0881</td>
<td>0.0832</td>
<td>0.0241</td>
<td>***</td>
</tr>
</tbody>
</table>

* An investigator driven stepwise model building process was undertaken where independent variables were added to the model one at a time. This table displays the Wald p-value for each variable at each step in the process and indicates when each variable was added to the model. This process continued until remaining independent variables were not significant at the 0.05 level.
Finally, self-reported level of satisfaction with the profession was significantly associated with reporting recent back pain. With very satisfied as the referent category, those indicating they were satisfied had an OR of recent back pain of 1.5 (95% CI 1.1 - 2.1) and those dissatisfied/very dissatisfied had an OR of 1.9 (95% CI 1.1 - 3.4). This model demonstrated good fit when utilizing the Hosmer-Lemeshow goodness of fit test ($X^2 = 5.2, p = 0.74$). The area under the ROC curve was 0.74; this model demonstrated a fair ability to discriminate between subjects who experienced recent back pain and those who did not.

<table>
<thead>
<tr>
<th>Potential Confounder</th>
<th>Adjusted Odds Ratio</th>
<th>% Difference after adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Past Back Problem</td>
<td>2.84</td>
<td>***</td>
</tr>
<tr>
<td>BMI</td>
<td>2.84</td>
<td>0.00%</td>
</tr>
<tr>
<td>Physical Activity</td>
<td>2.89</td>
<td>-1.76%</td>
</tr>
<tr>
<td>Current Smoker</td>
<td>2.84</td>
<td>0.00%</td>
</tr>
<tr>
<td>Certification Level</td>
<td>2.78</td>
<td>2.11%</td>
</tr>
<tr>
<td>Call Volume</td>
<td>2.80</td>
<td>1.41%</td>
</tr>
<tr>
<td>Satisfied With Profession</td>
<td>2.90</td>
<td>-2.11%</td>
</tr>
<tr>
<td>Intent to Leave</td>
<td>2.87</td>
<td>-1.06%</td>
</tr>
<tr>
<td>Service Type</td>
<td>2.88</td>
<td>-1.41%</td>
</tr>
<tr>
<td>Transport Type</td>
<td>2.83</td>
<td>0.35%</td>
</tr>
<tr>
<td>Transport Patients</td>
<td>2.85</td>
<td>-0.35%</td>
</tr>
<tr>
<td>Years Worked</td>
<td>2.73</td>
<td>3.87%</td>
</tr>
<tr>
<td>Marital Status</td>
<td>2.84</td>
<td>0.00%</td>
</tr>
<tr>
<td>Race</td>
<td>2.88</td>
<td>-1.41%</td>
</tr>
</tbody>
</table>

Table 6. Assessment of Confounding of Effects of Past Injury
2.4 Discussion

Results of this analysis indicate that 50% of study participants reported recent pain in the back or legs. Of those, one third reported a first incidence of back pain. The variables most strongly associated with recent back pain and likely to be open to intervention were prior back problems, health, and job satisfaction.

When attempting to describe work-related characteristics associated with back problems or on-the-job injury; prior occupational injury studies, focusing on EMS, have not accounted for past injury.\textsuperscript{17,27} Results from this analysis suggest that prior back problems were significantly associated with reporting recent back pain. Past back injury has been identified as a component of the natural history of low back pain among nurses\textsuperscript{20,43} and the general population.\textsuperscript{40} Although intuitive, this association had not yet been shown within the EMS profession. Current results seem to indicate, as in other populations, that prior injuries affect the risk of future injury to EMS professionals.

When controlling for the effects of past back problems, those individuals reporting fair or poor health had the largest OR for current back pain. This association has been noted in other working\textsuperscript{47} and non-working populations.\textsuperscript{41} Data from 850 individuals enrolled in the Berne Workplace Health Project indicated that individuals with poor self-rated health were significantly more likely to report recent back pain. Thomas et al.\textsuperscript{41} reported a strong, crude relationship between poor self-rated health and disabling back pain among primary care patients (OR = 3.5). However, this association did not remain after adjustment for confounders. Though self-reported health has been
associated with back pain there is limited data available describing how changes in self-reported health affect back pain. Also, in this cross-sectional cohort study it was impossible to determine if poor health caused back pain or vice versa.

Of the work-related factors assessed in this analysis only job satisfaction remained in the multivariable model, which has been associated with back problems in other studies.\textsuperscript{17, 42, 48, 49} There are many ways in which to measure the construct of job satisfaction. However, this analysis used a simple one-item question to determine an individual’s satisfaction with the EMS profession. Unfortunately one can only speculate about the perceived relationship between satisfaction and back pain. As job satisfaction has been a factor mentioned in numerous studies regarding back pain, further research among EMS professionals with better definitions of job satisfaction should be conducted. Papageorgiou et al.\textsuperscript{48} revealed a modest association between job dissatisfaction and low back pain among adults in the United Kingdom. Yip et al.\textsuperscript{49} reported that poor working relationships among nurses in Hong Kong resulted in an increased relative risk of back pain. Finally, in a study of approximately 2,000 individuals in Sweden, Vingard et al.\textsuperscript{42} found that individuals who reported mostly routine work, a surrogate indicator of job stress and dissatisfaction, had an increased risk of low back pain.

If job satisfaction was causally related to recent back pain then psychosocial workplace interventions may reduce the incidence of back problems. However, until this relationship can be further elucidated, work in such areas will be largely speculative.

In the present study, both gender and level of education were significantly associated with recent back pain. Males had a lower OR of recent back pain than women, and those with the highest level of education also had a lower OR than those reporting the
lowest level of education. Unfortunately, this current effort was unable to determine if individuals with differing levels of education participated in differing job tasks. It is plausible that EMS professionals with higher levels of education perform job tasks that put strain on the back less frequently than those with lower education. A systematic literature review of the association between education and back pain indicated that individuals with low levels of education were more likely to experience back pain. However, these are contradictory to the results seen among farmers. This may indicate that interventions used to reduce back pain in other industries may focus on different sub-populations than those at most risk in EMS. Therefore, injury-reducing interventions from other industries may need to be scrutinized prior to adoption in EMS.

It was interesting to note that call volume, a surrogate indicator for frequent strenuous work activity, was not significantly related to the outcome. However, strenuous work-related activities have been commonly associated with back pain in other populations. It may be that call volume was an inadequate marker of strenuous activity. Further research should be conducted to better identify the frequency and characteristics of strenuous work tasks within EMS and their association with recent back pain.

2.5 Strengths and Limitations

This study used a sample of nationally registered EMTs who had previously participated in the LEADS project. Although the response rate for this survey was higher than other LEADS efforts the generalizability of these reported estimates to all EMS professionals may still be questioned. Though a non-response follow-up was not conducted in this effort, the LEADS project has conducted follow-up of non-responders.
in the past. Brown et al.\textsuperscript{8} completed an analysis of EMT-Basics and Paramedics and found little evidence that non-responders differed from responders on demographic, attitudinal, or educational items in the core LEADS survey. This increases our confidence in the generalizability of these results.

There were a number of individuals who were not included in this analysis because they indicated that they were not currently practicing EMS professionals. There are multiple reasons why an individual may no longer be a practicing EMS professional including leaving the profession because of a back injury. However, one analysis of LEADS data indicated that a majority of individuals who stated that they were permanently or temporarily not practicing had never practiced in EMS.\textsuperscript{56} Therefore, these results may best represent those EMS professionals currently working for an EMS organization and not those who are temporarily or permanently not practicing.

During preliminary analysis it was noted that there was missing data within the final data set. A missing data analysis showed that 257 (27.6\%) individuals were missing data for at least one independent variable. There was an average of 1.5 missing items among the 257 individuals with missing data. Individuals with missing data were compared to those with complete data in regards to the outcome variable. There appeared to be no significant difference between individuals with missing data and those with complete data. Hence, it was unlikely that the exclusion of subjects with missing data created any biases.

The variables analyzed in this study were obtained through self-report on a questionnaire and no other information relating to individuals’ work-life or demographics
were available. Therefore, all of the limitations inherent to an observational analysis, including the potential for misclassification of cases and controls, pertain to this study.

Misclassification can result in information bias when variables are measured with error, an occurrence that is more probable with self-reported data. When the likelihood of misclassification does not vary between cases and controls (non-differential misclassification) any resultant bias is toward the null value of the measure of effect. That is, estimated ORs will be likely under-estimated and the relationships between variables would be even stronger without misclassification. However, non-differential misclassification can bias measures of effect away from the null if an exposure variable has more than two categories or more than one variable is involved.57

There is no indication that differential misclassification occurred. If exposure variables such as number of patients lifted per shift or the amount of weight carried per shift were collected and analyzed in this analysis greater concern regarding differential misclassification may be warranted. However, the present study was likely to have suffered from non-differential misclassification resulting in underestimates of the calculated measures of effect. Regardless, even in the face of misclassification bias the measures of effect estimated were large enough that it was unlikely that bias accounted completely for these findings.

Finally, the results of this study were limited by the nature of cross-sectional cohort study designs. Though variables with relatively large measures of effect have been identified in relation to back pain, one cannot speak to the causal relationship of
these variables. Therefore, future studies that incorporate randomization of EMS professionals to injury prevention techniques must be accomplished to truly speak to the causation and prevention of back pain.

2.6 Conclusion

In this analysis of a sub-population of the LEADS cohort, nearly half of the study population experienced pain in the back or legs at least one day in a two week period. One third of individuals sampled who had never reported back problems in past LEADS efforts reported incident back pain. Multivariable logistic regression indicated that work-life, health, and demographic characteristics of EMS professionals were associated with reporting recent back pain. The report of prior back problems and fair/poor health were most strongly related to recent back pain. This study lends support to the growing body of literature on back injuries among members of this critical workforce. Further studies of back pain among EMS professionals should attempt to assess the causality of these work-life, health, and demographic characteristics in relation to back pain.
CHAPTER 3

QUANTIFYING THE SEVERITY OF BACK PAIN AMONG EMS PROFESSIONALS

3.1 Introduction

Back pain in the workplace is a common occurrence, yet it is a construct that is difficult to define. Kent and Keating state that back pain is a frequent problem among the general population which results in considerable costs, both direct and indirect. Back pain has also been identified as a common occurrence in healthcare occupations. Musculoskeletal injuries, especially back strain, have been studied in nursing since the late seventies, with reports of back injury prevalence between 41-52%. The epidemiology of low back injury among nursing professionals is well known. Among females, nursing aides are at the greatest risk of back injury and in one study it was determined that in their fifth year of practice the prevalence of back injury for nurses was 64%. Emergency Medical Services (EMS) professionals are exposed to numerous occupational hazards. Back problems have been consistently identified as one
of the most prevalent occupational injuries in this health care profession.\textsuperscript{3, 15, 17, 21, 28, 29} These medical professionals can be found working in rural or urban environments, in private or municipal systems and as career or volunteer providers.\textsuperscript{8, 9}

As part of their job requirements, EMS professionals perform many tasks that put localized strain on the back.\textsuperscript{21-23} Examples of such tasks include moving patients from a bed to a stretcher, transporting patients down stairs, and performing cardiopulmonary resuscitation (CPR). It has been shown that musculoskeletal injuries, especially back injuries, are a common cause of injury among EMS professionals.\textsuperscript{3, 15, 21, 28, 29} However, the severity of these injuries has not been reported.

