

Safety behavior and work safety climate among landscaping and groundskeeping workers in North Carolina: A pilot study

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Abstract.

BACKGROUND: Each year, the average number of nonfatal occupational injuries among landscaping and groundskeeping workers are consistently above the total number of injuries for all other occupational injuries among worker in the U.S. From 2004 to 2007, fatalities among groundskeepers averaged 13.3 per 100,000 workers compared to an overall rate of 4.0 fatalities per 100,000 for all U.S. workers with the majority reported as either Hispanic or Latino.

OBJECTIVE: The aims of this project were to describe the use of personal protective equipment and work safety climate among a sample of landscaping and groundskeeping workers employed by public universities in North Carolina (N=67).

METHODS: Data from a cross-sectional study was collected among workers using group- administered surveys. Statistical associations with work safety climate were tested between personal, work and safety behavior characteristics with work safety climate scores using one-way ANOVA.

RESULTS: Nearly half of workers (49.3%) reported experiencing one or more work-related injuries or illnesses within the past 12 months. While work safety practices were perceived as being very important to management, only 56.7% reported having regular safety meetings. In bivariate analysis, work safety climate scores were significantly lower among those reporting race “other than white” ($P=0.01$).

CONCLUSIONS: This is the first study of its kind to evaluate work safety climate among landscaping and groundskeeping workers. Although self-reported safety practices were moderate, minority workers described their work safety climate as being poor. As a pilot study, these results suggest that employers of landscaping and groundskeeping workers could do more to improve safety climate within the organization with an emphasis on safety training for minority and underrepresented workers.

Keywords: Occupational, environmental, landscaping, behavior

1. Introduction

Nearly one million individuals are employed in the U.S. as full-time, landscaping and groundskeeping

workers [1]. Workers classified in this occupation (SOC 37-3011) work primarily outdoors, using power and non-power tools to ensure the grounds of businesses, institutions, houses and parks are maintained, attractive, orderly and healthy [1]. They perform various duties involving any combination of grass mowing, trimming, planting, dethatching, mulching, fertilizing, digging, raking, and planting. Many of these tasks are hazardous, placing workers

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at increased risk for occupational related injuries and even death [1–3]. Occupational hazards encountered by workers employed in the landscaping business are not well-described in the literature; however, potential risk factors include exposure to excessive noise, extreme temperatures (hot and cold), chemical exposures, insect bites, ergonomic stress, vibration, trauma from equipment, falls and vehicular accidents. From 2003 to 2008, fatalities among groundskeepers averaged 13.3 per 100,000 workers compared to an overall rate of 4.0 fatalities per 100,000 for all U.S. workers with the majority reported as either Hispanic or Latino [3].

In 2014, the U.S. Bureau of Labor Statistics reported the number of nonfatal occupational injuries and illnesses involving days away from work among groundskeeping workers was 264.8 per 10,000 full-time workers compared to 107.1 per 10,000 full-time workers in all other occupations [4]. In the same year, fatalities among groundskeeping workers accounted for nearly 2% ($n=78$) of total worker deaths ($N=4,585$), with the majority (47%) reported as Hispanic or Latino [4]. In light of these statistics, little published literature has evaluated the use of personal protective equipment (PPE) and risk factors leading up to these injuries and fatalities among workers in this industry. The combination of morbidity and mortality and what may be considered a suggested increase risk to underrepresented, immigrant and minority workers is equally disturbing.

There are 17 public universities in North Carolina, many of which occupy considerably large land area that requires a substantial number of employees to maintain its campus landscaping and grounds. Generally, in the institutional setting, groundskeepers operate under the direction of a front line supervisor with safety regulation and oversight provided by an environmental health and safety officer. Safety requirements and guidelines of these workers are governed primarily by federal and state laws under the U.S. Occupational Safety and Health Act (OSHA), and N.C. OSHA. The regulatory requirements for employers to provide personal protective equipment (PPE) and training is promulgated by the NC Department of Labor (NCDOL) Occupational Health under Federal Standard 1910.132, Subpart-I, which requires employers to provide necessary PPE. These items include protective clothing, respiratory devices, protective shields and barriers such as devices to protect ears, eyes, face, head and extremities at no cost to the employee.

