A DESCRIPTIVE STUDY OF WORKERS COMPENSATION BOARD CLAIMS IN THE PULP AND PAPER MANUFACTURING INDUSTRY

Troy Jones, University of Alberta
Shrawan Kumar, University of Alberta

tkjones@ualberta.ca

ABSTRACT

A comprehensive Workers Compensation Board of Alberta claims database for the pulp and paper manufacturing industry group describing the 645 injury claims occurring from 1997-2002 has been analyzed. The results of the study are reported with respect to: 1) claims trends in nature of injury, type of accident or exposure, source of injury, and body part injured, 2) the effect of work experience and worker age on the above classifications, 3) the impact of observed claims trends in terms of cost and duration of claim, and 4) the relationship of Alberta figures to overall incidence rates of non-fatal injuries/illnesses generally, and the characteristics of those injuries/illnesses specifically, reported by the Bureau of Labor Statistics. The majority of successful claims were experienced by males 35-44 years of age with 5-10 years of work experience. Musculoskeletal injuries were the most common nature of injury (54.0%) and the upper extremity was the most frequently injured region of the body (31.8%). The majority of claims were classified as medical aid (70.9%) and did not result in time loss. Disparities between the incidence rates of specific injury/illness characteristic categories indicate that the survey of occupational injuries and illness is not an accurate indication of the characteristics of accepted compensation claims in the pulp and paper manufacturing industry group of Alberta, Canada.

INTRODUCTION

The pulp and paper manufacturing industry of Canada employed an average of 66,959 workers annually between 1997 and 2001. During the same period the pulp and paper manufacturing industry contributed an average of approximately 8.3 billion dollars to the national gross domestic product (CANSIM, 2003a; CANSIM, 2003b). Within Alberta alone, the pulp and paper manufacturing industry accounted for an average of 3,448 person years worked, and generated approximately 0.46% (542 million dollars) of the provincial gross domestic product in 2001 (Reurink, 2003). The pulp and paper manufacturing industry group maintained a lost time claim rate an average of 72.7% lower then the provincial average, and 84.2% lower than the forest products manufacturing sub-group average. Between 1997 and 2002, the pulp and paper manufacturing industry accounted for 645 accepted Workers Compensation Board claims and ranked forth overall in accepted claims in the forest products manufacturing sub-group.

A descriptive analysis was performed of claims incidence within the pulp and paper manufacturing industry of Alberta for the purpose of assisting employers in developing and improving health and safety programs addressing prevention and rehabilitation of workplace injuries. The study was performed by analyzing a comprehensive Workers Compensation Board of Alberta dataset of claims incidence in the forestry industries of Alberta. Description of claim trends by accessing the Workers Compensation Board of Alberta database is currently the most accurate method of describing occupational injury/accident trends in Canada. National census data is available in Canada; however, census data is not collected in concurrent years and is primarily based on the subjective report of the general population. In addition to the subjectivity of the data, the lack of continuous data collection makes it difficult to control for the biasing effects of industry change due to legislation, market, technology, etc. as is somewhat possible when analyzing a sample collected in concurrent years. Data collected by federal agencies describing hospital admissions is also collected federally; however, the scope of this data is limited when considering work-place injury/accident trends as many injuries occurring in the work-place do not result in a hospital visit. Detailed information describing workplace injuries/illnesses within the pulp and paper manufacturing industry specifically is currently unavailable from either provincial or federal sources. Documents available from federal and provincial sources describe trends in broad industry subgroups only, in limited detail, and do not describe the characteristics of the individual industries comprising those groups. Further, documents available from provincial and federal sources describe lost time claims only and make no reference to those claims which result in medical aid only. The objectives of this study are: 1) identify claims trends in terms of nature of injury, type of accident or exposure, source of injury, and body part injured, 2) determine the effect of work experience and worker age on the above mentioned classifications, 3) assess the impact of observed claims trends in terms of cost and duration of claim, and 4) compare the overall incidence rates of non-fatal injuries/illnesses and the characteristics of those injuries/illnesses reported by the Bureau of Labor Statistics, to those observed in Alberta between 1997 and 2001.

