The Impact of Transporting EMS Patients on Employee Occupational Injuries in a Fulltime, Municipal Fire/EMS Agency

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ABSTRACT

On December 1, 1998, the Cuyahoga Falls Fire Department (CFFD) began transporting emergency medical service (EMS) patients to the hospital. Since that time, no significant changes—apart from transporting—have occurred in the way the Department provides EMS or with the Department itself. However, the annual number of occupational injuries has increased. The purpose of this study was to determine if there was a statistically significant relationship between CFFD transporting patients and the reported frequency of EMS-related occupational injuries among members of the CFFD over the six-year period of this study. The hypothesis (H_1) for this correlational study was that the difference between the expected and observed distributions of EMS-related occupational injuries in the three years after 1 December 1998 at the CFFD was statistically significant. A retrospective review of all CFFD occupational injury records was conducted using all injury reports collected between 1 December 1995 and 1 December 2001. EMS-related occupational injuries increased nearly ten-fold in the three years after the Department starting transporting when compared to the three years before. The increase was found to be statistically significant and the null hypothesis was rejected. Based on the findings of this study, the individual members of the CFFD who reported the most EMS-related occupational injuries included those between the ages of 30 and 40 (54%) or with less than eleven years service (61%). The most frequently injured body site was the back (69%) and the most frequently reported type of EMS-related injury was a sprain-strain (85%), usually of the back (76% of the sprain-strains). Recommendations secondary to this study included specific improvements in the information collected in an injury report, the use of a more versatile metric for injury data comparisons between agencies, and the targeting of specific population subsets with comprehensive injury reduction and prevention strategies.

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INTRODUCTION

Statement of the Problem

On December 1, 1998, the Cuyahoga Falls Fire Department (CFFD) began transporting emergency medical service (EMS) patients to the hospital in addition to their longstanding first-response, advanced life support (ALS) service. Since that time, no significant changes—apart from transporting—have occurred in the way the Department provides EMS or with the Department itself. But, the annual number of occupational injuries has increased. If this increase is related to transporting, management could undertake a much more focused injury mitigation and prevention program. Thus, the need to assess the relationship between transporting and work-related injuries, if any, emerged.

Generally, the quantity of EMS runs for CFFD increased incrementally each year of the six-year period of this study (Figure 1). Therefore, it was reasonable to expect a proportional increase in EMS-related occupational injuries secondary to the increase in EMS runs. The null hypothesis (H_0) in this correlational study was that there was no statistically significant difference between the expected and observed distributions of EMS-related occupational injuries in the three years after 1 December 1998 at the CFFD. Thus, the alternate hypothesis (H_1) was that the difference between the expected and observed distributions of EMS-related occupational injuries in the three years after 1 December 1998 at the CFFD was statistically significant. The independent variable in this study was identified as "EMS runs" (controlled for the condition of transport) and the dependent variable as "EMS-related occupational injuries."

Three questions have been answered by this research:

1. Was the difference between the expected and observed distributions of EMS-related occupational injuries after 1 December 1998 at the CFFD statistically significant?

2. What were the characteristics of the individuals who reported the most EMS-related occupational injuries on the CFFD during the research period?
3. What type of EMS-related occupational injury did members of the CFFD most frequently report during the research period?

Purpose of the Study

The purpose of this study was to determine if there was a statistically significant relationship between the activity of CFFD transporting patients and the reported frequency of EMS-related occupational injuries among members of the CFFD over the six-year period of this study.

BACKGROUND AND SIGNIFICANCE

The Cuyahoga Falls Fire Department is a municipal fire, rescue and EMS agency serving over 50,000 residents with 84 full-time employees who respond to nearly 7,000 fire, EMS and rescue alarms per year.

Prior to December 1998, the Cuyahoga Falls Fire Department responded to EMS calls and provided ALS care but did not transport patients to the hospital. With rare exception, CFFD relied on private ambulance companies for transport services. When transport was necessary, patients experienced a significant delay in getting to the hospital because of two factors: (a) the need for CFFD to call and wait for the transporting crew to arrive on scene and (b) the time it took a CFFD crew to give a patient and situation report to the transporting crew prior to transferring care.

In 1997, multiple factors were considered in order to improve the existing EMS system. These factors included the desire to (a) reduce transport time of a patient to the hospital, (b) increase consistency in patient care, (c) reduce out of service time for operational units, and (d) bill for EMS services in order to produce revenue. A committee was established by the Safety Director to examine the options. After considerable investigation, planning, and preparation, the CFFD began transporting EMS patients on 1 December 1998. The first month (December 1998) was planned as an operational test to determine if the existing resources, staffing and infrastructure could withstand the additional workload. Billing for transport services by an outside contractor was scheduled to commence in January 1999. In spite of the fact that December 1998 was the busiest month in the history of the CFFD with 565 runs (CFFD Annual Report, 1998), the test went well and billing began as scheduled. From 1998 to 1999, the average length of time CFFD units spent on the scene of an EMS incident decreased from twenty-seven minutes to sixteen (CFFD EMS Run Summary, 1999) and $1.4 million was billed in 2001 (CFFD EMS Run Summary, 2001).

There was initial hesitation by the fire fighters' union regarding the issue of transporting patients. However, to their credit, the potential for improving service was significant enough to compel the organization to support the policy and service change. This was in spite of the fact that duties of the union's members were being increased and income was being produced by the city without previously negotiated compensation for union members. The acceptance by the union may have also been influenced by several facts: (a) in 1999, the authorized strength of the Fire Department was raised from 80 to 84 (5% overall staffing increase), (b) in 1999, a favorable contract package was negotiated by the union, not long after transporting began, and (c) a local private ambulance company was aggressively pursuing privatization of EMS and many viewed transporting as improving job security.

In the planning stages in 1998, an increase in injuries was considered a strong possibility once transporting began. However, no specific estimates were made and the full potential impact on the organization was not assessed because the significance was considered incidental at the time. After transporting began, anecdotal evidence suggested that occupational injuries were on the rise and that some injuries were significant and costly. If an increase in severe injuries (see Table 6 for a description of “severe”) was a consequence of transporting, previous estimates of the impact and cost of this added service may have been greatly underestimated and the organization would definitely want to identify and implement specific injury prevention and mitigation strategies.

LITERATURE REVIEW

Although a number of studies have examined occupational exposures and injuries among hospital workers and firefighters (Kelen, 1990; Hochreiter & Barton, 1988; Centers for Disease Control [CDC], 1989; Halliday, 1982; and Dibbs, 1982), similar data on EMS field workers are sparse and data on EMS injuries secondary to transporting are nonexistent.

Gershon, Vlahov, Kelen, Conrad, & Murphy (1995) reviewed 1,045 total injury reports among employees of a large, urban fire department in Baltimore County, Maryland, in 1992. Of these, 819 injury reports were from fire fighters and 226 were from EMS workers. The 226 reports were filed by a total population of 197 EMS workers in an EMS Division that served 700,000 people over 610 square miles and responded to approximately 32,000 emergencies in 1992. The authors found sprains and strains to be the most commonly reported injuries (43%) and the back to be the most commonly injured body site (20%). They also noted that most injuries were caused by stretcher mishaps, especially during the transport of heavy patients.

However, they did not specifically correlate these injuries to transporting as an overall function of emergency medical services.

Schwartz, Benson and Jacobs (1993) reported a survey of occupational injuries among EMS workers in six New England states and found high rates of back injuries, assault, stress and injuries to extremities. Hoyga and Ellis (1990) reviewed injuries among EMS workers in Pittsburgh and found that low back injury was the most common. These studies support anecdotal reports suggesting that occupational injuries are not uncommon in EMS workers, and both studies noted the paucity of information on EMS workers and called for additional research (Gershon et al., 1995).

Lavender, Conrad, Reichelt, Johnson, and Meyer (2000) identified three categories of tasks performed by fire fighters and paramedics that were characterized as strenuous and frequently performed: (a) transferring a patient from a bed to a stretcher, (b) transferring a patient from the stretcher to a hospital gurney, and (c) lifting and transporting a patient on a stretcher or backboard on stairs and stairway landings.

Fire fighters and emergency medical technicians frequently engage in heavy lifting when they lift and transport patients (Dick, 1980; Lavender et al., 2000). The findings of Hoyga and Ellis (1990) are consistent with Anderson (1997) who summarizes numerous studies supporting a link between low back disorders and the performance of heavy lifting and material handling. These facts have caused some interest in research involving ergonomics and reducing conditions that cause lifting-related injuries. However, Lavender et al. reported that actual ergonomic design efforts to reduce the exposure of fire fighters to the hazards of heavy lifting have been minimal. Brigham (1994) suggested that traditional approaches such as training employees proper lifting techniques have been, "…relatively unsuccessful by themselves in reducing both the frequency and the severity of health care workers' back-injury problems" (p. 56).

In a study of British ambulance personnel, Rodgers (1998) concluded that the largest proportion of early retirements due to occupational disabilities were due to musculoskeletal injuries, with circulatory disorders being second and mental disorders being the third most common causes. The potential impact of these common injuries is illustrated when the author states that, "…awkward lifting of heavy loads over prolonged periods are associated with an increased incidence of disability later in life" (Rodgers, 1998, p. 128).

Although dated and quite general, Owens (1993) quotes Alan Saly of Local 2507 (representing New York City EMS) claiming that, "…a study done in 1988…revealed that 72% of…EMS people had back injuries every year" (p. 45). Mr. Saly is also quoted as claiming that, "There aren't a lot of EMS people who pass the 10-year mark without some sort of chronic health trouble—generally back problems" (Owens, 1993, p. 46).

