



Evaluating the effectiveness of a logger safety training program

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Abstract

Introduction: Logger safety training programs are rarely, if ever, evaluated as to their effectiveness in reducing injuries. **Method:** Workers' compensation claim rates were used to evaluate the effectiveness of a logger safety training program, the West Virginia Loggers' Safety Initiative (LSI). **Results:** There was no claim rate decline detected in the majority (67%) of companies that participated in all 4 years of the LSI. Furthermore, their rate did not differ from the rest of the WV logging industry that did not participate in the LSI. Worker turnover was significantly related to claim rates; companies with higher turnover of employees had higher claim rates. Companies using feller bunchers to harvest trees at least part of the time had a significantly lower claim rate than companies not using them. Companies that had more inspections per year had lower claim rates. **Conclusions:** High injury rates persist even in companies that receive safety training; high employee turnover may affect the efficacy of training programs. The logging industry should be encouraged to facilitate the mechanization of logging tasks, to address barriers to employee retention, and to increase the number of in-the-field performance monitoring inspections. **Impact on industry:** There are many states whose logger safety programs include only about 48 hours of safe work practices training. These states may look to West Virginia's expanded training program (the LSI) as a model for their own programs. However, the LSI training may not be reaching loggers due to the delay in administering training to new employees and high levels of employee turnover. Regardless of training status, loggers' claim rates decline significantly the longer they work for a company. It may be that high injury rates in the state of West Virginia would be best addressed by finding ways to encourage and facilitate companies to become more mechanized in their harvesting practices, and to increase employee tenure. Increasing the number of yearly performance inspections may also be a venue to reduce claim rates. Future research could investigate in better detail the working conditions of West Virginia loggers and identify barriers to job tenure, particularly for workers whose primary job task is chainsaw operation. A larger-scale study of the effect of performance monitoring inspections on claim rates is also warranted.

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1. Introduction

Many states have some form of logger training or certification, but they vary in type and length of training (Egan, Hassler, & Grushecky, 1997; Helmkamp, Bell, Lundstrom, & Ramprasad, 2004; Kinard, 2000; MacKay, Ellefson, & Blinn, 1996; Reeb, 1996). These programs

often have multiple goals, including training in safe work practices for a variety of jobs, first aid, sound environmental management practices, and business practices. In many states, certified or licensed logger programs only require approximately 4–8 hours of training in safe work practices (primarily chainsawing). Few, if any, of these programs have been rigorously evaluated in a quantitative manner to assess their ability to reduce injury. In general, even in other industries, there are relatively few examples of studies that have quantified injury reductions after training (Johnston, Cattledge, & Collins, 1994; Sulzer-Azaroff & Austin, 2000). Another challenge is that additional factors are

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often present, such as mechanization, which can confound training effects.

The state of West Virginia has a high rate of logging injuries as documented by workers' compensation injury claims data (Bell & Helmkamp, 2003). Most of these injuries are a result of being struck by a tree, tree limb, or log. Within West Virginia, the logging industry has the highest base rate premium of all industries, at \$52.20 per \$100 of payroll in 2004. In order to address high premiums, a group of logging industry stakeholders formed a task force and started the West Virginia Loggers' Safety Initiative (LSI); the history of this program is detailed by Carruth (2000). The LSI was designed as a 4-year pilot project with annual workers' compensation premium rate reductions (up to 15%) for participating logging companies. Specialized training was provided by logging industry volunteers and safety professionals for all members of the logging crew. Fellers received four 8-hour hands-on training sessions on safe chainsaw use and directional felling practices. Participating logging companies were also expected to maintain and encourage safe work environments for their employees, which included encouraging the use of safe work practices, the use of personal protective equipment, participating in ongoing training, and encouraging compliance with existing OSHA standards. An ongoing inspection program, done by third-party inspectors, was an integral component to encourage companies to maintain safe work practices (West Virginia Forestry Association, 2000). For each program year, a company was to receive one baseline inspection and two performance monitoring inspections. Companies were scored during all three inspections, with the requirement that a score of at least 80% be achieved at each of the two follow-up performance monitoring inspections. Companies that did not score at least 80% on a performance monitoring inspection were subject to another inspection within 10 days; if this inspection was not passed, the penalty was expulsion from the program, which required returning all insurance premium savings associated with participation in the program. The program was open to any employer regularly engaged in timbering that was in good standing with the West Virginia Workers' Compensation Division. The objective of this research was to evaluate the effectiveness of the West Virginia Loggers' Safety Initiative (LSI) in reducing injuries to loggers.

