Workdays Lost Due to Occupational Injuries Among Young Workers in Brazil

Vilma S. Santana, MD, PhD,[1]* Andrés Villaveces, MD, PhD,[2] Shrikant I. Bangdiwala, PhD,[3] Carol W. Runyan, PhD,[4] and Paulo Rogério Albuquerque-Oliveira, PhD[5]

Background *The severity of non-fatal work-related injuries has seldom been examined among young workers. We estimated the extent and distribution of workdays lost due to non-fatal work injuries using compensation data.*

Methods *Data are from the Brazilian Institute of Social Insurance, for 2006. The study population is comprised of all insured workers of age 16–24. Descriptive statistics reflect workdays lost due to health-related disability, according to sex, age group, wage, and trade.*

Results *Out of 4.8 million insured workers ages 16–24 years, we estimated 1,282,940 workdays lost. We observed a larger number of median workdays lost among males age 20–24 in retail and service trades (83 days) and among 16–19-year-old females in the agriculture/fish/forestry/cattle (142 days).*

Conclusions *Young workers experience a heavy burden of work-related injuries. Disability workdays may compromise school attendance and performance. Other potential impacts affect productivity and social insurance costs.* Am. J. Ind. Med. 55:917–925, 2012. *© 2012 Wiley Periodicals, Inc.*

KEY WORDS: young workers; occupational injuries; workdays lost; disability workdays; workers compensation data

INTRODUCTION

According to the International Labor Organization, the proportion of youth employed has been declining globally, but the absolute number increased by 34 million between 1998 and 2008. This corresponds to over 600 million young workers, of which 220 million were 15–19 years old and 394 million were in the age group 20–24 years in 2008 [ILO, 2010]. Several studies [Salminen, 2004; Lewko et al., 2010; Walters et al., 2010] reported an increased risk for non-fatal occupational injuries among young workers (16–24 years of age) when compared to other age groups. However, the severity of injuries, which may play a role in lost productivity, health costs, school attendance and performance, has received little attention. The severity of occupational injuries frequently is analyzed using the number of workdays lost. In the United States, data from the Survey of Occupational Injuries and Illnesses show that injured workers under age 18 had a median of 4 days away from work due to disability, between 1992 and 1997. Occupational injuries requiring

[1]Federal University of Bahia, Institute of Collective Health, Program of Environmental and Workers Health, PISAT, Salvador, Bahia, Brazil

[2]Department of Epidemiology, Injury Prevention Research Center, University of North Carolina at Chapel Hill, Gillings School of Global Public Health, Chapel Hill, North Carolina

[3]Department of Biostatistics, Injury Prevention Research Center, University of North Carolina at Chapel Hill, Gillings School of Global Public Health, Chapel Hill, North Carolina

[4]Department of Epidemiology and Colorado Injury Control Research Center, Colorado School of Public Health, Aurora, Colorado

[5]Ministry of Social Security of Brazil, University of Brasilia, Faculty of Technology, Brasilia, Distrito Federal, Brazil

Contract grant sponsor: National Council of Scientific and Technologic Development of Brazil, CNPq; Contract grant number: 301533/2008-3;

Contract grant sponsor: Health Ministry, Department of Science and Technology; Contract grant number: DECIT 400896/2005–6;

Contract grant sponsor: National Center for Injury Prevention and Control; Contract grant number: R149 CE000196.

Disclosure Statement: The authors report no conflicts of interests.

*Correspondence to: Prof. Vilma Sousa Santana, MD, PhD, Federal University of Bahia, Institute of Collective Health, Campus Universitario do Canela, Rua Augusto Vianna s/n, Salvador, Bahia, Brazil 40110-060. E-mail: vilma@ufba.br

Accepted 30 June 2012

DOI 10.1002/ajim.22099. Published online 27 July 2012 in Wiley Online Library (wileyonlinelibrary.com).