Several recent attempts to quantify occupational injuries in EMS have used lost work time data. However, neither of these studies reported injury severity.\textsuperscript{6, 65} It is also important to note that there is some evidence that EMS professionals continue to work while experiencing back problems/pain. Measuring back pain severity among EMS professionals may place into context the overall burden of back problems on the EMS workforce. This study aims to estimate back pain severity and factors associated with changes in back pain severity among currently working EMS professionals.

3.2 Methods

The data for this analysis came from a sample of 2,059 participants originally enrolled in the Longitudinal EMT Attributes and Demographics Study (LEADS). LEADS was created in 1999 to describe the individuals providing emergency medical services throughout the United States.\textsuperscript{8, 9} This project was developed and is managed by the National Registry of EMTs (NREMT) and the National Highway Traffic Safety Administration (NHTSA).
The LEADS Health and Wellness Follow-up Survey based participant selection on prior back problem status as indicated in past LEADS efforts. LEADS data from 2004-2006 were queried and all individuals reporting a back problem in any year (n=1,009) were selected as potential cases. There were 2,350 individuals who had never reported a back problem during that time and were eligible to act as potential controls. A random sample of 1,050 non-injured participants was selected as the probable control population, as illustrated in figure 1. This project received IRB approval from The Ohio State University. The methods used to collect the data for this study were the same as study one. Please refer to section 2.2 for a description of the questionnaire used.

3.2.1 Variable Description

The outcome variable for this analysis was the severity of recent back pain as indicated by the Aberdeen back pain scale (ABPS). The ABPS allows for the reporting of a score from 0 (minimal pain) to 100 (severe pain). The ABPS is a previously validated survey tool\(^3\)\(^7\),\(^6\)\(^6\) that has been primarily used to define the quality of life of patients and as an outcome measure in patients with low back pain.\(^6\)\(^7\)-\(^6\)\(^9\) The tool consists of 19 questions of which there are 3 to 6 possible responses. The questions pertain to the distribution of pain, effects of pain on function, and factors that aggravate or alleviate pain. Only individuals who reported back pain within the previous two weeks were included in this analysis.

Independent variables were selected based on prior work and their plausibility of being associated with recent back pain. Independent variables analyzed in this study were the same as analyzed in study one. Please refer to section 2.2.1 for a description of the independent variables which were assessed.
3.2.2 Data Analysis

The focus of this study was to analyze the severity of back pain among currently working EMS professionals. Therefore, those individuals who indicated that they were permanently or temporarily not practicing, were currently not performing EMS work for any organization, or could not be defined as practicing were excluded from analysis. Also, the data set was limited to participants who had reported back pain for one day or more in a two week period, the first question on the ABPS.

Initially, a missing data analysis was completed to determine the effect missing data would have on assessment of the outcome. Preliminary data analysis included the use of descriptive statistics. The frequencies of categorical responses among the sample population were first determined. Then, statistically significant relationships between the outcome variable and independent variables were assessed using simple linear regression by determining the difference in ALBPS scores and corresponding 95% confidence intervals. Data were analyzed using STATA version 9 (College Station, TX).

In order to better explore the relationship between the independent variables and the outcome, multivariable linear regression was performed. It has been well documented that past back problems are associated with recurrent injury and pain.\textsuperscript{40-42} Therefore, regression model building began with past back problem as the initial independent variable in the model. An investigator controlled stepwise approach was then undertaken where other independent variables were added to the model one at a time. The variable with the lowest Wald p-value and highest adjusted R-Squared value was then added. This process continued until independent variables added to the model did not reach a p-value less than or equal to 0.05.
Upon completion of the main effects model, plausible interaction terms were created and effect modification was assessed. Only those interaction terms with a Wald p-value ≤ 0.01 were added to the model. Finally, those variables that were not statistically significant were assessed for confounding the variables in the main effects model. Model fit was assessed using standard regression diagnostics (i.e. lack of fit tests and residual plots).  

3.3 Results  

The initial response rate for the survey was 1,058/2,058 (51.4%). Response rate was calculated using the American Association of Public Opinion Research Outcome Rate Calculator. There were 210 individuals with addresses that led to returned mail and 124 individuals who were ineligible because they were currently not practicing. This left 934 individuals available for analysis with a response rate of 54.2%. However, only the 470 individuals reporting an episode of back pain in the last two weeks were used in this analysis (See Figure 1).

During preliminary analysis it was noted that there were missing data within the final data set. A missing data analysis was conducted which revealed 110 (23.4%) individuals with missing data for at least one independent variable. There was an average of 1.5 missing items among the 110 individuals with missing data. Individuals with missing data were compared to those with non-missing data in regards to the outcome variable. There was no significant difference in ABPS among individuals with items missing compared to those with complete data.

Tables 7-9 describe the study population grouped by health, work-life, and demographic characteristics. Nearly 80% of the study population indicated that they
were white and more than 50% indicated that they were male. The average age of participants was 38.0 years. Only 255 participants (54.3%) indicated that they currently met recommended physical activity guidelines (moderate activity for 30 minutes 5 days a week or vigorous activity for 20 minutes 3 days a week). The average BMI for the study population was 28.7 kg/m$^2$ with 75.7% of the study population reporting being overweight or obese. There were 329 (70.0%) participants who had reported prior back problems. Finally, a majority of participants worked in urban settings (60.6%) and 75.5% reported performing mostly emergency transports.
<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Total Sample</th>
<th>Average ALBPS</th>
<th>ALBPS Difference (95% CI*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Past Back Problem**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>141</td>
<td>13.37</td>
<td>Reference</td>
</tr>
<tr>
<td></td>
<td>30.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>329</td>
<td>16.07</td>
<td>3.60 (1.70 – 5.49)</td>
</tr>
<tr>
<td></td>
<td>70.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BMI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal &lt;25</td>
<td>114</td>
<td>14.21</td>
<td>Reference</td>
</tr>
<tr>
<td></td>
<td>24.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight &gt;25-29.9</td>
<td>187</td>
<td>16.52</td>
<td>2.31 (0.05 – 4.57)</td>
</tr>
<tr>
<td></td>
<td>39.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese &gt;30</td>
<td>169</td>
<td>16.32</td>
<td>2.11 (-0.19 – 4.42)</td>
</tr>
<tr>
<td></td>
<td>36.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Health</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>87</td>
<td>11.94</td>
<td>Reference</td>
</tr>
<tr>
<td></td>
<td>18.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>309</td>
<td>15.41</td>
<td>3.47 (1.28 – 5.67)</td>
</tr>
<tr>
<td></td>
<td>65.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fair/Poor</td>
<td>74</td>
<td>22.52</td>
<td>10.58 (7.73 – 13.44)</td>
</tr>
<tr>
<td></td>
<td>15.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Physical Activity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Met Recommendations</td>
<td>206</td>
<td>15.48</td>
<td>Reference</td>
</tr>
<tr>
<td></td>
<td>43.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did Not Meet Recommendations</td>
<td>255</td>
<td>16.18</td>
<td>0.71 (-1.08 – 2.51)</td>
</tr>
<tr>
<td></td>
<td>54.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>9</td>
<td>17.19</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>1.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Current Smoker</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>395</td>
<td>15.58</td>
<td>Reference</td>
</tr>
<tr>
<td></td>
<td>84.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>75</td>
<td>17.51</td>
<td>1.93 (-0.47 – 4.33)</td>
</tr>
<tr>
<td></td>
<td>16.0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*CI=Confidence Interval

** p< 0.05 Determined by linear regression

Table 7. Sample Description and Average ALBPS by Independent Variables Related to Individual Health
<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Total Sample</th>
<th>Average ALBPS</th>
<th>ALBPS Difference (95% CI*)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Certification Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic</td>
<td>102</td>
<td>17.81</td>
<td>Reference</td>
</tr>
<tr>
<td>Paramedic</td>
<td>308</td>
<td>14.88</td>
<td>-2.93 (-4.76 – -1.10)</td>
</tr>
<tr>
<td><strong>Call Volume</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-9</td>
<td>171</td>
<td>17.05</td>
<td>Reference</td>
</tr>
<tr>
<td>10-39</td>
<td>255</td>
<td>14.85</td>
<td>-2.02 (-4.08 – -0.33)</td>
</tr>
<tr>
<td>40-50</td>
<td>44</td>
<td>17.39</td>
<td>0.34 (-2.87 – 3.55)</td>
</tr>
<tr>
<td><strong>Satisfied With Assignment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very Satisfied</td>
<td>126</td>
<td>16.35</td>
<td>Reference</td>
</tr>
<tr>
<td>Satisfied</td>
<td>279</td>
<td>15.19</td>
<td>-1.16 (-3.20 – 0.88)</td>
</tr>
<tr>
<td>Dissatisfied/Very Dissatisfied</td>
<td>65</td>
<td>18.01</td>
<td>1.66 (-1.24 – 4.56)</td>
</tr>
<tr>
<td><strong>Satisfied With Profession</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very Satisfied</td>
<td>131</td>
<td>14.97</td>
<td>Reference</td>
</tr>
<tr>
<td>Satisfied</td>
<td>271</td>
<td>15.87</td>
<td>0.89 (-1.13 – 2.92)</td>
</tr>
<tr>
<td>Dissatisfied/Very Dissatisfied</td>
<td>68</td>
<td>17.75</td>
<td>2.77 (-0.07 – 5.62)</td>
</tr>
<tr>
<td><strong>Intent to Leave</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Definitely Stay</td>
<td>255</td>
<td>14.92</td>
<td>Reference</td>
</tr>
<tr>
<td>Probably Stay</td>
<td>157</td>
<td>16.45</td>
<td>1.53 (-0.39 – 3.45)</td>
</tr>
<tr>
<td>Probably/Definitely Leave</td>
<td>58</td>
<td>18.64</td>
<td>3.73 (0.97 – 6.48)</td>
</tr>
</tbody>
</table>

