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RESEARCH ARTICLE

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Health and safety in the Maine woods: Assemblage and baseline characteristics of a longitudinal cohort of logging workers

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Abstract

Background: Logging remains one of the most hazardous industries in the United States, despite many safety improvements made in the last decades. Currently, we know little about regional trends in health conditions of logging workers, especially in the Northeast. However, the forest products industry is a critical component of the Northeast's economy, especially in the State of Maine.

Methods: This paper reports on the baseline data of a longitudinal cohort study involving Maine loggers, aimed to assess the health and safety of the industry.

Results: Three hundred twenty-five are included in these analyses, 246 mechanized loggers, and 79 conventional. On average mechanized loggers worked longer days (11.8 vs 9.7 hours) and had longer commutes from home to the woodlot (72.6 vs 40.7 minutes) than conventional loggers. For health factors, mechanized and conventional loggers had similar responses. Nearly two-thirds of both mechanized and conventional loggers had an annual physical in the previous year, and 36.3% had seen a health specialist during that same time period. The overall work-related injury and illness rate is 6.8 of 100 workers for this cohort.

Conclusions: These factors contribute to a need to work with the community on transforming logging into a safer and healthier profession for the current workforce, as well as the workforce of the future. This study provides the basis for an appropriate intervention, in collaboration with the loggers and industry stakeholders, to improve the lives of these vital workers.

KEYWORDS

forestry, health, logging, longitudinal cohort, Maine, occupational epidemiology, safety

1 | INTRODUCTION

Logging remains one of the most hazardous industries in the United States, despite many safety improvements made in the last decades. In 2018, logging was the most fatal civilian occupation in the United States, with a fatality rate of 97.6 per 100 000 FTE.[1] This rate is 27.9 times higher than the all-worker fatality rate of 3.5 per 100 000 FTE, placing logging workers ahead of fishing and related fishing workers (77.4 per 100 000 FTE) and aircraft pilots and flight engineers (58.9 per 100 000 FTE).[1] In a study assessing fatality rates from 2006 to 2015, researchers found trends to be volatile due to the relatively low number of loggers in the workforce (51 000 workers in 2015) but overall increasing at the time.[2] In 2006, the fatality rate was 85 per 100 000 FTE and by 2015, it had risen to 132.7 per 100 000 FTE. Although rates dropped in 2009 (65 per 100 000 FTE), in 2013 (91 per 100 000 FTE) and

again in 2017 (84.3 per 100 000 FTE), fatality rates persist between 25 and over 30 times the all-worker rate.[2]

Reported nonfatal injury and illness rates from 2006 to 2015 for logging workers are in overall decline.[2] The same analysis highlighted that although rates were declining, the injury and illness rates of logging workers was 40% higher than private industry.[2] Private industry employers reported that workplace injury rates in 2018 dropped to 2.8 per 100 FTE.[3] Nonfatal injury and illness rates did not include data for the self-employed, which is important since nearly a quarter of loggers in the workforce are self-employed.[4] Underreporting of nonfatal injury or illnesses may be a direct result of employment status, and whether employers provide health insurance or carry workers' compensation insurance. Such an underreporting supports the need for more rigorous accounting of logging injury and illness.

Currently, we know little about regional trends in health conditions of logging workers. This holds true for musculoskeletal issues and chronic health and disease among this population. In a 2014 study that examined musculoskeletal disorders in relation to personal and job-related risk factors in the Southeast United States, 70% of respondents who were mostly logging equipment operators reported neck and back pain.[5] Likewise, researchers in Virginia confirmed high rates of musculoskeletal disease symptoms (98%) in a separate study, but interestingly only work-related injury (not MSD symptoms) were positively related to years of experience.[6] Age was also not positively associated with back pain but rather with neck pain in logging workers in Southern United States.[5]

Considering research that has focused on logging safety or health, much of it has taken place outside the Northeastern United States. However, the forest products industry is a critical component of the Northeast's economy, especially in the State of Maine. One of the largest employment sources in rural Maine, logging provides year-round full-time jobs and is a key driver to the economic vitality to the region. Loggers supply raw materials for the forest products industry, which includes pulp, paper and paperboard, lumber, engineered wood and panel products, biofuels, and jobs and products for a host of other manufacturing sectors.[7]

