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Injuries among solid waste collectors in the private versus public sectors

Terry L. Bunn^{1,4}, Svetla Slavova^{2,4} and Minao Tang^{3,4}

Abstract

Solid waste collection is among the occupations with the highest risk for injuries and illnesses. Solid waste collector injuries were characterized in terms of injury risk and employment industry sector (public versus private) using Kentucky workers' compensation first reports of injury and claims data. When compared to 35–44-year-old workers, solid waste collectors who were under 35 years of age were less likely to have a workers' compensation first report of injury or claim that resulted in awarded benefits. The probability that a workers' compensation first report of injury or claim would result in an awarded benefit was higher if the worker was employed as a solid waste collector in the private sector compared to the public sector, or was injured due to a motor vehicle-related injury or a push-or-pull type of injury. A better understanding of the differences in the contributing factors for an injury that results in a first report of injury or claim with awarded benefits (e.g. job activities, new and refresher worker safety training, type of equipment used, differences in collection vehicle automation, and differential reporting of injuries on the job) between the public and private sectors is necessary to target injury prevention strategies in this high-risk occupation.

Keywords

Solid waste, injuries, public sector, private sector, age

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Introduction

In 2001, it was estimated that the solid waste industry in the United States included some 27 000 organizations (public and private sector) and employed approximately 368 000 people (Beck, 2001). The authors observed that while the solid waste industry only accounted for 0.5% of the US gross domestic product, industry output and employment were larger than the economies of North Dakota, Vermont, and Wyoming.

Solid waste collection is among the occupations with the highest risk for injuries and illnesses. Solid waste worker injuries and illnesses have been documented for a number of scenarios, injury types, and injury severities (Cimino, 1975; Dorevitch and Marder, 2001; Gellin, 1985; Ivens et al., 1998); one study predicted a musculoskeletal and dermal injury rate of 80 injuries per 100 workers (Englehardt et al., 2003). Biological and chemical exposures resulting in occupational illnesses have also been recorded in the solid waste worker population (Gelberg, 1997; Poulsen et al., 1995). Since the collection of solid waste continues to be performed with a variety of manual tasks, both injuries and illnesses continue to be of concern to employees and employers.

In a study on the size of the solid waste industry in the US, 53% of the solid waste facilities were owned by the

private sector (Beck, 2001). No estimates were included on solid waste collector injuries in the public and private sectors. To the authors' knowledge, there is no known published research on the characterization of solid waste collector injuries in terms of injury risk and industry sector (public versus private). The objectives of this study were to: (1) identify and characterize solid waste collector injuries in the private and public sectors; (2) determine whether there is a difference in the awarded benefits associated with first reports of injury and claims between the public sector and private sector; and (3) to determine if there is a sector-associated difference in

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workers' first reports of injury and claims based on age, type of injury, nature of injury, and body part injured.

Materials and methods

Study population

This study utilized Kentucky workers' compensation first reports of injury and workers' compensation claims for the years 1999–2008 which were obtained from the Kentucky Department of Workers' Claims. The data set provided was stripped of personal identifiers in order to protect worker confidentiality. Kentucky Workers' Compensation is established through the Workers' Compensation Act, Kentucky Revised Statute (KRS) Chapter 342. Kentucky employers are required to have workers' compensation insurance, be a member of a self-insured group or be qualified as self insured. Self-employed workers are not required to have compensation insurance so long as they have no employees. Agricultural employers are exempt from coverage (Guidebook to Workers' Compensation, 2005).

The general attributes of Kentucky workers' compensation first reports of injury and claims include the following items.:

1. All worker injuries that require at least one day off from work or result in a disability that extends beyond 60 days are required to be reported.
2. When a worker has lost at least 7 days of work due to an injury or has a permanent partial disability with no missed work days due to an injury, the worker is eligible for indemnity and/or lump sum payments. Indemnity payments associated with a first report of injury or claim were defined as paid income benefits to compensate for lost wages, functional impairment or death.
3. When a worker has lost at least 2 weeks of work due to an injury, the worker is eligible for lost wage compensation retroactive to the first day of work lost.

