Occupational Injuries Among Emergency Medical Service Providers in the United States

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Objective: *Occupational injury is a significant problem among emergency medical services (EMS) providers. A national survey was conducted to describe the problem of occupational injury among EMS providers.* ***Methods:*** *This study examined the most common types of nonfatal injuries and the activities and environments where injury most frequently occurred, including additional variables and paid versus volunteer status.* ***Results:*** *Occupational injury in the past 12 months was reported by more than 29% of 659 survey respondents, with multiple injuries reported by 64% of those reporting an injury. Paid providers had approximately twice the prevalence of overall injury than volunteer providers, controlling for age and gender. Paid providers were more likely than volunteer providers to experience back injury and physical assault.* ***Conclusions:*** *This study clearly identifies important occupational injury problems in EMS, including the need to examine paid and volunteer providers as separate occupational groups.* (J Occup Environ Med. *2009;51:963–968*)

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The occupation of emergency medical services (EMS) provider has seen tremendous growth since the development of the first volunteer rescue squads in the 1920s,[1] and particularly since the passage of the 1974 EMS Act.[2] EMS has evolved from services run by funeral homes that provided transportation only to include highly advanced ground and air ambulances that provide mobile intensive care for the most critically ill patients. According to the Health Resources and Services Administration, EMS providers will play an increasingly important role in future participation in the day-to-day management of many chronic health conditions (National Institute of Occupational Safety and Health and Health Resources and Services Administration, 1996). To ensure that a strong, capable EMS workforce is ready to take on these new challenges, it is crucial to protect their health and safety.

Enumerating the EMS workforce is difficult because there is currently no central licensing body, and the workforce includes a mixture of paid and volunteer EMS providers, with the bulk of rural populations covered by volunteer providers. The Bureau of Labor Statistics estimates approximately 150,000 paid EMS workers in the United States,[3,4] whereas estimates that include volunteer and part-time providers range from 500,000 to 830,000.[4,5]

The scant research available identifies EMS providers as having a high risk for occupational injury, with approximately 25% of EMS providers reporting at least one work-related injury in the previous 6

months.[6] Common injury causes included falls, being struck by objects, and lifting, with musculoskeletal complaints being the most common.[7–9] Motor vehicle crashes (MVCs) frequently cause more severe EMS injuries and are a leading cause of lost workdays.[8–10]

Existing studies on EMS providers have involved regional samples of primarily paid providers. Currently, no studies have examined differences between paid and volunteer EMS providers using a nationally representative sample. This cross-sectional study of a stratified random sample of EMS providers registered with the National Registry of Emergency Medical Technicians (NREMT) describes the incidence and characteristics of nonfatal occupational injuries among EMS providers in the United States and examines the relationship between employee status and injury.

Materials and Methods

Study Design and Population

This cross-sectional survey measured the frequency and characteristics of nonfatal occupational injuries among EMS providers in the United States. Participants were sampled from the NREMT, which includes approximately 230,000 EMS providers. NREMT provides certification for EMS providers that is recognized in 45 states and territories, as well as by the Department of Defense and other federal agencies.[11] There are NREMT certified providers in all 50 states, the District of Columbia, Guam, and the US Virgin Islands.[11]

Eligible participants included EMS providers who were employed or volunteering with a pre-hospital service at the time of the survey. Eligible participants were randomly selected from three strata of EMS providers based on their licensing level: EMT-basic, EMT-intermediate, and EMT-paramedic. First, responders were excluded from the sampling scheme because their work duties differ from emergency medical providers (for example, they would be unlikely to provide patient care in an ambulance setting). Individuals with the Department of Defense were also excluded because their military experience may not be comparable to the civilian workforce.

The original sample included 2100 providers who received a mailed survey in August 2005, with a reminder postcard sent 1 week later. Three weeks after the initial mailing, a replacement survey was sent to the nonrespondents. A total of 712 (34%) surveys were returned of which 37 were not filled out (ie, nonparticipants). Survey response was monitored by an identifier assigned to each participant and included on all survey materials so that individuals could not be tied to their written responses.

