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Injuries among electric power industry workers, 1995–2013

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ABSTRACT

Introduction: Workers in the electric power industry face many risks of injury due to the high diversity of work tasks performed in potentially hazardous and unpredictable work environments. *Method:* We calculated injury rates by age, sex, occupational group, and injury type among workers in the Electric Power Research Institute's (EPRI) Occupational Health and Safety Database (OHSD), which contains recordable injury, medical claims, and personnel data from 18 participating electric power companies from 1995 to 2013. *Results:* The OHSD includes a total of 63,193 injuries over 1,977,436 employee-years of follow-up, for an overall injury rate of 3.20 injuries per 100 employee-years. Annual injury rates steadily decreased from 1995 to 2000, increased sharply in 2001, and subsequently decreased to their lowest rate of 1.31 injuries per 100 employee-years in 2013. Occupations with the highest injury rates were welders (13.56 per 100 employee-years, 95% CI 12.74–14.37), meter readers (12.04 per 100 employee-years, 95% CI 11.77–12.31), and line workers (10.37 per 100 employee-years, 95% CI 10.19–10.56). Males had an overall higher injury rate compared to females (2.74 vs. 1.61 per 100 employee-years) although some occupations, such as meter reader, had higher injury rates for females. For all workers, injury rates were highest for those in the 21 to 30 age group (3.70 per 100 employee-years) and decreased with age. Welders and machinists did not follow this trend and had higher injury rates in the 65+ age group. There were 63 fatalities over the 1995 to 2013 period, with 21 fatalities (33.3%) occurring among line workers. *Conclusions:* Although injury rates have decreased over time, certain high-risk groups remain (i.e., line workers, mechanics, young males, older welders and machinists, and female meter readers). *Practical applications:* Protective measures and targeted safety programs may be warranted to ensure the safety of electric power workers.

1. Introduction

Workplace injuries and illnesses in the United States have declined over the past decade, but limited data on injury trends within the electric power industry are available. Although the U.S. Bureau of Labor Statistics (BLS) provides injury estimates for the utilities sectors, reporting an overall injury rate of 1.8 cases per 100 employee-years for 2013, this estimate is averaged over several diverse sub-industries including electric power generation, transmission and distribution, natural gas distribution, and water sewage systems, which are likely to have differing occupational hazards and associated risks (U.S. Bureau of Labor Statistics, 2013). Further, little is known about specific risk factors and vulnerable sub-populations that may have particularly high injury rates within the electric power industry.

The current analysis uses data gathered by the Electric Power Research Institute (EPRI) Occupational Health and Safety Database (OHSD) and is intended to update and expand upon an earlier publication characterizing injuries in the electric power industry (Kelsh et al., 2004). The OHSD program has been described previously (EPRI, 2012, 2015; Kelsh et al., 2004; Yager, Kelsh, Zhao, & Mrad, 2001). Briefly, the OHSD was created in 1999 to provide more detailed information about the occurrence of workplace injury among workers in the electric power industry (EPRI, 2001, 2004; Kelsh et al., 2004; Yager et al., 2001). Its main objectives are to: (a) monitor trends of injury and illness over time, across job characteristics, and worker demographics; (b) identify high-risk occupations and work environments; (c) quantify costs and lost time caused by work-related injuries and illnesses; (d) identify and prioritize injury/illness issues that merit focused research efforts; and (e) evaluate the effectiveness of prevention programs.

Workers in the electric power industry face many potential risks of injury, including injuries from hazardous and unpredictable work environments, physically demanding maintenance and repair activities,

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working long shifts, working in emergency situations, and driving. The initial report using EPRI OHSD data was based on 528,133 employee-years and 11,166 injuries over the 1995 to 2002 period and identified welders, meter readers, and line workers at highest risk of injury (Kelsh et al., 2004). Subsequent publications using OHSD data characterized risks, risk factors, and costs associated with thermal burns and neck injuries and factors distinguishing severity of sprain and strain injuries among electric utility workers (Fordyce, Kelsh, Lu, Sahl, & Yager, 2007; Fordyce, Morimoto, Coalson, Kelsh, & Mezei, 2010; Kelsh et al., 2009).

The goals of the current analyses were to characterize injury and illness rates using the current OHSD data, which includes a total of 1,977,436 employee-years and 63,193 recordable injuries over the 1995 to 2013 time-period. We examined injury rates over time and by age, sex, and occupation, to determine risk factors for injury and identify vulnerable sub-populations with high injury rates.

2. Methods

Definitions, classification methodology, and data standardization methodology used in the OHSD have been previously described in detail (EPRI, 2012, 2015; Kelsh et al., 2004; Yager et al., 2001). In brief, the OHSD currently includes data from 18 companies, comprising a total of 1,977,436 employee-years of follow up and 63,193 reportable individual injuries. Participation in the EPRI OHSD program is voluntary. Both small and large companies are present in the database with the five largest companies comprising over 60% of all workers. Three categories of data, including personnel files, reportable injury files, and medical claim files were requested from each participating electric power company and compiled to generate the EPRI OHSD data set. Employee date of birth, sex, hire date, job code, job title, and work location or business unit were abstracted from company personnel files for each of the study years 1995 to 2013 and each employee was assigned a unique identifier. Occupation and work location were defined by the employee's record status on January 1 of any particular year and entered into the database.