Maine has the highest concentration of jobs and quotients for logging equipment operators in the nation at 1.68 per 1000 jobs, with a location quotient of 9.50.[8] The location quotient is a variable used by the Bureau of Labor Statistics (BLS) to describe the relative ratio of an area's employment compared with the national average, where a quotient greater than one indicates the area has a higher share of that particular occupation over the national average concentration.[8] Forestry-related businesses contributed $9.8 billion to Maine's economy in 2014, with $882 million of that due directly to logging activities.[9] Wages have seen steady growth with the average Maine logger earning $41 470 in 2019, very close to the national average of $42 060.[8] Although logging is a vital force in Maine's economy, the Bureau of Labor Statistics projects a 13% decline in logging jobs from 2006 to 2026.[8] Yet there remains a need to keep aging workers in optimal health, and to ensure logging is an attractive career for young workers as retirements open positions.

This paper presents the baseline results of a longitudinal cohort study involving Maine loggers, aimed at assessing the health and safety of the industry. The entire study entails seven surveys spaced at 12-week intervals, a health questionnaire, and an in-person physical health assessment. These surveys and the health questionnaire focus on both past and present work-related injuries and chronic health conditions. The study also investigates the type of logging operations, job safety environment, personal protective equipment (PPE) and emergency action plans, work commute, diet, sleep, healthcare, medical insurance, worker's compensation, and social well-being. The physical health assessment collects information on cardiovascular risk factors and a variety of other endpoints including physical measures such as body mass index, waist-hip ratio and body fat percentage, audiometric testing, peak flow lung capacity, carbon monoxide testing, and vision. A physical examination was performed by a medical provider and included a musculoskeletal and neurological assessment.

2 | MATERIALS AND METHODS

We enrolled participants between March 2018 and May 2019 using a variety of methods including telephone, postal mail, and in-person recruitment. A contact list of loggers was developed from several sources including Certified Logging Professionals (CLP) trained loggers, Professional Logging Contractors of Maine (PLC), and an extensive business telephone directory internet search for logging businesses in the state of Maine. We began by randomizing companies and employees for recruitment but quickly realized this was not an effective means to enroll the cohort. Company level enrollment was replaced with an individual enrollment strategy where, in total, 1738 loggers were invited to complete the initial survey (Figure 1). Details on the mixed mode enrollment are found in Figure 2.

Telephone calls followed a standard call protocol of two morning, two afternoon, two evening, and one weekend phone call. For mailings, an initial mailing was followed by a second mailing 6 weeks after the first for nonresponders. Lastly, some loggers were enrolled in-person, while attending a safety training where we were conducting on-site health assessments. Once enrolled, loggers could choose their preferred method of contact: postal mail, email, telephone call, or text link.

We reviewed completed paper surveys for data quality assurance before entering into REDCap,[10,11] the electronic data capture system. Data were entered by (a) the participant after receiving a link to the survey by text message or email, (b) research staff completing data entry during a telephone interview, or (c) research staff entering the data from the paper surveys into REDCap. An overview of the survey categories can be found in Table 1.

Subjects were asked to characterize the percent of work time spent in (a) whole tree harvest, (b) cut to length, and/or (c) conventional logging. Subjects who indicated only whole tree harvest and/or cut to length were classified as "mechanized," while subjects who responded 100% conventional logging were classified as "conventional." Subjects who reported percent effort in both mechanized and