1.1. Work safety climate

Safety precautions and measures are critically necessary to prevent and reduce injury and death when working in hazardous environments. The obligation for employers to prioritize and operationalize values that support a culture of safety is an area that has been shown to facilitate improved worker health and reduce accidents and injuries among employees in the workplace [5]. The term, “safety climate” was introduced approximately 35 years ago as a meaningful way to measure the underlying safety culture of an organization [6]. Using validated surveys, data can be gathered from workers to evaluate what they perceive as how their employers value safety of their workplace environment. In general, workplaces that have higher survey scores associate with safer work place environments, whereby, leading to a reduced number of injuries and deaths. In pivotal research conducted by Zohar (1980), strong characteristics of having a good organizational work safety climate (WSC) include having a strong commitment by management to support safety, emphasis on worker safety training, regular and open communication with workers, safety inspections, good housekeeping principles, environmental control, a stable workforce and worker praise [6].

There have been no published research studies that have evaluated WSC among groundskeeping and landscaping workers. Previous studies have evaluated WSC among various occupational and industry sectors including, but not limited to, construction, [7, 8] truck driving, [9] poultry processing, [10] manufacturing, [11] hospitals, [12, 13] lone workers, [14] retail, [15] oil rigging [16] and agricultural farmwork [17, 18]. WSC is related to job safety performance, and the results can provide a meaningful and reliable measure for helping to predict injuries. The goal of this study is to characterize safety behavior and perceptions of safety of these workers in the work place so that risk factors leading up to illness and injuries may be better understood. To meet this goal, the specific objectives of this project are to, (1) describe personal and safety behavior characteristics of these workers, and (2) evaluate workers perceptions of WSC in the workplace. Outcomes of this pilot project may provide a better understanding of the association between work safety perceptions and factors that influence injuries, while assisting with interventions at the organizational level to enhance the safety of these workers.

2. Methods

Two public universities in North Carolina that employed landscaping and groundskeeping personnel as part of its workforce were randomly identified and selected to participate in this project. Workers employed at universities were selected because they represent a relatively stable, non-transient groundskeeping and landscaping workforce. One large university (>30,000 students: University A) and one small university (<30,000 students: University B) were selected to provide worker sampling variability. Individual meetings were held between the investigators, environmental health and safety officers and supervisors from each university to discuss the goals and logistics of the project prior to actual data collection. Surveys were conducted during the spring and summer months when workers were actively conducting groundskeeping duties. Participants received a \$10 gift card for completing the survey. The study protocol was reviewed and approved by East Carolina University, Institutional Review Board.

2.1. Participants

All workers were over the age of 18 years and employed by a North Carolina public university. The investigators worked with collaborating universities' environmental health and safety officers from each institution to identify and recruit workers. Employees gathered in a group setting and were read each question out loud by trained interviewers. Non-English, Spanish speaking individuals were administered surveys in a separate, private room with a bilingual interviewer. All participants were given specific instructions on how to complete the survey and were under no obligation to participate. Those that agreed to participate gave signed informed consent.

2.2. Data collection

Data were collected from a cross-sectional survey in May and June, 2015. Surveys were planned and coordinated in advance with safety supervisors and management so that the most number of workers could participate during a 20 minute break session. The survey instrument included items taken from a validated, pre-tested questionnaire developed by others and the investigators. Survey questions included items on participants' personal and work characteristics, occupational injuries and safety behavior.

A draft questionnaire was reviewed by the investigators and pre-tested with landscapers at another non-participating university prior to distribution. The Spanish questionnaire was translated into Spanish by Spanish speaking individuals familiar with dialect used predominantly in N.C.

Interviewers were trained on human subject protection and ethics, participant recruitment, participant selection and data collection procedures. Interviews took approximately 20 minutes to complete and were conducted in English and Spanish, depending on respondents' preference. Survey questions included information on demographics, work history, work environment occupational safety requirements, physical injuries and symptoms.