We could locate no peer reviewed literature describing the characteristics of injured/ill workers generally or injuries/illnesses specifically in the wood processing industries of Canada. With respect to epidemiologic studies examining the forestry industry generally, and the pulp and paper industry group specifically, only five studies could be located. Three studies describe only the logging and silviculture industry of New Zealand and do not include the wood products manufacturing industry sectors (Bentley, 2002; Marshal, 1994; Macfarlane, 1980). Layne and Landen (1997) describe injury characteristics in the forestry industry based on hospital emergency records but provide limited detail with regard to specific industries comprising the forestry sector. Only the study by Jinadu (1990) describing the 12 month history of workplace accidents in the wood products manufacturing industries of Nigeria presents injury characteristics similar to those described here.

METHODS

The Workers Compensation Board (WCB) of Alberta, Canada supplied a comprehensive dataset describing claim incidence from 1997 to 2002 for the purpose of performing a descriptive study describing claims incidence in the forest products manufacturing industries of Alberta. This paper is limited to those descriptive analyses performed on the pulp and paper manufacturing

industry. Coded claim numbers were generated for all claims to protect claimants from identification. Coded account numbers were also generated to protect individual companies from identification.

Recurrent incidences of the same injury within individuals were not considered separately as this circumstance resulted in the original claim being reactivated. Multiple claims within the same individual at different time periods were considered separately and included in the description of claim trends. Data allowing the determination of claims cost, duration of claim and nature of claim (lost time claim versus medical aid only) were controlled by limiting data considered to March 31 of the following year, thereby introducing a measure of comparability between the years considered.

The database supplied by the WCB contained the most detailed coding possible of the fields reported. The coding system used by the WCB Alberta is consistent with those used across compensation boards in Canada and the Bureau of Labor Statistics in the United States. A description of specific classifications within the data fields considered (with the exception of occupation classification) is available from the Canadian Standards Association in document Z795-96 (2001). The data field codes were individually considered and grouped by author into the categories reported. This was done to facilitate future studies of specific classification incidence within the characteristic groupings (i.e. musculoskeletal injuries) and provide increased detail to the reader.

A total of 645 WCB claims occurred in the pulp and paper manufacturing industry of Alberta from January 1, 1997 to December 25, 2002. Claims resulting in medical aid only (MA) and claims resulting in lost time (LTC) were both included in the database and considered in the claim incidence trends described. LTC claims were defined as those claims that incur compensation and/or pension costs from the date of accident to March 31 of the following year (15 months of costs development). An MA claim is defined as a claim that incurs medical aid costs only. Canadian employment and gross domestic product figures (provincial and national) are estimated, as a disparity between the industry classification system used by the WCB of Alberta and that used by provincial and federal agencies (North American Industrial Classification System) is possible. Age of the injured worker was reported at the time of injury and experience is reported as days worked up to the report of injury/illness.

To enable comparison of injury characteristics vs. BLS statistics, the coding structure adopted by the BLS was used to re-categorize the specific classifications and enable comparison between the comprehensive WCB data set and that based upon the Survey of Occupational Injuries and Illnesses performed by the BLS annually. The incidence of the specific characteristic groups was averaged across the five year period from 1997-2001 and compared. Some disparity may exist between the industrial classification systems used by the BLS and the WCB of Alberta. In this study the five year incidence rate averages of industries 261, 262, and 263 (Pulp mills, Paper mills, and Paperboard mills), as identified by the Standard Industry Classification used by the BLS, and industry 27102 (Pulp mills including; conversion of wood to pulp, manufacture of news print, leached kraft pulp mills, and chemithermomechanical pulp mills), as identified by Alberta Human Resources and Employment, were compared. Because industry 27102 was deemed to comprise three industry groups, according to the SIC classification scheme, the five-

year average based on the cumulative five year-averages of the three industries was used for the comparisons reported. Both overall incidence of non-fatal injuries and illnesses, and specific injury/illness characteristics (e.g. nature of injury) were compared according to the groupings specified by the Bureau of Labor Statistics. With respect to the comparisons of specific injury characteristic groups, WCB data set figures were adjusted by a factor of 2.8998 to arrive at incidence rates per 10,000 person years worked and to enable comparison to BLS figures. With regard to comparisons of incidence rates of the characteristics of injuries/illnesses, BLS incidence rates describe lost work day cases resulting in days away from work only (not including those which required restricted work activity only). BLS incidence data reported are based on non-fatal occupational injuries and are defined as involving one or more of the following: loss of consciousness, restriction of work or motion, transfer to another job, or medical treatment (other than first aid).