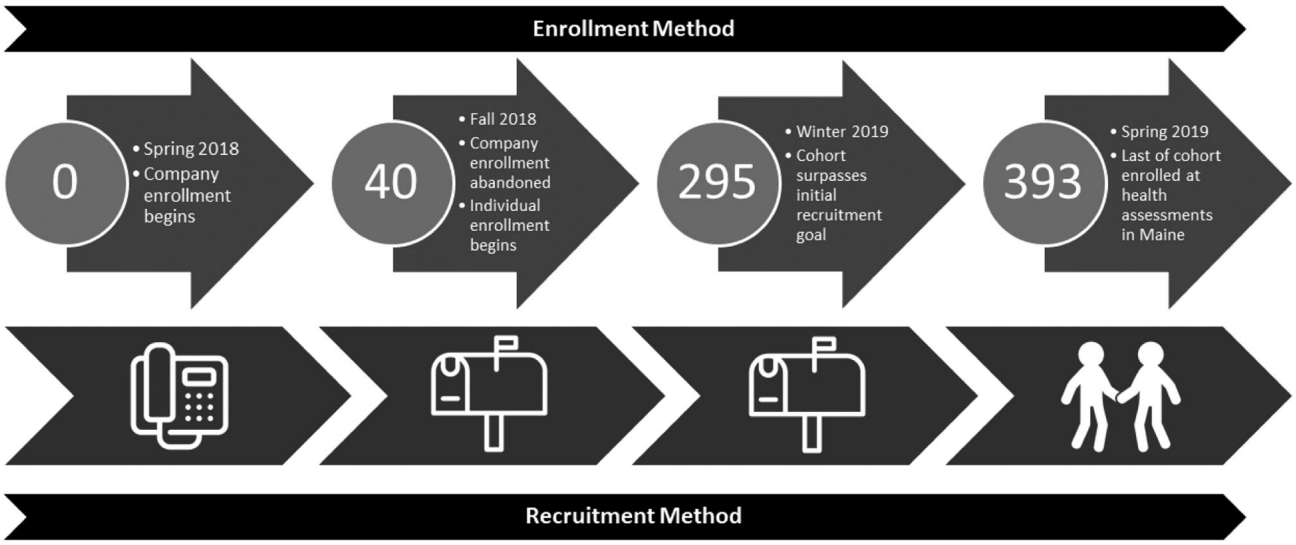

FIGURE 1 Enrollment table

conventional operations were classified as "both." Due to its limited size, this group of subjects ($n = 34$), were excluded from the analyses described below.

One continuous variable, the actual clock time the subject started work, was recoded to "before 6 AM" vs "after 6 AM." Further, there were several categorical variables which permitted a "don't know" response. The small number of subjects who selected this category were excluded from the analyses described below.

We completed all data analyses using SAS version 9.3 (Cary, NC). Categorical variables were summarized as frequencies and proportions. Continuous variables were summarized using means and standard deviations, or medians and interquartile range. Both binary and continuous outcomes were summarized within mechanized vs conventional logging strata and also within four levels of company size. These were sole proprietor, small (2-10 employees), medium (11-50 employees), and large (>50 employees). Categorical variables were tested for significance across these strata using chi-square or Fisher's Exact test as needed. Continuous variables were compared using the Kruskal-Wallis test or the Wilcoxon rank-sum test, depending on the number of levels. Mapping of zip codes was used to visualize geographic dispersion of the study cohort.