2.3. Measures

Work safety climate was evaluated using participant's responses to a 10-item perceived safety climate scale previously used by Gillen et al. [19]. The modified scale has been used by other researchers to evaluate work safety climate in various work sectors [8, 7, 10, 17, 19]. Scores from the first nine items in the work safety climate scale were reported for each question on statements about management's concern for safety activities. Response options used a four-point Likert scale format of "strongly agree" (4), agree (3), disagree (2), and strongly disagree (1). The tenth remaining item included two response categories (1–2) on perceptions related to how much supervisors seemed to care about safety with two response categories. The statements, "supervisors could do more to make my job safe" and "supervisors do as much as possible to make my job safe," were coded as disagree (0) and agree (1). After an analysis of internal consistency using Cronbach's alpha [20], one of the statements, "taking risks in not a part of my job," was removed due to lack of fit within the scale. A total WSC score was calculated by summing the remaining nine items and the Cronbach's alpha score increased to 0.89. The nine item responses were summed for a score ranging from 9 to 38 with higher values indicating a perceived better work safety environment.

Workers were asked to report their work activities in the last week. Occupational safety behavior questions included responses to wearing PPE including; safety shoes, safety glasses, work gloves, ear plugs/ear muffs, long pants and other. Responses were coded as Never/Rarely (1), About half the time (2), Most time/Always (3). Measures of occupational

injuries were assessed using dichotomous (Yes/No) responses by asking participants whether they had experienced injury or illness at work in the last 12 months. Items included; trauma from a cut, insect bite, respiratory or breathing problems, hearing, eye, sunburn or other. Information about personal characteristics were collected on gender, age, race, Hispanic ethnicity, years of school completed and smoking over the past week. Work characteristic questions included; number of years working in landscaping and/or groundskeeping; and, if currently working part-time in addition to their normal university job performing groundskeeping or landscaping duties for compensation.

2.4. Data analysis

Frequency counts and percentages were computed for all of the above measures. The mean, standard deviation, and Cronbach's alpha value were computed for the perceived WSC summary score. One-way analysis of variance (ANOVA) was used to assess associations between WSC scale with personal, work, occupational safety behavior and injury measures. Associations were considered statistically significant at the $P < 0.05$ level. All analyses were conducted using SPSS Statistics for Windows, version 20 (IBM Corp., Armonk, N.Y., USA).

3. Results

As shown in Table 1, a total of 67 workers participated in the study; with 48 (72%) reporting from University A and 19 (28%) workers from University B. Nearly all workers reported as being male (99.0%). Overall, the majority of workers were between 40 and 59 years (58.2%), white (52.2%) with a high school diploma or higher (76.1%) and married (65.7%). For job history and activities, the majority (59.7%) had worked more than five years as a groundskeeping worker and 26.9 percent worked outside of their regular, normal university job performing similar work. Overall, nearly 50.0% of workers reported experienced an injury/illness in the past 12 months at work with a cut (22.4%) and insect bite (9.0%) being the most common types reported. As shown in Fig. 1, the primary job activities of workers included working with the following; leaf blower (98.6%), weed eater (89.1%), riding mower (83.7%), push mower (77.6%), chain saw (77.4%) and other tools (75.4%). In Table 2, the behavior of using PPE by groundskeep-

Table 1
Personal, work and injury/illness characteristics of university groundskeeping workers ($n = 67$): North Carolina, 2015

	<i>n (%)</i>
Participants	
University A	48 (72%)
University B	19 (28%)
Personal Characteristic	
Sex	
Male	66 (98.5)
Female	1 (1.5)
Age, y	
18–25	3(4.5)
26–39	18(26.9)
40–59	39(58.2)
60 and older	7(10.4)
Race/Ethnicity	
White (not Hispanic)	35 (52.2)
Black (not Hispanic)	15 (22.4)
Hispanic or Latino	14 (20.9)
Other	1 (1.5)
Marital Status	
Married	44 (65.7)
Single, Never Married	19 (28.4)
Single, Divorced	2 (3.0)
Separated	1 (1.5)
Highest Year of School Completed	
High School Diploma or Equivalent	51 (76.1)
Smoke regularly*	20 (29.9)
Job History and Activities	
Length of time as a university groundskeeper	
12 months or less	6 (9.0)
1–5 years	21 (31.3)
More than 5 years	40 (59.7)
Currently doing groundskeeping work outside of university job	18(26.9)
Injury/illness experienced in the last 12 months when groundskeeping	
Any type of injury/illness	33 (49.3)
Cut (skin)	15 (22.4)
Insect bite	6 (9.0)
Hearing	2 (3.0)
Breathing or respiratory	3 (4.5)
Eye(s)	1 (1.5)
Sunburn	0 (0.0)
Other	6 (9.0)