over 20 days away from work occurred more often among males than females (9.8% vs. 9.0%) [US Department of Labor, 2000]. In 2001, also in the US, the National Institute of Occupational Safety and Health reported that work injuries among adolescents 14–15 years of age, requiring at least 21 days away from work, represented 2.2% of recorded cases, while among those 16–19 years old, the proportion was 16.1% [Runyan et al., 2006]. This supports the observation that worker injury severity is high in these both age groups. Studies focusing on specific trades like logging [Mujuru et al., 2006] or mining industries [Laflamme et al., 1996; Margolis, 2010], regardless of circumstances of occurrence (contact, handling, falls, or overexertion) [Margolis, 2010] revealed similar results. Distinctively, a Turkish study using data from cases treated in emergency departments found that adolescents 15–24 years of age had a higher median number of workdays lost than did those of older ages [Serinken et al., 2008]. However, using follow-up data of injured cases from emergency services in Brazil, Santana et al. [2009] did not find age differences in severity as measured by workdays lost.

In West Virginia in the US, Ehrlich et al. [2004] observed that among persons with compensated work injuries, the proportion of patients under 19 years requiring surgery was lower (2%) relative to adults (5.7%). Males more frequently required surgery than females (2.3% vs. 1.08%). McCall et al. [2007] using Oregon Workers' Compensation data from 1990 to 1997 reported that indemnity days were slightly higher among women compared to men (22.7 vs. 22.1), and lower (15.9 days) for 16 year olds compared to 19 year olds (24.4 days). They also reported that construction (33.2 days), agriculture (32 days), and logging (30.8 days) were the trades with longer average disability workdays for compensated occupational injuries among adolescents, while cases from food/drinking establishments experienced the shortest disability times (16.4 days). Using similar data from Rhode Island, Horwitz and McCall [2005] estimated 13 workdays lost per claim among adolescents age 15–19 and 15.8 lost workdays for adolescents of age 15 compared to 19 year olds (13.8 days). Compensated work-related injuries from logging and mill industries (54.5 days), trucking, warehousing and storage (34.5 days), personnel supply services (27.3 days), and construction (25.7 days) respectively, had the largest durations of work disability among adolescents.

In Brazil, one third of the labor force is insured by the National Institute of Social Insurance that entitles workers to compensation of health-related disabilities with special benefits for work-related injuries and illnesses. However, in 2006, among workers 16–24 years old only 13.4% were insured. Entitlement for compensation benefits requires at least 15 disability workdays [Santana et al., 2011], a longer requirement time than in other countries [McCall et al., 2007]. No previous estimates of duration of compensation benefits for work-related injuries among adolescents were found for Brazil. Data on severity, the potential impact on productivity and costs of work-related injury among young workers, can support the establishment of work injury prevention as a priority in occupational health policies in the country. While jobs covered by the social insurance (i.e., the compensation system) were expected to be safe because they are registered in the Labor and Employment Ministry and subjected to labor inspections, insured young workers 16–24 years of age have a high cumulative incidence rate of work-related injuries of 2.9/1,000 workers [Santana et al., 2011]. In this study, we examine the severity of compensated work-related injuries among young insured workers, and describe the age, sex, salaries, and trade distributions with respect to workdays lost.

METHODS

We used 2006 records of the Brazilian Ministry of Social Insurance, through the National Institute of Social Insurance, (INSS) which maintains the Information System of Compensation Benefits (SUB), examining data for workers aged 16–24 years. The study protocol was approved by the Internal Review Board of the Institute of Collective Health, Federal University of Bahia, which is certified by the Brazilian National Health Commission of Ethics in Research. Funding for occupation-related health benefits comes from the Work Injuries Insurance (*Seguro Acidentes de Trabalho, SAT*), which is mandatory for private firms. Self-employed, domestic workers, public officers, and the military are not covered. Each SAT insured worker is entitled to general or work-related compensation benefits or special indemnities when the number of disability workdays is 15 or more days. Employers are responsible for maintaining the workers' salaries for shorter disability times when worker become unable to work. Every injured worker is examined by occupational physicians who evaluate the diagnosis, assess if it is work-related, determine its severity and how many days away from work are to be expected. For injuries, further clinical complications, or recurrences of the same event, result in an extension of the compensated time under the same registration number. We considered in this analysis only work-related benefits related to temporary disability caused by injuries. In our analysis, we excluded repeated injuries and used only the most recent one, independent of its severity, and only when benefits were actually paid to the worker.