Because of extended disruptions in mail service to the Gulf Coast region after Hurricanes Katrina and Rita that coincided with the original mailing of the survey, the decision was made to exclude individuals from affected areas. The remaining eligible sample size was 1981, and the response rate for the 675 completed surveys was 34%. Surveys from 15 respondents were not included in the analysis because their service type was in an excluded category. Institutional Review Board approval for human subjects' research was obtained for this study.

Data Collected

The mailed survey was developed and pilot tested using a sample of paramedic students and a sample of actively employed EMS providers. The survey included demographic variables such as age, gender, state of residence, practice and certification level, length of service, number of calls per week, and average number of hours on duty per week. Providers were asked to provide information about the type of service where they performed the majority of their EMS work (hospital-based, fire-based, volunteer, county or municipal, other or not affiliated) as well as information about the size of the community (six population categories) where work was performed, estimated annual call volume, and whether the service transports patients.

Information was collected about work-related MVCs, assault, back injuries and back pain, slips or trips or falls and other injuries (sprains or strains, fractures or dislocations, internal injuries, punctures or lacerations) that had occurred in the last 12 months. Additional information for up to three MVCs included type of vehicle, injury sustained, type of collision, and associated crash factors and transport type. Specific information about the three most recent physical assaults was also collected. Physical assault was defined as attack or attempted attack with or without a weapon and with or without injury, without regard for perpetrator intent. Assault data included information about the perpetrator and the location of the assault, injury sustained by the provider and a brief narrative of the incident.

Analysis

To assess the level of representation of the study sample, the study participants were compared with the overall NREMT registry by gender, region, and certification level. Survey respondents were 66% men whereas the NREMT registrants were 72% men ($P < 0.01$). EMS providers certified at the EMT-intermediate level were more likely to respond (6% of NREMT but 31% of respondents) whereas those certified at the EMT-basic and EMT-paramedic level were less likely to respond ($P < 0.01$). Geographically, most survey respondents were from the North Central region of the US (33%), whereas the highest percent of NREMT was in the Atlantic region (29%; $P < 0.01$).

The main exposure variable was type of EMS provider employment, either paid or volunteer. Fisher exact and χ^2 tests were used to compare the employment type by demographic and work characteristics, as well as proportion reporting different types of injuries. Medical treatment, missed workdays, and worker's compensation claims were

compared by injury types. Logistic regression modeling was used to identify if volunteer providers experienced an increased odds ratio for overall injuries and for specific types of injuries. Confounders were identified based on prior studies (ie, impact of gender on injury) and for variables related to injury and associated with employment type (length of service, calls per week). The final model controlled for gender and average calls per week.

Results

Demographic and Service Characteristics

Paid and volunteer participants differed significantly according to most demographic and service characteristics (Table 1). Paid providers were 72% men, whereas volunteers were more evenly divided with 44% men and 56% women ($P < 0.01$). Paid providers were more likely to be between the ages of 26 and 35, whereas a higher proportion of volunteer providers were in the younger and older age categories ($P < 0.01$). Paid and volunteer providers were primarily from the north central region of the US (31% and 42%, respectively). Nearly, half of paid providers were registered as EMT-paramedics, whereas volunteers were equally divided as EMT-basics and EMT-intermediates with only 12% registered at the paramedic level. Although 61.9% of paid providers responded to at least 10 EMS calls per week, more than 75% of volunteer providers responded to four or fewer calls. Paid providers responded to an average of nearly 16 calls per week compare with four calls per week for volunteers.

Volunteer respondents primarily served communities of less than 25,000 residents, whereas paid providers demonstrated a more normal distribution of community size ($P < 0.01$). More than half of volunteers were from services which had less than 500 calls per year. Paid providers had a more even distribution across call volumes ($P < 0.01$).