The limited available contemporary literature concerning EMS occupational injuries has forced an examination of older literature in related fields where similar activities take place.

In a ten-year survey of the Portland, Oregon, Fire Department, Norris (1993) claims that an average of 31% of the injuries sustained were "strained, injured backs" (p. 31). Although the article does not describe the specific duties of the population studied (i.e., primarily firefighting, primarily EMS, etc.), the author also states that an average of 14% of the injuries sustained were on an "EMS run" (Norris, 1993, p. 32).

A survey by the International Association of Fire Fighters (IAFF) showed that EMS emergencies make up 61.3% of the alarms and that 14.8% of injuries at the scene of an emergency were EMS-related (The International Association of Fire Fighters [IAFF], 1998). The

IAFF also reported in a separate category from EMS-related injuries, that 7% of the injuries in their survey occurred while responding to, or returning from, an alarm. They also reported that back injuries made up 54.4% of their line of duty injuries (IAFF, 1998). However, the survey did not specify whether these back injuries were EMS-related or not. In a similar survey for the National Fire Protection Association (NFPA), Karter and Badger (2001) showed that 16.2% of firefighter injuries occurred at non-fire emergencies and that 5.5% of the total injuries occurred while responding to, or returning from, an alarm. The authors went on to report that the population studied experienced 0.73 injuries per 1000 incidents at non-fire emergencies (Karter and Badger, 2001). It appears that both the IAFF and NFPA agree that injuries reported while responding to, and returning from, alarms should be separated into a category of their own, and that a similar result was observed in both surveys (IAFF 7%, and NFPA 5.5%) in this category. The size of the IAFF and NFPA samples and the similarity in their results lends credibility to their inferences.

Throughout the world, health care occupations are ranked among those with high rates of injuries associated with manual handling activities (Victoria Dept. of Labour, 1988). Like Gershon et al. (1995) found in EMS workers, Langford (1998) reported that the most common injury associated with nurses in Australia who manually handled patients was of the back. Acknowledging the significant cost of these types of injuries, Retsas & Pinikahana (1999) concluded that, “The high incidence of…manual handling injuries…are not only a physical and emotional drain on the victim, they also generate substantial costs to the health industry” (p. 37).

Studying nurses and nurses aids, Fuortes, Shi, Zhang, Zwerling, and Schootman (1994) reported that health care personnel who perform or assist in patient transfers have back injury rates 3.3-fold higher than similar personnel who do not perform or assist in patient transfers.

Owen and Garg (1991) found that nurses rating patient handling tasks, including transfers in and out of bed, as a stressful activity associated with back pain. Moving patients—a primary activity for EMS personnel—"…requires strength, stamina, and skill to ensure safety…" (Zelenka, Floren, and Jordan, 1995, p. 354), and is a physically demanding task that is well documented in current literature as a source of injury, very often involving the back. Brigham (1994) summarized a study undertaken in 1989 of a large hospital where the highest frequency and severity of injuries were associated with the horizontal transfer of patients (e.g., from bed to gurney, gurney to bed, etc.)—not unlike the strenuous activity EMS personnel must perform regularly (Lavender et al., 2000).

In summary, although there is little available literature on the specific topic of transport-related EMS occupational injuries, it is clear from that which is available, as well as current and related health care literature, that manually handling patients is associated with a higher incidence of injuries, usually of the back. Since EMS operations also involve moving and handling of patients, an increase in injuries related to EMS was similarly expected.

PROCEDURES

A retrospective review of all Cuyahoga Falls Fire Department occupational injury reports was conducted using all employee injury records collected between 1 December 1995 and 1 December 2001 (six years). During this time members of CFFD, all of whom were full time employees, reported a total of 197 occupational injuries. Fifty-eight of these injuries (29.4%) were EMS-related.

Records included occupational injury reports completed by the affected employee, his or her supervisor, and any witnesses to the incident. All of the EMS-related injury records were analyzed and abstracted by two reviewers. The following data was abstracted and tabulated from each of the analyzed records using the form in Appendix 3.

1. Employee number of injured employee (to assess repeaters)
2. Whether it is an EMS-related occupational injury
3. Time lost (in number of hours)
4. Date and time of injury (the fixed point in time used for each data point; also used to assess how long individuals had been working prior to becoming injured)
5. Description of injury (e.g., how it happened and what happened)
6. Type of injury (e.g., strain-sprain, fracture, etc.)
7. Primary body site affected (e.g., neck, back, etc.)
8. Severity[1] of injury (severe = off work >7 days; moderately severe = off work 4-7 days; somewhat severe = off work 1-3 days; minor = no time off work)
9. Affected employee demographics (e.g., gender, age at time of injury, race, marital status, time on the job, and shift/station assignment)

The research procedures were reviewed and approved by the Deputy Fire Chief and only aggregate data were described. Re-injury or exacerbation of an existing injury was classified as a separate injury.

From the data collected, an analysis was made of the data for the three years before and after 0000 hours on 1 December 1998. The analysis included descriptive statistics and Chi-squared testing of the relationship between the expected and observed distributions of EMS-related occupational injuries in the three years after 1 December 1998 at the CFFD. The Chi-

[1]The Ohio Bureau of Workers' Compensation defines a "time lost" claim as an injury that requires 8 or more days off work, and the days need not be consecutive. An injury that requires less than this amount of time off is considered a "medical only" claim (Jaffy, Smith & Jaffy, 1997).

squared test was selected because it is the statistical test suggested when determining whether a given distribution differs significantly from an expected distribution (McEwan & Miller, undated). In order to make constant the incremental increase in EMS runs over the research period, the ratio of EMS-related occupational injuries to total EMS runs per 12-month period was also reported (Table 9). This ratio was then charted to illustrate the changes in the ratio both before and after transporting patients was initiated by the CFFD (Figure 2).

Definition of Terms

EMS-related. That which occurs secondary to, or is directly involved with, any emergency medical service activity directly related to a run by the Cuyahoga Falls Fire Department. This includes responding to, and returning from, EMS incidents.

Exposure. "Eye, mouth, other mucous membrane, non-related skin, or parenteral contact with blood, other body fluid, or other potentially infectious material" (United States Fire Administration [USFA], 2002, p. 135).

Occupational injury. Any injury such as a cut, fracture, sprain, amputation, etc., which results from a work-related event or from a single instantaneous exposure in the work environment (U.S. Department of Labor, 2001).

Limitations of the Study

Although the Cuyahoga Falls Fire Department collected occupational exposure data, the criteria for submitting an exposure report and what constitutes an exposure were poorly defined. This made it impossible to draw legitimate conclusions from an analysis of exposure data collected. That is, "exposure" was not well defined and so employees completed exposure reports whenever they felt they had been exposed. In practice, this ranged from significant needle-stick exposures to insignificant, and arguably nonexistent, exposures. Analysis of the available exposure information has, however, revealed the need for improved exposure data collection methods and policies.

The fitness level of injured individuals may have a relationship to the quantity and type of occupational injury, severity of injury, amount of time off work, and response to treatment/therapy. However, because an objective measure of fitness level of injured individuals has not been previously established, the study of this relationship is left to future research. In this study, fitness of the individual is considered to be constant over the relatively short research period.

Level of training, as it relates to occupational injuries, is recognized as an important potential variable. All members of CFFD were trained equally in preparation for transporting. Since the training was consistently provided for every member of the department, it was considered a constant in this study.

The relationship between quantity and type of injury sustained and the attitude of members of the fire fighters' union toward the significant policy change required to transport is difficult, if not impossible, to measure and therefore was not specifically included in this research. It is not beyond possibility that certain members of the Department (all Department members below the rank of Deputy Fire Chief are union members and belong to the bargaining unit) could have artificially increased the quantity of injuries in the research period. However, this possibility is considered unlikely because of the existence of a longstanding process that (a) includes numerous controls to assure the validity of a claim and (b) is believed by the union and fire administration to be effective. This process includes:

1. An initial assessment of the facts by an individual who eventually becomes an advocate for the claimant,

2. A review of the facts by a city attorney who has the option of confirming medical evidence by sending the claimant to a physician paid by the city,
3. An Ohio State Bureau of Worker's Compensation review that confirms a correlation between the mechanism of injury and the claimant's injury,
4. A formal medical review by the medical insurance provider for the city, and
5. Full adjudication by an Ohio State Industrial Commission hearing officer.

As evidence of the effectiveness of this process, since this process has been in place in the City of Cuyahoga Falls, adjudication favorable to the claimant has been achieved—that is, medical benefits have been paid and compensation has been awarded—in every case that made it to hearing by the Industrial Commission (R. Hannan, Personal Communication, December 18, 2001).

Comparing the Cuyahoga Falls Fire Department to other similar departments in terms of EMS-related injuries per member per year (or similar metric), quantity of EMS-related injuries, and types of EMS-related injuries was an initial objective of this study. However, the absence of available, specific and comparable data (e.g., "EMS-related" versus other types of injury data) forced this analysis to the realm of future research and was not included in this study.