RESULTS

Number of workers employed and total incidence of claims. The average number of person years worked in the pulp and paper manufacturing industry from 1997 to 2001 was estimated by dividing the total insurable earnings in the pulp and paper industry by the average wage in the industry according to WCB figures. During the five-year period described, an average of approximately 3,448 person years were worked in the pulp and paper industry of Alberta. Comparison of incidence rates of nonfatal occupational injuries and illnesses per 100 person years worked between the WCB Alberta dataset and that presented by the BLS is presented in Table 1.

Characteristics of the injured workers. Males accounted for 86.5% of accepted claims and females for 12.2% of accepted claims in the period from 1997 to 2002. The 35-44 year age group experienced the highest incidence of claims at 40.7% of claims, followed by the 45-54 year age group at 26.2 %, and the 25-34 year age group at 19.9% of the total. The average age at time of injury was 41 years with a standard deviation of 10.2 years. The number of days worked previous to experiencing the injury/accident that resulted in an accepted claim was highest in the 5-10 year experience group at 34.0 % of the total claims, followed by the > 20 years experience group at 15.2%, and the 2-5 year experience group at 13.1% of the total accepted claims. Of the claims described only 37.8% contained data describing the days worked before injury, thus conclusions drawn from interpretation of claim trends may be affected. Claims experience by occupation group, as defined by the National Occupation Classification (1971) of the five most frequently occurring occupation titles and their relative percentage, are presented in Table 2. Within the occupation classification, 59% of claims provided information on job title. Conclusions drawn from observed trends by occupation classification may therefore also be affected.

Claims characteristics. The WCB database analyzed described each claim with respect to four characteristic categories. Each claim was described in terms of nature of injury (NOI), type of accident or exposure resulting in injury (TOA), part of body injured (POB) and source of injury (SOI). The three leading classification groups and specific classifications by category are

presented in Table 3. Conclusions drawn from trends observed may be affected by the percentage of claims with information (NOI 98%, TOA 86%, POB 99%, SOI 78%).

Table 1: Comparison of nonfatal occupational injuries and illnesses in the pulp and paper manufacturing industry. Lost time claims (LTC) and Medical Aid claims (MA) compared to Lost Workday Cases (LWC), including cases with days away from work and cases with restricted work activity only, and Without Lost Workday cases (WLW). Incidence rates are based on the 5 year average 1997-2001 (Bureau of Labor Statistics 2003a).

		Incidence rate per 100 person years worked	% diff AB vs. BLS
Alberta	LTC & MA	3.288	66%
	LTC	0.957	41%
	MA	2.311	87%
BLS	LWC & WLW	4.98	
	LWC	2.335	
	WLW	2.645	

Table 2: Top five occupation classifications by claims incidence in the pulp and paper manufacturing industry of Alberta, Canada from 1997 to 2002.

Rank	Occupation description	Percent of total classified
1	Industrial/farm/construction machinery mechanics/repairmen	14.9
2	General laborers	3.7
3	Welders/flame cutters wire	3.3
4	General forestry logging occupations	2.8
5	Pipe fitters/plumbers/related fields	2.5

Table 3: Three most frequently occurring specific classifications by groupings.