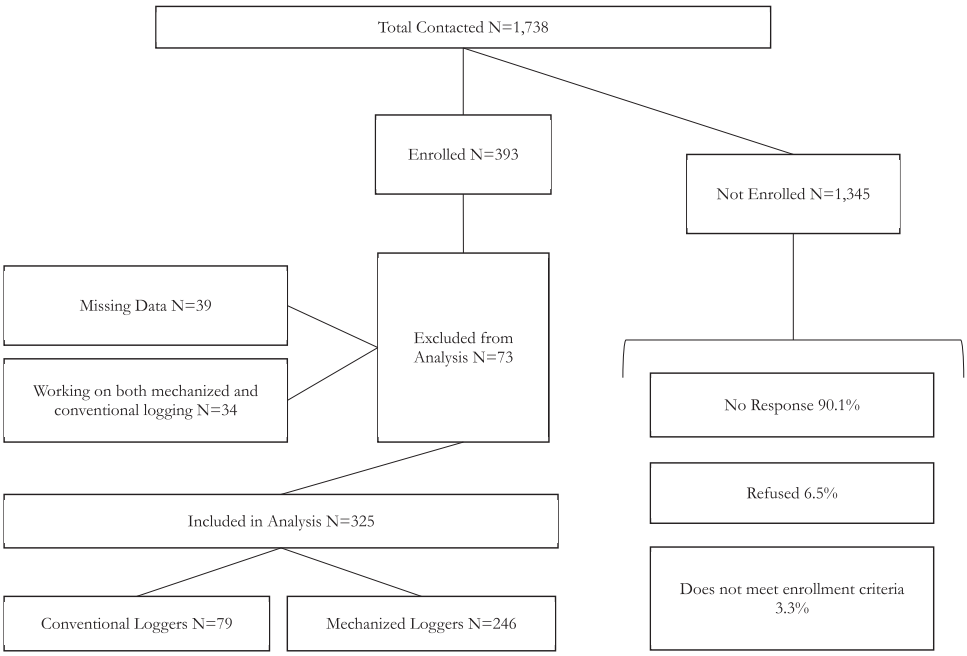

FIGURE 2 Recruitment and enrollment strategy

TABLE 1 Categories of initial survey questions

Work history	Current work role	Personal protective equipment	Workplace safety	Health questions
Time in logging	Percentage spent doing the following:	Employer or self-provided PPE?	Who is responsible for safety?	Birth year
Percentage spent doing the following: • Administrative tasks • Transportation or trucking • Hand felling trees • Operating logging equipment • Equipment maintenance • Other	• Administrative tasks • Transportation or trucking • Hand felling trees • Operating logging equipment • Equipment maintenance • Other How many people work in company?	• Hearing protection • Hard hat • Eye protection • Steel-toe boots • Chaps • Hi-vis vest • Work gloves • Other	Work-related safety training in last 12 weeks? Who provides safety training? Emergency action plan?	Gender Annual checkup in past year? Health specialist in past year? Work-related injury or illness in past year? • What month? • What happened? • Type of care? • How many missed workdays? • Did you change work tasks due to • injury/illness?
Role change over time?	How many days a week do you work? Work start time Work stop time Commute time			Musculoskeletal pain? Health insurance? Does employer provide workers' comp? Ever filed workers' comp claim? Ever injured at work but not filed claim?

Abbreviation: PPE, personal protective equipment.

Any variable that was found to differ significantly across either the mechanized vs nonmechanized strata or across levels of company size, were tested in a model that included both of these stratifying variables as well as their interaction. For continuous variables, a two-level mixed analysis of variance (ANOVA) model that included a random effect for company was used. For binary outcomes, a generalized linear mixed-effects model (GLMM) that employed a logit link function was used. For some of these models, it was necessary to remove the random effect of company to allow the model to converge. The Institutional Review Board of the primary institution approved all protocols.

3 | RESULTS

The overall response rate for the initial survey was 22.6%. The respondents were geographically dispersed across the state of Maine (Figure 3). In total, 393 loggers completed the initial survey, of which 325 are included in these analyses: 246 mechanized and 79 conventional loggers. The survey respondent demographics can be found in Table 2. The vast majority of respondents were male (99%). The mean age of conventional loggers was nearly 5 years older than mechanized loggers (50.1 vs 45.2, $P = .0058$). Many survey respondents had over two decades of logging experience, with conventional loggers having a reported five additional years, on average, in the industry ($P = .0045$) over their mechanized logger counterparts.

On average mechanized loggers worked longer days (11.8 vs 9.7 hours) and had longer commutes from home to the woodlot (72.6 vs. 40.7 minutes) than conventional loggers. Both of these differences were statistically significant. The rate of loggers receiving safety training within twelve weeks of survey administration was also significantly different between mechanized and conventional loggers, with mechanized loggers much more likely to have had such training. Additionally, the probability of having an emergency action plan for each worksite was higher for mechanized loggers than conventional loggers (marginally statistically significant). Usage of PPE is outlined in Table 3.

For health factors, mechanized and conventional loggers had similar responses. Nearly two-thirds of both mechanized and conventional loggers had an annual physical in the previous year, and 36.3% had seen a health specialist during that same time period (specialist physician, physical therapy, chiropractor, etc.). Twenty-two work-related injury/illness events were reported in this initial survey (6.5% of mechanized loggers and 7.6% of conventional). The resulting overall work-related injury and illness rate is therefore 6.8 of 100 workers for this group.