2. Methods

Originally started in 1999, the LSI was reinstated each year through 2003, then discontinued in 2004. Currently the LSI was reinitiated in 2005 and will continue through 2006. For these analyses, we selected LSI data from the continuous 4-year period beginning July 1, 1999, and ending June 30, 2003. In general, new companies could enroll each July. Data from the program were obtained from

the parties organizing and managing the LSI program, and from the West Virginia Bureau of Employment Programs (WVBEP), and the West Virginia Workers' Compensation Commission (WVWCC).

West Virginia (WV) has a state-mandated workers' compensation (WC) insurance system. In general, only a small percentage of WV employers are eligible to be self-insured; companies that are run by a sole proprietor or partnership who do not claim any employees, or those that are part of a larger corporation can exempt themselves from coverage. WC claim records for the entire WV logging industry were obtained from the WVWCC. Variables requested for each injury claim included industry code, injury date, type of incident, source of injury, nature of injury, body part injured, incident description, worker's age, and total dollar amount paid out (medical and indemnity payments) for each claim. No personal identifiers were present in the data. Claim data were received approximately 5–7 months after the end of the calendar year. Many claims were still open and final dollar amounts could be more than reported. We did not have information on reserve amounts set aside for each claim, so additional costs could not be estimated. Claim costs were tabulated just for the time companies were current participants in the LSI program.

Denominator information, in the form of employment data, were requested from the WVBEP, Unemployment Compensation Division for the logging industry (SIC code 2411). State law requires companies to report their monthly number of employees in addition to payroll and other employee information. These data are from the "ES202" or "Covered Employment and Wages Program," a cooperative program involving the U.S. Bureau of Labor Statistics and the State Employment Security Agencies.

Data obtained from the parties managing the LSI program included employment, injury, and administrative data. Employment data were recorded in a different format than the employment data collected by the state; rather than monthly number of employees, hire and termination dates were available for each individual logger. The administrative data included the training histories of individuals while they were in the program, and information from logging job site inspections. Injury claim data were received by the parties administering the LSI from the WVWCC for the companies that enrolled in the LSI only for the time they were active participants in the LSI.

Workers' compensation claim rates were calculated with the number of WC claims in the numerator and the number of monthly reported employees in the denominator, extrapolated to 100 full-time equivalents (FTE) per year. Injury rates for LSI companies discussed in the paper refer to only the time each company was currently enrolled in the LSI during the 4-year period. For example, a company may have been in existence for the whole time of the LSI, but only enrolled from July 1, 2000 - June 30, 2001, so injury rates would only be calculated on the one year they participated

in the LSI. Poisson regression, using SAS v.8 software (SAS, 1993), was used to assess trends over time in the claim rates and also to detect differences in rates between groups (e.g., such as LSI and non-LSI-participating companies).

3. Results

From 1999 through 2003 there were approximately 460 logging companies licensed to log in WV each year that reported at least one employee to the WVBEP. During this 5-year period, an average of 1,430 total employees were reported by the entire industry to the WVBEP each year. A total of 88 companies enrolled in the LSI for at least one year of the 4-year program.