Inclusion criteria for workers' compensation first reports of injury and claims were: (1) all accepted cases – 'open' and 'closed' first reports of injury and claims (<1% of all first reports of injury and claims were not closed); (2) claimants of all ages and those with age unknown; (3) out-of-state residents who were injured in Kentucky; and (4) 'lost-time' first report of injury and claims. Industry codes were classified using Standard Industrial Classification (SIC) codes and occupations were coded using the Standard Occupational Classification (SOC) system. This project was approved by the Institutional Review Board of the University of Kentucky.

Study design

Selection of solid waste collectors' workers' compensation first reports of injury and claims was based on a number of different selection criteria.

1. Industry code for refuse system collection [Standard Industry Code ([SIC code] 4953)].
2. Occupation code for garbage collectors [Standard Occupational Classification Code (SOC code 53-7080), or truck drivers (SOC code 53-3032)].
3. Key word search for 'tipper'.

Once cases were selected using the criteria above, cases that were not solid waste collector-related were deleted. Water and sewage treatment, and recycling facility workers were not included in the study. All cases were then manually verified for inclusion in the final dataset.

To determine the actual number of solid waste collection drivers in the public and private sectors, the following method was used: the 'occupation' field was searched for 'truck drivers' and a keyword search for the word 'driver' was performed within the narrative text field. Each narrative was read to exclude those records where a driver was described but the driver was not the employee who was injured, and to exclude those records that were not related to solid waste collection. The final dataset contained 2113 records: 1077 for the private sector and 1036 for the public sector.

Statistical analyses

A logistic regression model was used to estimate the probability that a workers' compensation first report of injury or claim would result in an awarded benefit. A workers' compensation first report of injury or claim with an awarded benefit was defined as one with a monetary amount awarded. A first report of injury or claim with no monetary amount awarded was considered a non-awarded first report of injury or claim. Multiple factors were considered as potentially related to the outcome: industry sector, age, length of time on the job, gender, season, region, nature of injury, body part injured, and cause of injury. Due to a high percentage (about 60%) of missing values, the variable 'length of time on the job' was excluded from further analysis.

A chi-squared test was used to assess the association between the outcome and the potential risk factors. The variables that were suggestive for association were included in a multiple logistic regression model to test the hypothesis that there is a differential probability in awarded benefits between the private and public sector workers' compensation first reports of injury and claims. The statistical significance of possible effect modifiers was evaluated by including their two-way interactions with the industry sector in the multiple logistic regression model. The cause of injury was considered a possible confounder and was included in the logistic regression after grouping the causes into the following categories: motor vehicle-related, fall/slip, lifting/handling, strain, struck by/falling or flying object, and all other injury causes. The statistical analysis was performed using SAS[®] 9.2 software.

A forward selection method was used to build the logistic regression model. The model fit was evaluated using a Hosmer and Lemeshow goodness-of-fit test, the percent of concordant pairs and the max-restricted *R*-square.

Results

Almost all of the injured solid waste collectors were male in both the public and private sectors (Table 1). When age was examined, the solid waste collector age group with the highest frequency of injuries was the 25–34-year-old group in the private sector, and the 35–44-year-old group in the public sector. The public and private sectors recorded equivalent proportions of injured solid waste collection workers who were older than 55 years of age and younger than 25 years of age. The mean age of injured solid waste collectors in the private sector was 36 years \pm 10 years and was 38 years \pm 10 years in the public sector. The length of time on the job before the injury occurred was only recorded for approximately 35–40% of the workers. A greater proportion

of workers in the private sector were employed for less than 1 year on the job when they were injured compared to the public sector.

Alternative applications of SOC codes were used to identify solid waste collectors in the public and private sectors. Within the private sector, the garbage collector and truck driver occupations were recorded for approximately equivalent percentages (46% coded as garbage collectors and 44% coded as truck drivers) of the solid waste collectors who were injured. This is in contrast to the public sector where almost all of the injured solid waste collectors were coded as garbage collectors (96%) and only a few were coded as truck drivers (4%). A keyword search was performed on the dataset (data not shown) to capture solid waste truck drivers. Within the public sector, there were at least 51 injured solid waste collection drivers within the dataset: 37 drivers were coded as a ‘truck driver’ in the occupation field and 14 were coded as a ‘garbage collector’ within the occupation field but were described as the driver in the narrative text field. Within the private sector, there were at least 490 solid waste

