

FOCUS ON EMS SAFETY

OCCUPATIONAL INJURIES AMONG EMERGENCY MEDICAL SERVICES PERSONNEL

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ABSTRACT

Background. Emergency medical services (EMS) personnel treat 22 million patients a year in the United States, yet little is known of their injury risks. **Objectives.** To describe the epidemiology of occupational injuries among EMS personnel, calculate injury rates, and compare the findings with those for other occupational groups. **Methods.** This was a retrospective review of injury records kept by two urban agencies. The agencies submitted all 617 case reports for three periods between January 1, 1998, and July 15, 2002. The agency personnel worked an estimated 2,829,906 hours during the study periods. Cases were coded according to U.S. Department of Labor (DOL) criteria. **Results.** Four hundred eighty-nine cases met the DOL inclusion criteria. The overall injury rate was 34.6 per 100 full-time (FT) workers per year (95% confidence interval [CI] 31.5–37.6). “Sprains, strains, and tears” was the leading category of injury; the back was the body part most often injured. Of the 489 cases, 277 (57%) resulted in lost workdays, resulting in a rate of 19.6 (95% CI 17.3–21.9) per 100 FT workers; in comparison, the relative risks for EMS workers were 1.5 (95% CI 1.35–1.72) compared with firefighters, 5.8 (95% CI 5.12–6.49) compared with health services personnel, and 7.0 (95% CI 6.22–7.87) compared with the national average. **Conclusions.** The injury rates for EMS workers are higher than rates reported by DOL for any industry in 2000. Funding and additional research are critical to further defining the high risks to EMS workers and developing interventions to

mitigate this serious problem. **Key words:** Occupational injuries; occupational safety; emergency medical technicians; wounds and injuries.

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Emergency medical services (EMS) personnel treat 22 million patients per year in the United States.¹ Of the estimated 900,000 EMS workers in the United States, approximately 180,000 are full-time (FT) workers¹; volunteers provide much of the nation’s EMS.² EMS personnel are among the first responders to natural and man-made disasters and are a crucial component of the nation’s disaster response system.

Prior studies carried out within the EMS workforce have suggested that EMS workers are at high risk for occupational injuries. Gershon et al. evaluated injuries among 197 FT EMS workers who sustained 226 occupational injuries in 1992.³ Hoya and Ellis studied 254 injury reports from a population of urban EMS providers and found an occupational injury rate of 50 cases per 100 FT workers for males and 86 cases per 100 FT workers for females per year.⁴ Schwartz et al. evaluated 439 survey questionnaires returned by EMS workers in six New England states and reported a back injury rate of 25.4, an assault rate of 20.3, and a collision injury rate of 9.9 per 100 FT EMS workers per year.⁵ Other specific occupational hazards for EMS workers that have been identified include transportation-related incidents,^{6–14} hand injuries,¹⁵ back injuries,¹⁶ violence,^{17–23} infectious diseases,^{24–28} and stress.^{29–40} One study determined that the EMS occupational fatality rate over a six-year period was 12.7 per 100,000 FT workers per year⁴¹: a rate more than twice the national average.

The objectives of this study were to describe the epidemiology of occupational injuries among EMS personnel, calculate injury rates, and compare the findings with those of other occupational groups. The rates and the comparisons are necessary to describe the findings in a way that enables public health officials, government officials, agency administrators, and EMS workers to better understand the risks associated with the occupation.

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A high injury rate is associated with personal health consequences and may be associated with a high employee turnover rate, a shortened career span, and, ultimately, a reduction in the quality of emergency medical care provided to the community. A high injury rate is also associated with a large economic impact for EMS employees, EMS agencies, and their communities. This study is a precursor to efforts to prioritize, develop, and evaluate interventions that can be implemented to reduce these occupational risks.

METHODS

Study Design

This descriptive epidemiologic study was a retrospective analysis of data from two urban agencies, identified as EMS1 and EMS2. Both agencies requested that their participation be anonymous. These two agencies were convenience samples chosen because of the availability of their data and the willingness of their administrators to participate.