		Classification groupings			
		Nature of injury	**Type of accident or exposure**	**Part of body injured**	**Source of injury**
Leading classifications and relative % of total classified	**1**	Musculoskeletal injuries (54.0%) ♦ 80.6% Sprains, strains tears ♦ 3.8% Tendonitis ♦ 3.0% Soreness pain/hurt except back	Bodily reaction/exertion/movement (33.4%) ♦ 23.8% overexertion ♦ 17.3 % overexertion-lifting, overexertion-pulling/pushing	Upper extremity (31.8%) ♦ 26.6% shoulder including clavicle, scapula ♦ 15.3% elbow ♦ 14.3% fingers except thumb	Bodily condition or motion (24.1%) ♦ 99.2% bodily motion-injured/ill worker classification
	2	Wound (cut/amputations/other) (17.5%) ♦ 40.9% bruise/contusion ♦ 28.2% cut laceration ♦ 12.7% foreign body	Struck by contact with (18.2%) ♦ 18.8% struck against stationary object ♦ 17.9% struck against object general ♦ 15.8% struck by falling object	Spine/trunk (21.3%) ♦ 57.4% lower back, unspecified location ♦ 24.2% general back including spine /spinal cord ♦ 7.4% lumbar region	Parts and machinery (18.6%) ♦ 8.7% plate/metal panel and the valve/nozzle ♦ 6.5% chain ♦ 5.4% beam and pipe/duct/tubing
	3	Traumatic injuries (10.2%) ♦ 60.9% fractures ♦ 20.3% crushing injuries ♦ 9.4% dislocation	Exposure to environment (15.7%) ♦ 29.9% exposure to noise over time ♦ 20.6% inhalation of substance general ♦ 16.1% contact with hot object/substance, contact with skin, eye(s) or other category	Lower extremity (16.0%) ♦ 39.2% knee ♦ 31.4% ankle ♦ 7.8% lower leg	Structure or surface (14.2%) ♦ 17.3% floor/walkway ground surface ♦ 17.1% ground classification ♦ 8.6% door

Comparison of Alberta and BLS incidence statistics. Table 4 presents a comparison of the incidence rates for the three most frequently occurring classification groupings, by characteristics category, between the BLS and Alberta, using the classification scheme adopted by the BLS.

Cost and duration of claims. The data fields of claim classification (lost time claim vs. medical aid only), total time lost due to injury/accident, and total cost of injury were normalized to include values accumulated to March 31 of the following year only. The figures reported in this section reflect this time period (1997-2000) in an effort to control for the confounding effect of different cost/time/etc. accumulation due to duration of the claim at the time of database extraction. Of the claims accepted by the WCB of Alberta, Canada in the pulp and paper

manufacturing industry from 1997 to 2000, 29.1% incurred compensation and/or pension costs and are therefore considered lost time claims. 70.9% of claims resulted in medical aid costs only and required no time away from work. Mean days lost from work due to injury/accident in the pulp and paper manufacturing industry from 1997 to 2000 was 4.63 days lost with a standard deviation of 17.63 days. An average of 540 days were lost annually during the period examined due to injuries/illnesses resulting in a claim. Inspection of the claim duration categories reveal that no time was lost in 76.2% of all claims. The mean cost of claims was $1,359 with a standard deviation of $4,399. The median cost of claims was $307. The average annual claim cost of $158,695 was generated in the pulp and paper manufacturing industry in the period examined.

Table 4: Top three most frequently occurring specific classifications by classification group according to BLS classification scheme. Alberta WCB (LTC and MA) claims incidence vs. Bureau of Labor Statistics Survey of Occupational Injuries and Illnesses, lost work day cases only, with days away from work (Bureau of Labor Statistics, 2003b).

Classification grouping	**Nature of Injury**			**Type of accident or exposure**						
	Sprains and strains	**Bruises**	**Fractures**	**Contact with objects**				**Overexertion**		**Exposure to harmful substance or environment**
				Total	**Struck by object**	**Struck against object**	**Caught in or compressed or crushed**	**Total**	**In lifting**	
Alberta LTC and MA	139.2	23.2	19.1	75.4	27.3	23.2	18.6	65.5	18.6	45.8
Alberta LTC	37.1	5.2	7.5	21.5	9.9	5.8	4.6	19.7	7.5	16.8
Alberta MA	102.1	18.0	11.6	53.9	17.4	17.4	13.9	45.8	11.0	29.0
BLS LWC	54.2	12.1	13.0	41.2	17.0	10.4	12.6	28.7	10.0	9.4
% diff LTC and MA	257%	192%	148%	183%	160%	222%	147%	228%	186%	488%
% diff LTC	68%	43%	58%	52%	58%	56%	37%	69%	76%	179%
% diff MA	188%	149%	89%	131%	102%	167%	110%	160%	110%	309%