Table 1. Injuries among Kentucky solid waste collectors by demographic characteristics, 1999–2008

Demographic characteristics	Private sector number (%)	Public sector number (%)	<i>p</i> -value
Gender	<i>n</i> = 1076	<i>n</i> = 1036	<i>p</i> = 0.0109
Male	1059 (98%)	1002 (97%)	
Female	17 (2%)	34 (3%)	
Age (years)	<i>n</i> = 1077	<i>n</i> = 1036	<i>p</i> < 0.0001
≤ 24	132 (12%)	100 (10%)	
25–34	367 (34%)	276 (27%)	
35–44	349 (32%)	377 (36%)	
45–54	166 (15%)	207 (20%)	
55+	63 (6%)	76 (7%)	
Length of time on job ^a	<i>n</i> = 1077	<i>n</i> = 1036	
< 1 year	198 (18%)	108 (10%)	
≥ 1 year	198 (18%)	317 (31%)	
Missing values	681 (63%)	611 (59%)	
Occupation ^b	<i>n</i> = 1077	<i>n</i> = 1036	
Garbage collector	500 (46%)	999 (96%)	
Truck drivers, heavy and light	472 (44%)	37 (4%)	
Laborers except construction	81 (8%)	0	
Supervisors	11 (1%)	0	
All other	13 (1%)	0	
Industry ^c	<i>n</i> = 1077	<i>n</i> = 1036	
Refuse systems	1008 (94%)	0	
Executive offices	0	986 (95%)	
Local trucking without storage	38 (4%)	1 (< 1%)	
Executive and legislative combined	0	29 (3%)	
Air and water resource and solid waste management	0	16 (2%)	
Help supply service	13 (1%)	0	
Other	18 (2%)	4 (< 1%)	

^aA chi-squared analysis was not performed due to the high number of missing values.

^bA chi-squared analysis was not performed due to coding inconsistencies and empty cells.

^cA chi-squared analysis was not performed due to empty cells.

collection drivers with 471 coded as a 'truck driver' within the occupation field. By using a keyword search for 'driver' in the narrative field and by reading each narrative, 16 additional cases were identified as truck drivers but had been coded as a 'garbage collector', and three truck drivers had been coded as 'laborers except construction'. According to the Standard Occupational Classification Manual, 2000, the use of either 'truck driver' or 'garbage collector' is correct to describe the driver according to the SOC definitions for these categories.

The majority of the identified solid waste collector injuries in the private sector had been coded within the refuse system collection industry (SIC 4953) (94%) with a few in the local trucking without storage industry (SIC 4212) (4%). Within the public sector, the majority of the injured solid waste worker cases had been coded within the executive offices industry (SIC 9111) (95%), with a few coded within the executive and legislative combined industry (SIC 9131) (3%) and the air, and water resource, and solid waste management industry (SIC 9511) (2%). The executive offices industry 9111 is defined as offices of chief executives and their

advisory and interdepartmental committees and commissions. Since there is no specific SIC code for refuse system collection available within the public sector, the identified solid waste worker injury cases had been coded primarily within SIC 9111.

Strains were the most common type of injuries among solid waste collectors in both the public and private sectors (Table 2), although solid waste collectors in the public sector recorded a larger percentage of strains than solid waste collectors in the private sector (64% in the public sector versus 48% in the private sector). Fractures were more common in the private sector (12%) compared to the public sector (4%). Solid waste collectors in the private sector also experienced a higher percentage of multiple physical injuries, dislocations, and hernias than those in the public sector. In contrast, public sector solid waste collectors suffered a higher percentage of strains, contusions, and sprains than those in the private sector.