Study Population

The two agencies employed 409 FT EMS workers during the study period. The EMS1 agency provided data for all injury cases for two time periods: January 1998 to May 2000 and October 1, 2001, to July 14, 2002 (data for the missing interval were unavailable due to a change in contractors). The EMS2 agency provided data for all injuries that occurred between January 1999 and December 2001. Each agency provided basic information about the demographics of its workforce at the beginning of the study period (i.e., January 1998 for EMS1 and January 1999 for EMS2). However, neither agency was able to provide information about how the demographics changed over time. These demographic data include the number of employees, an estimate of hours worked, and distribution by gender, job title, and age.

Setting

Both agencies are sole 9-1-1 EMS providers in cities that rank in the top 100 most populous cities in the United States.⁴² The cases from both agencies are from FT civilian EMS workers (i.e., non-firefighters).

Human Subjects

This project was reviewed and approved by the George Washington University Committee on Human Research on November 27, 2002. The requirement for informed consent was waived by the institutional review board.

Data Collection

In both agencies, workers were required to immediately notify a designated agency representative in the event of any on-duty injury or illness. At the EMS1 agency, independent contractors collected the incident reports and maintained the database supplied to the first author. At EMS2, the agency's safety officer maintained the records and supplied the database to the first author. Representatives of both agencies were confident that all reported cases were represented in the database submitted.

Although the three data sets differed in format, each set typically included the following data for each incident: date of incident, age, gender, cause of injury, type of injury, body part(s) injured, job title, lost workdays (yes/no), and a short narrative. "Lost workdays" (LWD) was defined at both agencies as those incidents that involved days away from work, days of restricted work activity, or both. This definition was consistent with the U.S. Department of Labor (DOL) Bureau of Labor Statistics definition for lost workdays.⁴³ No on-duty fatalities occurred during the study periods.

The EMS1 agency submitted 325 cases for the earlier 126-week period and 151 cases for the 41-week period. The EMS2 agency provided 141 cases for the period of January 1999 to December 2001. A total of 617 injury and illness case reports were submitted by the two agencies. Inclusion criteria for the study were that the case: 1) was describing an EMS worker, 2) was not a duplicate record of the same incident, and 3) met the DOL criteria for a recordable work-related injury. Those recording criteria are "Nonfatal occupational injuries which involve one or more of the following: Lost worktime, loss of consciousness, restriction of work or motion, transfer to another job, or medical treatment other than first aid"⁴³ as well as any cuts or punctures with exposure to potentially infectious materials.⁴⁴ All data fields and narratives were evaluated for each case.

Measurements

The authors used standard DOL data definitions⁴⁵ to categorize each case. Data from each narrative were used to code and further classify each case in accordance with detailed coding practices.⁴⁶

After a review of procedures with the second author (an experienced user of the DOL codes), the first author coded all cases. A randomly selected group of cases was independently coded by the second author and compared with those coded by the first author. Although some minor variations were noted, the differences would not have changed the study results.

The primary outcome measures were the rates of injuries per 100 FT workers per year. This measure was selected as the most appropriate way both to quantify the

incidents and to compare the rates with other groups of workers.

Primary Data Analyses

SAS 8.2 (SAS Institute, Cary, NC) was used to analyze the data. Rates were calculated using the standard DOL formula for 100 full-time-equivalent workers per year.⁴⁷ The 95% confidence intervals (CIs) were calculated using standard formulas.^{48,49}

RESULTS

Four hundred eighty-nine cases met the inclusion criteria for this study. Because this study was restricted to injuries only, 13 recordable illnesses were excluded. The EMS1 agency had an estimated 337 EMS employees during the two study periods. Approximately 45% of the workforce was female, and the average worker age was 38 years. The EMS2 agency had 72 employees during the study period. Twenty-eight percent of the workers were female, and the average age of the workforce was 34 years. There were approximately 409 EMS workers in these two agencies during the study period.