Classification Grouping	**Part of Body**									**Source of Injury**		
	Head		**Trunk**			**Upper extremities**				**Worker motion or position**	**Parts and materials**	**Floor, walkways or ground surfaces**
	Total	**Eyes**	**Total**	**Back**	**Shoulder**	**Total**	**Finger**	**Hand**	**Wrist**			
Alberta LTC and MA	51.0	15.7	126.4	71.3	29.0	75.4	22.6	8.1	12.2	59.7	47.6	23.2
Alberta LTC	13.9	5.2	38.9	20.3	7.5	19.1	6.4	2.3	4.1	16.2	15.7	10.4
Alberta MA	37.1	10.4	87.6	51.0	21.5	56.3	16.2	5.8	8.1	43.5	31.9	12.8
BLS LWC	5.7	5.8	43.8	30.7	10.1	32.0	12.6	5.8	6.2	28.7	16.9	15.1
% diff LTC and MA	899%	268%	289%	232%	288%	236%	179%	140%	196%	208%	281%	154%
% diff LTC	245%	89%	89%	66%	75%	60%	51%	40%	65%	57%	93%	69%
% diff MA	653%	179%	200%	166%	213%	176%	129%	100%	131%	151%	188%	85%

Worker characteristics: Age and experience. No census information was available indicating the characteristics of the total pulp and paper manufacturing work force. For this reason calculation of relative risk given specific characteristics of the population could not be derived. The distribution of age within occupation groups has therefore not been accounted for and is taken to be an important limitation of this study. Physical exposure given required job demands (specific to occupation) will vary significantly among age groups due to the tendency towards supervisory work at more advanced ages. Thus, observed differences in nature of injury

groupings among age and experience groups may be largely due to the variability in occupations (tasks) those groups are performing. Figures 1 and 2 describe the observed differences between age and experience groups, respectively. Cost and duration of claim trends illustrated in Figure 1 are based on the linear regression model normalized to the highest value and excluding groups smaller then 25. Nature of injury and body part injured trends illustrate the percentage of claims attributable to the described group.

Figure 1: Claim trends by age group in the pulp and paper manufacturing industry group of Alberta, Canada from 1997-2002.

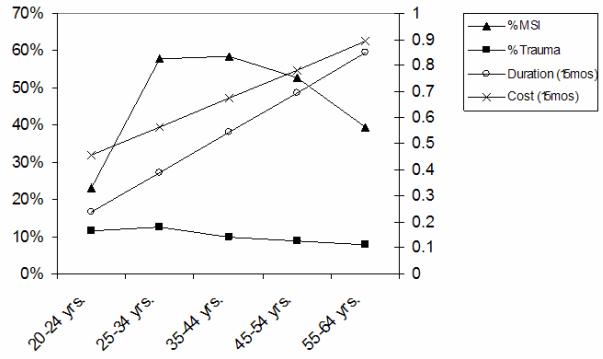
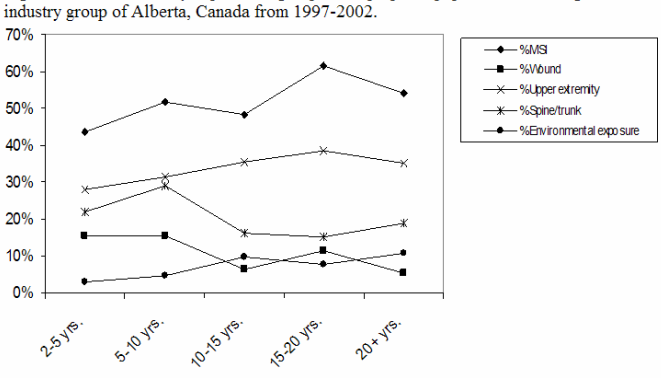


Figure 2: Claim trends by experience group in the pulp and paper manufacturing industry group of Alberta, Canada from 1997-2002.