Lifting was the most frequent cause of injury among solid waste collectors in both the private and public sectors (28% in the private sector versus 37% in the public sector). Motor

Table 2. Injuries among Kentucky solid waste collectors by injury type, 1999–2008

Injury characteristics	Private sector number (%)	Public sector number (%)	<i>p</i> -value
Nature of injury	<i>n</i> = 1077	<i>n</i> = 1036	<i>p</i> < 0.0001
Sprain/strain	514 (48%)	663 (64%)	
Other	221 (21%)	109 (11%)	
Contusion	130 (12%)	150 (15%)	
Fracture/dislocation	134 (12%)	37 (4%)	
Laceration/puncture	78 (7%)	77 (7%)	
Cause of injury	<i>n</i> = 1077	<i>n</i> = 1036	<i>p</i> < 0.0001
All other	298 (28%)	248 (24%)	
Fall/slip	179 (17%)	154 (15%)	
Lifting/handling	297 (28%)	379 (37%)	
Motor vehicle-related	158 (15%)	53 (5%)	
Strain	68 (6%)	79 (8%)	
Struck by falling or flying object	50 (5%)	55 (5%)	
Push/pull	27 (3%)	68 (7%)	
Body part injured	<i>n</i> = 1077	<i>n</i> = 1036	<i>p</i> = 0.1704
Arme/elbow/shoulder/hand/wrist/finger	264 (26%)	269 (28%)	
Back	251 (25%)	244 (25%)	
Multiple body parts	181 (18%)	134 (14%)	
Ankle/foot/toe	115 (11%)	114 (12%)	
Knee/lower leg	116 (11%)	107 (10%)	
Other	150 (14%)	168 (16%)	
Length of time off after injury ^a	<i>n</i> = 1077	<i>n</i> = 1036	
< 7 days	192 (18%)	267 (26%)	
≥ 7 days and < 14 days	83 (8%)	92 (9%)	
≥ 14 days and < 30 days	58 (5%)	27 (3%)	
> 30 days	86 (8%)	28 (3%)	
Missing values	658 (61%)	622 (60%)	

^aA chi-squared analysis was not performed due to the high number of missing values.

vehicle-related injuries were more frequently reported in the private sector (15%) compared to the public sector (5%); push-or-pull injuries were more frequently reported in the public sector than in the private sector (7% in the public sector versus 3% in the private sector). The body part most frequently injured was the low back area for solid waste collectors in both the private and public sectors.

Solid waste collection workers in the public sector were off less than 7 days for their injury at work (26%) more frequently than those in the private sector (18%). Private sector-employed solid waste collectors were off for 30 days or greater more often than solid waste collectors in the public sector. Similar to the length of time on the job before the injury occurred, there was a high percentage of missing values for length of time off in both the public and private sectors (61% in the private sector vs. 60% in the public sector).

A higher percentage of injured public sector-employed solid waste collectors were not awarded any workers' compensation benefits (87%) in comparison with 79% in the private sector (Table 3). Percentages of lump sum agreements, agreements approved by the administrative law judge, and one-time payments were higher for injured solid waste collectors in the private sector compared to the public sector. Agreement totals were calculated by multiplying the agreement amount by the length of the agreement (these could also be one-time payments and, if so, the single sum was the total agreement amount). Agreements may include medicals, vocational rehabilitation, etc. Median lump sum benefits and

indemnity benefits (award amount multiplied by length of award) were not significantly different between the injured private sector solid waste collectors and the public sector solid waste collectors.

A significantly higher proportion of workers' compensation first reports of injury and claims (19%) were compensated (proportion of compensated claims among all claims) in the private industry sector compared with the public sector (11%) as highlighted in Table 4. When examining awarded benefit status by age, the proportion of awarded benefit first reports of injury and claims increased significantly by age group from 8% in the 24-and-under age group to 24% in the 55-and-older age group. The Cochran–Armitage test for a linear trend in proportions was significant ($p < 0.0001$), indicating that there was a significant linear increase in the proportion of workers' compensation first reports of injury and claims with awarded benefits by age group. When examining injury cause, the highest percentage of workers' compensation claims with awarded benefits was greatest for those who had suffered a motor vehicle-related injury on the job; there was a significant association between the measured outcome and the cause of injury. There was no significant difference in the percentage of workers' first reports of injury and claims with awarded benefits between genders, by season of injury, or by worker residence region.