After a unit staffing policy change on 1 December 1998, CFFD EMS units began responding with a minimum of three personnel (formerly only two) to all incidents. In addition, one of the three responders was frequently a promoted fire officer (e.g., lieutenant). Prior to the policy change, the two responders on an EMS unit were almost always non-officers (e.g., fire fighters). This unit staffing policy change was based on observation of other similar systems and was intended to achieve three goals:

1. Effectiveness. Three personnel could carry all necessary equipment, including the cot, to the patient in only one trip. Two personnel could not.
2. Efficiency. Three personnel could carry out the necessary tasks at the patient's side (e.g., vitals, report writing, history, exam, treatment, etc.) in less time than two. In addition, three personnel had to call for assistance less often than smaller crews, thus taking other units out of service less often.
3. Safety. Three personnel can lift and move a patient more safely than only two. Or, as Dick (1980) stated, "By the simple addition of a third person to the crew, a gurney and patient can be lifted into or out of an ambulance with far less strain than normal" (p. 22).

Regarding the potential for these facts to impact this study, two opposing hypotheses surfaced:

1. Since there was a one-third increase in the number of personnel responding on an EMS unit, a similar increase in occupational injuries was anticipated.
2. Having more personnel at each incident reduced the number of occupational injuries because there were more individuals available among whom work could be distributed and to act as "safety officers" preventing unsafe acts prior to an injury.

More than one apparatus often responded to EMS alarms depending on the location and/or apparent severity of the alarm. Because of this, the number of personnel that attended EMS runs also varied, usually from three to seven individuals. This variation and factoring it into this study forced a comparison metric to be devised that would allow staffing (employees) per call to remain constant: EMS-Related Injury Index (EMS-related injuries per 100,000 full-time employees per run per year)(Table 2).

Over the six-year period of this study, the CFFD annual EMS call volume has increased at a fairly constant rate (~3.2% per year), with the exception of 1996 (CFFD Annual Reports, 1995-2001)(Figure 1). This exception may be explained by the fact that the end of 1995 was when carbon monoxide detectors were widely marketed and sold over the holiday season. Over the subsequent 12 months or so, both EMS and fire calls increased for CFFD secondary to false alarms due to (a) the malfunctioning of these early devices, and (b) the public's inexperience with the devices, including what to do when they alarmed. It is reasonable to assume a relatively

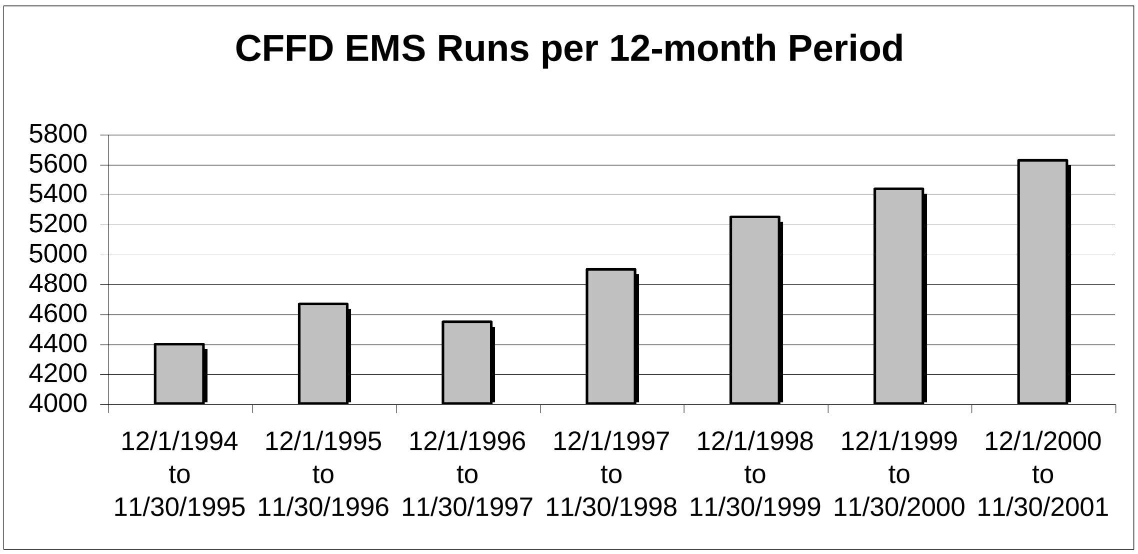

Figure 1. The number of EMS runs made by the CFFD by year from 1 Dec 1994 to 30 Nov 2001.

linear increase in EMS-related occupational injuries as the number of EMS runs increases. To factor this assumption into this study, the EMS-Related Injury Index (Table 2) was the metric chosen to allow the number of runs to remain constant across comparisons.

Based on the Fire Chief's interpretation of a recommendation of the International Association of Fire Chiefs (IAFC) regarding the NFPA's 1710 standard (National Fire Protection Association [NFPA], 2001), a policy was implemented on 31 July 1999 whereby CFFD EMS personnel were asked to limit on-scene time to a maximum of nineteen minutes. Personnel were instructed to write a memo to the Fire Chief if they spent more than nineteen minutes on the scene of an EMS response (Sewald, 1999; Appendix 1). In short, an administrative policy was implemented that may have affected whether personnel rushed or not and, thus, affected the incidence of injuries at the scene. Although the policy change must be noted as having the potential to affect this study, it has never been specifically identified to the CFFD Workers' Compensation Representative as contributing to or causing an injury (R. Hannan, personal communication, December 18, 2001).

In January of 1999, as a consequence of policy decision to begin transporting, Cuyahoga Falls Ordinance 24-1999 was passed raising the authorized strength of the fire department from 80 to 84 sworn members. Due to sporadic retirements and time spent in the testing and procurement process, the actual number of fire department employees frequently varied from this authorized maximum. The average number of fulltime fire department employees was 79.8 over the full six-year period of this research, 77.0 in the three years prior to 1 December 1998, and 82.5 in the three years after 1 December 1998 (Table 2). This fact was incorporated into this research by specifically identifying which period was being used (e.g., all six years, the three years before, or the three years after transporting began) and applying the appropriate average number of fire department fulltime employees for that period.

Over the past decade, the CFFD and its fire fighters' union (IAFF Local 494) have undertaken an effort to educate employees about the importance of documenting injuries, including those thought to be minor. The impact this action has had on the number or frequency of documented work-related injuries has not been studied, but may have progressively affected the quantity of reports of injuries through the research period. This also raises the issue of workers being reluctant to report and document injuries due to (a) concerns about how such reports are received, (b) lack of interest in completing paperwork, and (c) stoicism. Although anecdotal, these possibilities suggest that this study may actually be an underestimation of injuries in this population. In addition, as Gershon et al. (1995) stated, “It is clear that to obtain accurate data, workers need to perceive a nonpunitive, supportive attitude by supervisors…” (p. 36).

In 1998, EMS response districts were re-configured with the intention of reducing overall response times. This redistricting caused more alarms for some stations and their crews and less for others. Thus, some individuals responded to more or less calls at various points throughout the research period and therefore may have been more or less exposed to occupational injuries depending on their assignment. Regarding the potential for this fact to impact this research, there seems to be two opposing hypotheses:

1. An individual performing more job-related duties than another is at higher risk of occupational injury.
2. An individual regularly performing more job-related duties than another may be better prepared and experienced to operate safely, and thus be at less risk of occupational injury.

Although the importance of testing these two mutually exclusive hypotheses was recognized, appropriate data were not routinely collected in the available record system and therefore were not included in this study.

EMS-related occupational injuries secondary to on-the-job training and station activity (unrelated to a run) have been excluded from this study. Only EMS-related occupational injuries that occurred between the receipt of, and return to service from, a specific alarm were included.

On rare occasions prior to 1 December 1998, CFFD transported patients. Occasionally after 1 December 1998, EMS-related occupational injuries occurred during alarms where CFFD did not transport the patient. To control for this condition (transport), only EMS-related occupational injuries that occurred on calls without CFFD transport were included in this study prior to 1 December 1998, and only EMS-related occupational injuries that occurred on calls with CFFD transport were included in this study after 1 December 1998.

Work stress is recognized as an important outcome variable (Gershon et al., 1995) and has been reported in other research (Allison, Whitley, & Revicki, 1987; Schwartz et al., 1993). The location where treatment was received for, and the causes of, injuries are also important topics for study that have been reported in other research (Gershon et al., 1995). But, work stress, treatment location, and injury cause data were not routinely collected in the available record system and therefore were not included in this study.

It is reasonable to assume that the more hours an employee works the higher their likelihood of becoming injured. Overtime (work in addition to one's normal work week) is regularly available to employees of the CFFD. As the need for overtime arises, it is first offered to individuals with the least accumulated overtime hours for the calendar year. Those less inclined to accept overtime could work hundreds of hours less per year than those who accepted all the overtime offered. As Table 1 shows, the employees who reported injuries worked almost exactly the expected amount of overtime. Those who reported injuries over the research period made up 43% of the population and in 2001 worked 42% of the overtime. Thus, the overtime distribution reflected the underlying proportion of injured versus non-injured employees and there was no significant discrepancy between the observed and expected values in these categories (p = 0.93).

Table 1

Overtime Comparison Between Employees Who Reported Injuries and Those Who Did Not

	Individual Employees[a]		Overtime Worked[b]	
	N	%	Hours*	%
Employees Who Reported Injuries[c]	35	43	4022.75	42
Employees Who Did Not Report Injuries[c]	47	57	5500.50	58
TOTAL	82	100	9523.25	100

Note. On 1 December 2001, the roster was short two personnel, both in the hiring process.

[a]$N = 82$ (as of 1 December 2001).