*CI=Confidence Interval

** p< 0.05 Determined by linear regression

Table 8. Sample Description and Average ALBPS by Independent Variables Related to Work-Life Characteristics
Table 8 continued

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Total Sample</th>
<th>Average ALBPS</th>
<th>ALBPS Difference (95% CI*)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Community Size</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>169</td>
<td>16.49</td>
<td>Reference</td>
</tr>
<tr>
<td></td>
<td>36.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>285</td>
<td>15.68</td>
<td>-0.81 (-2.68 – 1.06)</td>
</tr>
<tr>
<td></td>
<td>60.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>16</td>
<td>13.25</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>3.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Service Type</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire Based</td>
<td>130</td>
<td>14.73</td>
<td>Reference</td>
</tr>
<tr>
<td></td>
<td>27.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>125</td>
<td>15.98</td>
<td>1.25 (-1.13 – 3.63)</td>
</tr>
<tr>
<td></td>
<td>26.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>164</td>
<td>16.82</td>
<td>2.09 (-0.14 – 4.32)</td>
</tr>
<tr>
<td></td>
<td>34.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>51</td>
<td>15.63</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>10.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Transport Type</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mostly Emergency</td>
<td>355</td>
<td>15.25</td>
<td>Reference</td>
</tr>
<tr>
<td></td>
<td>75.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mostly Scheduled Transports</td>
<td>100</td>
<td>18.19</td>
<td>2.94 (0.78 – 5.10)</td>
</tr>
<tr>
<td></td>
<td>21.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>15</td>
<td>15.73</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>3.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Transport Patients</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>63</td>
<td>17.66</td>
<td>Reference</td>
</tr>
<tr>
<td></td>
<td>13.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>395</td>
<td>15.63</td>
<td>-2.22 (-4.82 – 0.38)</td>
</tr>
<tr>
<td></td>
<td>84.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>12</td>
<td>13.78</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>2.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Years Worked</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 1</td>
<td>44</td>
<td>17.39</td>
<td>Reference</td>
</tr>
<tr>
<td></td>
<td>9.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-4</td>
<td>141</td>
<td>14.42</td>
<td>-2.97 (-6.26 – 0.31)</td>
</tr>
<tr>
<td></td>
<td>30.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-10</td>
<td>164</td>
<td>16.11</td>
<td>-1.28 (-4.51 – 1.95)</td>
</tr>
<tr>
<td></td>
<td>34.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥11</td>
<td>120</td>
<td>16.66</td>
<td>-0.74 (-4.09 – 2.61)</td>
</tr>
<tr>
<td></td>
<td>25.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>1</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>0.2%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

37
<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Total Sample</th>
<th>Average ALBPS</th>
<th>ALBPS Difference (95% CI*)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/Unmarried Couple</td>
<td>318</td>
<td>16.12</td>
<td>Reference</td>
</tr>
<tr>
<td>Divorced/Widowed/Separated</td>
<td>59</td>
<td>16.77</td>
<td>0.65 (-2.05 – 3.34)</td>
</tr>
<tr>
<td>Never Married</td>
<td>92</td>
<td>14.33</td>
<td>-1.79 (-4.04 – 0.46)</td>
</tr>
<tr>
<td>Missing</td>
<td>1</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>374</td>
<td>15.66</td>
<td>Reference</td>
</tr>
<tr>
<td>Minority</td>
<td>85</td>
<td>16.24</td>
<td>0.57 (-1.69 – 2.83)</td>
</tr>
<tr>
<td>Missing</td>
<td>11</td>
<td>20.85</td>
<td>--</td>
</tr>
<tr>
<td><strong>Gender</strong> **</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>149</td>
<td>17.13</td>
<td>Reference</td>
</tr>
<tr>
<td>Male</td>
<td>279</td>
<td>15.21</td>
<td>-1.91 (-3.80 – 0.03)</td>
</tr>
<tr>
<td>Missing</td>
<td>42</td>
<td>16</td>
<td>--</td>
</tr>
<tr>
<td><strong>Level of Education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School</td>
<td>38</td>
<td>14.98</td>
<td>Reference</td>
</tr>
<tr>
<td>Some College</td>
<td>200</td>
<td>15.97</td>
<td>0.98 (-2.39 – 4.36)</td>
</tr>
<tr>
<td>Associates Degree</td>
<td>99</td>
<td>17.43</td>
<td>2.44 (-1.19 – 6.08)</td>
</tr>
<tr>
<td>Bachelors Degree or Greater</td>
<td>129</td>
<td>14.71</td>
<td>-0.27 (-3.79 – 3.24)</td>
</tr>
<tr>
<td>Missing</td>
<td>4</td>
<td>20.67</td>
<td>--</td>
</tr>
</tbody>
</table>

*C* = Confidence Interval

**p** < 0.05 Determined by linear regression

Table 9. Sample Description and Average ALBPS by Independent Variables Related to Demographic Characteristics
The average ABPS for all participants was 15.9 (95% CI 15.0 – 16.8). Tables 7-9 also report the average ABPS and the difference in ABPS by demographic, work-life, and health characteristics. Past back problems, overall health, certification level, call volume, intention to leave, transport type, gender, and age were found to be significantly associated with ABPS. Individuals reporting fair or poor health had a difference in ABPS of 10.58 (95% CI 7.73 – 13.44) compared to those reporting excellent health. Paramedics had a significantly lower ABPS compared to EMT-Basics with a difference of -2.93 (95% CI -4.76 - -1.10) and those working mostly scheduled transports had higher pain scores 18.19 compared to those working mostly emergency transports 15.3; with a difference of 2.94 (95% CI 0.78 – 5.10). There was a significant difference between males and females (-1.91, 95% CI -3.80 - -0.03) with males having the lower ABPS score. Finally, for every 10 year increase in age ABPS score increased by 1.2 (p < .01)

A linear regression model was constructed to further elucidate the relationship between independent variables and ABPS. Table 10 displays the investigator controlled stepwise process that was used in constructing the multiple regression model. Plausible interaction terms were tested (i.e. prior back problems and health, prior back problem and certification level, and health and certification level) however, no interaction term significantly improved the fit of the multiple regression model. Also, confounding was assessed and it was determined none of the remaining variables met the criteria for being a confounder.
Table 10. Investigator Driven Stepwise Model Building Process (paper 2)

Table 11 summarizes the final multiple regression model containing the variables past back problems, overall health, certification level, and age. Regression diagnostics indicated adequate model fit and the adjusted R-squared value was 0.15. After controlling for the other variables in the model, self-reported health was found to be strongly associated with changes in ABPS. Individuals who reported fair/poor health had the largest unit change in ABPS at 10.1 (7.2 – 12.9). Also, past back problems were found to be significantly associated with pain scores. An individual’s average ABPS increased by 3.03 (1.22 - 4.83) units if they had reported back problems in the past.
Table 11. Final Multivariable Linear Regression Model

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Coefficient</th>
<th>SE</th>
<th>95% CI</th>
<th>Wald</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>8.61</td>
<td>2.04</td>
<td>4.60 - 12.61</td>
<td>4.22</td>
<td>0.000</td>
</tr>
<tr>
<td>Past Back Problem</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>3.03</td>
<td>0.92</td>
<td>1.22 - 4.83</td>
<td>3.30</td>
<td>0.001</td>
</tr>
<tr>
<td>Health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good Health</td>
<td>3.57</td>
<td>1.11</td>
<td>1.39 - 5.75</td>
<td>3.22</td>
<td>0.001</td>
</tr>
<tr>
<td>Fair/Poor Health</td>
<td>10.07</td>
<td>1.44</td>
<td>7.24 - 12.91</td>
<td>6.99</td>
<td>0.000</td>
</tr>
<tr>
<td>Certification Level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paramedic</td>
<td>-3.13</td>
<td>0.9</td>
<td>-4.09 - -1.37</td>
<td>-3.49</td>
<td>0.001</td>
</tr>
<tr>
<td>Age (years)</td>
<td>0.08</td>
<td>0.04</td>
<td>0.00 - 0.17</td>
<td>1.98</td>
<td>0.049</td>
</tr>
</tbody>
</table>

* R-Squared – 0.15

3.4 Discussion

In this first effort to quantify back pain severity among a currently working population of EMS professionals an average pain score of 15 out of 100 was estimated. Though this pain score was relatively low, it was not unexpected. Defining the severity of musculoskeletal disorders is difficult and often relies on length of disability rather than severity because injury severity scores typically fall on the low end of severity.\(^{71}\)

However, this study was able to demonstrate a change in back pain severity based on health, work-life, and demographic characteristics.

Several studies have attempted to assess work-related and personal characteristics associated with occupational injuries using lost work days. Chau et al.\(^ {72}\) assessed the relationship between work-related and personal characteristics with a dichotomous severity variable defined as an injury requiring > 60 days of sick leave. Results indicated that individuals under 30 years of age were less likely to have severe injuries and those with hearing loss were more likely to report severe injuries. Horwitz and McCall\(^ {73}\)
present a linear regression model of total disability days indicating that individuals who work night shifts, when adjusting for other demographic variables, had, on average, more lost work days than those working other shifts. Finally, Kines et al. present a distribution of injuries among construction workers in Denmark whereby strains and sprains occurred most frequently yet had a low mean absence per injury.

In this current analysis, reporting a past back problem was significantly associated with increases in pain severity. It is intuitive that past injuries may be associated with current pain; however, past injury has not been previously taken into account when attempting to describe work-related characteristics associated with back problems or on-the-job injury among EMS professionals.

Among patients seeking care for low back pain Vingard et al. noted that the strongest risk factor for seeking care after adjusting for gender, and physical and psychological loads, was reporting back pain > 3 months earlier. Chronic low back pain has also been shown to be associated with earlier incidents of acute low back pain. Prior injury and work position (i.e. bending or stooping) were also associated with increased injury in a cohort of nurses. Regarding the severity of back injury, Tate et al. found that time lost due to an injury increased threefold if a back injury had been previously reported.