The percentage of workers' compensation first reports of injury and claims that resulted in awarded benefits was compared between the public and private industry sectors for each age group and is shown in Figure 1. A Mantel–Haenszel

Table 3. Injuries among Kentucky solid waste collectors by first report of injury and claim disposition and awards, 1999–2008

First report of injury and claim disposition and awards	Private sector		Public sector		<i>p</i> -value ^a
Disposition	Number (%)		Number (%)		$p < 0.0001^*$
None	850 (79%)		906 (87%)		
Lump sum agreement on first report	99 (9%)		60 (6%)		
Agreement approved by administrative law judge	81 (8%)		32 (3%)		
Award (by administrative law judge)	20 (2%)		6 (< 1%)		
Other	27 (3%)		32 (3%)		
Award period	Number (%)		Number (%)		$p < 0.0001^*$
Null	871 (81%)		893 (86%)		
One time payment	181 (17%)		100 (10%)		
Monthly/weekly	4 (< 1%)		13 (1%)		
Missing values	21 (2%)		30 (3%)		
Characteristics of award or agreement	Private sector		Public sector		<i>p</i> -value ^b
	Number	Median	Number	Median	
Lump sum benefits	181	\$11 000	95	\$9465	$p = .06$
Indemnity benefits	29	\$20 035	25	\$41 212	$p = 0.42$
Impairment (percentage) benefits	206	0%	113	3%	$p = 0.02^*$
Disability (percentage) benefits	206	4%	113	5%	$p = 0.60$
Total benefits	206	\$12 498	110	\$10 042	$p = 0.64$

^aChi-square test.

^bTwo-sample test for medians.

*Significant at $p < 0.05$.

Table 4. Factors for Kentucky solid waste collector injuries by workers' compensation first reports of injury and claims awarded benefit status

Factor	Not awarded benefits	Awarded benefits	<i>p</i> -value
Gender	Number (%)	Number (%)	0.7950
Male	1751 (85%)	310 (15%)	
Female	44 (86%)	7 (14%)	
Age	Number (%)	Number (%)	<i>p</i> < 0.0001
≤ 24 years of age	214 (92%)	18 (8%)	
25–34 years of age	561 (87%)	82 (13%)	
35–44 years of age	610 (84%)	116 (16%)	
45–54 years of age	305 (82%)	68 (18%)	
55+ years of age	106 (76%)	33 (24%)	
Season of injury	Number (%)	Number (%)	<i>p</i> = 0.3556
Spring	454 (85%)	82 (15%)	
Summer	505 (87%)	78 (13%)	
Fall	404 (83%)	84 (17%)	
Winter	433 (86%)	73 (14%)	
Worker residence region	Number (%)	Number (%)	<i>p</i> = 0.7107
Appalachia	447 (85%)	82 (15%)	
Non-Appalachia	1349 (85%)	235 (15%)	
Industry sector	Number (%)	Number (%)	<i>p</i> < 0.0001
Private	871 (81%)	206 (19%)	
Public	925 (89%)	111 (11%)	
Cause of injury	Number (%)	Number (%)	<i>p</i> < 0.0001
All other	476 (87%)	70 (13%)	
Lifting/handling	586 (87%)	90 (13%)	
Fall/slip	282 (85%)	51 (15%)	
Lifting	564 (86%)	89 (14%)	
Motor vehicle-related	156 (74%)	55 (26%)	
Strain	126 (86%)	21 (14%)	
Struck/falling object	95 (91%)	10 (10%)	
Push/pull	75 (79%)	20 (21%)	
Nature of injury	Number (%)	Number (%)	<i>p</i> < 0.0001
Sprain/strain	1028 (87%)	149 (13%)	
Contusion	251 (90%)	29 (10%)	
Fracture/dislocation	110 (64%)	61 (36%)	
Laceration/puncture	143 (92%)	12 (8%)	
Other	264 (80%)	66 (20%)	
Body part injured	Number (%)	Number (%)	<i>p</i> < 0.0001
Arm/elbow/shoulder/hand/wrist/finger	432 (81%)	101 (19%)	
Back	409 (83%)	86 (17%)	
Multiple body parts	261 (83%)	54 (17%)	
Ankle/foot/toe	219 (96%)	10 (4%)	
Knee/lower leg	180 (81%)	43 (19%)	
Other	295 (93%)	23 (7%)	

test was used to detect the pattern of association between the outcome and sector variable across the different age strata. Looking at the 2 × 2 tables (industry sector × outcome for each age stratum), the chi-squared statistic was significant for the 25–34, 35–44, and 45–54 age groups, borderline significant for the 24 and under age group (*p* = 0.06), and not significant for the 55-and-older age group (*p* = 0.22).