Cost and duration of claims: by injury/accident category. Within the nature of injury groupings the categories of traumatic injuries and poisoning accounted for the highest mean cost and mean days lost. Higher mean cost and duration is also reflected in higher lost time claim to medical aid only ratios (LTC / MA). Poisoning claims had the highest severity as measured by the LTC / MA ratio at 1.13 followed by traumatic injuries at 1.04. Measuring impact on industry may be more accurately accomplished through determining the percentage of total cost and total days lost attributable to the various nature of injury categories. In terms of percentage of total cost, musculoskeletal injuries accounted for the highest percentage at 53%. By this criteria, among the nature of injury categories musculoskeletal injuries had the largest impact on the pulp and paper industry due to high incidence, despite ranking fifth in terms of mean cost, fourth in terms of mean duration, and last (sixth) with respect to severity as measured by the LTC/MA ratio. Traumatic injuries accounted for the second highest proportion of costs at 20% of claims costs, followed by wound injuries at 16%. Total incidence continues to be the most important indicator of percentage of total cost and total days lost when analyzing the type of accident or exposure field. The type of exposure categories with highest overall incidence account for the highest percentage of costs and days lost. Again, the categories associated with traumatic type injuries (i.e. caught in vs. bodily reaction/exertion) are associated with higher mean claim costs and days lost, and higher lost time claim to medical aid ratios (LTC to MA). With respect to body part injured, mean cost per claim and duration of claim was highest in lower extremity injuries followed by upper extremity injuries and finally spine/trunk injuries. Lower extremity injuries accounted for the highest percentage of total cost followed by upper extremity injuries and lastly spine/trunk injuries. Percentage of total days lost was highest in the upper extremity followed by the lower extremity and lastly the spine/trunk. In terms of severity of injury, measured by the LTC / MA ratio, injuries to the lower extremity were most likely to result in time away from work at .47 followed by spine/trunk injuries at .43 and upper extremity injuries at .38. Analysis of the source of injury/accident field again revealed the source of injury more likely to result in traumatic type injuries (injuries/illnesses due to machinery) were associated with higher mean

claims costs and days lost (also reflected in higher LTC to MA ratios), while overall percentage of claims costs and days lost were largely influenced by overall incidence.

DISCUSSION

Worker characteristics. Conclusions regarding the relative risk of specific worker populations are not possible, given that no information is collected on the industry workforce as a whole. Additionally, the occupation descriptions available describe groups of specific occupations only and the classification scheme used has not been updated since 1971. These limitations make the identification of specific worker groups for intervention based on age, experience, gender, or specific occupation difficult. The strength of the conclusions is further compounded by the percentage of claims with information on worker experience and occupation, 38% and 59% respectively. As musculoskeletal injures were observed to be the most frequently occurring nature of injury, and the cumulative effect of physical exposures related specifically to occupation and duration of employment (experience) are deemed to be important factors in their incidence, the limited information in these data fields is taken to be a very important limitation of the database examined.

Comparison of WCB and BLS incidence rates. Significant differences exist between the incidence rates reported by the BLS and those observed in the pulp and paper manufacturing industry of Alberta from 1997 to 2001. Possible explanations for this disparity include fundamental differences in the industry groups, differences in the reporting structure and data collection methodology, differences in the industrial processes of the two countries, and environmental factors. Differences in the method of determining person years worked between Alberta figures and BLS figures may contribute substantially to differences in incidence rates. Person years worked in Alberta were determined by total insurable earnings divided by average industrial wage, and averaged over five years and adjusted for comparison to BLS incidence rates. BLS data is based on total hours worked by employees during the calendar year. The method used in Alberta may underestimate hours worked by low hourly wage earners and thus over express injury/illness trends in this population. The authors are confident that the comparisons are valid however, given that a complete population of claims collected in Alberta was compared to a sample collected from 178,000 employer reports, based on five year averages, using the same coding structure.

CONCLUSION

It has been demonstrated from the above analyses that as the age of the worker increases mean cost and duration of claim also increases. As the number of days worked increases the nature of injury distribution also changes. Those with a greater amount of experience displayed higher proportions of musculoskeletal injuries and a decreasing number of wound and traumatic injuries. Interestingly, as the days worked increased so too does the likelihood that the source of injury/accident will be the result of exposure to environmental factors. These experience trends suggest that the role of cumulative load in the precipitation of musculoskeletal injuries within this industry should be examined. As well, the effect of worker experience in safe and efficient performance of industrial tasks resulting in less wounds and traumatic injuries should be examined. The distribution of occupational tasks among the experience groups has not been

considered however, and the relative percentage of claims with information must be considered in conclusions. The predominance of musculoskeletal injuries within this industry suggests that intervention strategies directed at the prevention and treatment of musculoskeletal injuries may have the greatest impact on overall claim cost and duration. With regard to the part of body injured, lower and upper extremity injuries have demonstrated the greatest impact on the pulp and paper manufacturing industry, followed by the spine/trunk. Again, interventions focused on body regions in this order, taking into consideration the type of accident/exposure and the source of the injury, have the greatest potential to reduce injuries/illnesses in the pulp and paper manufacturing industry. Large disparities between the incidence rates of specific injury/illness characteristic categories indicate that the survey of occupational injuries and illness is not an accurate indication of the characteristics of accepted compensation claims in the pulp and paper industry group of Alberta, Canada.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the support of the Natural Science and Engineering Council of Canada, the Canadian Institutes for Health Research, the Alberta Heritage Foundation for Medical Research, the University of Alberta, and the Alberta Forest Products Association of Alberta in the completion of this project. In addition the kind assistance of Lloyd Harman (AFPA), Jamie Simpson (WCB), Ian Hooper (AHRE), and May Finstad (WCB) is recognized.