As expected, self-reported health was strongly associated with increases in pain severity. This strong association may be due to the fact that individuals who reported decreased levels of health did so because they were currently experiencing back pain. However, there has been some evidence that poor health is associated with incident back
problems among working individuals.\textsuperscript{41,47} However, this current analysis cannot
determine how an individual’s change in health perception affects his or her pain
severity.

Finally, both age and EMS certification level were associated with changes in
back pain severity. Age had a very modest effect on severity; for each year increase in
age, pain severity increased by less than one unit. Although this effect may be small it is
intuitive. EMS professionals’ certification level has been shown to be associated with
incident and prevalent occupational injuries,\textsuperscript{17,65} however there is limited understanding
as to why this association may exist. In the current study paramedics on average report
less severe pain then EMT-Basics, yet prior research indicates that paramedics are more
likely to report current occupational injuries or recent back problems. This relationship
may be a surrogate indicator for the between-job variation in tasks performed among
EMT-Basics and paramedics.

In this study pain severity was estimated among a population of EMS
professionals and factors associated with variations in severity were identified. Further
research regarding back pain severity among a working population of EMS professionals
should focus on the changes in pain severity over time and ways to prevent and
ameliorate it. Understanding individuals’ baseline pain severity may allow for the
identification of factors that alleviate this pain over time.

\textbf{3.5 Limitations}

This analysis has several notable limitations including use of a self-report
questionnaire, numerous individuals with missing data, and a sample population selected
from the NREMT. Variables analyzed were limited to those included on the
questionnaire and no other information relating to an individuals work-life or demographics were available. There was no attempt made to analyze specific job functions or work tasks such as lifting or moving patients or objects that may be related to changes in pain severity.

The outcome variable for this study was self-reported pain severity as assessed by the Aberdeen back pain scale. The validity and reliability of the ABPS has been previously assessed\textsuperscript{37, 66} however, this scale has not been used to assess baseline pain severity in an occupational setting. As mentioned above, occupational injury severity is usually assessed through analysis of lost work time data. This study did indicate that mean severity scores for an occupational population could be estimated. Though an attempt was made to analyze only actively-practicing EMS professionals, individuals included in this analysis may have been on short-term disability.

Finally, a sample of nationally registered EMS professionals based on the LEADS project was used and may present concerns regarding the generalizability of these results. Currently 46 states use the National Registry certification examination at some level of EMS certification.\textsuperscript{76} Yet, only 5 states require continuous national certification.\textsuperscript{77} It may be possible that there are differences between EMS professionals who were never nationally registered as well as with those who let their registration lapse. Currently, the National Registry of EMTs provides a data source with a known national number of providers from which to sample. This ability to sample a known population is missing from other national and state data sets.

The response rate for this survey was higher than other LEADS efforts. Though a non-response follow-up was not conducted in this effort, the LEADS project has
conducted follow-up of non-responders in the past. Brown et al.⁸ completed an analysis of EMT-Basics and Paramedics and found little evidence that non-responders differed from responders on demographic, attitudinal, or educational items on the core LEADS survey. This increases our confidence in the generalizability of these results. Though questions of external generalizability may still remain due to the number of participants, this study should accurately represent nationally registered EMS professionals.

3.6 Conclusions

This study was able to estimate the severity of recent back pain among EMS professionals who had reported any pain in the last two weeks. Also, several health, work-life and personal characteristics were identified as being associated with changes in back pain severity. Future studies should track pain severity in individuals over time to identify factors that alleviate this pain.
CHAPTER 4

EVALUATION OF OCCUPATIONAL INJURIES IN AN URBAN EMERGENCY MEDICAL SERVICES SYSTEM BEFORE AND AFTER IMPLEMENTATION OF MECHANICAL STRETCHERS

4.1 Introduction

Emergency Medical Services (EMS) professionals are exposed to many occupational hazards.\textsuperscript{1-7} It is also recognized that musculoskeletal injuries such as back injuries are frequently reported in this occupation.\textsuperscript{8, 17} This is similar to other healthcare professions, specifically nursing.\textsuperscript{18-20} Much like nursing, EMS professionals perform many tasks that place strain on the back.\textsuperscript{21-23} However, unlike nursing, there are currently no known formal studies conducted to assess the impact of interventions on back injuries among EMS professionals.\textsuperscript{24-26}

EMS professionals work in unusual conditions and are required to perform many job tasks that put localized strain on the back and other joints.\textsuperscript{21-23} Though the frequency of these job tasks may vary, several strenuous tasks occur on a regular basis. These tasks center on the movement of the patient to a stretcher and the subsequent lifting of the stretcher into an ambulance. The perceived risk lies in lifting patients of varying weight, sometimes greater than 300 pounds, to a stretcher, and then lifting the patient plus the stretcher into a position to be loaded into an ambulance.
Among nurses, the risk of back injury has been an important topic since the late seventies. Literature suggests that nurses have a prevalence of back injury between 41-52%. The epidemiology of low back injury among nursing professionals is well known. It has been demonstrated that nurses with less seniority and those involved with lifting and transferring patients have higher rates of injury. Engkivist et al. performed a case-control study indicating that the types of work performed, such as transferring patients at least once a shift, were associated with injury.

In the nursing profession it has been well established that frequent bending and lifting is associated with higher risks of back pain. Ergonomic studies of lifting techniques have also been performed on nurses and have demonstrated excessive compressive forces. There is an emerging body of ergonomic work in EMS currently focusing on lateral transfer techniques. However, there is limited work in EMS regarding the lifting and loading of patient stretchers.

Several recent studies in the nursing literature have indicated that mechanical lift devices may be effective at reducing back injury risk. In 2001 Yassi et al. conducted a randomized trial to compare three lifting programs at Winnipeg’s Health Sciences Center. The lifting programs under review were “usual practice,” “no strenuous lift,” and “safe lifting.” The “no strenuous lift” program involved the utilization of mechanical lifting devices to eliminate manual handling of patients. There were no statistically significant differences within the study arms with regards to injury rate pre- and post- intervention. However, though not significant, the “no strenuous lift” arm resulted in a decreased injury rate; from 8.2 to 6.1 injuries per 100,000 paid hours. This study was limited by its relatively small sample size (346 nurses) and its small follow-up time (one year).
Evanoff et al.²⁴ analyzed Occupational Health and Safety Administration (OSHA) forms (OSHA 200) from nine healthcare facilities in Missouri to determine if introducing mechanical patient hoists reduced musculoskeletal injuries. A pre-intervention post-intervention study design was utilized. The pre-intervention and post-intervention periods were variable as lift devices were introduced in different facilities at different times. During the study period there were 412 musculoskeletal injuries. There were 6.68 pre-intervention and 5.48 post-intervention injuries per 100 full time equivalents (FTE). This led to a marginally non-significant rate ratio of 0.82 (95% CI, 0.68-1.00). However, there was a significant decrease in the lost-work-day injury rate ratio 0.56 (95% CI, 0.41-0.78). This study may have been limited by the non-random allocation of mechanical lift devices. Devices were only placed on nursing floors where there was staff interest and a perceived need.

Finally, Li²⁵ used a pre-post intervention study to evaluate the use of mechanical lift devices among nursing staff. This intervention included 138 nurses from three separate nursing units in one hospital. The main difference between this study and the study by Evanoff et al.²⁴ was that injuries potentially related to lifting patients were abstracted from OSHA logs. Also, worker compensation costs were calculated for the pre and post intervention phases.

During the 19 month pre-intervention period and the 26 month post-intervention period there were 30 injuries identified as being potentially related to lifting. Of those 30 injuries, eight resulted in lost work time. Rates of injury decreased from 10.3 to 3.8 injuries per 100 FTE post-intervention. This led to a rate ratio of 0.37 (95% CI, 0.16-0.88). Also, average worker compensation costs decreased from $484 to $151 per FTE.
The use of mechanical lifting devices may be effective in EMS for reducing back injuries. In a majority of EMS systems, once a patient has been placed on a stretcher two EMS professionals must lift the stretcher to a loading height and then again lift the stretcher into the back of an ambulance. A stretcher that is mechanized to decrease the effort of lifting stretchers into the loading position may help reduce the burden of back injury, although currently there are no known studies in EMS that have examined the use of mechanical lifting devices. It was hypothesized that a device used to limit the effort EMS professionals use to lift patients may reduce the occurrence of back injuries. The objective of this study was to evaluate occupational injuries in an urban EMS system before and after implementation of mechanical stretchers.

4.2 Methods

4.2.1 Setting

The data for this observational pre-post intervention analysis were obtained from Austin Travis County EMS (A/TCEMS). This project has received IRB approval from The Ohio State University and the American Institutes for Research. A/TCEMS is a third service/public safety utility model EMS system. It is the primary advance life support provider for an approximately 1,100 square mile service area inclusive of both the city of Austin and Travis County, TX. In 2007 A/TCEMS had a departmental staff in excess of 450 individuals and A/TCEMS paramedics responded to greater than 110,000 calls for service.
4.2.2 Intervention

In December 2006, A/TCEMS purchased and placed into service battery operated hydraulic patient stretchers manufactured by Stryker (Power-Pro XT). These stretchers were placed into service based on the perception of the A/TCEMS administration that an injury reduction benefit may occur. The stretchers were not implemented with the current study design in mind. It has been proposed by the manufacturer that injury reduction after implementation may occur because the stretcher limits the amount of weight an EMS professional must lift. This is accomplished by utilizing a hydraulic system to raise and lower the undercarriage of the stretcher.\(^{86}\) The stretcher does not load itself into the back of an ambulance and A/TCEMS does not currently utilize a device to auto load stretchers. A/TCEMS personnel were trained on the use of the stretcher prior to full implementation.

At this time no rigorous independent, third party investigation of the Stryker automated stretcher has been conducted. Several case studies have been reported by the manufacturer claiming reductions in injury and worker compensation benefits.\(^{87,88}\) Also, the stretchers are marketed as ergonomic in design; however, at this time there appear to be no known studies related to the efficacy of this device in reducing injuries.