4. LSI participation status

The LSI companies were a dynamic cohort; every year there were different numbers of companies in the program as companies signed up and dropped out during the 4-year program. In the first year of LSI (July 1, 1999 – June 30, 2000), 58 companies participated, in the second year (July 1, 2000 – June 30, 2001), 75 companies participated, in the third year (July 1, 2001 – June 30, 2002), 65 companies participated, and in the fourth year (July 1, 2002 – June 30, 2003) 57 companies participated.

The majority of companies (36) and the majority of the full-time equivalents (FTE; 67.5%) were in the group (Current 1, 2, 3, 4) that started in LSI year 1 and stayed

enrolled until the end of the program in year 4 (Table 1). The remainder of the companies stayed in for less than 4 years, with no other category accounting for more than 15% of total person-time.

When the claim rate for all companies ever in the LSI are compared with the rest of the WV logging industry that were never enrolled in the LSI, there is no significant difference (rate ratio=1.00, 95% CI: 0.88–1.26) between the two, with both having a claim rate of 16.23 per 100 workers. When companies that joined in the beginning of LSI and stayed on all 4 years are separated from companies that joined LSI for less than 4 years (Fig. 1), the LSI all 4-years group had a lower claim rate (15.37 per 100 workers) than the LSI less than 4 years group (18.03 claims per 100 workers), but this difference was not significant (rate ratio=1.03, 95% CI: 0.85–1.25). In comparison to the rest of the WV logging industry, neither of these LSI subgroups had significantly different rates; for the LSI all 4-years-group the rate ratio was 1.05 (95% CI: 0.88–1.26) and for the LSI less than 4-years-group the rate ratio was 1.11 (95% CI: 0.88–1.39).

Injury claim patterns did not differ significantly between LSI and non-LSI companies. There was no significant difference in the frequency of injury claim types ($\chi^2=7.81$, $p=0.1665$), with struck-by injuries being the most common type (42.9%). There also was no significant difference in the nature of injury claims between the two groups ($\chi^2=8.91$, $p<0.1123$), with sprains, strains, and dislocations being the most common nature of injury claim (27.1%), followed closely by bruises, contusions, and concussions (22.7%). In general,

Table 1
Distribution of companies and workers' compensation claims rates by LSI participation status

Participation category	Year(s) current in LSI (Dates)	Number of companies	# workers	# claims	Percent of total person-time	Workers' compensation claims rate per 100 workers
LSI less than 4 years	1 7/1/99-6/30/00	3	9	1	0.6	11.2
LSI less than 4 years	2 7/1/00-6/30/01	5	20	1	1.5	4.9
LSI less than 4 years	3 7/1/01-6/30/02	1	3	0	0.2	0.0
LSI less than 4 years	4 7/1/02-6/30/03	3	11	2	0.8	19.0
LSI less than 4 years	12 7/1/99-6/30/01	7	61	19	4.3	31.3
LSI less than 4 years	23 7/1/00-6/30/02	3	28	1	2.0	3.5
LSI less than 4 years	34 7/1/01-6/30/03	3	30	6	2.1	20.0
LSI less than 4 years	123 7/1/99-6/30/02	7	94	37	6.7	39.4
LSI less than 4 years	234 7/1/00-6/30/03	12	199	15	14.3	7.5
LSI all 4 years	1234 7/1/99-6/30/03	36	943	145	67.5	15.4

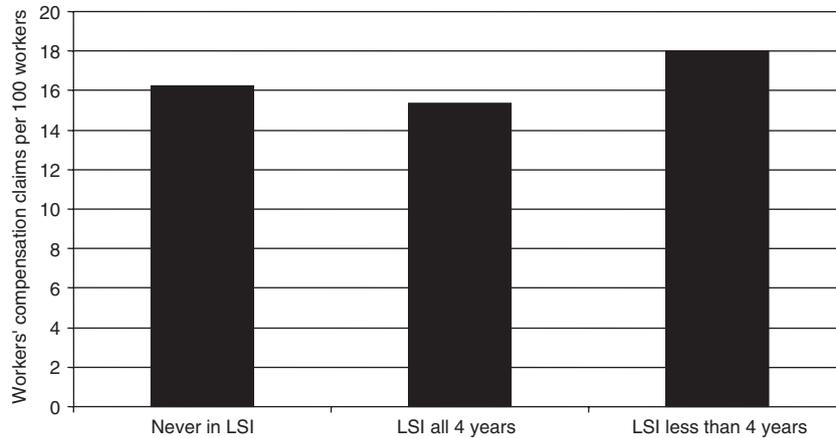


Fig. 1. Unadjusted worker's compensation claim rates among LSI participation groups.