Rates of health insurance coverage were similar between conventional and mechanized loggers, with 79.8% and 74.3%, respectively. Rates of employer-provided workers' compensation coverage differed dramatically between mechanized and conventional loggers ($P < .0001$) with mechanized loggers more likely to have workers' compensation coverage. Between a quarter to a third of loggers have filed a workers' compensation claim or had one filed for them throughout their career. Additionally, 23% of workers have been injured on the job but not filed a claim due to a variety of reasons. When the variables considered in Table 2 were each entered into a mixed ANOVA model (continuous endpoints), or a GLMM, no significant main or interaction effects were seen for presence of an emergency action plan, workdays per week, or age. Continuous outcomes are found in Table 4 and binary outcomes are presented in Table 5.

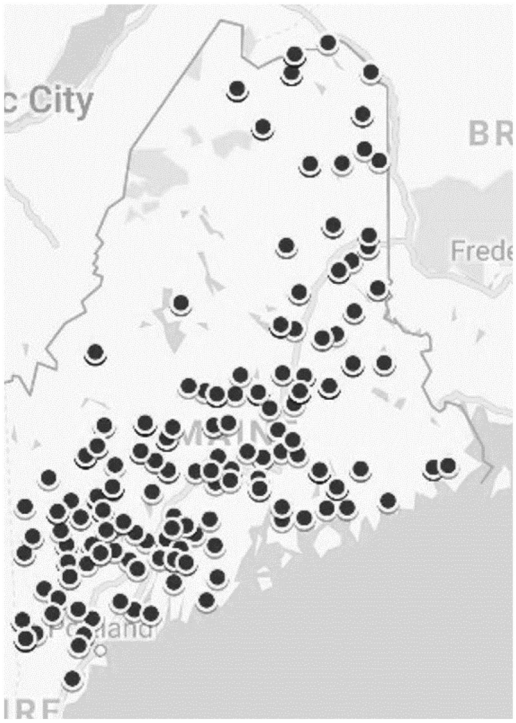

FIGURE 3 Geographic distribution of survey respondents

4 | DISCUSSION

This study adds substantial information to the literature about Maine loggers' nonfatal work injuries, work history, and access to healthcare. The nature of the logging workforce differs across the country[5,12-14] and this is the first study of its kind attempting to fully

TABLE 2 Number of survey respondents by type of logging

Size of operation (number of employees)	Survey respondents by type of logging	
	Mechanized	Conventional
Sole (1)	20	45
Small (2-10)	103	21
Medium (11-50)	86	7
Large (50+)	31	4
Unknown size	6	2
Total	246	79

TABLE 3 Has personal protective equipment (self- or employer-provided)

	Percent, yes	
PPE category	Mechanized	Conventional
Hearing protection	82.1	96.2
Hi-vis vest	89.4	43.0
Chaps	45.9	88.6
Eye protection	93.9	88.6
Hard hat	98.4	100.0
Steel-toe boots	98.8	97.5
Work gloves	96.7	96.2

Abbreviation: PPE, personal protective equipment.

characterize the health and safety issues of Maine loggers. The results from this baseline survey, the first of seven, along with in-person health assessments will provide the needed information for our research team to partner with the industry in improving logger health and safety in this high-risk occupational setting.

Paradoxically, although many loggers say that working outdoors and being independent contributes to their well-being, the remote work locations, long work hours, and lack of access to services can act as barriers to healthy living. Research has shown that although many loggers find satisfaction in their chosen profession, they would not advise their children to enter the industry.[15,16] These factors contribute to a need to work with the community on transforming logging into a safer and healthier profession for the current workforce, as well as the workforce of the future.