Definition of Variables

We define as occupational injuries all cases classified by the International Classification of Diseases and

Injuries (ICD-10) under Chapter XIX, codes S00–S99 and T00–T98, certified by INSS occupational physicians as related to an occupational cause (i.e., factors from the workplace, when performing job-related activities out of the workplace, or when commuting). ICD codes for external causes of injuries were not available in this database. We estimated the total number of workdays lost using records from the time of initiation of compensation (i.e., when the worker effectively started to receive the benefit), to the corresponding closure of the case. We added 15 days to each individual number of workdays lost to obtain the total workdays lost. Because of its non-normal distribution we studied the median number of workdays lost per benefit, and when applicable, created a dichotomous variable with cutoff at the 90th percentile of the total distribution.

We did not use statistical inference tests because the data consisted of the total population of work-related compensations. For this descriptive analysis, we stratified subjects by age and sex. Compensation benefits reflect monthly salaries of each worker up to the maximum value of US$1,800.00. These were categorized into quartiles for descriptive purposes, as follows (in US dollars): 1st quartile: <$163.00, 2nd: $164.00–$203.00; 3rd: $204.00–$257.00; 4th: $257.00 or more. To classify trades, we used the Brazilian National Classification of Trades (CNAE), matched to the International Standard Industrial Classification of All Economic Activities, ISIC, version 4.0, from the United Nations, and aggregated the original four-digit codes into six trade groups that concentrate adolescents: (a) agriculture/fishing/forestry/cattle; (b) extraction industries, including mining, quarrying; (c) all manufacturing industries, and its more common subgroups, that is, food/beverage, textile, logging, metallurgic, and others); (d) construction; (e) retail; and (f) services, and its common subgroups of food/lodging, transport/warehouse/communications, and other services. These data are collected for administrative purposes, and the database is anonymous with respect to individuals and firms.

RESULTS

In 2006, there were 4.8 million insured workers in Brazil, and 14,499 compensations for temporary occupational injuries among people ages 16–24. This corresponds to a total of 1,283,519 workdays lost, including workdays lost before eligibility for indemnity to be paid (Table I). Total workdays lost varied from 30 to 591 among work-related injury compensated claims closed in 2006.

Sex and Age

Males experienced 86.9% of all workdays lost (n = 1,115,951) and women 13.1% (n = 167,491). Similar male to female proportion ratios were estimated in each of the two age groups studied, with males exceeding the female proportions more than sixfold. Overall, the median number of compensated workdays lost due to work injuries was 74, with males consistently experiencing slightly greater work loss than females in each of the two age groups (Table I). For both males and females, the median workdays lost was slightly greater in the older group (20–24).

Salaries

In addition to sex and age differences, we observed socioeconomic disparities in the number, median, and 90th percentile of workdays due to occupational injuries among young workers (Table II). Among males 16–19 years old, the proportion of lost workdays due do compensated occupational injuries was 36.0% in the lowest salary quartile compared to only 13% in the highest salary quartile. In contrast, the median lost workdays observed in the 1st salary quartile (68 days) rose to 75 days within the 4th quartile in this same age–sex group; however, the 90th percentile ranged only from 149 to 151 days across the salary groups. In the group of males 20–24 years old, this trend changed. The proportion of workdays lost in the higher salary group (30%) was greater than in the 1st quartile of salaries (22.0%), while the 90th percentile of workdays lost ranged from 158 to 170 days accordingly, between the bottom and top wage groups.

Trends were different for 16–19-year-old females. Although the proportion of workdays lost by occupational injuries was higher in the lowest salary group (41.9%) when compared to those workers in the upper salary range (8.5%), there was no clear pattern for the median number of workdays lost, and the 90th percentile fell from 154 days (lowest salary group) to 120 days among those in the highest wage group. For the group of females aged 20–24 years, the relation between salary and occupational injury disability time showed no clear patterns except for slightly higher median workdays lost among persons with lower salaries.