*One pack or 20 cigarettes per week.

ers within the last week of work included wearing safety shoes (92.5%), followed by safety glasses (89.6%), long pants (79.1%), ear plugs/ear muffs (62.7%), work gloves (68.7%) and other safety equipment (10.4%).

3.1. Work safety climate

The mean score for the nine item scale was 24.94 ($SD = 9.53$), a 1.06 difference below the median score of 26.0 (Table 3). Most participants (74.6%)

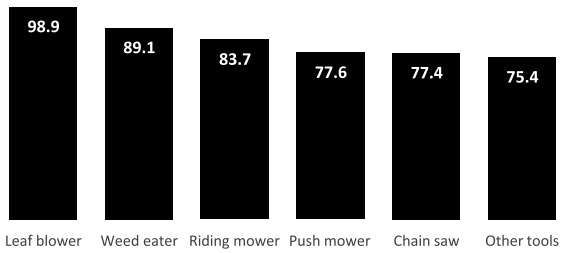


Fig. 1. Types of Equipment Used by University Groundskeeping Workers within Past Week ($n = 67$): North Carolina, 2015.

Table 2
Self-reported behavior of personal protective equipment (PPE)
of university groundskeeping workers ($N = 67$):
North Carolina, 2015

Safety Gear Worn When Working	Never/Rarely	Half the time	Most of the time/Always
	<i>n (%)</i>		
Safety shoes	2 (3.0)	NR	62 (92.5)
Safety glasses	1 (1.5)	3 (4.5)	60 (89.6)
Long pants	1 (1.5)	10 (14.9)	53 (79.1)
Ear earplugs/Earmuffs	18 (26.9)	1 (1.5)	42 (62.7)
Work gloves	3 (4.5)	16 (23.9)	46 (68.7)
Other safety equipment	6 (9.0)	2 (3.0)	7 (10.4)

NR = not reported; Not all participants responded, therefore, may not add to 100%.

agreed with the statement “work safety practices were very important to management.” Over three-fourths (76.1%) of groundskeepers agreed that “workers are regularly made aware of dangerous work practices or conditions” and over 49.0% of workers reported that they “regularly received praise for safe conduct; 67.2% percent of workers “received instructions when hired” and 56.7% attended regular safety meetings.” Over 76.0% reported workers have almost total control over personal safety and nearly 42% reported that “the possibility of being injured at work in the next 12 months was very likely.” Over 70.0% percent reported “safety equipment is always available.”

When asked about work organization and perceptions of how much supervisors seemed to care about worker safety, 29.9% reported that their supervisor could do more to make their job safe, and 64.2% did as much as possible to make the job safe. In a separate analysis, we compared WSC scores of each university we found a slightly higher mean score among the university with more groundskeeper participants (University A) compared to the university (University B), with less participants (25.23 ($SD = 11.09$) vs. 24.20 ($SD = 3.02$)).

3.2. Associations with perceived safety climate

Race and ethnicity, were significantly associated with safety climate (Table 4). The mean score among those that reported “other” race or ethnicity (including Hispanic, Black, Asian, Other) was 19.91 ($SD = 7.19$); whereas, those reporting “white” non-Hispanic race was 27.34 ($SD = 3.8$). The mean WSC score was lower among those reporting not using a chainsaw (20.75; $SD = 7.67$) compared with those workers who used a chainsaw (23.54; $SD = 5.79$). Perceived WSC scores were not statistically significant with age, being injured on the job, using a riding or push mower, or wearing earplugs/earmuffs, safety glasses or other safety equipment.