[b]Overtime hours worked and paid in the 2001 calendar year.

[c]Over the six year research period (1 December 1995 through 1 December 2001)

*$p = 0.93$

Reporting errors, incomplete reports, and lack of documented details all conspired to limit the availability and usability of data. In addition, local constraints and influences may prevent the results of this study from being generalized to other EMS populations. Regardless, this study may offer guidance and insight in future research efforts. In the end, there is no question that meaningful analysis of this type of data requires complete and detailed documentation of injuries.

RESULTS

All reports of injuries to members of the CFFD for the period from 1 December 1995 to 1 December 2001 were reviewed. After excluding records that were not EMS-related (139 reports), a total of 58 reports classified as EMS-related injuries were reviewed and abstracted (29.4% of all injury reports). These 58 reports were filed from a total population that varied slightly in size from month to month but averaged 79.8 personnel over the research period (between 1 December 1995 and 1 December 2001).

In examining the literature and analyzing the results of this study, the need arose for a metric that could be used to compare one set of occupational injury data to another and still be able to make the number of runs and employees influencing the data constant over the research period. Because no such metric was published in the existing literature, the EMS-related "Injury Index" was defined and used herein to describe the number of injuries (EMS-related only in this study) per 100,000 fulltime employees (FTE) per run per year. Table 2 shows the results of this computation applied to the data in this study. By each of the various measures (e.g., injuries per employee, injuries per employee per year, injuries per run, EMS-Related Injury Index [EII]), EMS-related injuries increased nearly tenfold (Range = 8.56 – 9.91×, depending on the metric) in the three years after 1 December 1998 when compared to the three years before (Table 2).

Table 2

Comparison of Various Metrics Before and After Transporting

	In the 3 Years Before 1 Dec 1998	In the 3 Years After 1 Dec 1998	In the 6 Years Between 1 Dec 1995 & 1 Dec 2001
EMS-related injuries	5	53	58
Average number of employees[a]	77.0	82.5	79.8
Injuries per employee	0.0649	0.6424	0.7268
Injuries per employee per year	0.0216	0.2141	0.1211
EMS runs (from Table 9)	14,110	16,305	30,415
Injuries per 1000 runs	0.3543	3.2505	1.9069
EMS-Related Injury Index (EII)[b]	0.1534	1.3133	0.3983

Note. The number of fulltime employees working on the CFFD at any moment is time is dependent on exactly when retirements/resignations occur, whether an entrance test is needed or whether a certified list exists, and how long the procurement process takes. All injuries described are EMS-related.

[a]This was computed by summing the number of fulltime CFFD employees on the job each month of the research period and dividing this value by the number of months in the period being averaged.

[b]The "EMS-Related Injury Index" is computed by the following equation where "Runs" and "Years" are for the research period and "Employees" is the average number of employees working during the research period:

$$\frac{\textit{Number of EMS-Related Injuries} \times 100{,}000}{\textit{Employees} \times \textit{Runs} \times \textit{Years}}$$

Generally, the demographic makeup of employees who filed injury reports reflected the underlying distribution of the department as a whole (Table 3). Injuries categorized by gender, race, and marital status were not subjected to statistical testing because it would lack sufficient power for detecting differences due to the small number of values. Statistical testing was carried out on the observed and expected values in two categories: age and time on the job ("years worked"). Members of CFFD between the ages of 30 and 40 and greater than 50 reported slightly more EMS-related injuries than expected, while members of CFFD between the ages of 41 and 50 reported slightly fewer EMS-related injuries than expected [χ^2 (3, N = 79.86) = 4.43, p = 0.22]. In both cases, however, the differences between the observed and expected injuries were not found to be statistically significant. In addition, members of CFFD with less than 11 years of service reported more EMS-related injuries than expected [χ^2 (5, N = 79.86) = 10.90, p = 0.053]. The differences between the observed and expected injuries by years worked approached but did not achieve statistical significance at the 0.05 level.

Table 3

Comparison of the Demographic Characteristics of CFFD Employees who Reported EMS-Related Injuries Between 1 December 1995 and 1 December 2001 and CFFD Overall

	Injuries[a]		CFFD Overall[b]	
	N	%	*N*	%
Gender				
Men	56	97	79.15	99
Women	2	3	0.71	1
Age (years)*				
<30	6	10	7.86	10
30-40	31	54	33.00	41
41-50	19	33	32.86	41
>50	2	3	6.14	8
Race				
White	55	95	76.86	96
Non-White	3	5	3.00	4
Marital status				
Married	55	95	70.71	89
Unmarried	3	5	9.14	11

(*table continues*)

Table 3

(continued)

	Injuries[a]		CFFD Overall[b]	
	N	%	*N*	%
Years worked**				
<2	5	9	5.14	6
2-5	12	21	10.57	13
6-10	18	31	19.58	25
11-15	16	27	19.71	25
16-20	4	7	16.00	20
>20	3	5	8.86	11

Note. . "Age," "Marital Status" and "Years Worked" were at time of injury. Statistical testing was not carried out on these demographics because it would lack sufficient power for detecting differences due to the small number of values.

[a]$N = 58$. "Injuries" are EMS-related only that were recorded between 1 December 1995 and 1 December 2001 by CFFD.

[b]$N = 79.86$. This value was computed by counting the number of employees on the job on 1 December of each year between 1995 and 2001 and averaging the resulting values over the six-year period of this study.

*$p = 0.22$

**$p = 0.053$

The types of injuries reported are summarized in Table 4. Sprain-strains were by far the most common type of injury, accounting for 85% of the reports. Seventy-six percent ($n = 37$) of the sprain-strain injuries were of the back. In contrast, 43% of the injuries reported by Gershon et al. (1995) were sprain/strains, however they did not report how many of the sprain-strain injuries were of the back.

Table 4

Types of EMS-Related Occupational Injuries Reported

	Injuries	
	N	%
Sprain-Strain	49	85
Contusion	3	5
Disc Herniation	3	5
Laceration	2	3
Fracture-Dislocation	1	2
TOTAL	58	100

The body sites of the injuries reported are depicted in Table 5, with the back being the most frequently cited. Seventy-six percent (n = 37) of the sprain-strain injuries were of the back. In contrast, Norris (1993) reported that 31% of sprain-strain injuries were of the back. But, the author did not differentiate between job duties and the injuries reported included more than just those exclusively related to EMS.

Table 5

Body Sites Involved in EMS-Related Injuries Reported

	N	%
Back	40	69
Ankle	6	10
Hand(s)	4	7
Knee	3	5
Shoulder	2	3
Abdomen	1	2
Arms	1	2
Leg	1	2
TOTAL	58	100

Severity of the reported injuries is listed in Table 6. Over three-quarters of the injuries were minor and involved no lost time, but several resulted in extensive leave and significant medical intervention. Three individuals (all severe injuries) accounted for 81% of the total time lost, and all three occurred after 1 December 1998. Two of these reports were secondary to back injuries and one to a traumatic hand injury. The back injuries each involved 32 and 22 days off work, respectively. These were by far the injuries that involved the most time lost in this study. The hand injury involved 9 days off work. Less than one quarter of the injuries reported (n = 14, 24%) accounted for all (100%) of the time lost. One individual with a back injury eventually received a permanent disability retirement and there were no deaths reported during the reporting period.

Table 6

Severity of EMS-Related Injuries by Time Off the Job (Time Lost)

	EMS-Related Injuries		Time Lost in Hours		Average Time Lost in Days Per Injury[a]
	N	%	*N*	%	
Severe (>7 days lost)	3[b]	5	1516.5	81	21
Moderately Severe (4-7 days lost)	2[c]	3	157.5	8	3.3
Somewhat Severe (1-3 days lost)	9	16	207.0	11	0.96
Minor	44	76	0	0	0
TOTAL	58	100	1881.0	100	

Note. "Time Off the Job" is work time missed due to an injury.

[a]One "day" is a 24-hour shift for a fire fighter/paramedic.

[b]Two of these injuries were back injuries (herniations) and the third was a traumatic hand injury.

[c]Both of these injuries were sprain/strains of the lower back.

To identify trends, the period of time during an EMS alarm when an injury occurred was abstracted and tabulated. In Table 7, "period 1" is the time period from receipt of the call to the responding unit going enroute to the scene, "period 2" is from the enroute time to the unit's arrival at the scene, "period 3" is the time from arrival on scene to when the responding unit is enroute to hospital, "period 4" is from the enroute time to their arrival at the hospital, and "period 5" is from the hospital arrival time to when the unit returned to quarters. Over 80% of all injuries began during the on-scene component of the call (period 3). Of the four injuries that occurred during period 2 (en-route to scene), three were from a single vehicle crash during icy road conditions in February of 2001.

Table 7

When EMS-Related Injuries Began by Period

	N	%
Period 1	1	2
Period 2	4	7
Period 3	48	83
Period 4	2	3
Period 5	3	5
TOTAL	58	100

It is reasonable to assume that the number of EMS calls to which a particular station and/or shift responded should somehow correlate to the number of EMS-related occupational injuries reported by that station and/or shift. Unfortunately, the available data did not include sufficient detail to derive shift and station information from only EMS alarms. But, it did allow for deriving shift and station information from all types of alarms (e.g., fire, rescue, EMS, etc.), 76% of which were EMS-related on average (CFFD Annual Reports, 1995-2000). Table 8 compares the station and shift on which injured employees worked when an injury occurred to the volume of calls per station and shift (averaged over a five-year period for all types of alarms). Even given the limitations of the available data, the greatest number of injuries occurred at the busiest station and on the busiest shift, as expected.