Trade Groups

We also found major differences in the distribution of workdays lost by trade groups (Table III). For males, the numbers of disability workdays were higher in the ''manufacturing industries'' group, 42.0% (82,563 days) within the 16–19 age group compared to 40.5% (372,216 days) for those age 20–24 years. Among females in both age groups, workdays lost were most common in retail, followed by the manufacturing industries, and services categories. Table III also shows differences in the median duration of workdays lost across industry groups within sex and age categories. Among males age 16–19 years of age, the longest median disability time for compensated

TABLE I. Number of Compensated Occupational Injuries (15 or More Days), Workdays Lost and Median Days by Benefit, According to Sex and Age Groups, Brazil, 2006

		Workdays lost for severe occupational injuries			
Age groups/sex	No. of compensated claims	Cumulative workdays lost for all claims	%	Median workdays lost per claim	90th percentile of workdays lost per claim
16–19 years	2,658	226,652	100.0	70	153
Males	2,290	196,554	86.7	71	153
Females	368	30,098	13.3	66	150
20–24 years	11,841	1,056,867	100.0	75	160
Male	10,218	919,397	87.0	75	164
Females	1,623	137,470	13.0	72	149
16–24 years (all)	14,499	1,283,519	100.0	74	159
Males	12,508	1,115,951	86.9	74	161
Females	1,991	167,568	13.1	70	149

TABLE II. Distribution of Workdays Lost by Injury (15 or More Days), According to Sex, Age Group, and Salary Quartiles, Brazil, 2006

		Workdays lost for severe occupational injuries			
Age groups/sex	No. of compensated claims	Cumulative workdays lost for all claims	%	Median workdays lost per claim	90th percentile of workdays lost per claim
Males					
16–19 years					
Salary quartile					
1st	851	70,679	36.0	68	149
2nd	634	54,416	27.6	71	152
3rd	510	45,937	23.4	74	169
4th	295	25,522	13.0	75	151
20–24 years					
Salary quartile					
1st	2,262	201,995	22.0	75	158
2nd	2,367	207,387	22.5	73	157
3rd	2,613	234,663	25.5	75	162
4th	2,976	275,352	30.0	77	170
Females					
16–19 years					
Salary quartile					
1st	142	12,641	41.9	69	154
2nd	118	8,281	27.6	60	122
3rd	74	6,612	22.0	73	178
4th	34	2,564	8.5	62	120
20–24 years					
Salary quartile					
1st	413	34,026	24.7	69	142
2nd	458	39,045	28.4	72	142
3rd	428	35,832	26.1	73	147
4th	324	28,567	20.8	74	158

TABLE III. Workdays Lost From Compensated Occupational Injuries (15 or More Disability Days) by Sex, Age Groups and Trade, Brazil, 2006

	Males				Females			
Variables	No. of Injuries	Cumulative workdays lost for all claims	%	Median workdays lost per claim	No. of Injuries	Cumulative workdays lost for all claims	%	Median workdays lost per claim
16–19 years of age	2,290	196,554	100.0	71	367	30,098	100.0	66
Agric/fishing/forestry/cattle	82	6,334	3.2	60	3	416	1.4	142
Extraction industries	16	1,116	0.6	67	3	244	0.8	92
Manufacturing industries	1,022	82,563	42.0	65	124	9,455	31.4	61
Food/beverages	259	19,547	9.9	62	43	3,938	13.1	68
Textile/clothing/shoes	168	13,444	6.8	61	41	2,781	9.2	57
Logging	97	8,480	4.3	67	7	519	1.7	81
Metal mechanic	92	7,351	3.7	71	2	171	0.6	86
Other industries	406	33,741	17.2	68	31	2,046	6.8	59
Construction	97	8,706	4.4	79	8	510	1.7	52
Retail	667	60,983	31.0	78	133	11,412	37.9	72
Services	406	36,852	18.7	77	97	8,061	26.8	69
Food/lodging	61	5,537	2.8	78	28	2,160	7.2	66
Transport/communication	57	5,643	2.9	87	2	257	0.9	129
Other services	288	25,672	13.1	76	67	5,644	18.8	70
20–24 years of age	10,211	919,397	100.0	75	1,623	137,470	100.0	72
Agric/fishing/forestry/cattle	331	26,430	2.9	67	21	1,333	1.0	50
Extraction industries	129	10,807	1.2	75	13	979	0.7	61
Manufacturing industries	4,429	372,216	40.5	68	439	34,865	25.4	67
Food/beverages	1,073	83,789	9.1	64	146	10,730	7.8	62
Textile/clothing/shoes	546	46,151	5.0	71	103	7,925	5.8	63
Logging industry	354	32,497	3.5	76	28	2,142	1.6	62
Metal industry	514	44,868	4.9	70	23	1,902	1.4	67
Other industries	1,942	164,911	17.9	68	139	12,166	8.8	77
Construction	645	60,411	6.6	79	20	1,815	1.3	90
Retail	2,582	247,001	26.9	83	509	45,303	33.0	77
Services	2,102	202,532	22.0	83	621	53,175	38.7	74
Food/lodging	242	23,781	2.6	84	121	10,589	7.7	75
Transport/communication	463	44,631	4.9	80	38	3,594	2.6	76
Other services	1,397	134,120	14.6	84	462	38,992	28.4	74