TABLE 1
Characteristics of Providers and Services, Paid, and Volunteer EMS Providers

	All Providers, *N* (%)	Paid Providers, *N* (%)	Volunteer Providers, *N* (%)	*P*
Total	659 (100.0)	529 (80.3)	130 (19.7)	
Provider characteristics				
Gender				<0.0001
Male	434 (66.0)	377 (71.4)	57 (43.9)	
Female	224 (34.0)	151 (28.6)	73 (56.1)	
Age (yrs)				0.0002
18–25	93 (14.1)	72 (13.6)	21 (16.1)	
26–35	228 (34.6)	198 (37.4)	30 (23.1)	
36–45	174 (26.4)	138 (26.1)	36 (27.7)	
46–55	127 (19.3)	100 (18.9)	27 (20.8)	
56–65	30 (4.6)	19 (3.6)	11 (8.5)	
≥65	7 (1.1)	2 (0.4)	5 (3.9)	
Region				<0.0001
Pacific	44 (6.7)	42 (7.9)	2 (1.5)	
South Central	104 (15.8)	94 (17.8)	10 (7.7)	
Mountain	74 (11.2)	53 (10.0)	21 (16.1)	
New England	53 (8.0)	34 (6.4)	19 (14.6)	
Atlantic	165 (25.0)	141 (26.7)	24 (18.5)	
North Central	219 (33.2)	165 (31.2)	54 (41.5)	
Registry level				<0.0001
EMT-basic	161 (24.4)	105 (19.9)	56 (43.1)	
EMT-intermediate	232 (35.2)	174 (32.9)	58 (44.6)	
EMT-paramedic	265 (40.2)	249 (47.1)	16 (12.3)	
Calls responded per wk				<0.0001
0–1	81 (12.5)	38 (7.3)	43 (33.6)	
2–4	129 (19.9)	75 (14.4)	54 (42.2)	
5–9	108 (16.6)	86 (16.5)	22 (17.2)	
10–19	148 (22.8)	142 (27.3)	6 (4.7)	
20–29	93 (14.3)	90 (17.3)	3 (2.3)	
30 or more	90 (13.9)	90 (17.3)	0 (0.0)	
Average calls per wk	13.5	15.9	4.0	<0.0001
Service characteristics				
Community size (people)				<0.0001
<2,500	103 (15.9)	42 (8.1)	61 (47.3)	
2,500–24,999	180 (27.7)	135 (26.0)	45 (34.9)	
25,000–74,999	124 (19.1)	110 (21.1)	14 (10.9)	
75,000–149,999	65 (10.0)	62 (11.9)	3 (2.3)	
150,000–500,000	88 (13.6)	86 (16.5)	2 (1.6)	
>500,000	87 (13.4)	83 (16.0)	4 (3.1)	
Annual call volume				<0.0001
0–500	164 (25.2)	80 (15.3)	84 (65.6)	
501–3,000	193 (29.7)	163 (31.2)	30 (23.4)	
3,001–10,000	105 (16.1)	96 (18.4)	9 (7.0)	
10,000 or more	148 (22.8)	146 (28.0)	2 (1.6)	
Unknown	40 (6.1)	37 (7.1)	3 (2.3)	

Reported Injuries

Nearly, 30% of respondents reported at least one injury within the past 12 months that occurred on duty or while performing EMS duties (Table 2). Injuries were reported under back injury, motor vehicle collisions, assaults, and the "other injury" category (slips or trips or falls, sprains or strains, punctures or penetrations, fractures or dislocations, and internal injury not previously reported). The 197 injured respondents reported a total of 307 injury events, with approximately 64% of injured providers experiencing multiple injury events during the reporting period. (Injuries were reported by 32.7% of paid providers and 18.5% of volunteer providers, and paid providers were 2.15 times more likely to

TABLE 2
Prevalence of Reported Injuries Among Emergency Medical Service Providers and Odds Ratio for Increased Injury Among Paid EMS Providers