The EMS1 agency reported that its 337 employees worked 2,208 hours per year on average (42.5 hours per week). The first study period covered 126 weeks and the second 41 weeks, for a total of 167 weeks, resulting in an estimate of 2,391,858 total hours worked. The EMS2 agency reported that its 72 workers were paid for 145,622 hours in 2000 (an average of 2,023 hours per person per year). EMS2 personnel worked an estimated 438,048 hours during the 156-week study period. The total number of hours worked at both agencies during the study period was estimated to be 2,829,906.

Table 1 illustrates the demographic characteristics of the workforce and the injury cases and rates at the two

EMS agencies. Females and 25-to-34-year-olds were the groups with the highest injury rates.

The injury rate for EMS2 was higher than the rate for either of the EMS1 subgroups (Table 2). The overall rate for both agencies was 34.6 per 100 FT workers per year.

Of the 489 injuries noted in Table 3, 277 (57%) resulted in LWD (rate 19.6/100 FT workers; 95% CI 17.3–21.9). The same table notes that the DOL classification “sprains, strains, and tears” was the leading LWD case type by nature of injury; the back was the body part injured most often; and the source of the largest number of cases was the patient being assisted. Of the 277 LWD cases, 119 (43%) were caused by overexertion, 34 were transportation incidents, 36 were caused by falls, and eight resulted from assaults.

Firefighters and health services workers were selected as appropriate groups for comparison. The DOL does not publish rates for fire service personnel. However, it does provide links to related agencies for each state.⁵⁰ The published documents from all 50 states were examined for the year 2000. California,^{51,52} Maine,^{53,54} New Jersey,^{55,56} and New York^{57,58} were the only states to publish rates for fire personnel in that year. Neither the DOL nor the states publish rates for EMS.

DISCUSSION

The EMS rate of 34.6 injuries per 100 FT workers per year (CI 31.5–37.6) was higher than the rate reported by the DOL⁵⁹ for any industry in 2000 (the midpoint of the study). Compared with the national average for that year, the relative risk of injury with LWD for EMS workers was 7.0 (CI 6.22–7.87).

Comparison with Previous Studies of EMS Workers

Although Gershon et al. did not use the standard injury definitions, nor did they compute rates, their finding of

TABLE 1. Numbers of Workers, Total Injuries, Hours Worked, Rate per 100 Full-Time (FT) Workers per Year, and 95% Confidence Intervals (CIs) of the Rate by Demographic Factor and by Data set: 1998 to 2002 (*n* = 409 Workers, 489 Cases)

Demographic Characteristics	Workers, EMS1	Workers, EMS2	Total Workers	Total Injuries	Hours Worked	Rate per 100 FT Workers (95% CI)
Age						
<25 years	27	11	38	49	258,557	37.9 (27.3–48.5)
25–34 years	113	34	147	196	1,008,873	38.9 (33.4–44.3)
35–44 years	100	19	119	128	825,346	31.0 (25.6–36.4)
45–54 years	85	5	90	81	633,708	25.6 (20.0–31.1)
55+ years	12	3	15	9	103,422	17.4 (6.0–28.8)
Unknown				26		
Gender						
Male	187	52	239	259	1,643,601	31.5 (27.7–35.4)
Female	150	20	170	227	1,186,305	38.3 (33.3–43.2)
Unknown				3		
Total	337	72	409	489	2,829,906	34.6 (31.5–37.6)

The worker's age was not indicated for 26 cases; three cases did not identify the injured worker's gender.