patterns of injury claims were as described for the entire logging industry in Bell and Helmkamp (2003).

5. Trends over the four-year LSI period

Trends over the 4-year LSI time period (July 1, 1999 – June 30, 2003) were examined for each group (never in LSI, LSI all 4 years, LSI less than 4 years). Neither the never in LSI (slope estimate=0.0067, p=0.8471) nor the LSI all 4 years (slope estimate=0.1140, p=0.1335) showed any significant trend in claim rates (Fig. 2). The LSI less than 4 years group did show a significant decline in their claim rate (slope = -0.58, p<0.0001).

Companies that were enrolled in the LSI program in years 1 and 2 (Current 1, 2), and those enrolled in years 1, 2, and 3 (Current 1, 2, 3) had the highest claim rates (Table 1). These two groups of companies showed a borderline significant decline (slope estimate=-0.3825, p=0.0565) during the years they were in LSI; year 1 had a claim rate of 44.1 per 100 workers, year 2 had a rate of 36.4 per 100

workers, and year 3 had a rate of 15.6 per 100 workers. If the Current 1, 2 and Current 1, 2, 3 companies are removed, there is no decline seen in the remainder of the companies that enrolled in the LSI less than 4 years (slope estimate= 0.1563, p=0.4914).

6. Pre- and post-LSI analysis

A pre- and post-LSI analysis was done for the companies that participated in all 4 years of the LSI program and for the non-LSI companies. Historical workers' compensation claim data and employment data were available for the West Virginia logging industry to 1995; however, in order to do a pre-post LSI analysis, companies must have had employment data prior to the LSI program. Of the 36 companies that participated for all 4 years, 6 did not have at least 12 months of employment data on record prior to the LSI and were excluded. Additionally, because of the documented decline in workers' compensation claim rate after beginning to use a feller buncher (Bell, 2002),

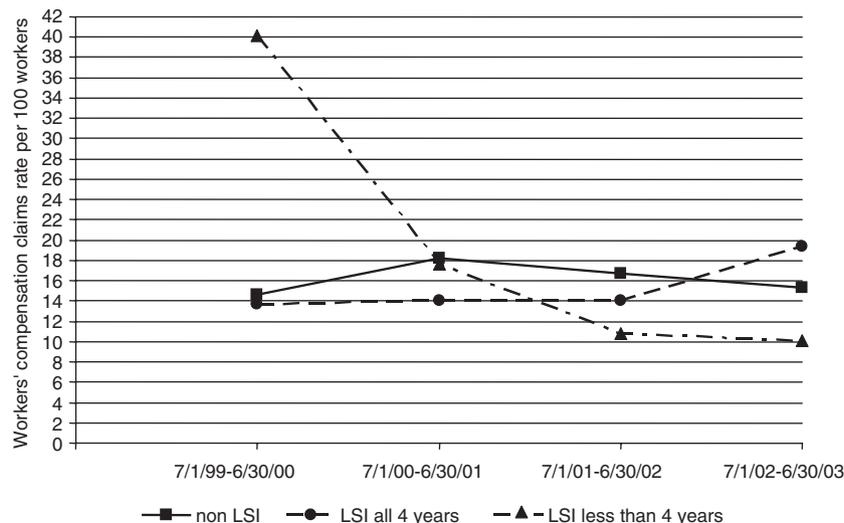


Fig. 2. Trends over the 4-year LSI period.