REFERENCES

Alberta Human Resources and Employment. Occupational injury and disease in Alberta: 2001 summary. Edmonton, Alberta: Information Services, Alberta Human Resources and Employment; 2002.

Alberta Human Resources and Employment. Occupational injury and disease in Alberta: 2000 summary. Edmonton, Alberta: Information Services, Alberta Human Resources and Employment; 2001.

Alberta Human Resources and Employment. Occupational injury and disease in Alberta: 1999 summary. Edmonton, Alberta: Information Services, Alberta Human Resources and Employment; 2000.

Alberta Human Resources and Employment. Occupational injury and disease in Alberta: 1998 summary. Edmonton, Alberta: Information Services, Alberta Human Resources and Employment; 1999.

Alberta Human Resources and Employment. Occupational injury and disease in Alberta: 1997 summary. Edmonton, Alberta: Information Services, Alberta Human Resources and Employment; 1998.

Bentley TA, Parker RJ, Ashby L, Moore DJ, Tappin DC. The role of the New Zealand forest industry injury surveillance system in a strategic ergonomics, safety and health research programme. Appl Ergon. 2002;5:395-403.

Bureau of Labor Statistics [homepage on the Internet]. Case and demographic characteristics for work-related injuries and illnesses involving days away from work. 2003b. [cited 2003 15 May]. Available from: http://www.bls.gov/iif/oshcdnew.htm.

Bureau of Labor Statistics [homepage on the Internet]. Industry injury and illness data. 2003a. [cited 2003 May 15]. Available from: http://www.bls.gov/iif/oshsum.htm#00Illness%20Data.

Canadian Standards Association. Z795-1996 (Reaffirmed 2001): Coding of Work Injury or Disease Information. Etobicoke, Ontario: Canadian Standards Association; 2001.

CANSIM [database on the Internet]. Ottawa, Ontario: Statistics Canada; 2003 (a). Table number 281-0023: Employment (SEPH), unadjusted for seasonal variation, by type of employee for selected industries classified using the North American Industry Classification System (NAICS), monthly (Persons). Available from: http://cansim2.statcan.ca.

CANSIM [database on the Internet]. Ottawa, Ontario: Statistics Canada; 2003 (b). Table number 281-0024: Employment (SEPH), unadjusted for seasonal variation, by type of employee for selected industries classified using the North American Industry Classification System (NAICS), annual (Persons). Available from: http://cansim2.statcan.ca.

CANSIM [database on the Internet]. Ottawa, Ontario: Statistics Canada; 2003 (c). Table number 379-0017: Gross Domestic Product (GDP) at basic prices, by North American Industry Classification System (NAICS), annual (Dollars). Available from: http://cansim2.statcan.ca.

Dominion Bureau of Statistics. Occupational classification manual census of Canada, 1971. Based on Canadian Classification and Dictionary of Occupations. Ottawa, Ontario: Information Canada; 1971.

Jinadu MK. A case-study of accidents in a wood processing industry in Nigeria. West Afr J Med. 1990;1;63-8.

Layne LA, Landen DD. A descriptive analysis of nonfatal occupational injuries to older workers, using a national probability sample of hospital emergency departments. J Occup Environ Med. 1997;9:855-65.

Macfarlane I. Forestry injuries and fatalities in New Zealand. J Trauma. 1980;5:413-416.

Marshall SW, Kawachi I, Cryer PC, Wright D, Slappendel C, Laird I. The epidemiology of forestry work-related injuries in New Zealand, 1975- 88: fatalities and hospitalizations. N Z Med J. 1994;988:434-7.

Reurink J. Manager, economic analysis and forecasting. Policy and business information, Alberta economic development. 2003; personal communication.