TABLE 2. Injury Cases, Hours Worked, Rate per 100 Full-Time Workers per Year, and 95% Confidence Intervals (CIs) of the Rate by Data Set and for All Injury Cases ($n = 489$ Cases)

Data Set*	Injury Cases	Hours Worked	Injury Rate (95% CI)
EMS1a	298	1,804,635	33.0 (29.3–36.8)
EMS1b	81	587,223	27.6 (21.6–33.6)
EMS2	110	438,048	50.2 (40.8–59.6)
Total	489	2,829,906	34.6 (31.5–37.6)

*Data set EMS1a identifies cases that occurred at the EMS1 agency during the period January 1998 to May 2000. EMS1b identifies cases occurring at that agency between October 1, 2001, and July 14, 2002. EMS2 identifies the cases occurring at the EMS2 agency between January 1999 and December 2001.

226 occupational injuries in a population of 197 FT EMS workers at one urban agency in one year³ suggests a rate of approximately 115 per 100 FT workers. Hoga and Ellis⁴ reported injury rates of 50 cases per 100 FT workers for males and 86 cases per 100 FT workers for females compared with our rates of 31.5 per 100 FT workers for males and 38.3 per 100 FT workers for females. However, the other EMS papers do not use DOL standard case definitions, which makes direct comparison difficult.

TABLE 3. Emergency Medical Services Injury Cases by Department of Labor Classification: Type, Total Cases, Lost Workday (LWD) Cases, LWD Rate per 100 Full-Time Workers per Year, and 95% Confidence Interval (CI), for Select Categories by Nature of Injury, Body Part, Source, and Event or Exposure,* 1999 to 2002 ($n = 489$)

Type	Total Cases	LWD Cases	LWD Rate (95% CI)
Nature of injury			
Fractures	15	13	0.9 (0.5–1.6)
Sprains, strains, and tears	271	176	12.4 (10.6–14.3)
Cuts, lacerations	22	10	0.7 (0.3–1.3)
Wounds	48	24	1.7 (1.1–2.5)
Multiple trauma	65	38	2.7 (1.8–3.5)
Body part			
Shoulder	22	14	1.0 (0.5–1.7)
Back	135	88	6.2 (4.9–7.5)
Multiple trunk locations	32	21	1.5 (0.9–2.3)
Fingers	39	10	0.7 (0.3–1.3)
Knees	42	30	2.1 (1.4–2.9)
Ankles	32	19	1.3 (0.8–2.1)
Multiple body parts	62	37	2.6 (1.8–3.5)
Source			
Health care patients	156	106	7.5 (6.1–8.9)
Medical surgical instruments	53	13	0.9 (0.5–1.6)
Stretchers	33	16	1.1 (0.6–1.8)
Vehicles	91	54	3.8 (2.8–4.8)
Event			
Falls	49	36	2.5 (1.7–3.4)
Overexertion—except lifting	54	37	2.6 (1.8–3.5)
Overexertion—lifting only	129	82	5.8 (4.5–7.0)
Transportation	58	34	2.4 (1.6–3.2)
Assault	14	8	0.6 (0.2–1.1)
Total	489	277	19.6 (17.3–21.9)

*Only leading types are shown within each category.

TABLE 4. Total Rate for All Injury Cases, Number of Injury Cases with Lost Workdays (LWDs), LWD Rate per 100 Full-Time (FT) Workers, Relative Risk (RR) for EMS Workers for LWD Cases, and 95% Confidence Interval (CI) of the RR: Emergency Medical Services (EMS) Rates Compared with 2000 Rates for Fire Workers, Health Workers, and the Department of Labor (DOL) National Average

	Total Rate	LWD Cases	LWD Rate per 100 Ft Workers	Relative Risk (95% Ci)
EMS workers	34.6	277	19.6	
Fire workers				
California	14.2	1,100	7.3	2.7 (2.35–3.06)
Maine	8.9	100	4.6	4.3 (3.39–5.36)
New Jersey	17.0	1,100	9.3	2.1 (1.85–2.40)
New York	34.3	6,100	30.2	0.6 (0.58–0.73)
Average rates and total cases	18.6	8,400	12.9	1.5 (1.35–1.72)
Health services workers	6.9	270,500	3.4	5.8 (5.12–6.49)
DOL total	5.8	2,587,000	2.8	7.0 (6.22–7.87)

Comparison with Other Industries

Table 4 compares rates of LWD EMS injuries from this study with the published LWD rates for fire service personnel, health services personnel, and the U.S. national average.^{59,60} Comparison rates are all from the year 2000, the midpoint of this study.