Table 8

Comparison of EMS-Related Injuries to Historical Call Volume by Shift and Station

	Historical Call Volume[a]	Injuries	
	%	*N*[b]	%
Station			
1	41	26	45
2	19	11	19
3	25	17	29
4	15	4	7
TOTAL	100	58	100
Shift[c]			
A	37	27	46
B	30	12	21
C	33	19	33
TOTAL	100	58	100

[a]These values include all types of calls by CFFD (e.g., EMS, fire, rescue, etc.) averaged over the years 1995 through 2000. On average, 76% of these calls were EMS-related (CFFD Annual Reports, 1995-2000).

[b]Reflects the station and shift at which an employee worked when he or she became injured.

[c]"Shift" is defined as a 24-hour period from 0800 one day to 0800 the next. A particular shift (i.e., B shift) is scheduled to work every third day, or 24 hours out of every 72 hours.

Injury frequency is broken down by time of day and compared to the historical number of incidents in Table 9. Unfortunately, the available data did not include sufficient detail to derive time of day information from only EMS alarms. But, it did allow for deriving time of day information from all types of alarms (e.g., fire, rescue, EMS, etc.), 76% of which were EMS-related on average (CFFD Annual Reports, 1995-2000). Even given the limitations of the available data, the greatest number of injuries occurred during the busiest time periods, as expected. Table 9 shows that 53% of the EMS-related injuries occurred between 0800 and 1559 hours and 41% of the incidents occurred in the same period. In contrast, 24% of the EMS-related injuries occurred between 1600 and 2359 hours and 40% of the incidents occurred in the same period. The “Number of Incidents” data included in Table 9 were from all types of calls received by the CFFD during the research period, not just EMS calls. Although an average of 76% of all calls over the research period were EMS, lack of detail in the available data did not allow categorization of incidents by both type of call (e.g., “EMS” vs. “other”) and time of day. Thus, it was impossible to determine the percentage of EMS calls (only) that occurred in the specified time periods for the ideal comparison of EMS calls to EMS-related injuries.

Table 9

EMS-Related Injuries and Historical Percent of Incidents by Time of Day

	Injury		Number of Incidents[a]
Time of Day	*N*	%	%
0800 – 1559	31	53	41
1600 – 2359	14	24	40
0000 – 0759	13	22	19
TOTAL	58	100	100

[a]These values include all types of calls by CFFD (e.g., EMS, fire, rescue, etc.) averaged over the years 1995 through 2000. On average, 76% of these calls are EMS-related. (Source: CFFD Annual Reports, 1995-2000)

Table 10

Quantity of EMS-Related Occupational Injuries and EMS Runs per 12-month Period

	EMS Runs	Injuries	Ratio[a]
Before 1 December 1998			
1 Dec 1995 - 30 Nov 1996	4,666	2	0.0004
1 Dec 1996 - 30 Nov 1997	4,547	0	0
1 Dec 1997 - 30 Nov 1998	4,897	3	0.0006
Subtotal	14,110	5	0.0004[b]

(*table continues*)

Table 10

(continues)

	EMS Runs	Injuries	Ratio[a]
After 1 December 1998			
1 Dec 1998 - 30 Nov 1999	5,246	11	0.0020
1 Dec 1999 - 30 Nov 2000	5,435	17	0.0031
1 Dec 2000 - 30 Nov 2001	5,624	25	0.0044
Subtotal	16,305	53*	0.0032[b]
TOTAL	30,415	58	0.0019[c]

Note. CFFD began transporting on 1 December 1998.

[a]This is the ratio of injuries to EMS runs in the same time period.

[b]This is the ratio of the subtotal number of injuries to the subtotal number of EMS runs over the research period either before or after 1 December 1998 (as indicated).

[c]This is the ratio of the total number of injuries to the total number of EMS runs over the research period.

*$p < 0.01$

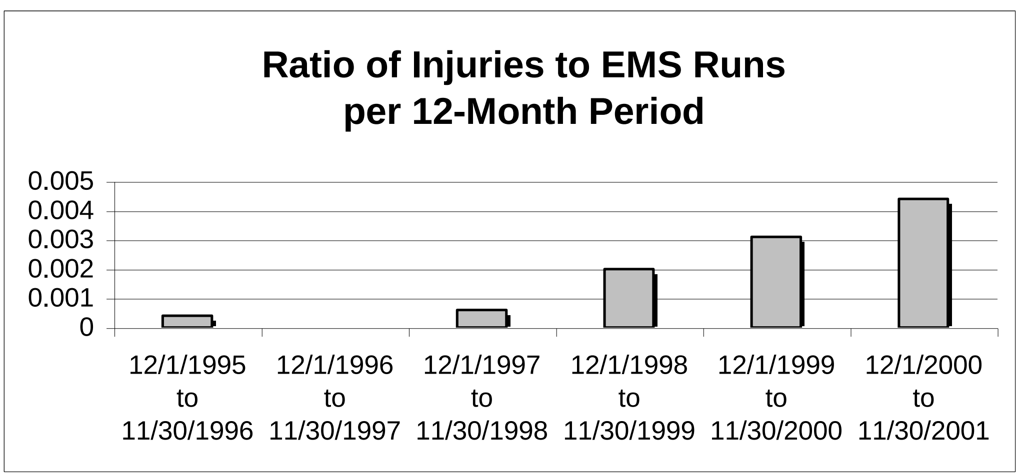

Figure 2. The ratio of injuries to EMS runs made by the CFFD by year from 1 Dec 1995 to 1 Dec 2001.

Table 10 and Figure 2 compare quantity of injuries to the number of EMS runs per year between 1 December 1995 and 1 December 2001. Nine percent (*n* = 5) of the injuries occurred prior to the Cuyahoga Falls Fire Department transporting and 91% (*n* = 53) after. While the number of EMS runs increased in a relatively linear fashion over the research period (with the exception of the period between 1 Dec 1995 and 30 Nov 1996 due to carbon monoxide detector alarms), the quantity of injuries increased dramatically after 1 December 1998. The ratio of EMS-related injuries to EMS runs also increased significantly after 1 December 1998. It was reasonable to expect the increase in this ratio to remain constant if the number of EMS-related injuries increased proportionally to EMS runs and nothing else was affecting the number of EMS-related injuries. This however was not the case.

It was also useful for comparison to summarize both EMS runs and EMS-related injuries for the periods before and after 1 December 1998 (Table 11). It was reasonable to expect any increase in injuries between these two periods to be proportional to the increase in EMS runs if the increase in injuries were a linear function of the increase in EMS runs. The fact that the actual increase in EMS-related injuries after transporting began was statistically significant suggested that something besides the increase in EMS runs was involved.

Table 11

Comparison of EMS Runs and EMS-Related Injuries Before and After 1 December 1998

	EMS Runs		EMS-Related Injuries	
Period[a]	Actual	%	Expected[b]	Actual
Before Transporting Began	14,110	46.4	26.9	5
After Transporting Began	16,305	53.6	31.1	53*
TOTAL	30,415	100	58	58

[a]"Period" indicates the 36 months either before or after 1 December 1998.

[b]Expected values are determined by multiplying the percentage of EMS runs for the period by the total EMS-related injuries (58).

*$p < 0.01$

Over the six-year research period, thirty-five individual members of the Cuyahoga Falls Fire Department (43% of the department as of 1 December 2001) reported EMS-related injuries. Of these thirty-five individuals, 40% ($n = 14$) reported more than one injury over the research period (Table 12). Of the fourteen individuals who reported more than one injury over the research period, 93% ($n = 13$) were married, the average age was 40, and the average time on the job was 9.2 years at the time of each of their respective injuries. The number of individuals who reported multiple injuries is similar to the number that would be expected if injuries occurred randomly across the total population. So, the observed distribution of multiple injuries is not significant (Rich Einsporn, Associate Professor, Department of Statistics, University of Akron, Personal Communication, September 24, 2002).

Table 12

Frequency of EMS-Related Injury Reports per Individual

	N^a	%
1	21	60
2	9	26
3	2	6
4	2	6
5	1	2
TOTAL	35	100

[a]Thirty-five individual members of the Cuyahoga Falls Fire Department reported EMS-related injuries between 1 December 1995 and 1 December 2001.

Since the observed distribution of EMS-related occupational injuries at the CFFD for the three years after the Department starting transporting was far greater than the expected distribution of these injuries for the three years before, the null hypothesis was rejected and the alternate hypothesis was accepted. A Chi-squared test (one way) on injuries versus runs for the three years after transporting began resulted in χ^2 (1, N = 53) = 33.25, $p < 0.01$. The probability that the actual distribution occurred by chance approached zero, thus the increase in injuries after 1 December 1998 was found to be statistically significant. Thus, the answer to the first research question is "yes."

Based on the findings of this study, the answers to the second and third research questions were that the individual members of the CFFD who reported the most EMS-related occupational injuries included those between the ages of 30 and 40 (54%) or with less than eleven years service (61%). The most frequently injured body site was the back (69%); and, the most frequently reported type of EMS-related injury was a sprain-strain (85%), usually of the back (76% of the sprain-strains). Although a few EMS-related injuries involved more than seven days off work (5%), most (76%) were minor and involved no lost time. Most of the EMS-related injuries occurred while working at the scene of an EMS run (83%) that occurred between 0800 and 1559 hours (53%). Most of the EMS-related injuries occurred while working on an apparatus that responded from CFFD Station 1 (45%).