The industry is still largely dominated by men, as it has been for generations. While the majority of our cohort has decades of logging experience, respondents' work experience ranged from 6 months to sixty years. These age and experience results are consistent with other recently published data.[17] The industry has seen a radical transformation from the logging of their grandfathers' era. Today, the majority of logging in Maine is mechanized, and while conventional logging is still an important part of the industry, the work tasks and risks differ between the two methods. A Maine logging business survey ($n = 209$) from 2017 reported a mix of 53% conventional and 47% mechanized loggers, and while our cohort is weighted more heavily to mechanized logging, we feel our cohort more closely represents today's industry. Conventional loggers begin work later and work a shorter day, on average, when compared to mechanized loggers. This difference does not imply an easier workday for conventional loggers. In fact, the later start time is due to the need for daylight to see in the woods, and the shorter day reflects a strenuous day's activity using a chainsaw, over the operation of heavy equipment inside a protective cab. From the mechanized loggers' perspective, work begins well before dawn, with help from the bright flood lights of the equipment. While the majority of mechanized loggers' work takes place inside the cab, they too must be aware of their surroundings when getting in and out multiple times a day to checking equipment for proper operation. Regardless of logging style, the mental acuity needed to properly and safely fell trees is high and requires a great deal of skill.

TABLE 4 Continuous outcomes, mixed analysis of variance results

			Type of logging, mean (SD)		*P* values		
Category	Outcome	Size	Mechanized	Conventional	Type of logging	Size	Interaction
Demographics	Average age, y	Sole (1)	46.1 (11.3)	50.3 (14.7)	.171	.1737	.4024
		Small (2-10)	42.8 (13.0)	50.4 (13.1)			
		Medium (11-50)	45.6 (12.3)	43.7 (14.1)			
		Large (50+)	51.6 (12.0)	57.0 (5.4)			
	Years in logging	Sole (1)	24.3 (12.4)	28.9 (14.3)	.036	.1633	.9063
		Small (2-10)	22.2 (13.6)	28.3 (14.9)			
		Medium (11-50)	22.8 (12.1)	25.6 (15.0)			
		Large (50+)	29.5 (13.3)	38.5 (8.5)			
Workday and commute characteristics	Workdays per week	Sole (1)	5.1 (0.7)	4.7 (1.8)	.2036	.9871	.762
		Small (2-10)	5.1 (1.0)	4.7 (0.9)			
		Medium (11-50)	4.9 (1.0)	4.9 (0.4)			
		Large (50 +)	4.9 (0.3)	5.0 (0.0)			
	Length of workday	Sole (1)	11.7 (2.5)	9.4 (3.0)	.0002	.0889	.3007
		Small (2-10)	11.8 (2.5)	9.4 (2.3)			
		Medium (11-50)	12.0 (1.7)	11.7 (3.6)			
		Large (50+)	11.6 (2.1)	9.5 (1.0)			
	Commute time	Sole (1)	67.0 (41.4)	39.5 (40.9)	<.0001	.4295	.688
		Small (2-10)	65.7 (39.4)	37.3 (30.8)			
		Medium (11-50)	73.9 (42.9)	50.8 (30.6)			
		Large (50+)	95.1 (62.0)	36.2 (16.0)			