The average rates per 100 FT workers per year for fire personnel in the United States were estimated to be lower than our rates for EMS workers. Compared with fire workers, the relative risk for EMS workers was 1.5 for LWD cases (CI 1.35–1.72). Houser et al. found that 36% of injuries to firefighters were classified as sprains, strains, and tears,⁶¹ compared with 55% for EMS workers in our study. Health services personnel had an LWD rate of 3.4 per 100 FT workers (CI 3.39–3.41); the relative risk for EMS compared with health services was 5.8 (CI 5.12–6.49).

Prevention

A search of the literature found only three reports documenting interventions to reduce occupational risks among EMS workers: Peate⁶² and O'Connor et al.⁶³ evaluated interventions to reduce unintentional needlestick incidents among paramedics; Maguire and Porco reported a 50% reduction in ambulance collisions following a multifactorial intervention.⁶ Further study is required to determine causal factors, and then to identify effective prevention strategies.

LIMITATIONS

The 409 workers included in this study are only a small fraction of the nation's EMS workforce and, because they are all FT employees of urban agencies, the

findings may not be generalizable to the larger EMS population. This was a retrospective analysis of administrative records that were not designed for our specific study. The records include a limited number of fields and little narrative. This limited the scope of both the analyses and the findings. Also, there was no mechanism to validate these data with hardcopy records because we did not have access to the agencies' raw data.

It is possible that EMS workers self-treat after some injuries, thus resulting in an undercount of reportable cases, although this is less likely for the LWD cases. It would have been ideal to track risk factors that varied over time,⁶⁴ but we did not have information on exposure to various risk factors among the workers. Some of the injury type and rate differences between the agencies may reflect variation in agency size as found by Personik.⁶⁵

Our comparison with other industries may not precisely reflect differences in risk. With the possible exception of fire, the rates for the comparison industries are based on cases and hours worked by all workers in the industry, including administrative, housekeeping, and maintenance staff. The EMS rates are based on cases among, and hours worked specifically by, EMS workers. The relative risk for EMS compared with fire may be higher than reported because cases occurring among EMS workers employed by fire departments may have been coded as firefighters. Also, some cases coded as firefighters may have occurred when the firefighter was assigned to EMS duties, as in a recent National Institute for Occupational Safety and Health study.⁶⁶

Neither participating agency was able to specify the exact number of hours worked by the EMS personnel during the study period. Therefore, the denominator data are an estimate based on the information that was available from the agencies. However, the EMS2 agency was able to provide the specific number of hours paid to ambulance personnel for one of the study years, 2000—thus providing the most reliable figure for hours worked. EMS2 reported that its 72 EMS workers were paid for 145,622 hours in 2000. In that year, EMS2 had 32 reportable cases and 25 cases with LWD; this is a rate of 44.0 per 100 FT workers for all cases (CI 28.7–59.2) and 34.3 for LWD cases (CI 20.9–47.8). Comparing the EMS2 LWD rate for the year 2000 with the DOL LWD rate for the year 2000, the relative risk for EMS workers was 12.3 (CI 8.3–18.1).

CONCLUSIONS

Our findings have shown that the rate of injuries among EMS workers was higher than the rate for any private industry published by the DOL in 2000.

More funding is needed for further research to evaluate risk factors and to examine short- and long-term disabilities resulting from occupational injuries. Future

projects must also focus on the development, implementation, and evaluation of interventions to reduce the rate of occupational injuries in this population.

EMS personnel treat approximately 22 million patients a year in the United States; improving the health of this workforce may ultimately have a positive impact on the health of the nation.

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