Basic work history and demographic data for all company employees and not just injured employees were used to calculate injury rates. In addition to personnel data, injury event information (location, accident description, injury mechanism), data about the injury itself (body region, nature of injury), and claims information (work days lost, medical costs) were requested and incorporated into the database. Location refers to a worker's primarily work location and may or may not represent where an injury took place. A standardized coding system for injury mechanism was developed using a combination of injury source codes (e.g., vehicle collision, fall, "struck by") and data contained in accident descriptions. The mechanism of injury classification characterizes the event leading to the worker's injury and usually represents the immediate or preceding cause based on temporality; however, the mechanism of injury may or may not represent the underlying or preventable cause. Data for nature of injury and body region injured were coded and classified into a standard common format based primarily on Bureau of Labor Statistics guidelines (EPRI, 2001). The OHSD contains 26 categories for nature of injury (e.g., sprains and strains, fractures and dislocations, heat and thermal burns) and 15 categories for body region injured (e.g., back and trunk, hand and finger). From over 35,000 unique reported job titles, we created 22 specific job categories using an occupational classification system previously developed for electric power industry workers (Kelsh, Kheifets, & Smith, 2000). Unclassifiable primary work location codes and missing nature of injury and injured body region information were updated based on a thorough review of the narrative accident description when the relevant information was provided.

All reported lost time and "recordable" injury/illness claims have been included in the injury analyses. The Occupational Safety and Health Administration (OSHA) definition of a "lost time injury or illness" requires that a worker miss one full day of work (or shift) after the injury date. An OSHA recordable injury involves medical attention "beyond first aid" or loss of consciousness or results in days away from work, restricted work activity, or job transfer. Because some utilities could not provide reports on less severe, first-aid-only, or non-injury events, the EPRI OHSD database excludes such data.

To ensure data confidentiality, the OHSD program policy restricts use of the data to peer-reviewed health and safety research proposals only and does not distribute personnel and individual records. In addition, all personal identifiers were removed from data records and the name of each participating company was replaced with a generic identifier.

3. Statistical analyses

Injury rates are expressed as the number of injuries and illnesses per 100 employees during a year of follow-up. The rate per 100 employee-years is equivalent to that used for OSHA reporting purposes, which estimates rates per 200,000 work hours (OSHA 300 rate). Although injury rates estimate the relative occurrence and risk of injury, they do not directly reflect the severity of an injury. Time lost from work, measured by full time equivalents (FTEs), can be used as a proxy to examine injury severity. FTEs lost was defined as the total number of days lost divided by 240 workdays which assumes an average of four weeks off per year for workers (Kelsh et al., 2004). For recordable injuries where no lost time was reported, 0.002 FTEs lost, which is equivalent to one half day lost, was assigned to represent an approximate midpoint of the potential time away from work. Fatality rates are expressed per 100,000 employee-years.

To date, six companies have provided data for the entire 19-year period. Six additional companies have provided data for the majority of the past 10 years. One company (Company N) provided only total employee data for the 1995 to 1999 period and did not report demographic or job description data. Thus, data for company N for this period are excluded from rate calculations, with the exception of overall OHSD injury rates.

Given the deviance criteria (degrees of freedom ratio close to one) and the dispersion estimate criteria (over-dispersion parameter equal to zero), the calculation of confidence intervals assumes an underlying Poisson distribution. Upper and lower 95% confidence limits were estimated using the methods described by Fleiss (Fleiss, 1981). To investigate injury trends over time, a Poisson regression model was fit to the data, adjusting for the observation time per year. For trends in FTEs lost rates over time, a negative binomial regression model fit the data best based on deviance and dispersion estimate criteria. To address the sex-specific differences in injury rates between occupations, we performed an age-adjusted Mantel–Haenszel analysis to estimate injury-rate ratios by occupation (Fleiss, 1981). For the three occupations with the highest injury rates, mechanisms of injury and body regions of injury were analyzed. Additionally, an analysis of injury by seasons was performed. We defined winter as December through February, spring as March through May, summer as June through August, and fall as September through November.

4. Results

The majority of electric power industry workers were male (73.4%), providing a total of 1,451,143 employee-years of observation (Table 1). Female workers accounted for 22.9% of the workforce and 452,260 employee-years. Sex was not reported for 3.7% of the study population. The majority of workers were between 41 and 60 years of age (58.9%), with 31.1% of the workforce 40 years or younger and only 5.4% 61 years or older.

The most common injury type was sprains and strains, accounting for 40.9% of all injuries (Table 2). Sprains and strains were the primary contributor to reported medical costs at 43.7%. Although representing