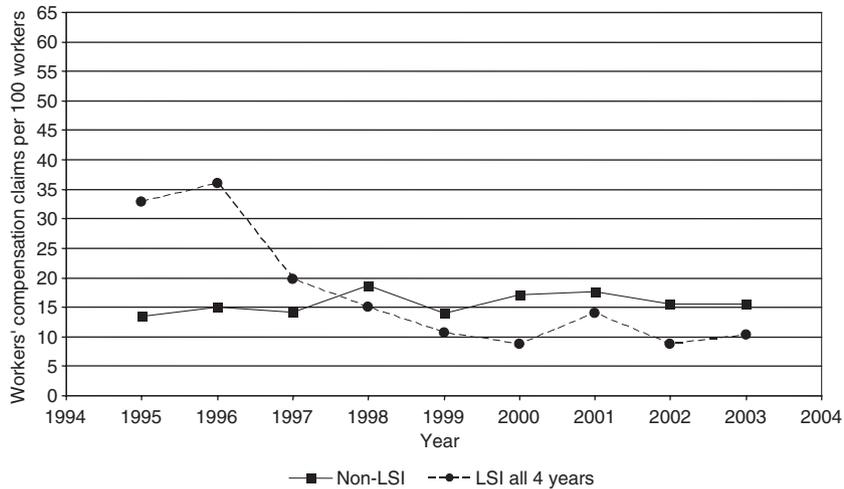


Fig. 3. Claims trends in companies without feller bunchers by LSI participation status.

companies known to be using these machines were removed from the analysis so that any pre-post analyses would not be confounded by pre-post feller buncher use.

Companies that never joined the LSI had a non-significant increase in the workers' compensation claim rate from the pre-LSI period (January 1, 1995 – June 30, 1999) with a rate of 15.1 claims per 100 workers to the post-LSI period (July 1, 1999 – December 31, 2003) with a rate of 16.2 claims per 100 workers (rate ratio=1.06, 95% CI: 0.96–1.18). LSI all-4-years companies had a significant decline with a claim rate of 21.9 per 100 workers in the pre-LSI period to a rate of 9.9 claims per 100 workers in the post-LSI period (rate ratio=0.45, 95% CI: 0.31–0.64). When examined in greater detail (Fig. 3) it is apparent that the decline occurred in the years prior to the LSI program, and there was no significant trend in the post-LSI period.

Of the 80 total LSI companies, 20 had less than 12 months of employment data on record prior to the start of

the LSI program. Claim rates were compared for the LSI time period from 01 July 1999 – 30 June 2003 between the companies with >12 months of prior employment data to those with <12 months employment data. Companies with less employment history had a significantly greater claim rate (32.2 claims per 100 workers) compared to the companies with more employment history (10.9 claims per 100 workers, rate ratio=2.94, 95% CI: 2.31–3.74).

7. On-the-job inspections

There was a significant positive relationship between average inspection score per company per program year and the company's claim rate for that year (slope=0.0386, p=0.0040). In the current LSI, every company had at least one inspection per year. The number of inspections a company received varied from program year to program year, however, 85% of the time, companies received the