4.2.3 Data Collection

This observational study analyzed data from the A/TCEMS Record Management System (RMS) and the Worker Compensation administrator’s database. Data were collected by A/TCEMS staff as routine occupational injury reporting. RMS data included information about each employee’s employment status (active or separated) and
was the source of occupational injury reporting (type of injury, cause of injury). A majority of the fields included in the RMS occupational injury section were information collected as mandated by OSHA. The Worker Compensation administrator’s database included injuries in which an employee lost work time or worker compensation benefits were paid out. Data analyzed for this project included information from the RMS collected from 01/01/1999 - 04/30/2008. For the purposes of this study the pre-intervention period was considered the time between 01/01/1999 - 12/31/2006, with the post-intervention time period being any date after and including 01/01/2007.

RMS data were utilized to determine the number of individuals at risk for injury during the study period. A list of 1,047 active and separated employees was used to calculate the amount of person-time during each year of available data and during each intervention period. Initially, an analysis of job titles was undertaken and those individuals whose titles were consistent with administrative or non-field personnel were eliminated from the analysis.

The denominator data (person-time) for calculating injury rates consisted of the number of days an individual was employed by A/TCEMS for any year of observation. For each year of observation person-time was summed, divided by 365, and expressed as full-time equivalents (FTE). Actual hours worked were not available for this analysis. Therefore, it was assumed that all employees performed full-time duties for A/TCEMS during their tenures. All rates were presented as per 100 FTE and all worker compensation rates were presented as dollars per FTE.
4.2.3 Data analysis

In order to meet the stated objective a descriptive analysis of A/TCEMS data was undertaken. Initially, incidence rates for each year were calculated including all injuries among the eligible population. Incidence rate calculations were then performed for four injury sub-groups: injuries reported as strains or sprains; injuries affecting the neck, shoulder, back and knees; injuries affecting only the neck and back; and injuries with a reported cause of stretcher lifting or lowering. Overall and subgroup analysis of lost-work-time injuries, reported as injury rates, and worker compensation rates were also calculated.

Incidence rates among the injury sub-groups and lost work time were also calculated for the pre- and post-intervention period. The rate ratio (RR) and corresponding 95% confidence interval (CI) were presented as the estimated measure of intervention effect. RR were calculated as the ratio of the incidence of injury in the exposed group (post-intervention group) and the incidence of injury in the unexposed group (pre-intervention). Data analysis was conducted using Stata version 9 (College Station, TX) and Microsoft Excel (Redmond, WA).

4.3 Results

There were 1,478 injuries reported during the observation period among 706 eligible employees contributing 2,793 person-years of observation. This resulted in an overall incidence rate of 52.9 injuries per 100 FTE per year. Figure 1 displays the yearly
injury rate by all injuries and by sub-group. The largest incidence of strains and sprains occurred in 2004 with 30.5 injuries per 100 FTE. In 2006, incidence of injuries due to lifting or lowering the stretcher was at its peak of 11.7 injuries per 100 FTE.

Figure 2. Injury Rate per 100 FTE per Year
There were 2,087 and 706 person-years of observation pre and post intervention, respectively. Table 12 displays the estimated incidence rates and RR for all injuries and subsequent subgroups. In the pre-intervention time period there were 1,275 reported injuries compared to 203 injuries post intervention. The incidence rates pre-intervention and post-intervention were 61.1 and 28.8 per 100 FTE, with a corresponding RR of 0.47 (95% CI 0.41 - 0.55). Strains and sprains had a RR of 0.43 (95% CI 0.33 - 0.55) when comparing pre- and post-intervention time periods. The lowest rate ratio noted was among the subcategory of stretcher related injuries (RR 0.30; 95% CI 0.17 – 0.52).

<table>
<thead>
<tr>
<th>Population</th>
<th>Interval</th>
<th>Person-Years</th>
<th>Total Injuries</th>
<th>Injury Rate/100 FTE</th>
<th>Injury Rate Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Population</td>
<td></td>
<td>2793</td>
<td>1478</td>
<td>52.92</td>
<td></td>
</tr>
<tr>
<td>All Injuries</td>
<td>Pre Post</td>
<td>2087.14</td>
<td>1275</td>
<td>61.09</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td></td>
<td>705.83</td>
<td>203</td>
<td>28.76</td>
<td></td>
</tr>
<tr>
<td>Strain/Sprain</td>
<td>Pre Post</td>
<td>2087.14</td>
<td>471</td>
<td>22.57</td>
<td>0.43</td>
</tr>
<tr>
<td></td>
<td></td>
<td>705.83</td>
<td>68</td>
<td>9.63</td>
<td></td>
</tr>
<tr>
<td>Anatomy group*</td>
<td>Pre Post</td>
<td>2087.14</td>
<td>379</td>
<td>18.16</td>
<td>0.49</td>
</tr>
<tr>
<td></td>
<td></td>
<td>705.83</td>
<td>63</td>
<td>8.93</td>
<td></td>
</tr>
<tr>
<td>Back Injury only</td>
<td>Pre Post</td>
<td>2087.14</td>
<td>284</td>
<td>12.65</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>705.83</td>
<td>36</td>
<td>5.10</td>
<td></td>
</tr>
<tr>
<td>Stretcher Injury only</td>
<td>Pre Post</td>
<td>2087.14</td>
<td>137</td>
<td>6.56</td>
<td>0.30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>705.83</td>
<td>14</td>
<td>1.98</td>
<td></td>
</tr>
</tbody>
</table>

*Back, Neck, and Knees

Table 12. Overall and Subcategory Incidence Rates and Rate Ratios for Occupational Injury

Over the study period there were 255 injuries that resulted in a total of 8,674 days away from work. Figure 3 displays the yearly rate of injury requiring days away from

54
work by all injuries and by sub-group. The largest incidence of injuries resulting in days away from work occurred in 1999 and 2005 with an incidence rate of 16.6 and 15.1 lost-work-day injuries per 100 FTE. Beginning in 2005 there was a relatively linear decrease in the lost-work-day injury rate. At the time of data analysis there had been no reported lost-work-day injuries in 2008.

Figure 3. Rate of Lost Workday Injuries per 100 FTE
The incidence rate of injuries resulting in lost workdays during the study period was 9.6 days per 100 FTE per year (See Table 13). Pre-intervention the incidence rate was 12.2 per 100 FTE per year compared to an incidence rate of 2.0 per 100 FTE. The corresponding RR of injuries resulting in lost work days was 0.16 (95% CI 0.09 - 0.28) comparing pre and post intervention. Due to limitations in the data set, it was not possible to calculate incidence rates or RR for lost-work-time injuries due to stretcher usage. As subcategories of injury type become more specific there was a relative increase in the RR of injuries resulting in lost-work-days.

![Table 13. Overall and Subcategory Incidence Rates and Rate Ratios for Injuries with Lost Work Days](image)

Over the 10-year study period approximately $2.5 million of worker compensation costs were accrued leading to a rate of $915.28 per person-year. A sizable decrease in worker compensation costs was noted post intervention. These results are displayed in Table 14. For all injuries pre-intervention worker compensation costs were
$1,182.25 per person-year compared to $125.90 per person-year post-intervention leading to a worker compensation costs decrease of $1,056.35 per person-year. When assessing back injuries specifically, a cost decrease of $581.72 per FTE was estimated after the post intervention time period.

<table>
<thead>
<tr>
<th>Population</th>
<th>Interval</th>
<th>Person-years</th>
<th>WCB paid (dollars)</th>
<th>WCB paid per FTE (dollars)</th>
<th>Difference (dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Population</td>
<td>Pre 2793</td>
<td>2,556,377</td>
<td>915.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Post 705.83</td>
<td>88,862.79</td>
<td>1,182.25</td>
<td>125.90</td>
<td>-1,056.35</td>
</tr>
<tr>
<td>All Injuries</td>
<td>Pre 2087.14</td>
<td>2,467,514.00</td>
<td>1,015.52</td>
<td>73.74</td>
<td>-941.79</td>
</tr>
<tr>
<td></td>
<td>Post 705.83</td>
<td>52,043.74</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strain/Sprain</td>
<td>Pre 2087.14</td>
<td>2,119,540.00</td>
<td>843.98</td>
<td>36.98</td>
<td>-807.00</td>
</tr>
<tr>
<td></td>
<td>Post 705.83</td>
<td>28,103.41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anatomy Group*</td>
<td>Pre 2087.14</td>
<td>1,761,508.00</td>
<td>609.30</td>
<td>27.58</td>
<td>-581.72</td>
</tr>
<tr>
<td></td>
<td>Post 705.83</td>
<td>26,103.41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back Injuries only</td>
<td>Pre 2087.14</td>
<td>1,271,697.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Post 705.83</td>
<td>19,469.10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Back, Neck, and Knees

Table 14. Overall and Subcategory Worker Compensation Bureau Costs Pre and Post intervention

### 4.4 Discussion

Over approximately 10 years of observation a rate of 52.9 injuries per 100 FTE per year was estimated among field staff in this urban, third service EMS system. This estimate was higher than, but similar to, injury rates reported in other EMS systems. This was only the second study in EMS which estimated injury rates among full-time employees. Multiple studies have focused on identifying the most prevalent causes of injury among EMS professionals. By focusing future research on injury rates it may be possible to better assess changes in rates of injury among this population.
Though relatively similar methods were used in this current study and the study by Maguire et al.\textsuperscript{6} there were some notable differences. One of the main objectives of the Maguire et al. paper was to compare their findings with other occupational groups. As such, they took great effort in coding and categorizing all types of injuries to be comparable with the Department of Labor’s standard injury definitions. However, the primary objective of this paper was to assess changes in injury rates among EMS professionals after implementation of mechanical stretchers. This type of intervention assessment was specifically called for by Maguire et al.\textsuperscript{6}.

A significant reduction in relative incidence of injury pre- and post-intervention was seen for all occupational injuries and for subcategories of injuries. These rate ratios mirror those seen in the nursing profession when mechanical lifts were introduced and lifting of patients was reduced.\textsuperscript{24-26} However, the methods of introduction of these interventions into EMS and nursing differ dramatically. As mentioned above the mechanical stretchers utilized in the current study were implemented based on a perceived need of management staff. This was not the case in nursing where interventions were introduced after ergonomic assessments were completed. There is a body of literature in nursing describing the ergonomics involved in the profession\textsuperscript{90} as well as ergonomic analyses of intervention efficacy.\textsuperscript{91} This type of research is limited in EMS.