Three relatively unexpected findings were discovered in the research:

1. Although found not to be statistically significant, members of CFFD between the ages of 30 and 40 and greater than 50 reported more EMS-related injuries than expected, while members between the ages of 41 and 50 reported fewer EMS-related injuries than expected [χ^2 (3, N = 79.86) = 4.43, p = 0.22] (Figures 3 and 4);
2. Although found only to be approaching statistical significance, members of CFFD with less than 11 years of service reported more EMS-related injuries than expected [χ^2 (5, N = 79.86) = 10.90, p = 0.053] (Figures 4 and 6); and
3. Twice as many EMS-related injuries were reported between the hours of 0800 and 1559 than were reported between the hours of 1600 and 2359, yet a similar number of incidents generally occurred during these two time periods (Table 9).

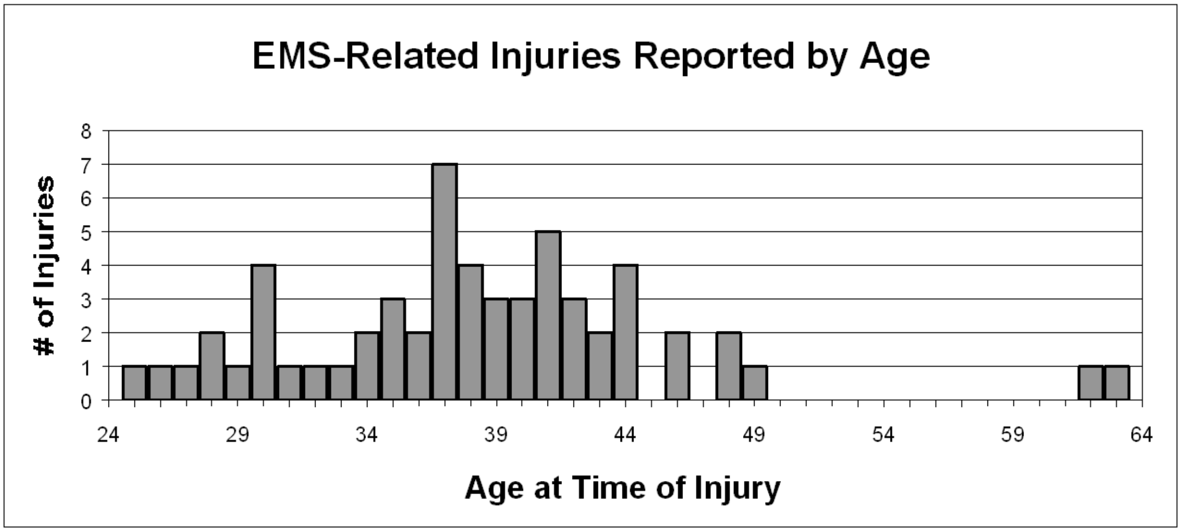

Figure 3. The frequency of EMS-related injuries by age at the time of the injury (*N* = 58).

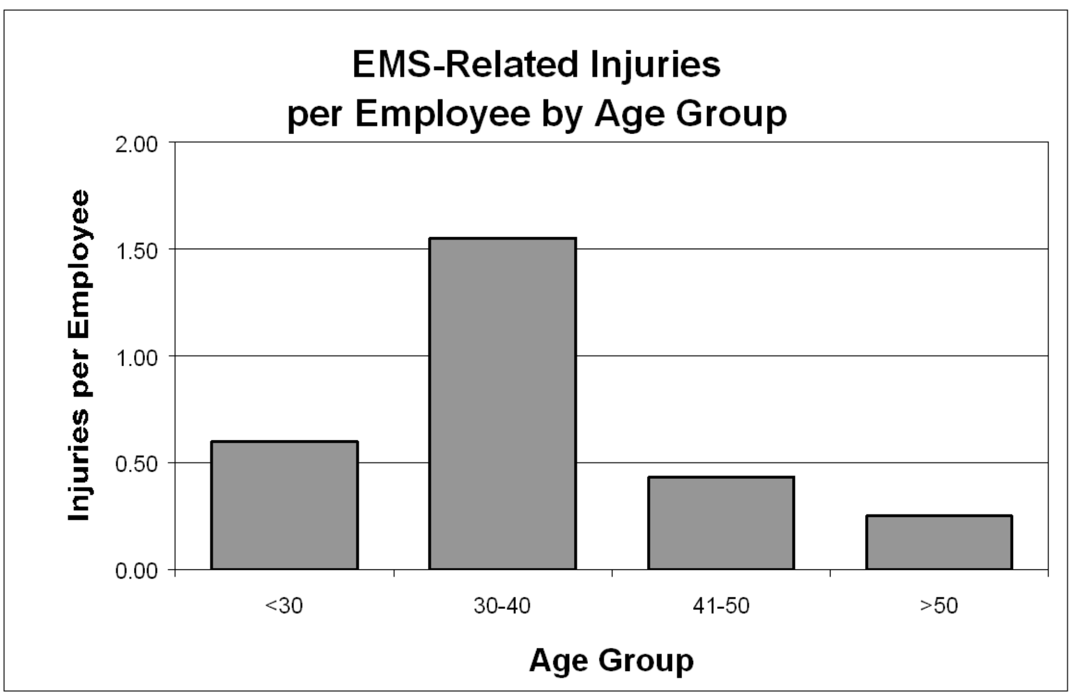

Figure 4. The EMS-related injuries reported per employee in each age group (Table 3).

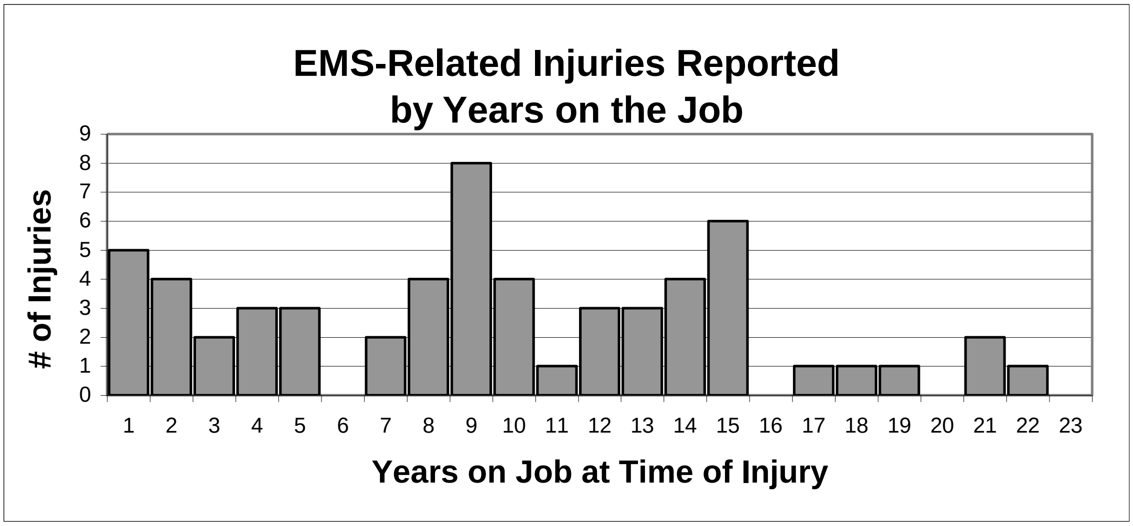

Figure 5. The frequency of EMS-related injuries by years of service at the time of the injury (N = 58).

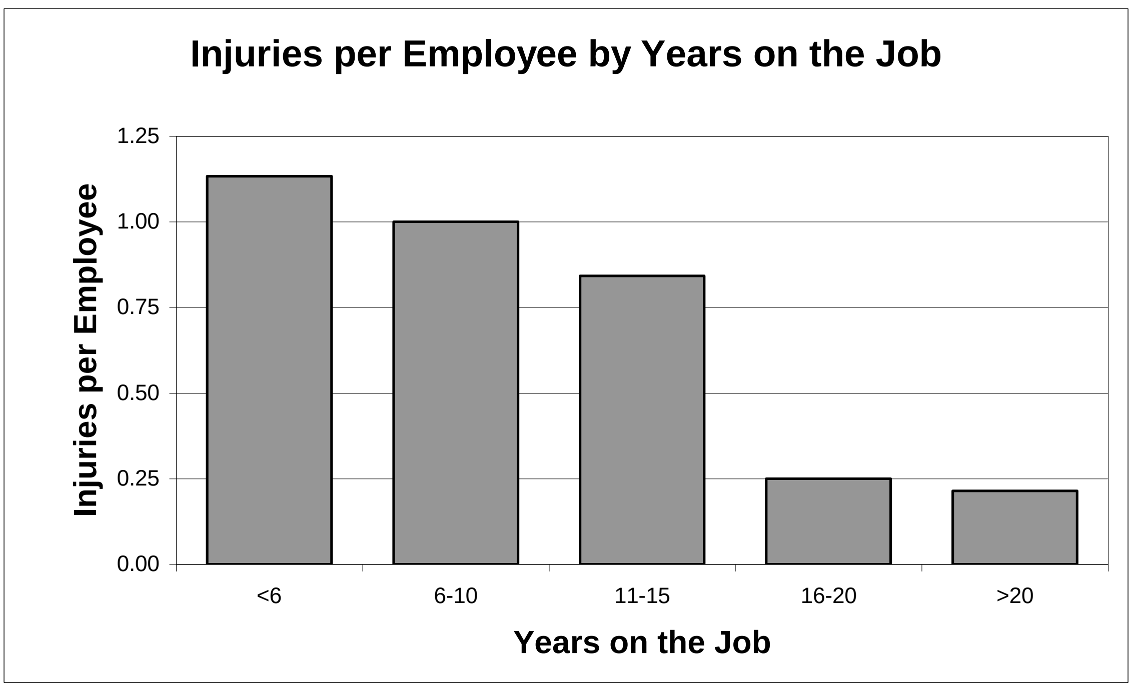

Figure 6. The EMS-related injuries reported per employee by years on the job (Table 3).