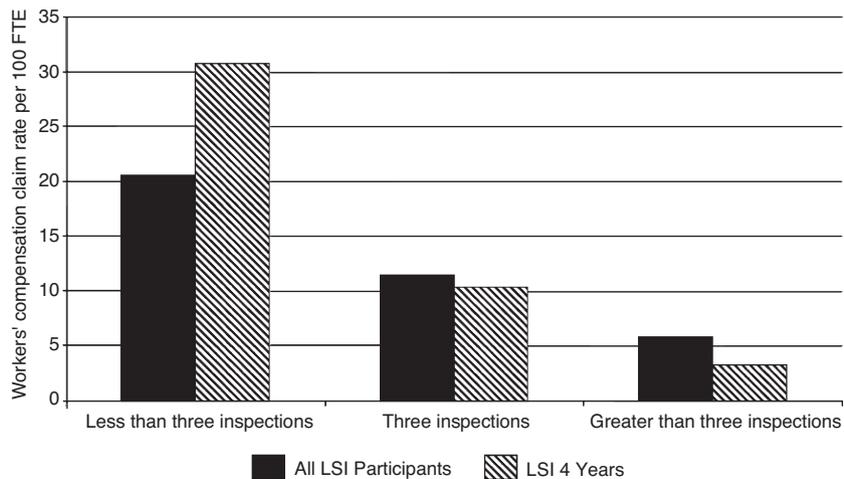


Fig. 4. Workers' compensation claim rates by number of inspections for all LSI participants and the subgroup of LSI participants active for all years of the program.

standard three inspections, 9% of the time, companies received less than three inspections (1 or 2), and 6% of the time, they were inspected four times. After adjusting for feller buncher use, there was a significant negative relationship between the number of inspections and claim rates (slope=0.4917, $p < 0.0001$). The relationship between increased performance inspections and lower claim rates was even stronger when only companies that participated in all 4 years of the LSI program were included in the analysis (slope=0.9362, $p < 0.001$). Fig. 4 shows the unadjusted claim rates for less than three inspections, three inspections, or more than three inspections.

8. Feller buncher use

Among the LSI companies, feller buncher use accounted for a significant difference in claim rates. LSI companies using feller bunchers (n=20) had a claim rate that was less than half that of companies not using a feller buncher (n=68, 8.45 claims per 100 workers vs. 19.25 claims per 100 workers, rate ratio=0.43, 95% CI: 0.30–0.63, Fig. 5).

9. Training, job tenure, and employee turnover

An average annual turnover measure was calculated for each company during the time they participated in the LSI program by dividing the total number of separations by the average annual number of employees, times 100. The measure ranged from 0% to 230% employee turnover; turnover for all companies during the time they participated in the LSI averaged 56%. High employee turnover was significantly positively associated with claim rate (slope estimate=1.01, $p < 0.0001$).

Approximately one-quarter (26.8%) of total loggers (1,304) had no record of receiving any job-related training

Table 2

Multivariate Poisson regression model looking at the effects of job tenure and job specific training on workers' compensation injury claim rates (adjusted for feller buncher use) for companies in the Loggers' Safety Initiative training program

Variable	Adjusted Rate ratio	95% Confidence interval	
		Lower	Upper
<i>All claims</i>			
Feller buncher use			
Yes	1.0	–	–
No	2.17	1.51	3.12
Job Tenure			
>2 months	1.0	–	–
≤2 month	2.19	1.47	3.28
Job specific training			
Post-training	1.0	–	–
Pre-training	0.68	0.41	1.14
No training recorded	1.39	0.89	2.15
<i>Struck-by claims</i>			
Feller buncher use			
Yes	1.0	–	–
No	2.48	1.46	4.22
Job Tenure			
>2 months	1.0	–	–
≤2 months	2.05	1.19	3.53
Job specific training			
Post-training	1.0	–	–
Pre-training	0.75	0.37	1.51
No training recorded	1.98	1.14	3.43

Results are shown for all claims, and for the subgroup of claims that were the result of a struck-by incident. Statistically significant rate ratios are shown in boldface type.

while their employer was in the LSI program, while the remaining 73.1% had at least one training session on record. The median time until date of first training session (for all jobs combined) was 58 days (1.9 months). Approximately 25% of loggers received their first training session in the first month of starting the LSI program. Nearly 8% of loggers had training recorded on or before their first day of starting the LSI program.