4. Discussion

These findings expand knowledge about the importance of WSC and safety behavior of landscaping and groundskeeping workers. This is the first study to our knowledge to report on WSC and to evaluate risk factors that may contribute to illness and fatalities. Although a large percent of workers reported wearing PPE between 62% and 93% of the time while working, nearly one-half of reported having experienced at least one injury or illness within the past 12 months. While a majority of participants reported personal safety as being important to management, not all workers attended regular safety meetings. Although most workers stated that proper PPE was available when doing their job, nearly two-thirds of workers felt that they would be injured within the next 12 months.

There are a paucity of studies available on safety behavior of groundskeeping workers. While two studies we identified described types of injuries and fatalities [2, 21] among these workers, only one available published study was available that examined behavior and use of personal protective equipment (PPE) among commercial groundskeepers [22]. In comparison, our study findings reported significantly higher use of PPE (i.e., long pants, work gloves and safety glasses) of university groundskeepers than those of commercial landscapers and grounds workers. Similarly, the use of hearing protection devices (HPDs) were relatively low in both studies. The lack of hearing protection by workers is concerning and may lead to hearing problems including noise induced hearing loss (NIHL). An overwhelming majority of workers reported using leaf blowers

Table 3

Individual work safety climate scores^a among university groundskeeping workers (*n* = 67): North Carolina, 2015

Work Safety Climate Items	Frequency	
	<i>n</i>	%
Workers' safety practices are very important to management	50	74.6
Workers are regularly made aware of dangerous work practices or conditions	51	76.1
Workers are regularly praised for safe conduct	33	49.3
Workers receive instructions on safety when hired	45	67.2
Workers attend regular safety meetings	38	56.7
Workers have almost total control over personal safety	48	76.1
The possibility of being injured at work in the next 12 months is very likely.*	28	41.8
Proper safety equipment is always available	47	70.1
Supervisors could do more to make my job safe	20	29.9
Supervisors do as much as possible to make my job safe	43	64.2
Summary Score		
Mean: 24.94		
Median: 26.00		
Standard Deviation: 9.53		
Alpha: 0.89		

^aReporting "strongly agree" and "agree". *Reverse scored.

which are typically worn on the back and produce loud engine noise near at or near ear level. In a separate study, average noise levels among landscapers with backpack blowers was identified at noise levels exceeding the OSHA 85 dBA action level [23].

Other studies related to WSC and landscapers and/or groundskeepers could not be identified. However, when we compared these results with a study by Gillen et al., of WSC among construction workers (*n* = 97), groundskeeper scores in this study fared considerably higher. More than one half (58.0%) of workers in their study reported receiving instructions on safety policies when hired compared with 67.2% in our study; 55.0% attended regular safety job safety meetings compared with 56.7%, and 38.0% stated that supervisors could do more to promote job safety, compared with 64.2% among groundskeeping workers [19]. The comparative difference between receiving instructions when hired are not surprising, given that a public, academic institution would be more likely to have a health and safety officer, a direct supervisor and strict regulatory policies than that of a traditional work environment of a construction site.

Finally, the association between WSC and race identified that minority workers experience increased safety and health risks compared with non-minorities. Given that nearly half of workers were minorities, this finding is concerning and warrants further investigation. Minority and immigrant workers are particularly vulnerable and face workplace challenges that influence their occupational risk, such as work orga-

Table 4

Associations of personal and work characteristics with work safety climate score of university groundskeeping workers (*n* = 67): North Carolina, 2015

Characteristic	Perceived WSC score Mean (<i>SD</i>)	<i>P</i> -value ^a
Age		0.84
18–39	24.53 (6.74)	
40 and older	25.10 (10.50)	
Race/Ethnicity		<0.01
White	27.34 (3.8)	
Other*	19.91 (7.19)	
Ever injured on the job		0.26
Yes	23.00 (6.89)	
No	25.04 (6.25)	
Work other landscaping job		0.46
Yes	27.50	
No	23.97	
Type of Equipment Used		
Riding mower		0.77
Yes	24.02 (6.57)	
No	23.46 (7.17)	
Push mower		0.86
Yes	23.93 (6.74)	
No	23.50 (7.09)	
Chainsaw		0.02
Yes	25.34 (5.79)	
No	20.75 (7.67)	
Safety gear worn		
Ear earplugs/Earmuffs		0.43
Yes	25.33 (5.77)	
No	22.75 (10.69)	
Safety glasses		0.28
Yes	32.00 (9.65)	
No	24.54 (2.82)	
Other safety equipment		0.39
Yes	23.17 (5.67)	
No	20.20 (8.22)	