An ergonomic study of lifting techniques concluded that mechanical assist devices placed less stress on the low back than traditional techniques.\textsuperscript{91} Also, in nursing
Evidence-based processes have been used to evaluate methods to reduce occupational injury.\textsuperscript{92} EMS should begin to focus on implementing evidence-based occupational health interventions based on sound ergonomics.

Though benefiting employees’ health should be of paramount concern, this study did identify a post-intervention cost savings. Implementation of ergonomic programs have also been shown to be cost effective in nursing.\textsuperscript{93} In fact, one study estimated that the time to direct-cost payback of mechanical lift devices was 2.5 years.\textsuperscript{94} Unfortunately, the current study was unable to calculate the direct cost payback for the mechanical stretchers. Further analysis of occupational interventions in EMS should include more rigorous assessment of the economic impact of interventions.

Although a large measure of effect was noted in this study regarding reductions in injury rate and lost-work-time injuries, it was difficult to attribute the entirety of this effect to the implementation of a single device. Large measures of effect, such as those noted in this study, have been seen in nursing but only after implementing a complex and multifaceted injury reduction program;\textsuperscript{95-97} mechanical lifts were only one part of those programs.

Injuries specifically related to stretcher use had the largest rate reduction as indicated by a RR of 0.30. This may indicate a specific effect of the stretcher intervention. However, through conversation with A/TCEMS staff it was likely that, unintentionally, a multifaceted approach to injury reduction had been adopted during the intervention period. Over the course of implementing the mechanical stretchers A/TCEMS changed their shift structure and employed a full-time safety officer.
Unfortunately, this analysis was unable to measure the exact moments of these interventions as they were ongoing processes. Though injuries were reduced overall during this time period, the greatest reduction was seen in stretcher-related injuries.

While this study found significant injury rate decreases in an urban EMS system more systematic studies of occupational interventions in EMS systems are needed. Specifically, EMS needs more ergonomic studies of job tasks that may be prone to occupational interventions and further assessment of proposed “ergonomic” interventions. One area where this type of evidence-based approach has begun in EMS has been in the area of lateral transfers. However, few if any EMS systems have adopted the recommendations set forth in these ergonomic assessments. It is likely that greater injury rate reductions in EMS can be seen if an evidence-based ergonomic approach to injury reduction is undertaken.

4.5 Limitations

This retrospective pre-post quasi experimental study design had several limitations. The use of a pre-post study design will have the common limitations inherent in this design type. Specifically, any changes in injury rates observed cannot be solely attributed to the implementation of the intervention. Mercer et al. stated that though pre-post studies may have limited external validity they may be useful for determining the feasibility of interventions. Zwerling et al. also state that simple quasi-experimental studies using historical controls can give a first assessment of the promise of a particular intervention.
Common threats to the validity of these results must be discussed. One of the largest threats was that no control group was utilized in this study. Individuals measured in the pre-intervention group were also measured in the post-intervention group. This study therefore cannot account for the effects of past injury on the probability of future injury. Maturation of the study population may be another threat. It was possible that as individuals obtain more EMS experience they learn from their mistakes or the mistakes of others when it comes to lifting techniques. More likely than not, non-differential maturation occurred in this analysis because new employees entered throughout the study as older employees dropped out.

As the intervention in this retrospective study was implemented based on administrative concerns and not evidence-based ergonomics, this could be a potential source of bias. As previously mentioned, an unintentional multifaceted approach to worker safety may have been put into practice throughout the organization during the time of stretcher implementation. These external influences on the post-intervention population were likely to have contributed to some of the estimated effect. However, the largest RR estimated was among those injuries involving stretcher use. Though bias may be present, it most likely does not account for all of the estimated measure of intervention effect.

A strength of this study was that the method by which A/TCEMS reports on the job injuries has remained the same since the RMS data collection system was put into place. The ability to track changes in injury rates over time and assess those changes in
the presence of a proposed occupational injury intervention has not yet been accomplished in EMS. These methods may be strengthened by controlling for bias through randomizing interventions among participants in an EMS system.

4.6 Conclusion

The rates of occupational injuries in this EMS system were higher than those found in other healthcare professions but similar to the few EMS studies that have been conducted. A significant decrease in the rate of injury was estimated after the intervention period. While the estimated rate decreases may not be explained completely by the intervention, rate decreases in an EMS system were observed over the course of a year and a half. Future studies should further investigate the impact of randomized, evidence–based, ergonomic interventions on occupational injuries among EMS professionals.
CHAPTER 5

CONCLUDING REMARKS

The preceding chapters have attempted to demonstrate that back injuries among EMS professionals are a threat to the health of the workforce. These papers have also discussed modifiable characteristics that may reduce the likelihood and severity of back pain. Finally, an analysis of an EMS system that has employed some ergonomic interventions indicated reductions in overall injury and musculoskeletal injuries. This chapter will reiterate the findings of these three papers.

Within studies 1 and 2 several similar themes emerged as being related to recent back pain and back pain severity, specifically past back problems and self-reported health. Results from these analyses suggest that prior back problems were significantly associated with reporting recent back pain and the severity of that pain. Past back injury has been identified as a component of the natural history of low back pain among the general population\textsuperscript{40} and nurses.\textsuperscript{20,43} Among patients seeking care for low back pain, Vingard et al.\textsuperscript{42} noted that the strongest risk factor for seeking care after adjusting for gender, and physical/psychological loads, was reporting back pain > 3 months earlier. Chronic low back pain has also been shown to be associated with earlier incidents of acute low back pain.\textsuperscript{41} Prior injury and work position were also associated with increased
injury in a cohort of nurses.\textsuperscript{43} Regarding the severity of back injury, Tate et al.\textsuperscript{75} found that time lost due to an injury increased threefold if a back injury had been previously reported.

When controlling for the effects of past back problems, those individuals reporting fair or poor health in both study 1 and 2 were significantly associated with a higher likelihood of recent pain and more severe pain. These strong associations may be due to the fact that individuals who reported decreased levels of health did so because they were currently experiencing back pain. However there has been some evidence that poor health is associated with incident back problems among working individuals.\textsuperscript{41, 47}

Data from 850 individuals enrolled in the Berne Workplace Health Project indicated that individuals with poor self-rated health were significantly more likely to report recent back pain. Thomas et al.\textsuperscript{41} reported a strong, crude relationship between poor self-rated health and disabling back pain among primary care patients (OR = 3.5). However, this association disappeared after adjustment for confounders.

Though self-reported health has been associated with back pain there are limited data available describing how changes in self-reported health affect back pain. Also, in these current retrospective studies it was impossible to determine if poor health caused back pain or vice versa.

Interestingly, the surrogate indicator for strenuous work activity that was collected, call volume, was not significantly related to either of the outcomes in studies 1 or 2. However, strenuous work-related activities have been commonly associated with back pain in other populations.\textsuperscript{53-55} It may be that call volume was an inadequate
marker of strenuous activity. Further research should be conducted to better identify the frequency and characteristics of strenuous work tasks within EMS and their association with recent back pain.

Finally, a number of independent variables were associated with reporting recent back pain but not associated with pain severity and vice versa. Gender, level of education, and job satisfaction were found to be associated with reporting recent back pain but not with pain severity. However, there is conflicting information in the back injury literature regarding the strengths of these associations. In study 1, those with the highest level of education had lower odds of recent back pain than those reporting the lowest level of education. A systematic literature review of the association between education and back pain indicated that individuals with low levels of education were more likely to experience back pain. However, these are contradictory to the results seen among farmers.

Within study 2 certification level and age were associated with increased pain severity. While the association of increasing pain severity with increasing age may be intuitive, certification level is not. EMS professionals’ certification level has been shown to be associated with incident and prevalent occupational injuries, however there is limited understanding as to why this association may exist. In the current study paramedics on average report less severe pain then EMT-Basics, yet prior research indicates that paramedics are more likely to report current occupational injuries or recent back problems. This relationship may be a surrogate indicator for the between job variation in tasks performed among EMT-Basics and paramedics.
While studies 1 and 2 described back pain within the EMS workforce, study 3 evaluated the effect of a mechanical stretcher intervention on all occupational injuries and back related injuries. A significant reduction in relative incidence of injury pre and post intervention was seen for all occupational injuries and for sub-categories of injuries. These rate ratios mirror those seen in the nursing profession when mechanical lifts were introduced and lifting of patients was reduced.\textsuperscript{24-26} However, the methods of introduction of these interventions into EMS and nursing differ dramatically.

Although a large measure of effect was noted in this study regarding reductions in injury rate and lost-work-time injuries it was difficult to attribute the entirety of this effect to the implementation of a single device. Large measures of effect, such as the ones noted in this study, have been seen in nursing but only after implementing a complex and multifaceted injury reduction program.\textsuperscript{95-97} Mechanical lifts were part of these programs but only one piece.

Through conversation with A/TCEMS staff it was likely that, unintentionally, a multifaceted approach to injury reduction had been adopted during the intervention period. Over the course of implementing the mechanical stretchers A/TCEMS changed their shift structure and employed a full-time safety officer. Unfortunately, this analysis was unable to measure the exact moments of these interventions as they were ongoing processes. Though injuries were reduced overall during this time period the greatest reduction was seen in stretcher-related injuries.

Results from this dissertation: indicated that nearly half of the population in study 1 experienced pain in the back or legs, estimated the severity of back pain among EMS professionals, and also estimated the rates of occupational injury in an EMS system. A
common theme of work-life and demographic characteristics were found to be associated with recent back pain and pain severity. Also, a significant decrease in the rate of injury was estimated after the implementation of mechanical stretchers. These studies lend support to the growing literature on back injuries among members of this critical workforce, and further studies of back pain among EMS professionals should attempt to assess the causality of these work-life, health, and demographic characteristics in relation to back pain. Future studies should track back injuries in individuals over time to identify factors that reduce re-occurrence and alleviate current pain severity. Also investigation into the impact of evidence–based ergonomic interventions on occupational injuries among EMS professionals should occur.
LIST OF REFERENCES


86. Power-Pro Powered Ambulance Cot.


APPENDIX A

LEADS HEALTH AND WELLNESS FOLLOW-UP STUDY
Dear Emergency Medical Service Colleague:

Your assistance is needed!