DISCUSSION

EMS-related occupational injuries, as well as the ratio of injuries to runs, increased dramatically after 1 December 1998 (see Table 10 and Figure 2). Statistical testing made it clear that in the CFFD the incidence of EMS-related injuries had a significant, positive relationship to EMS runs on which patients were transported. In light of this strong possibility, there is little doubt that transporting patients to the hospital played a role—probably a significant one—in the number of EMS-related occupational injuries on the CFFD during the research period.

Peterson (1999) observed that sprains and strains often result when, "…firefighters rush to accomplish a task, don't pay attention, aren't physically fit, or work beyond their capacity" (p. 25). An analysis of the CFFD data indicates that most of the sprain and strain injuries did not occur while performing lifesaving maneuvers but rather while moving and/or carrying a patient under conditions less strenuous and more controlled than what normally would be characterized as an emergency. There are proper methods of moving and carrying a patient. But, "it takes training, experience, and supervision to ensure that they're done safely" (Peterson, 1999, p. 25).

The body site most often involved is notable. In this study, 69% of the reported EMS-related injuries were of the back. These findings were consistent with the findings of Gershon et al. (1995), Lavender et al. (2000), Hoyga and Ellis (1990), Owens (1993), Norris (1993), and Langford (1998). National statistics indicate that 15%-20% of the U.S. population has reported low back pain at some time in their lives (Anderson, 1999). In addition, 50% of the working population admits to lower back pain each year (Vallfors, 1985, & Sternbach, 1986); and, back injuries are the most common reason for office visits to occupational physicians, orthopedic specialists and neurosurgeons (Mitterer, 1999). Low back problems are also expensive. Approximately 93 million workdays are lost each year in the United States due to back pain with a cost estimated at $30-$50 billion annually (Mitterer, 1999). Although specific costs were not assessed or recorded for each injury in this study, it is reasonable to assume that the combination of direct costs (e.g., diagnosis, treatment, rehabilitation, etc.) and indirect costs (e.g., replacement at work, inability to function normally at home, loss of community service activities, spousal adaptation to the injury, etc.) would likely be non-trivial.

The results of this study show that, over the research period, 0.12 injuries were reported per fulltime employee of the CFFD per year with an EMS-related Injury Index of 0.3983 (Table 2). In contrast, an average of 1.2 injuries reported per fulltime employee (FTE) per year was reported by Gershon et al. (1995), and 0.95 injuries per worker per year can be extrapolated from Schwartz et al. (as cited in Gershon et al., 1995). Although not specifically reported, enough information is available in Gershon et al. to compute an EMS-related Injury Index of 3.58—nearly ten times the overall injury rate described in this study. In addition, these authors also reported significantly different results than the present study regarding the most frequently injured body site, injury type, severity of injuries, and others (Table 13). The significant differences between those findings and this study may be explained by the stark differences between the respective populations studied. For instance, the population studied by Gershon et al. involved more females, more unmarried workers, and a significantly less experienced workforce (Table 13). The differences may also be attributed to the fact that these authors included exposures and injuries in their data (unlike this study), but they did not publish sufficient data on age and training of personnel to do a direct comparison on these variables. Combinations of influences not specified in these studies may have also played a role. These influences may include, but are certainly not limited to, differences in job duties, call volume/frequency, environmental characteristics, training, equipment, and other less tangible criteria.

Table 13

Comparison of the Findings of Gershon et al. (1995) and the Present Study

	Present Study	Gershon et al. (1995)
Injuries per employee[a] per year	0.12	1.2
Site		
Back	69%	20%
Type		
Sprain and Strain	85%	44%
Contusion	5%	10%
Severity		
Severe	5%	15%
Moderately Severe	2%	9%
Somewhat Severe	17%	17%
Minor	76%	46%
Demographics		
Male	97%	67%
Female	3%	33%

(*table continues*)

Table 13

(continued)

	Present Study	Gershon et al. (1995)
Demographics (*continued*)		
Marital Status		
Married	95	71
Unmarried	5	29
Years Worked		
<2	9	24
2-10	52	73
>10	39	3

[a]Gershon et al. (1995) described individuals as “EMS workers” and “fulltime employees.”

The NFPA (Karter & Badger, 2001) survey reported 0.73 injuries per 1000 incidents for non-fire emergencies. Response-related injuries were categorized separately and not included in this value. Four of the EMS-related injuries reported herein were response-related. So, if response-related injuries were excluded from the values reported in Table 2, the CFFD reported 1.8 EMS-related injuries per 1000 incidents over the six-year research period. This is more than twice what the NFPA reported (0.73) in 2001 but may be explained by the differences in the respective populations studied. Specifically, the NFPA’s survey reported that 16.2% of the alarms to which their population responded were for “non-fire emergencies” (Karter & Badger, 2001, p. 50). However, from 1995 to 2000 (on average) 76% of CFFD responses were EMS alarms (CFFD Annual Reports, 1995-2000). Although the populations from which these values (16.2% and 76%, respectively) were derived may not be identical, their similarities—combined with the notable differences in the number of EMS or non-fire responses by each—lend credibility to claims that occupational injuries in EMS are very common.

Vatter (1999) reported that 53% of injuries sustained by members of a fire department about half the size of CFFD were “sprain/strain/stress-related” (p. 130), versus 85% in the present study. In stark contrast to CFFD, their average number of first-responder medical responses is about 100 per year and 96% of their calls were not EMS-related (Vatter, 1999). The fire department studied by the author generally responded to significantly fewer EMS calls than CFFD and not surprisingly reported significantly fewer sprain/strain/stress-related injuries as a result.

Forty-one percent of the members of the CFFD overall were between the ages of 30 and 40, but this same group filed over half of the injury reports (Table 3). This contrasts with the fact that 41% of the members of the CFFD were between the ages of 41 and 50, yet this group reported 33% of the EMS-related injuries over the research period ($p = 0.22$). Possible explanations for these statistically insignificant observations included that members of the younger (30-40) age group tended to be put in positions where strenuous labor was required because of their relative lack of seniority and (often) superior physical capabilities. They also tended to be more aggressive and therefore more apt to put themselves into situations that could cause injuries. Whereas, members of the older (41-50) age group were less likely to do the same and therefore reported fewer injuries. The “years worked” data also seems to support these suppositions. Members with 16 or more years on the job reported only 12% of the injuries but made up 31% of the population; and, those with less than 11 years experience made up 44% of the population but reported 61% of the injuries ($p = 0.053$).

It is reasonable to assume that the quantity of EMS-related occupational injuries reported in a given time period should increase as the number of EMS calls during that same period increases. Analysis of the data in Table 9 shows that 53% of the EMS-related injuries occurred between 0800 and 1559 hours and 41% of the incidents occurred in the same period. In contrast, 24% of the EMS-related injuries occurred between 1600 and 2359 hours and 40% of the incidents occurred in the same period. The “Number of Incidents” data included in Table 9 were from all types of calls received by the CFFD during the research period, not just EMS calls. Although an average of 76% of all calls over the research period were EMS, lack of detail in the available data did not allow categorization of incidents by both type of call (e.g., “EMS” vs. “other”) and time of day. Thus, it was impossible to determine the percentage of EMS calls (only) that occurred in the specified time periods for the ideal comparison of EMS calls to EMS-related injuries. This alone may have accounted for the discrepancy between percentages of injuries and number of incidents in any particular time period. However, the notable difference (53% vs. 24%) between the number of injuries in the first period (0800 - 1559) and the second period (1600 – 2359) definitely suggests a need for further study.

Thirty-five members of the CFFD (44% of the average annual number of employees, 79.86; Table 2) reported injuries during the research period (Table 12). This means that the remaining members of the CFFD (56%) reported no injuries during the research period. Forty percent of those members who did report at least one injury during the research period (*n* = 14, or 17.5% of 79.86, the average number of employees per year) reported more than one injury. Five of these members (6% of the department) reported more than two injuries during the research period. The maximum number of injuries reported during the research period by any individual was five, and only one individual did so. This individual eventually received a permanent disability retirement. The overall distribution of injuries in this study is roughly what would have been expected if injuries occurred randomly across the population studied (Rich Einsporn, Associate Professor, Department of Statistics, University of Akron, Personal Communication, September 24, 2002).

The results of this study clearly show that EMS-related injuries are common and very likely related to the function of transporting patients to the hospital. In order to control both the direct and indirect costs of these injuries, the CFFD will have to target those likely to report an EMS-related injury (e.g., employees in a specified age and seniority range, on scene, at busiest stations and shifts, etc.) and educate them on injury prevention and reduction strategies.