	Reported Injuries*			
	Paid, *N* (%)	Volunteer, *N* (%)	Total, *N* (%)	Odds Ratio for Paid Providers (95% CI)†
Any reported injury				2.15 (1.31–3.54)
Yes	173 (32.7)	24 (18.5)	197 (29.9)	
No	356 (67.3)	106 (81.5)	462 (70.1)	
Physical assault				2.72 (1.46–5.06)
Yes	134 (25.6)	13 (10.2)	147 (22.6)	
No	390 (74.4)	115 (89.8)	505 (77.4)	
Physical assault injury				NA‡
Yes	18 (13.4)	1 (7.7)	19 (12.9)	
No	116 (86.6)	12 (92.3)	128 (87.1)	
MVC				1.55 (0.66–3.61)
Yes	43 (8.2)	7 (5.5)	50 (7.7)	
No	482 (91.8)	121 (94.5)	603 (92.3)	
MVC injury				NA‡
Yes	5 (13.5)	0 (0.0)	5 (11.9)	
No	32 (86.5)	5 (100.0)	37 (88.1)	
Acute back injury				1.66 (0.82–3.39)
Yes	73 (13.9)	10 (7.9)	83 (12.8)	
No	452 (86.1)	116 (92.1)	568 (87.2)	
Slip/trip/fall				1.19 (0.65–2.21)
Yes	69 (13.0)	15 (11.5)	84 (12.8)	
No	460 (87.0)	115 (88.5)	575 (87.2)	
Sprain/strain				NA‡
Yes	43 (8.1)	2 (1.5)	45 (6.8)	
No	486 (91.9)	128 (98.5)	614 (93.2)	
Puncture				NA‡
Yes	37 (7.0)	2 (1.5)	39 (5.2)	
No	492 (93.0)	128 (98.5)	620 (94.8)	

*Reported injury totals are not mutually exclusive.
†Odds ratio for paid EMS providers (logistic models controlled for age and gender).
‡NA, not applicable or not available because of small cell sizes.

report an injury [95% CI = 1.31 to 3.54] after controlling for age and gender.) Paid providers were more likely to be injured when controlling for call volume as well, with paid providers experiencing an average of 21 injuries per 100 calls and volunteer providers an average of 11 injuries per 100 calls.

Injury Events and Injuries by Type

Physical assault was the most commonly reported event, with 22.6% of all providers reporting that they had been physically assaulted in the past 12 months (Table 2). Physical assault was reported much more frequently among paid providers, who were 2.72 times more likely to report an assault than volunteer providers (95% CI = 1.46 to 5.06). Physical assaults led to injury in 12.9% of events, for an overall assault injury prevalence of 2.9% among all providers. The frequency of assault injury for volunteer providers was less than 1%, which was not a large enough number to calculate an odds ratio. Patients were the most frequent perpetrator for both groups for all physical assaults. Patients who perpetrated assaults against EMS providers were most commonly reported as under the influence of alcohol or other drugs.

MVCs were reported by 7.7% of providers, with a slightly higher proportion reported by paid (8.2%) than volunteer (5.5%) providers. The odds ratio of 1.55 was not significant (95% CI = 0.66 to 3.61). Crashes with resulting injury were more frequent at night (60%), involved patient transports (60%), involved use of lights and sirens (100%), and occurred during clear weather (100%). Broadside collisions accounted for 80% of injury crash types and 80% of those reporting injury were driving at the time of the crash. All reported injury collisions involved an ambulance. MVCs led to injury in 11.9% of crashes, and MVC injuries were reported by 0.8% of respondents. All MVC injuries were reported by paid providers.

Acute back injury was reported by 12.8% of providers overall, 13.9% of paid, and 7.9% of volunteer providers. Paid providers were 1.66 times more likely to report acute back injury, and this difference was significant at the 90% confidence level but not the 95% confidence level (95% CI = 0.82 to 3.54). Paid providers were significantly more likely to report back pain at work (40% vs 27% of volunteers, $P < 0.01$). The prevalence of back pain outside work did not vary significantly between paid (40%) and volunteer providers (33%) ($P = 0.20$).