TABLE 5 Binary outcomes, generalized linear mixed models

			Type of logging (%)		*P* values		
Category	Outcome	Size	Mechanized	Conventional	Type of logging	Size	Interaction
Demographics	Gender, male	Sole (1)	100.0	100.0	…	…	…
		Small (2-10)	98.1	100.0			
		Medium (11-50)	100.0	100.0			
		Large (50+)	100.0	100.0			
Workday characteristics	Work start time before 6:00 AM	Sole (1)	80.0	34.1	<.0001	.0148	.7944
		Small (2-10)	81.4	40.0			
		Medium (11-50)	96.5	71.4			
		Large (50+)	96.7	50.0			
	Work stop time by 4:00 PM	Sole (1)	35.0	79.5	.0380	.9681	.1475
		Small (2-10)	37.2	71.4			
		Medium (11-50)	50.6	57.4			
		Large (50+)	60.0	50.0			
Safety	Work-related safety training in last 12 weeks?	Sole (1)	20.0	31.1	.1746	.0012	.0303
		Small (2-10)	63.0	66.7			
		Medium (11-50)	73.5	85.7			
		Large (50+)	83.3	25.0			
	Emergency action plan for each worksite (yes)	Sole (1)	79.0	71.1	.9836	.6892	.9927
		Small (2-10)	80.2	85.7			
		Medium (11-50)	91.8	85.7			
		Large (50+)	96.5	75.0			
Health	Annual checkup in the last year (yes)	Sole (1)	70.0	60.0	.9759	.9835	.5056
		Small (2-10)	54.4	71.4			
		Medium (11-50)	63.9	71.4			
		Large (50+)	67.7	100.0			
	Health specialist in the last year (yes)	Sole (1)	30.0	40.0	.3496	.9003	.9953
		Small (2-10)	32.0	38.1			
		Medium (11-50)	36.0	42.9			
		Large (50+)	38.7	50.0			
	Work-related injury or illness in the last year (yes)	Sole (1)	5.0	6.7	.9802	.9538	.9433
		Small (2-10)	4.8	14.3			
		Medium (11-50)	9.1	0.0			
		Large (50+)	6.4	0.0			
	Currently experience musculoskeletal pain (yes)	Sole (1)	36.8	40.5	.7344	.9901	.7675
		Small (2-10)	36.4	38.1			
		Medium (11-50)	41.7	28.6			
		Large (50+)	29.0	50.0			
Insurance	Currently have health insurance (yes)	Sole (1)	80.0	77.8	.9760	.9714	.8548
		Small (2-10)	70.6	81.0			
		Medium (11-50)	74.4	85.7			
		Large (50+)	80.6	100.0			
	Health insurance holders (employer provided)	Sole (1)	43.7	51.4	.1305	.1233	.4341
		Small (2-10)	60.9	52.9			
		Medium (11-50)	84.1	66.7			
		Large (50+)	83.3	50.0			
	Employer provides workers' compensation coverage (yes)	Sole (1)	40.0	15.9	.9932	<0.0001	.5240
		Small (2-10)	88.2	42.9			
		Medium (11-50)	96.5	85.7			
		Large (50+)	100.0	25.0			
		Sole (1)	40.0	22.2	.3353	.9609	.3002

(Continues)

TABLE 5 (Continued)

Category	Outcome	Size	Type of logging (%)		*P* values		
			Mechanized	Conventional	Type of logging	Size	Interaction
	Ever filed a workers' compensation claim or had one filed for you (yes)	Small (2-10)	24.3	35.0			
		Medium (11-50)	31.8	28.6			
		Large (50+)	51.6	25.0			
	Ever been injured at work, not filed a workers' comp. claim (yes)	Sole (1)	40.0	26.0	.9778	.9993	.0917
		Small (2-10)	19.4	47.6			
		Medium (11-50)	20.0	0.0			
		Large (50+)	16.1	0.0			

This study saw representation from a wide variety of loggers, both in logging style and in geography. The response rate for our baseline survey was consistent with, and at times exceeded that of, other known studies of the logging industry in the Northeast.[18] Past research had acknowledged the difficulty of enrolling logging subjects due to outdated mailing lists[18] and we worked diligently to clean our list before starting enrollment. While our cohort represents about 20% of all Maine loggers,[19] the wide dispersion of the participants points to generalizability across Maine, and potentially further across the Northeast, depending on how similar or different logging operations are in neighboring states. We acknowledge though, that loggers who participated in this study may be more conscious of safety and health than non-responders because the cohort was recruited in large part through logging safety organizations.

It took more than a year to enroll the entire cohort, and this can be attributed to several factors: (1) our organization was practically unknown to the study population at the outset of this project; (2) inherently, loggers' work takes them to geographic areas which are difficult to reach, both physically and electronically; and (3) in the hierarchy of competing priorities for a logging operation, health and safety, while important, sometimes fall below other critical and time-dependent issues. Through the process of enrolling and interacting with loggers in this study, we have built rapport with an industry that was previously unknown to us, and we to them. Indeed, the trust and partnerships built across the state are key outcomes of the study: they have proved effective in retaining study subjects for the longitudinal portion of this current research and will lay the groundwork for interventional studies in the future.