RECOMMENDATIONS

The process of conducting this research has provided valuable insight into potential improvements in reporting criteria and the type of data that should be included in an injury or exposure report. If better reporting criteria existed for exposures (e.g., “what is an exposure and when should it be reported?”), the minimal data that was collected could have been a great deal more useful. In addition, collecting more detailed data for both injuries and exposures (e.g., cause, whether protective equipment was used, the location where treatment was received, etc.) would have undoubtedly increased the value of this research.

In analyzing the available data for this study, three distinct categories of injuries presented themselves: EMS-incident-related injuries (defined as “EMS-related” herein), fire-incident-related injuries, and non-incident-related injuries (e.g., response related, training, etc.). Because this study focused on EMS-related occupational injuries, reports of injuries that fell into other categories were excluded from the data set. However, the CFFD injury reporting system did not separate each collected report into one of these discrete categories. Each had to be manually classified based on the full content of the report. For ease of analysis, it is highly recommended that all future occupational injury reports be separated into these categories (at least) at the time of reporting.

In reviewing the relevant literature, it became apparent that a standard metric did not exist for comparing EMS-related injuries among agencies. Although "injuries per employee per year" was often reported, it did not offer any insight as to how often employees were in a position to become injured (e.g., frequency/number of responses or runs). Since it is reasonable to assume that the more runs a particular employee attends, the more injuries he or she is likely to report, "injuries per employee per year" was not adequate as a metric since it did not factor in run frequency. Therefore, a variation on this metric was devised for this study and termed "EMS-Related Injury Index" (EII). This metric is defined as "injuries per 100,000 employees per run per year. Depending on the type of research, the "EMS-related" element could also be replaced with "fire-related" (FII) or "non-incident-related" (NII), as the situation required.

Since data on whether personal protective equipment (PPE) was worn, as well as exactly what and how it was worn, was not universally recorded when an injury and exposure were reported, it is unknown how many injuries and exposures could have been prevented or mitigated with proper PPE. This was a significant shortcoming of the underlying injury reporting system. Minimum recommended information that should be collected in an injury report are listed in Appendix 2. This list is a compendium of data fields that, should they all have been available, would have substantially improved the value of this study.

Although detailed information on injury cause was rarely collected, enough information was available to establish that at least 39 of the 58 reported EMS-related injuries (67%) were associated with the movement of a patient (e.g., lifting and moving actions). Therefore, it may be reasonable to assume that implementing a training program on lifting and moving patients might reduce the number of injuries experienced by members of CFFD. Also, since over 80% of the injuries began during the on-scene component of the call and since specific personnel experienced a disproportionate number of injuries (e.g., between the ages of 30 and 40, and less than 11 years experience, etc.), this training could be targeted at high-risk employees operating in high-risk situations. However, the relatively small size of the CFFD may allow appropriate training to be conducted for all employees. Brigham (1994) suggested that traditional approaches such as training employees in proper lifting techniques have been, "…relatively unsuccessful by themselves in reducing both the frequency and the severity of health care workers' back-injury problems" (p. 56). Although there may be little evidence that a targeted training program would reduce or prevent EMS-related injuries, it is an option that prudent managers cannot overlook as a component of a larger, more comprehensive, injury reduction, prevention and mitigation program. In the final analysis, "safety improvements and the resulting decrease in injuries will depend on increasing the knowledge, training, and supervision of personnel operating at incidents" (Peterson, 1999, p. 110).

In terms of specific injury reduction and prevention strategies, several recommendations can be made to employees:

1. Call for help more often for lifting; two is almost never enough.
2. Use back belts (Mitterer, 1999).
3. Educate employees about value of a strong back.
4. A study conducted at a heavy metal foundry supports the fact that stretching prior to beginning work reduces reported back injuries (Mitterer, 1999).

5. Change physical work situations so that the need for providers to expose themselves to risky lifting situations is reduced or eliminated.
6. Lift properly – *Principles of Lifting* (Mitterer, 1999).
    a. Prepare for the lift mentally. Visualize how the lift will occur and what the end result will be.
    b. Plant your feet firmly with a wide base of support.
    c. Bend your knees.
    d. Grasp the load firmly, keeping it close to the center of your body.
    e. Keep your spine upright.
    f. Lift with your legs.
    g. Don’t twist with your body. While lifting, shift your feet.

The extent to which employees are amenable to adopting precautionary behaviors needs to be better understood. Prospective evaluations of injuries and prevention strategies are warranted in this understudied population.

Secondary to this study, it will be recommended that the CFFD implement the following steps to improve data collection procedures and the value of data collected and to target specific subsets of the member population for reduction in EMS-related injuries.

1. Establish specific reporting criteria for reporting exposures and define “exposure” as used in the established criteria.
2. Improve the data collected for reported injuries and exposures to include the collection of information listed in Appendix 2, as a minimum.

3. Educate all employees in the results and recommendations of this study, with emphasis on subsets of the Department that have reported a disproportionate number of EMS-related injuries.

For those interested in conducting similar research, the availability of relevant and complete data is essential. It is recommended that a form similar to the one in Appendix 3 (used in this study) be used to manually abstract data if electronic means are not available for direct manipulation and analysis of data.

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APPENDIX 1

CUYAHOGA FALLS FIRE DEPARTMENT
INTER-OFFICE COMMUNICATION

TO: ALL

FROM: Capt. G. SEWALD

DATE: 07/31/99

SUBJECT: On Scene Times

Per Chief Snyder; Please limit on scene times on EMS calls to a maximum of 19 minutes if at all possible. There has been a slight increase in on scene times throughout our transport period. Under all circumstances provide all pertinent and necessary care to our patients. Chief Snyder has ordered that all calls where on scene times exceed 18:59 (19:00), that crews shall provide documentation as to the reason for the extended on scene time. i.e., "rendered on scene treatment for heart patient," or "lengthy movement from high rise to vehicle." It is understood some calls inherently take longer but provide the proper patient care above all else and document those times over 19:00 minutes on transport calls only. Keep up the fine work.

SEWALD 1C

APPENDIX 2

Suggested Minimum Information to Capture for Occupational Injuries

1. Category of injury type: EMS-incident-related, fire-incident-related, or non-incident-related (i.e., response related, training related, etc.)
2. Employee name and employment number
3. Employee's address, phone number, and all contact information
4. Job classification at time of injury (e.g., firefighter, inspector, captain, etc.)
5. Job being performed at time of injury
6. Date of injury
7. Time of injury (exact)
8. Location of employee when injury occurred (address of site and location within any buildings and rooms involved) – include a drawing or map if possible
9. Names, addresses, and phone numbers of all witnesses to injury
10. *Detailed written* description of exactly what happened by the employee
11. Preliminary description of the cause of the injury by the employee's supervisor
12. Date injury reported to employer
13. Time injury reported to employer
14. Date employee last worked
15. Date employee returned to work
16. Name and address of treating physician, if used
17. Name and address of hospital used for treatment of injury, if used
18. Exact date and time when treatment was first sought
19. Description of any equipment involved in injury
20. Detailed written report from any witnesses of exactly what they saw
21. Detailed written report from the employee's supervisor at the time of the injury regarding what they saw and/or think happened
22. Employee's age and marital status at the time of the injury
23. Employee's sex
24. At what point during a call did the injury occur? (e.g., en route, on scene, etc.)
25. Whether or not the injury was related to a call
26. If the injury was related to a call, what type of call?
27. Employee's time on the job (in years) at the time of the injury
28. Whether or not a patient transport was related to the injury
29. Type of injury (e.g., fracture, puncture, laceration, sprain-strain, etc.)
30. Body site(s) affected by the injury (e.g., head, arm, back, shoulder, leg, ankle, etc.)
31. Time off work because of injury (in hours)
32. Specific shift, station and apparatus assignment at the time of the injury
33. Whether personal protective equipment was worn; if so, detailed description of what and how it was worn
34. Assessment by supervisor regarding how the injury could have been prevented, if applicable
35. Whether lifting or moving an object or person was involved in the injury; if so, details of situation including what was being lifted/moved and its approximate weight
36. Objective measure of the injured individual's level of fitness at the time of injury.

APPENDIX 3

CFFD EMS-Related Injury Data Collection Form (revised: 11/8/2001)

Employee number of injured/exposed:	
Age at time of injury/exposure:	
Male ?	Y N
Caucasian ?	Y N
Married at time of injury/exposure ?	Y N
EMS-related ? (Happened during call, not trng or otherwise)	Y N
Injury ? (if not, then it's an exposure)	Y N
Transport by CFFD involved in call on which injury/exposure occurred ?	Y N
Shift at time of injury/exposure (A, B, or C):	A B C
Station at time of injury exposure (1 – 4):	1 2 3 4
Years on job at time of injury/exposure in years (to one decimal point, e.g., "3.4")	
Period when injury/exposure started: 1 = rct of call to en route 2 = en route to arrival on scene 3 = arrival on scene to en route hospital 4 = en route hospital to arrive at hospital 5 = arrival hospital to termination of call	1 2 3 4 5
Date of injury/exposure (mm/dd/yyyy):	
Time of injury/exposure (hh:mm, military):	
Type of primary injury/exposure (e.g., fracture, puncture, laceration, bruising, dislocation, needle stick, etc.):	
Primary body site affected (e.g., wrist, hand, arm, shoulder, leg, ankle, thigh, head, etc.):	
Time off work (lost time) in hours: ("severity" is derived from this value)	
What happened (brief narrative description):	
Individual completing form:	