Slips, trips, and falls were reported by 12.8% of providers. Paid providers were 1.19 times more likely to report slip, trip, or fall injury, although this difference also reached significance only at the 90% confidence level. Sprains and strains were reported by 6.8% of providers, and puncture wounds were reported by 5.2%. The majority of both of these injury types were reported by paid providers, and the number of volunteer providers was too small to calculate odds ratios.

Treatment, Restricted Work, and Compensation Claims From Injuries

All five MVC injuries required medical treatment and led to restricted workdays, although only three of the five injured reported that a worker's compensation claim was filed (Table 3). Among other injury types reported

TABLE 3
Injury-Related Medical Treatment, Missed Work Days, and Worker's Compensation Claims by Injury Type and EMS Providers

	Paid				Volunteer				
	Reported Injury, *N*	Medical Treatment, *N* (%)	Restricted Work Days, *N* (%)	Filed Worker's Compensation Claim, *N* (%)	Reported Injury, *N*	Medical Treatment, *N* (%)	Restricted Work Days, *N* (%)	Filed Worker's Compensation Claim, *N* (%)	Total Reported Injuries, *N*
MVC injury									
Yes	5	5 (100.0)	5 (100.0)	3 (60.0)	0	NA	NA	NA	5
No	38	0 (0.0)	0 (0.0)	2 (40.0)	7				45
Back injury									
Yes	73	44 (63.8)	31 (49.2)	14 (22.6)	10	5 (50.0)	4 (40.0)	2 (20.0)	83
No	452	25 (36.2)	32 (50.8)	48 (77.4)	116	5 (50.0)	6 (60.0)	8 (80.0)	568
Missing	0	4	10	11	0	0	0	0	
Sprain/strain									
Yes	43	24 (55.8)	18 (41.9)	14 (32.6)	2	1 (50.0)	0 (0.0)	1 (50.0)	45
No	486	19 (44.2)	25 (58.1)	29 (67.4)	128	1 (50.0)	2 (100.0)	1 (50.0)	614
Puncture									
Yes	37	17 (46.0)	5 (13.5)	9 (24.3)	2	1 (50.0)	0 (0.0)	1 (50.0)	39
No	492	20 (54.0)	32 (86.5)	28 (75.7)	128	1 (50.0)	2 (100.0)	1 (50.0)	620
Slip/trip/fall									
Yes	69	15 (21.7)	10 (14.5)	11 (15.9)	15	6 (40.0)	1 (6.7)	2 (13.3)	84
No	460	54 (78.3)	59 (85.5)	58 (81.7)	115	9 (60.0)	14 (93.3)	13 (86.7)	575

NA, not applicable or not available.

by paid providers, back injuries were the most likely to require medical treatment (63.8% of paid and 50% of volunteer) and lead to restricted workdays (49.2% and 40% volunteer). Worker's compensation claims were filed for more than 20% of back injuries. A higher proportion of sprains and strains led to a compensation claim (32.6% for paid and one of the two injuries for volunteer), although fewer required medical treatment or restricted workdays than did back injuries. Nearly, half of puncture wounds led to medical treatment, but few required restricted workdays. Slips, trips, and falls had the lowest reports of medical treatment, restricted workdays, and compensation claims. Injuries were too infrequent among the smaller sample of volunteer EMS providers to examine outcome trends.

Discussion

This is the first published study of nonfatal occupational injuries in EMS providers to include a national sample of EMS providers, whereas previous studies have included single departments, service types, or geographic areas. It is also the first to compare injury experiences of paid and volunteer EMS providers. These findings concur with previous studies that occupational injury is a serious, frequent problem among EMS providers.[6,8] Furthermore, injury experiences differ significantly between paid and volunteer providers.