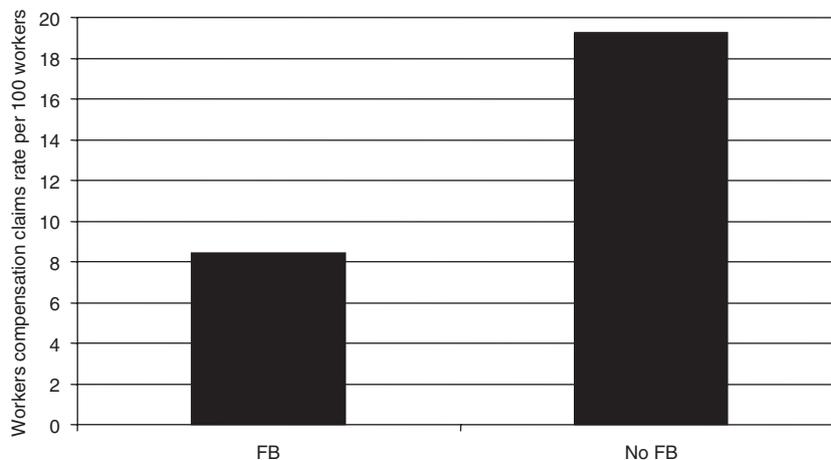


Fig. 5. Comparison of LSI companies with and without feller bunchers.

Of the 423 loggers whose primary job was listed as chainsaw operator, 32.8% had no record of receiving any of the four hands-on training sessions on safe chainsaw use and felling practices. Further, 37.3% had record of receiving all four chainsaw training sessions, and 26.7% received between one and three training sessions. A varying proportion of other primary job classifications had no record of receiving any training: 27.6% of skidder/dozer operators, 21.2% of trucker/loader operators, and 5.1% of owner/operators.

The median time for employment at a company in LSI was just under 10 months. Twenty-five percent of the loggers were employed for 3 months or less per company. Chainsaw operators had the lowest median employment with any one company at a time, at less than seven months employment per company.

Training and job tenure were significantly correlated ($\chi^2=492.7$, $p<0.0001$); the longer a logger stayed with a company, the more likely he/she was to have received training; loggers with less time per company were less likely to receive training. In order to determine whether training or tenure was most predictive of claim rates, a multivariate model was used, with the variables feller buncher use (yes vs. no), training (no training vs. at least one job-related training session), and job tenure (less than or equal to two months employment with a company vs. greater than two months with a company) present in the model. Results in Table 2 show that after adjusting for feller buncher use and job tenure, there was no effect of training on total claims. When just struck by claims were examined, there was evidence that loggers who had never had a training session had a significantly increased claims rate in comparison to loggers that had at least one training session. However, there was no significant decline in injury claims from pre- to post-training for trained loggers.

10. Cost of workers' compensation claims

Two values were calculated, average cost per claim, and average cost per logger. Average cost per logger is the total claim cost average over all loggers, not just injured loggers. Compared to the non-LSI and LSI less than 4 years groups, the average cost per logger was lowest for LSI all-4-years participants (Table 3). Companies using feller bunchers had

the lowest average claim cost per logger, regardless of LSI participation.

11. Discussion

The West Virginia Loggers' Safety Initiative was considered to be a "pilot project," and the costs associated with the program (approximately \$400,000 per year) are substantial (Carruth, 2000). In this evaluation of the program, there was no strong evidence to suggest that the program was effective in reducing injuries in companies participating in the training. The bulk of the total person-time under study (67%) came from companies that participated in the program all 4 years (1, 2, 3, 4), and this group showed no trend over the study period; essentially their rates did not decline. Furthermore, the claim rate for these companies did not differ significantly from that of companies that participated for only part of the 4-year program and dropped out, nor did it differ significantly from the rest of the WV logging industry that never participated in the LSI program. After adjustment for job tenure, loggers did not show a decline in claim rate from pre- to post-training.

Factors that were associated with significant claim rate differences were whether or not a company used a feller buncher, number of on-the-job inspections, employee job tenure, whether or not the company had at least a year of employment data on record prior to the LSI program (a small amount of employment data on record likely indicates that a company is a newer operation), and worker turnover.