The Cochran–Mantel–Haenszel statistic was significant ($Q_{MH} = 34.84$ with 1 df) indicating a strong association between outcome and industry sector, adjusting for age. The private industry sector had significantly more first reports of injury and claims with awarded benefits than the public industry sector with a consistent pattern of association. The estimated common odds ratio was 2.12 and

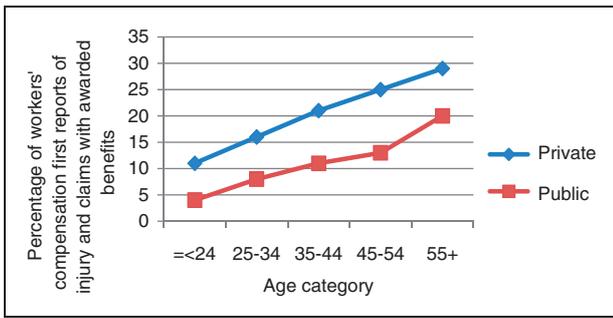


Figure 1. Solid waste collector injuries by age and percentage of workers' compensation first reports of injury and claims with awarded benefits.

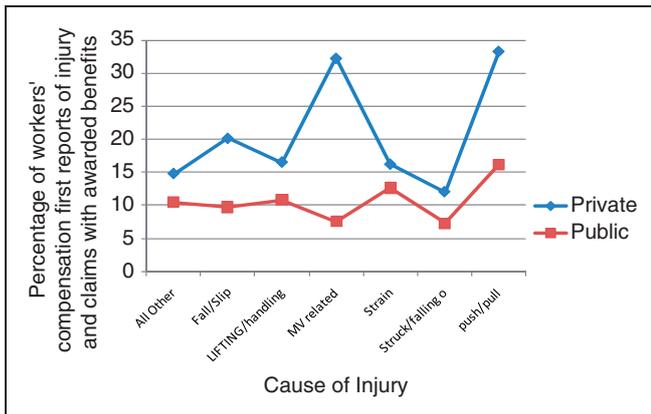


Figure 2. Solid waste collector injuries by cause of injury and percentage of workers' injury and claims with awarded benefits.

Breslow–Day test did not reject the hypothesis for homogeneous odds ratios across the age strata.

The percentage of workers' compensation first reports of injury and claims with awarded benefits was higher for motor vehicle-related injuries in the private sector (32%) compared to the public sector (8%) as identified in Figure 2. Push-or-pull injuries were also more frequently reported in the private sector (33% first reports of injuries and claims with awarded benefits in the private sector vs. 16% in the public sector).

A logistic regression model was constructed to predict the probability that a Kentucky solid waste collector workers' first report of injury or claim would result in awarded benefits as highlighted in Table 5. The type of industry sector, age group, nature of injury, body part injured, and cause of injury, along with their two-way interactions were included in the forward selection method to identify the significant terms. The two-way interactions were not significant and were dropped from the final model. The probability that a workers' compensation first report of injury or claim would result in awarded benefits was higher if the worker was employed as a solid waste collector in the private sector compared to a solid waste collector in the public sector after adjusting for age, cause of injury, nature of injury, and

body part injured. When compared with workers who were 35–44 years of age, solid waste collectors who were less than 35 years of age were less likely to have a workers' compensation claim that resulted in awarded benefits. After accounting for age, industry sector, body part injured, and the nature of injury, motor vehicle-related injuries [odds ratio (OR)=2.242; confidence interval (CI), 1.434, 3.506] and push/pull type injuries (OR=2.021; CI, 1.097, 3.721) increased the odds that a workers' compensation first report of injury or claim would result in awarded benefits compared to 'all other' injuries. Fractures and dislocation injuries increased the odds that the workers' compensation first report of injury or claim would result in awarded benefits compared to 'all other' nature of injuries; contusions, laceration or puncture types of injuries, and sprains or strains decreased the odds. The Hosmer and Lemeshow goodness-of-fit test indicated an acceptable fit ($p=0.1971$). The model correctly classified 72% of the cases suggesting that there were factors that could not be accounted for.