*Includes, Black, Hispanic, Asian, Other. ^a*P* value from one-way ANOVA.

nization factors [24]. There are few published data and information available on the socio-demographics of groundskeeping workers. However, in 2014, the U.S. Department of Labor reported that Hispanics accounted for 16.1% of the total U.S. workforce, and that landscaping services ranked among the highest (43.1%) occupation representing Latino employment. Pegula [21] noted from 1992 to 2002, that the number of fatally injured groundskeepers born outside of the U.S. more than quadrupled and that the majority were from Latin America; primarily Mexico [21]. Between 2003 and 2008, the Bureau of Labor Statistics stated that nearly one-third or 31% of groundskeeping fatalities ($n = 1,142$) were Hispanic or Latino [3]. These figures represents an extremely high number of workers that are primarily immigrant, lower educated and non-English speaking that exhibit increased risk and vulnerability to injury in the occupational setting [24, 25]. Although our study did not find any statistical associations among race/ethnicity with injuries, it is evident from these and other report results that more research is needed. Future investigations should explore the barriers and challenges that confront Latinos and other minorities in landscaping and groundskeeping, to understand why these deaths and injuries are occurring in this workforce. All health and safety printed material offered in Spanish must take into account workers with low literacy levels or the content will be meaningless and not understood.

The association of WSC and use of chain saw is interesting. When we cross analyzed the data by race/ethnicity, we found that a significant lower percent of minorities reported using the chainsaw versus non-minority, white workers. We expect that because of the extreme hazardous nature associated with working with chainsaw that proper protection would be readily available to workers and that most involved with this particular dangerous duty, exercise proper work- safety practices.

4.1. Strengths and limitations

This is the first published study to our knowledge documenting types of injuries and WSC among landscaping and groundskeeping workers employed in an institutional environment. More research is needed among workers in this overlooked occupation to provide additional clues for evaluating risk factors associated with WSC. As a pilot study, these results should be interpreted in light of its limitations. The cross-sectional design and self-reporting of responses may have biased the results by over or underestimat-

ing responses on injuries, behavior, and perceptions. Immigrant, Latino workers are less likely to accurately self-report out of fear of consequences by their employers [26]. The relatively small sample of workers were localized to a few N.C. institutions which may limit its generalizability in general and to other institutions.

An estimated 450 groundskeeping workers with groundskeeping or landscaping related Standard Occupational Codes (SOC-37-3011; 37-1012; 37-3021) are employed by a N.C. publicly supported state university [27, 28]. However, this figure may be an underestimate of workers, because job classifications, categories and job duties oftentimes differ, and therefore, may not accurately reflect total employment reporting for this group. In addition, some public institutions may contract with private, commercial landscaping and groundskeeping operations which may reflect different worker safety behavior and WSC scores than those workers employed by a university. A strength of the study included the combination of participants from a large and small sized institutional workforce which provided variation and valuable insight into the workforce dynamics of groundskeepers and landscaping workers.

5. Conclusion

Nearly one-half of landscaping and groundskeeping workers experience injuries and illness from their jobs and minority workers express poor WSC. Employers are obligated by law to protect workers from harm and should place high emphasis on improving and promoting work place safety. Targeted methods centered on offering culturally diverse training and regular safety meetings for underrepresented workers that have little or no formal education should be a priority. Future research should expand the number and ethnic groups of groundskeeping workers while examining their different workplace operating environments (i.e., commercial, governmental, institutional). A better understanding of risk factors attributable to safety behavior and work safety climate may provide sufficient evidence for exploring casual relationships. As a pilot study, these results suggest that employers of landscaping and groundskeeping workers in public academic institutions in N.C. should improve WSC within the organization with a focus on safety training of minority and underrepresented workers.

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Conflict of interest

None to report.

Contributor statement

All authors contributed to the conceptualization and design of the study, interpretation of the data, and critical revisions of the article.

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Human participant protection

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