In general, mechanized and conventional loggers had similar utilization rates of healthcare and health insurance coverage, though they varied on workers' compensation coverage. By percentage, more than half of conventional loggers in our study reported being sole proprietors; and in Maine, these business owners are not required to have workers' compensation coverage for themselves. This surely is part of the reason the rates of workers' compensation coverage differ between mechanized and conventional loggers. It is worrisome that one in five loggers do not have health insurance. This is an area requiring both continued exploration and immediate action, for example, connecting loggers to local health insurance navigators when we are conducting in-person health assessments.

As the industry evolves, many loggers have switched from conventional to mechanized logging. However, there is still a strong contingent of conventional loggers, especially in areas not suited to certain heavy equipment. The differences in length of workdays and commute times between mechanized and conventional logging are not surprising. There are concerns, especially for mechanized operations, about the impact of long commutes and lengthy work shifts on logger health. We are eager to analyze these data from the ongoing longitudinal surveys to better understand how seasonality influences these factors.

While some factors varied between the type of logging operation, the overall size of operations, regardless of type, also had an influence. This was apparent when focusing on safety training and emergency action plans. There was a general trend that the larger the operation, the more likely they were to report safety training and having an emergency action plan. We attribute this to an increasing likelihood of workplace procedures and management structures, though this needs to be studied more. Also, at the largest tiers of conventional logging this trend did not hold, as indicated by our GLMM results for work-related safety training in the last 12 weeks. This variable [work-related safety training] was significant for the interaction between type of operation and size. Part of this could be explained by relatively few study subjects reported working as a conventional logger for an employer who had more than fifty workers.

Lastly, overall injury and illness rates from this cohort (6.8/100 FTE) are higher than the rates reported in the Survey of Occupational Injuries and Illnesses (SOII) for Maine (1.8/100 workers) and nationally (3.5/100 FTE) for loggers, though we need to collect more data to see if this trend holds true.[3] The SOII is known to undercount cases,[20,21] though in recent years they have made efforts to increase response rates by allowing for responses electronically. We know from our research that the majority of loggers preferred to answer our surveys via the postal mail, most likely due to the ease of filling them out when time allowed, and not having to worry about connectivity issues.

4.1 | Limitations

As with any research, this study is not without limitations. Excluding loggers who reported working on both mechanized and conventional

operations meant that we are missing the data form 34 individuals. We plan to compare the results from that sub-group to those presented here, but that is out of scope for this report. As with any self-reported data, these results are subject to memory decay,[22] reporting bias, and limited detail. Given that we collected data using a variety of methods, including participant-generated responses (written/typed) and through phone, it is possible that we elicited more detail on phone calls, since it was an active experience, vs the passive experience of writing/typing. Those who enrolled may have a stronger interest in their health or safety, but we feel that the size of the cohort and geographic distribution overcome this limitation somewhat.

5 | CONCLUSIONS

Maine loggers have shown interest in their industry's health and safety by participating in this study. On average, these workers have twenty years of experience in the woods, and the majority of our cohort are involved in mechanized logging operations, though a sizable contingent are conventional loggers. Overall, the loggers' lengthy commutes and long workdays focus research interest on the role of fatigue and sleep deprivation on safety. The significant rates of musculoskeletal pain reported by both mechanized and conventional loggers are also an area of concern. This report is the first in a series of analyses, meant to understand changes in logging workers' risk, exposures, and health over time. Together with analyses of forthcoming surveys and in collaboration with the loggers and industry stakeholders, this report will provide the basis for an appropriate intervention to improve the lives of these vital workers.

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interests.

DISCLOSURE BY AJIM EDITOR OF RECORD

John D. Meyer declares that he has no conflict of interest in the review and publication decision regarding this article.

AUTHOR CONTRIBUTIONS

ES, PJ, and LH were involved in the conception and design of this study. KF, LH, and JG was responsible for data acquisition and for processing data into our electronic databases. NK was responsible for cleaning these data and creating SAS data sets. JG authored the introduction and contributed to the survey design. ES and PJ completed these analyses and co-wrote the methods and results. ES authored the remainder of the manuscript. The entire team reviewed the final manuscript and made edits.

ETHICS APPROVAL AND INFORMED CONSENT

All protocols were approved by the Institutional Review Board of the Mary Imogene Bassett Hospital (Bassett Medical Center).

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