Discussion

Although a number of studies have been performed regarding injuries within the solid waste industry, to our knowledge, this is the first study that compared solid waste collector injuries in the private and public sectors. One known study performed on Florida municipal solid waste collectors reported injury numbers and ratios of Occupational Safety and Health Administration (OSHA) 200 injuries to workers' compensation cases for one public and one private solid waste collection agency (Englehardt et al., 2003). Thirty-seven percent of the solid waste collector OSHA 200-recorded injuries became workers' compensation cases (injuries resulting in greater than 7 days off) in the public industry compared to 9% in the private industry. An analytic predictive Bayesian assessment of total injury rates for musculoskeletal and dermal injuries was performed on the cohort but only solid waste worker employment numbers in the private industry were included in the calculation; public sector solid waste worker employment numbers were not included in the calculation.

The advantage of using the Kentucky workers' compensation system for this present study was that both first reports of injury and claims were used for the study; workers' compensation cases contained all worker injuries that required only one day off from work to be reported, not seven, such as in Florida. Therefore, workers' compensation cases using the Kentucky data set could be more representative of all reportable solid waste collector injuries within the private and public sectors when compared with workers' compensation data sets in other states which may require more than one day off from work due to an injury before it can be reported.

Injury rates could not be calculated for this study since the number of workers employed in the solid waste collector

Table 5. Multiple logistic regression predicting the probability that a Kentucky solid waste collector workers' compensation first report of injury or claim will result in awarded benefits

Variable	Odds ratio	95% confidence interval
Type of industry sector		
Private vs. public	1.660	1.262–2.183 ^a
Age		
Ages ≤ 24 vs. 35–44 years	0.427	0.249–0.734 ^a
Ages 25–34 vs. 35–44 years	0.695	0.504–0.959 ^a
Ages 45–54 vs. 35–44 years	1.078	0.759–1.531 ^a
Ages 55+ vs. 35–44 years	1.412	0.885–2.253
Nature of injury		
Contusion vs. all other	0.416	0.250–0.693 ^a
Fracture/dislocation vs. all other	1.923	1.210–3.058 ^a
Laceration/puncture vs. all other	0.330	0.168–0.650 ^a
Sprain/strain vs. all other	0.519	0.351–0.768 ^a
Body part injured		
Ankle/foot/toe vs. all other	0.576	0.258–1.289
Arm/elbow/shoulder/hand/wrist/finger vs. all other	3.556	2.156–5.865 ^a
Back vs. all other	3.328	1.963–5.641 ^a
Knee/lower leg vs. all other	3.672	2.055–6.564 ^a
Multiple body parts vs. all other	2.330	1.352–4.017 ^a
Cause of injury		
Fall/slip-related vs. all other	1.302	0.849–1.998
Lifting/handling vs. all other	1.148	0.782–1.686
Motor vehicle-related vs. all other	2.242	1.434–3.506 ^a
Strain vs. all other	1.769	0.989–3.166
Struck/falling vs. all other	0.939	0.440–2.005
Push/pull vs. all other	2.021	1.097–3.721 ^a

^aSignificant at $p < 0.05$.

occupation could not be determined for either the public or the private sectors. A single occupation or industry could not be used to determine injury rates. In order to capture solid waste collector cases, a combination of SIC industry codes, SOC occupation codes, and a narrative keyword search was performed on the dataset. It was felt that we were fully able to identify solid waste collector cases using this method to capture cases but could not determine injury rates since solid waste collectors encompass more than one industry and occupation category, and accurate employment numbers could not be calculated for the public and private sector denominators.

The types of injuries filed with workers' compensation by solid waste collectors (sprains and contusions) in Kentucky are consistent with other studies (An, 1999; Cimino, 1975; Dorevitch and Marder, 2001; Gelberg, 1997; Gellin, 1985). Dorevitch and Marder (2001) determined that sprains and strains (44.5%) and abrasions, cuts, and contusions (31%) comprised the majority of injuries when analysing workers' claims from Cincinnati and San Francisco. In a study of Danish waste collectors in one company, twisting and soft part injuries were the most common injuries reported (Ivens et al., 1998). Due to the historical manual labour and

emerging automation involved in solid waste collection today, the types of injuries observed in this study were not surprising.