We would like to thank you for participating in past LEADS surveys and we are again calling on you to assist us in answering important questions concerning the EMS workforce. The National Registry of EMTs (NREMT), in conjunction with the National Highway Traffic Safety Administration (NHTSA) and The Ohio State University, is conducting a "mid-year" survey of past LEADS respondents focusing on the health and well being of EMTs. We are requesting your participation through completion of this survey. However, this participation is strictly voluntary.

In addition to providing a comprehensive picture of the demographics of EMTs and Paramedics across the nation, this survey also will ask for information on back injuries, hearing loss and latex allergies in greater detail than previous efforts. Additionally, we will be asking you about a wide range of topics, such as education, finances, management, patient care and the impact of your EMS job on your personal life. This will allow us to see how your feelings about the profession and your professional needs may change over time. This effort will allow us to learn more about the important health issues facing EMS personnel and to help identify the critical issues affecting our profession.

Your privacy is important to us, and your responses will be kept absolutely confidential. Only data summarizing groups of participants will be reported. Data from previous LEADS surveys you may have completed will also be analyzed and your privacy will be maintained throughout. We will share brief summaries of these findings with you throughout the life of the study.

Since you were randomly selected, your responses will represent those of many other EMS providers. The few minutes you spend can have a real impact on how our profession will meet the challenges of the future. Our understanding of the health risks to EMTs will help us plan and implement interventions to prevent injury and improve your work and home lives. To participate in this study, complete the enclosed survey and return it in the enclosed postage paid envelope as soon as possible, but no later than September 30th 2007.

If you have any questions, or want to obtain more information about this very important project, please contact Jon Studnek at (614) 885-4484 or via email at jons@nremt.org.

Once again thank you for your participation.

Jon Studnek
EMS Research Fellow

P.S. It is essential that your address on file at the National Registry is current at all times. You may update your address for this project by contacting this office via telephone or by visiting our website www.NREMT.org.
LEADS Health and Wellness Follow-up Survey

1. At what level are you currently practicing as an EMT?
   - First Responder
   - EMT-Basic
   - EMT-Intermediate (a level between EMT-Basic and Paramedic)
   - EMT-Paramedic
   - Temporarily not practicing
   - Permanently not practicing

2. How many different organizations do you currently perform EMS work for?
   - 0 ➔ If 0, go to question 9
   - 1 ➔ If 1, please answer the questions in this section about this EMT job
   - 2 or more ➔ If 2 or more, please answer the questions in this section about your main EMT job

3. Approximately how many calls do you respond to during a typical week?
   - 0
   - 1
   - 2 to 4
   - 5 to 8
   - 10 to 19
   - 20 to 29
   - 30 to 39
   - 40 to 49
   - 50 or more

4. In a typical week, how many hours do you perform the duties of an EMT?
   - 0
   - 1 to 8
   - 9 to 16
   - 17 to 40
   - 41 to 60
   - More than 60

5. How satisfied are you with your current EMS assignment?
   - Very satisfied
   - Satisfied
   - Dissatisfied
   - Very dissatisfied

6. Are you with the EMS profession?
   - Very satisfied
   - Satisfied
   - Dissatisfied
   - Very dissatisfied

7. How likely is it that you will choose to leave the EMS profession in the next 12 months?
   - Definitely stay ➔ go to question 9
   - Probably stay ➔ go to question 9
   - Probably leave
   - Definitely leave
   - I have already left

8. Does your intention to leave EMS have anything to do with your health?
   - Yes
   - No

9. What is the highest level of education that you have completed?
   - Did not complete high school
   - High school graduate/ GED
   - Some college
   - Associate's Degree (A.A., A.S.)
   - Bachelor's Degree (B.A., B.S.)
   - Graduate/Professional Degree (M.A., M.S., Ph.D.)

10. In the last 12 months have you experienced any of the following? (Please mark one circle per line)

    | Condition                        | Yes | No |
    |----------------------------------|-----|----|
    | My health status has significantly worsened |     |    |
    | Hearing problems                 |     |    |
    | Sleeping problems (such as insomnia) |     |    |
    | Latex allergies                  |     |    |
    | Back problems                    |     |    |
    | TB test turned positive          |     |    |

Marking Instructions
- Use number 2 pencil only.
- Make dark marks that fill the oval completely.
- Erase cleanly any mark you wish to change.
- Make no stray marks.
11. Which of the following best describes your current marital status?
- Married
- Divorced
- Widowed
- Separated
- A member of an unmarried couple
- Never been married

12. How would you rate your overall health?
- Excellent
- Good
- Fair
- Poor

13. During the past 30 days, other than your regular job, did you participate in any physical activities or exercise such as running, calisthenics, golf, gardening, mowing the lawn or walking for exercise?
- Yes
- No → go to question 16

14. Approximately how many days a week do you engage in at least 30 minutes of moderate-intensity physical activity above the usual activity, at work or home?
- 1
- 2
- 3
- 4
- 5
- 6
- 7

15. Approximately how many days a week do you engage in at least 20 minutes of vigorous-intensity physical activity above the usual activity, at work or home?
- 1
- 2
- 3
- 4
- 5
- 6
- 7

16. During the past 12 months, how many days have you been absent from your EMS job(s) due to an EMS work related illness or injury?
- 0 days
- 1 day
- 2 to 4 days
- 5 to 9 days
- 10 or more days

17. During the past 12 months, have you experienced back pain that resulted in limitation or restriction of your work or recreational activities?
- Yes
- No

18. Are you currently serving in a military unit in either an active or reserve capacity?
- Yes
- No

19. What is your height?

20. What is your weight?

---

3 Marking Examples
Correct Mark
Incorrect Marks
21. Have you smoked at least 100 cigarettes in your entire life?
   - Yes
   - No → go to question 24

22. Do you now smoke cigarettes every day, some days or not at all?
   - Every Day
   - Some Days
   - Not at all

23. During the past 12 months, have you stopped smoking for one day or longer because you were trying to quit smoking?
   - Yes
   - No

24. In the past 2 weeks how many days did you suffer pain in the back or leg(s)?
   - None at all → go to question 44
   - Between 1 and 5 days
   - Between 6 and 10 days
   - More than 10 days

25. On your worst day with leg or back pain during the past 2 weeks how many painkilling tablets did you take?
   - None at all
   - Less than 4 tablets
   - Between 4 and 8 tablets
   - Between 9 and 12 tablets
   - More than 12 tablets

26. Is your leg or back pain made worse by any of the following? (Please mark all that apply)
   - Coughing
   - Sneezing
   - Sitting
   - Standing
   - Bending
   - Walking

27. Do any of the following actions ease your leg or back pain? (Please mark all that apply)
   - Lying down
   - Sitting down
   - Standing
   - Walking

28. In your right leg do you have any pain in the following areas? (Please mark all that apply)
   - The buttock
   - The thigh
   - The shin or calf
   - The foot or ankle

29. In your left leg do you have any pain in the following areas? (Please mark all that apply)
   - The buttock
   - The thigh
   - The shin or calf
   - The foot or ankle

30. Do you have any loss of feeling in your legs?
   - No
   - Yes—Just one Leg
   - Yes—Both Legs

31. In your right leg do you have any weakness or loss of power in the following areas?
   - Hip
   - Knee
   - Ankle
   - Foot

32. In your left leg do you have any weakness or loss of power in the following areas?
   - Hip
   - Knee
   - Ankle
   - Foot

Marking Instructions
- Use number 2 pencil only.
- Make dark marks that fill the oval completely.
- Erase cleanly any mark you wish to change.
- Make no stray marks.

80
33. If you were to try and bend forward without bending your knees how far down do you think you could bend before the pain in your legs or back stopped you?
- I could touch the floor.
- I could touch my ankles with the tips of my fingers.
- I could touch my knees with the tips of my fingers.
- I could touch my mid thighs with the tips of my fingers.
- I couldn't bend forward at all.

34. On the worst night during the last 2 weeks how badly was your sleep affected by leg or back pain?
- Not affected at all
- I didn't lose any sleep but needed tablets
- It prevented me from sleeping but I slept for more than 4 hours
- I only had 2-4 hours of sleep
- I had less than 2 hours of sleep

35. On your worst day with leg or back pain during the last 2 weeks did the pain interfere with your ability to stand?
- I could stand as long as I wanted without extra pain
- I could stand as long as I wanted but it gave me extra pain
- Pain prevented me from standing more than 1 hour
- Pain prevented me from standing more than 30 minutes
- Pain prevented me from standing more than 15 minutes
- Pain prevented me from standing at all

36. On your worst day with leg or back pain during the last 2 weeks did the pain interfere with your ability to stand?
- I could stand as long as I wanted without extra pain
- I could stand as long as I wanted but it gave me extra pain
- Pain prevented me from standing more than 1 hour
- Pain prevented me from standing more than 30 minutes
- Pain prevented me from standing more than 15 minutes
- Pain prevented me from standing at all

37. On your worst day with leg or back pain during the last 2 weeks did the pain interfere with your ability to walk?
- Pain did not prevent me walking any distance
- Pain prevents me walking more than 1 mile
- Pain prevents me walking more than 1/2 mile
- Pain prevents me walking more than 1/4 mile
- I can walk but less than 1/4 mile
- I was unable to walk at all

38. In the last 2 weeks did leg or back pain prevent you from carrying out your housework or other daily activities?
- No not at all
- I could continue with my work but my work suffered
- Yes for one day
- Yes for 2-6 days
- Yes for 7 days or more
39. In the last 2 weeks how many days have you had to stay in bed because of leg or back pain?
   - None at all
   - Between 1 and 5 days
   - Between 6 and 10 days
   - For more than 10 days

40. In the last 2 weeks has your sex life been affected by leg or back pain?
   - Not affected by the pain
   - Mildly affected by the pain
   - Moderately affected by the pain
   - Pain prevents any sex life at all
   - Does not apply

41. In the last 2 weeks have your leisure activities been affected by leg or back pain?
   - Not affected by the pain
   - Mildly affected by the pain
   - Moderately affected by the pain
   - Severely affected by the pain
   - Pain prevents any social life at all

42. In the last 2 weeks has the pain interfered with your ability to look after yourself (e.g. washing, dressing, etc.)?
   - Not at all
   - Because of the pain I needed some help looking after myself
   - Because of the pain I needed a lot of help looking after myself
   - Because of the pain I could not look after myself at all

43. In the last 2 weeks how many episodes of back pain were due to your work as an EMT?
   - Almost all
   - Many
   - Nearly half
   - A few
   - Hardly any
APPENDIX B

LEADS CORE SURVEY
The LEADS project is a cooperative effort of the National Registry of Emergency Medical Technicians and the National Highway Traffic Safety Administration designed to identify the attributes and demographic information which accurately reflect the individuals involved in delivering emergency medical services throughout the United States.
LEADS Core Survey

Marking Instructions
• Use number 2 pencil only.
• Make dark marks that fill the circle completely.
• Erase clearly any mark you wish to change.
• Make no stray marks.