Paid providers reported the occurrence of an acute back injury in the past 12 months twice as frequently as volunteers (14% vs 7%). Previous studies found that back injury increased with the training level of the provider, with paramedics reporting the highest incidence.[7,8] Our findings are consistent since paramedics were more likely to be paid providers. Although these injuries were twice as common among paid providers as volunteers, decisions to seek treatment, file a workers' compensation claim or have restricted workdays did not vary by service type.

Back injury prevention programs in health care settings have demonstrated varied success in reduction of back injury and back pain. Previous studies have identified three effective components in back injury prevention programs: use of mechanical lifts; zero lift policies; and use of lift teams.[12–14] Because of cumbersome equipment, personnel limitations and the diverse nature of the EMS work environment, these interventions are not feasible for prevention of back injury in EMS. Development of back injury prevention programs for EMS will likely require not only further research, but also creativity.

MVCs were a relatively uncommon occurrence and were reported by <1% of all respondents. Injury as a result of MVC was also rare, accounting for <2% of all reported injuries, far less than previous studies.[6–10,15] Previous studies have focused on worker's compensation claims, which include more severe injuries. Reporting of MVC injuries in self-reported survey may also be lower if providers are injured severely enough that they leave the profession because of the severity of the injuries. Paid and volunteer providers reported involvement in MVC with equal frequency, but all injuries were among paid providers. Without exposure information to determine the number of miles traveled, it is difficult to compare the frequency of crashes between the two groups. Although paid providers tended to have higher call volumes than volunteers, volun-

teers, who cover primarily rural areas, may travel a greater number of miles per call. Variables correlated with injury during EMS MVCs include passenger restraint, late night and high traffic volume calls, and lights and siren responses.[10,15] These conditions may be more likely in urban areas. Prevention of MVCs involving EMS providers has focused on evidence-based risk reduction using tools such as priority dispatching, additional driver training, and black box technology to warn drivers of dangerous conditions or behaviors.

The most commonly reported injury for both paid and volunteer providers was a slip, trip, or fall, accounting for 25% of all injuries among paid providers and 47% among volunteers. Programs developed for other industries may lend themselves, in whole or in part, to adaptation to EMS. Although high frequencies of slips, trips, and falls among both paid and volunteer providers indicate the need for prevention programs, it is important that these programs are designed for field medical use and take into account differences in these populations. Prevention measures that require additional purchases (ie, special footwear) may be acceptable to the paid provider (simply part of the required uniform) but create a barrier for the volunteer due to cost or inconvenience, ultimately reducing their ability (or willingness) to volunteer.

Limitations of this study include recall and nonresponse bias. With such a high frequency of injury, it is possible that all providers did not recall injury events during the preceding 12 months. However, the similarity of our findings to those of other studies indicates that any recall bias is likely to be limited. Potential nonresponse bias was evaluated by comparing known characteristics of nonrespondents (responder level and region), the respondent group, and the NREMT as a whole. Significant differences were found between the groups. It is important to note, however, that though results of this study should be generalized with caution to any larger group, this study contributes significantly to the limited body of literature on occupational injury in EMS because of its broad scope of injury types and mechanisms, nationwide sample and examination of injuries from the perspective of paid versus volunteer providers, a variable not examined in previous studies.

This study provides evidence to aid in future research on occupational injury among EMS providers. Although injuries were less prevalent in volunteer than paid providers, the occupational risks are likely to be similar. Although prevention approaches may work equally well for paid and volunteer providers, each service must prioritize which types of injury prevention programs would be most beneficial. The establishment of better surveillance systems to track characteristics and trends in the EMS workforce and their injuries during time would be an important contribution to assist in making these decisions. Translational research that adapts programs from other health care or field settings is needed to address MVC prevention; slips, trips, and falls; workplace violence reduction; and lifting safety. Although the data that is currently available is still limited by time, numbers, and methodological issues, it is imperative that occupational injury research into evidence-based prevention programs begin before more providers are injured and lost from this valuable workforce.

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