Among companies that participated in the LSI for any length of time, those using feller bunchers at least some of the time during harvesting operations had a claim rate that was less than half of the claim rate of companies not using them. These results are similar to those found during an earlier study on feller buncher use in West Virginia (Bell, 2002). Additionally, this study found that companies with feller bunchers filed over \$2,000 less in workers' compensation claim costs per logging employee per year than companies without feller bunchers.

For all U.S. businesses combined, annual average turnover is estimated at about 17% (Carlino, 1988). High employee turnover (56% on average) is an important issue in these logging companies. It is possible that the training provided to these loggers has benefits, however, it may be

Table 3
Workers' compensation claims costs by LSI participation status for the time currently participating in LSI

Total companies	Total claims amount	Average cost per claim	Number of FTE	Average yearly cost per employee
Non-LSI	\$22,155,541.5	\$33,067.9	4,127.3	\$5,368.0
LSI all 4 years	\$4,599,756.8	\$31,722.4	943.2	\$4,876.5
LSI less than 4 years	\$3,064,311.8	\$37,369.6	454.6	\$6,739.6
Companies without feller bunchers	\$28,350,017.8	\$33,080.5	5080.0	\$5,580.6
Companies with feller bunchers	\$1,469,592.3	\$36,739.8	445.1	\$3,301.2

The LSI program ran from 01 Jul 1999–30 Jun 2003. Logging companies not participating in the LSI were assessed during this four year time period.

that the continual turnover of employees makes it difficult to have a “trained population.” Tree fellers have the most dangerous job on the logging operation (OSHA, 2000). In the LSI program, fellers were supposed to receive four day-long training sessions within the first year of employment, however, of all the loggers with chainsaw listed as their primary job task in employment records, slightly over one-third showed no record of receiving any of these four training sessions. Only approximately one-third received all four training sessions as planned. Many loggers left the company before a full year of employment was accrued. Employee turnover in this group of loggers also includes workers that switched companies (where they were considered to be a new hire at the new company) and workers that stayed with the same company but had intermittent employment; when they separated from a company but then were rehired with the same company they were also treated as a new hire.

Logging is challenging physical work in a constantly changing environment. It may be that workers who are laid off or leave the job, even for short periods of time, and return to work regress in their skills and attentiveness. It is possible that loggers that received training through the LSI program left and joined another logging company that was in the non-LSI group. Workers’ compensation claim rates for the non-LSI companies did not decrease from 1995–1998 to 1999–2003; this indicates that even if trained workers did switch to non-LSI companies it did not lead to a reduction in claim rates.

It is possible that there were positive effects of the training, but that this study did not have the power to detect them; each program year only approximately 15% of insured companies participated in the LSI. It is also possible for training to be beneficial, but unless it leads to behavior change in the workplace, then it is not effectual. Studies have documented increases in safety knowledge after training (Helmkamp et al., 2004), but other research has shown that increases in knowledge do not necessarily translate into reduced injury rates (Daltroy et al., 1997). In this study, higher scores on performance monitoring inspections did not correlate with lower claim rates. On-the-job feedback and reinforcement of new training, and knowledge of consequences for non-conformance are considered to be critical parts in the jump from knowledge to behavior change (Quintana, 1999). It is not known to what degree LSI training was reinforced on the job in trained loggers by supervisors and coworkers. For workers who perform many of their tasks in isolation, on-the-job feedback may be particularly difficult (Olson & Austin, 2001). However, the finding that as the number of performance inspections went up, the claims rates were lower, suggests that on-the-job feedback from third-party inspectors may have led to safer work practices. Companies had a fourth inspection only if they did not receive a passing score on one of the three standard inspections, and they were threatened with expulsion from the program if

they did not receive a passing score on the additional performance inspection. It is also a possibility that the threat of removal from the program, necessitating pay-back of all insurance premium savings associated with the program, may have made company owners stress safe work rules to a greater degree. The number of observations that were in the less than three and greater than three inspection categories were small, so these results should be interpreted cautiously.

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