1. At what level are you currently practicing as an EMT?
   - First Responder
   - EMT-Basic
   - EMT-Intermediate (a level between EMT-Basic and Paramedic)
   - EMT-Paramedic
   - Temporarily not practicing
   - Permanently not practicing

2. For how many different organizations do you currently perform EMS work?
   - 0 ⇒ If 0, go to question 18
   - 1 ⇒ If 1, please answer the questions in this section about this EMT job
   - 2 or more ⇒ If 2 or more, please answer the questions in this section about your main EMT job

3. Which of the following best describes the community in which you do most of your work as an EMT?
   - Rural area (less than 2,500 people)
   - Small town (2,500 - 24,999 people)
   - Medium town (25,000 - 74,999 people)
   - Large town (75,000 - 199,999 people)
   - Suburb of a medium sized city
   - Suburb of a large city
   - Suburb of a small city
   - 256 city (less than 500,000 people)

4. What is the zip code of the community in which you do most of your EMT work?

5. Which of the following best describes the type of EMS Service for which you do most of your EMT work?
   - Fire Based
   - County or Municipal (for example, third service)
   - Private, for profit
   - Private, not for profit
   - Hospital Based
   - U.S. Federal Government (non-military)
   - Military
   - I am not affiliated with any organization
   - Other: (PLEASE SPECIFY)

6. Does the EMT service that you are primarily affiliated with transport patients?
   - Yes
   - No

7. When you are at work as an EMT, what proportion of your calls are emergency calls and what proportion of your calls are scheduled transports?
   - All of my calls are emergency calls
   - Most of my calls are emergency calls
   - About equal numbers of emergency calls and scheduled transports
   - Most of my calls are scheduled transports
   - All of my calls are scheduled transports

Page 2
8. How many calls do you respond to during a typical week?
   - 0
   - 1
   - 3-4
   - 5-9
   - 10-15
   - 16-20
   - 21-25
   - 26-30
   - 31-40
   - 41-60
   - 61 or more

9. In a typical week, how many hours are you available for an EMS response?
   - 0
   - 1-3
   - 4-6
   - 7-9
   - 10-12
   - 13-15
   - 16-18
   - 19-21
   - 22-24
   - More than 24

10. In a typical week, how many hours do you perform the duties of an EMT?
    - 0
    - 1-3
    - 4-6
    - 7-9
    - 10-12
    - 13-15
    - 16-18
    - 19-21
    - 22-24
    - More than 24

11. How satisfied are you with your current EMS assignment?
    - Very satisfied
    - Satisfied
    - Dissatisfied
    - Very dissatisfied

12. How satisfied are you with the EMS profession?
    - Very satisfied
    - Satisfied
    - Dissatisfied
    - Very dissatisfied

13. During the past 12 months, have you been authorized to provide new patient care treatments or procedures?
    - Yes
    - No

14. Please indicate how satisfied you are with the following aspects of your EMS position.
    (Please mark one circle per line)
    - Working relationships I have with other EMTs
    - The amount of pay and benefits I receive
    - Having a job that is exciting
    - The technical challenges provided by the job
    - Performing a variety of tasks in a variety of different situations
    - My work schedule
    - Opportunities for advancement at my job
    - Being able to work without close supervision
    - Being able to help others

15. How satisfied are you with your direct supervisor?
    - Very satisfied
    - Satisfied
    - Dissatisfied
    - Very dissatisfied

16. Are you nationally registered as an EMT-Basic, EMT-Intermediate, or EMT-Paramedic because it is a requirement of your job?
    - Yes
    - No
    - Not currently nationally registered

17. How likely is it that you will choose to leave the EMS profession in the next 12 months?
    - Definitely stay
    - Probably stay
    - Probably leave
    - Definitely leave
    - I have already left
### Education

16. What is the highest level of education that you have completed?
- [ ] Didn’t complete high school
- [ ] Some college
- [ ] High school graduate/GED
- [ ] Associate’s Degree (A.A., A.S.)
- [ ] Bachelor’s Degree (B.A., B.S.)
- [ ] Graduate Degree (M.A., M.S., Ph.D., etc.)

19. In the past 12 months, did you receive any EMS continuing education?
- [ ] Yes
- [ ] No → If no, go to question 23

20. In which of the following ways did you receive this EMS continuing education? (PLEASE MARK ONE CIRCLE PER LINE)
- [ ] a) Computers
- [ ] b) Conferences
- [ ] c) TV/radio (or such reviews)
- [ ] d) Video
- [ ] e) Classroom instruction

21. In the last 12 months, how many hours of classroom continuing EMS education did you receive?
- [ ] None → If none, go to question 23
- [ ] 1-8
- [ ] 9-16
- [ ] 17-24
- [ ] 25-32
- [ ] 33-40
- [ ] 41-48
- [ ] More than 48

22. Please evaluate your classroom instructors with respect to each of the following characteristics: (PLEASE MARK ONE CIRCLE PER LINE)
- [ ] a) Technical knowledge of the subject area
- [ ] b) Practical knowledge (clinical skills)
- [ ] c) Teaching ability
- [ ] d) Enthusiasm
- [ ] e) Availability to answer questions outside class
- [ ] f) Professionalism

### Personal

23. In the past 12 months have you experienced any of the following? (PLEASE MARK ONE CIRCLE PER LINE)
- [ ] My health status has gotten significantly worse
- [ ] Hearing problems
- [ ] Sleeping problems (such as insomnia)
- [ ] Latex allergies
- [ ] Back problems
- [ ] TB test turned positive

24. Which of the following best describes your current marital status?
- [ ] Married
- [ ] Widowed
- [ ] A member of an unmarried couple
- [ ] Divorced
- [ ] Separated
- [ ] Never been married

25. How would you rate your overall health?  
- [ ] Excellent
- [ ] Good
- [ ] Fair
- [ ] Poor

26. How would you rate your overall physical fitness?  
- [ ] Excellent
- [ ] Good
- [ ] Fair
- [ ] Poor

27. During the past 12 months, how many days have you been absent from your EMS job(s) due to an EMS work related illness or injury?
- [ ] None
- [ ] 1 day
- [ ] 2 to 4 days
- [ ] 5 to 9 days
- [ ] 10 or more days
### Finance

28. About how much money, before taxes, did you earn from all sources in the past 12 months?
- 0
- $1 to $999
- $1,000 to $9,999
- $10,000 to $14,999
- $15,000 to $19,999
- $20,000 to $24,999
- $25,000 to $29,999
- $30,000 to $34,999
- $35,000 to $39,999
- $40,000 to $44,999
- $45,000 to $49,999
- $50,000 to $54,999
- $55,000 to $59,999
- $60,000 to $64,999
- $65,000 to $69,999
- $70,000 to $74,999
- $75,000 to $79,999
- $80,000 to $84,999
- $85,000 to $89,999
- $90,000 to $94,999
- $95,000 to $99,999
- $100,000 or more

29. About how much of this money did you earn from EMS related jobs in the past 12 months?
- 0
- $1 to $999
- $1,000 to $9,999
- $10,000 to $14,999
- $15,000 to $19,999
- $20,000 to $24,999
- $25,000 to $29,999
- $30,000 to $34,999
- $35,000 to $39,999
- $40,000 to $44,999
- $45,000 to $49,999
- $50,000 to $54,999
- $55,000 to $59,999
- $60,000 to $64,999
- $65,000 to $69,999
- $70,000 to $74,999
- $75,000 to $79,999
- $80,000 to $84,999
- $85,000 to $89,999
- $90,000 to $94,999
- $95,000 to $99,999
- $100,000 or more

30. Are you a volunteer EMT?  ○ Yes  ○ No

### Demographic and Background Questions

31. In what year were you born?

32. What is your gender?  ○ Male  ○ Female

33. Which of the following categories describes you?  (YOU MAY SELECT MORE THAN ONE)
- American Indian or Alaska Native
- Hispanic or Latino
- Asian
- Black or African American
- Native Hawaiian or Other Pacific Islander
- White

34. Are you currently serving in a military unit in either an active or reserve capacity?  ○ Yes  ○ No

35. How many years have you worked as an EMT?
- I have never worked as an EMT
- Less than one year
- 1 - 2 years
- 3 - 5 years
- 6 - 10 years
- 11 - 15 years
- 16 - 20 years
- 21 or more years

36. We are interested in why you decided to enter the EMS profession. Please indicate whether each of the following factors were important in your decision to enter EMS.

- Having a friend or family member who worked in EMS or worked with EMS
- I thought that I would enjoy helping others
- I wanted a job with good pay and benefits
- I just kind of fell into it.
- There was an accident or other serious medical situation at which I was unable to help
- I wanted a job that was exciting
- It provided me with an opportunity for a new career
- It was a job requirement
- It provided an opportunity to learn if I wanted to pursue other health care opportunities
- My job provided financial incentives for becoming an EMT
- A teacher or counselor recommended EMS as a career for me
- It helped me get another public safety job (firefighter, police officer, etc.)
- Other (PLEASE DESCRIBE)
In what Industry, if any, were you employed prior to becoming an EMT? (PLEASE MARK ONE)

- Agriculture/Farming
- Business Service
- Education
- Finance/Insurance/Real Estate
- Health Care
- Manufacturing
- Military
- Other Government
- Restaurant/Food Beverage
- Retail Distribution
- Transportation/Utilities
- None - was a student
- None - was unemployed
- Other (SPECIFY)

In the last 12 months, have you ever done any of the following as part of your job as an EMT? (PLEASE MARK ONE CIRCLE PER LINE)

- Perform patient care duties in an emergency department
- Perform patient care duties in a health care setting other than an emergency department (such as a doctor’s office, nursing home, hospital unit, etc.)
- Perform inter facility transfer of critical care patients
- Transport emergency patients to a health care facility other than an emergency department
- Treat and release emergency patients without transport
- Participate in health monitoring programs

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>