Fractures and motor vehicle-related injuries were more common among solid waste collectors in the private sector than in the public sector, and increased the odds that a workers' compensation first report of injury or claim would result in awarded benefits. In contrast, strains and sprains, and lifting or handling and push-or-pull injuries were more frequently reported among solid waste collectors in the public sector. Based on these results, there exists the possibility that there may be differences in the numbers and types of solid waste vehicles used for solid waste collection. There is a possibility that more manual labour and less automated solid waste collection occurred in the public sector during the time period analysed that resulted in a higher proportion of musculoskeletal disorders when compared with the private sector. On the other hand, the lower proportion of musculoskeletal disorders and a higher proportion of motor vehicle-related injuries reported in the private sector might indicate that solid waste collectors in the private sector were utilizing more automated solid waste collection vehicles compared to the public sector during the study period.

Younger solid waste collectors had lower odds of having workers' compensation first reports of injury or claims that resulted in awarded benefits compared to 35–44-year-old solid waste collectors. There could be many reasons for this. First, the lower proportion of compensated injuries among younger solid waste collectors could be related to employment rates and not numbers; employment rates could not be calculated due to the lack of numerator and denominator data since more than one occupational or industry code is needed to capture all solid waste collector cases. Second, younger workers may perform different job activities than older solid waste collectors. Finally, younger solid waste collectors might be less likely to report a work-related injury compared to older solid waste collectors; if these injuries were reported, the difference in compensation probability between younger and older workers might be increased.

This study has identified solid waste collectors within the private industry sector as a worker population with a higher probability to have a workers' compensation first report of injury or claim that resulted in awarded benefits; however, there are some limitations to this study. It is possible that a few cases were either unidentified or misclassified, and not included in the final data set. In addition, solid waste workers who suffered an injury on the job could have been compensated by another type of insurance such as personal medical insurance or a spouse's medical insurance, and would not have been included in the workers' compensation dataset.

Differential claims management may also exist between the public and private sectors. In a study by Englehardt et al. (2003), the authors reported that for one public and one private collection agency in Florida, there was a difference in the percentage of OSHA/SAF 200 reportable injuries that became workers' compensation cases. The average percentage of reportable injuries that became workers' compensation cases was 9.35% for the private agency and 37.1% for the public agency. The results of the above study were only for one public agency and one private agency, so their results may not be generalizable to the entire public and private solid waste sectors. Disparities, due to minority, ethnic status or gender status, could also exist regarding whether the first reports of injury or claims were accepted or compensated. Differential injury incidence rates, injury reporting differences, and workers' compensation differences could also have existed between the private and public sector solid waste industries (Azaroff et al., 2002).

Other limitations of the study are that age, work experience, and/or the type of injury could have affected the calculation of workers' compensation benefits. According to the Kentucky Commissioner of the Department of Workers' Claims, age could be a factor for older workers, but only if there was proof that the older worker lacked the physical capacity to return to the prior type of job activity, and,

therefore, could have been awarded a higher workers' compensation benefit. Work experience does not play a role in the calculation of Kentucky workers' compensation benefits for an injury on the job. The type of injury is a factor in the calculation of workers' compensation benefits only when the injury results in a percentage of impairment (AMA Guides to the Evaluation of Permanent Impairment, 5th Edition, 2001). Some states have a schedule of benefits according to the type of injury suffered on the job but Kentucky has not followed a schedule of benefits since 1980.

Conclusions

The findings from this study suggest that solid waste collectors in the private sector are more likely to have injuries that resulted in a workers' compensation first report of injury or claim with awarded benefits when compared with those in the public sector. Older solid waste collectors were also more likely to have workers' compensation first reports of injury and claims with awarded benefits. A better understanding of the differences in the contributing factors for an injury that results in a first report of injury or claim with awarded benefits (e.g. job activities, new and refresher worker safety training, type of equipment used, differences in collection vehicle automation, and differential reporting of injuries on the job) between the public and private sectors is necessary to target injury prevention strategies in this high-risk occupation. Enhanced worker safety training related to lifting is recommended.

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