occupational injuries occurred in the transport/communication (87 days), construction (79 days), food/lodging and all retail (78 days each) groups, respectively. In contrast, within the 20–24-years-old male group, the highest median lost workdays occurred among those in food/lodging and other services, each with a median of 83 days lost. Among the females, the range of lost workdays was from 52–142 days in the 16–19-year-old group and 50–90 in the 20–24-year-old group. However, a small number of 16–19-year-old women had a large number of days lost; three cases in the agriculture/fishing/forestry/cattle trade; two in the transport/warehouse/communication group, and three from the extraction. Among 20–24-year-old women, the higher median workdays lost occurred in construction (median of 90 days), followed by ''other manufacturing'' industries and retail trades, each with a median of 77 days of work loss.

Tables IV and V show the proportions and median lost workdays by the three most common types of occupational injuries for males and females; fractures of the lower limbs, fractures of the upper limbs; and amputations. Worth mentioning is the large number (n = 1,027) of occupational amputations experienced by young workers in only 1 year: 213 among 16–19-year-old males, and 728 in the 20–24-year-old males (Table IV), while females (Table V) experienced 86 amputations, 21 in the younger (age 16–19) and 65 in the older (age 20–24) group. Among males, amputations were the most common type of compensated work injury in the logging industry in both age groups with 25 cases (25.8% of all injuries in

TABLE IV. Distribution of Compensated Occupational Injuries by Major Type of Injuries, Proportions, and Median Workdays Lost Among Males, Brazil, 2006

	Fractures of lower limbs		Fractures of upper limbs		Amputations		Other	
Variables	N (%)	Median workdays lost per claim	N (%)	Median workdays lost per claim	N (%)	Median workdays lost per claim	N (%)	Median workdays lost per claim
16–19 years of age	447 (100.0)	98	701 (100.0)	68	213	82	929 (100.0)	62
Agric/fish/forest/cattle	13 (15.9)	89	25 (30.5)	60	9 (11.0)	91	35 (42.6)	60
Extraction industry	—	—	8 (50.0)	68	—	—	8 (50.0)	65
Manufacturing industries	135 (13.2)	85	294 (28.8)	64	129 (12.6)	73	464 (45.4)	60
Food/beverages	30 (11.6)	90	69 (26.6)	60	23 (8.9)	62	137 (52.9)	60
Textile/clothing/shoes	23 (13.7)	162	48 (28.6)	61	18 (10.7)	76	79 (47.0)	56
Logging	6 (6.2)	69	18 (18.6)	77	25 (25.8)	64	48 (49.5)	62
Metal mechanic	12 (13.0)	72	32 (34.8)	59	15 (16.3)	74	33 (35.9)	77
Other industries	64 (15.8)	81	127 (31.3)	75	48 (11.8)	77	167 (41.1)	60
Construction	25 (25.8)	85	31 (32.0)	74	5 (5.2)	98	36 (37.1)	68
Retail	180 (27.0)	104	214 (32.1)	74	47 (7.1)	90	226 (33.9)	65
Services	94 (23.2)	105	129 (31.8)	67	23 (5.7)	92	160 (39.4)	68
Food/lodging	12 (19.7)	107	18 (29.5)	62	4 (6.6)	74	27 (44.3)	81
Transport/communication	19 (33.3)	111	18 (31.6)	88	2 (3.5)	305	18 (31.6)	58
Other services	63 (21.9)	104	93 (32.3)	67	17 (5.9)	92	115 (39.9)	70
20–24 years of age	2,155 (100.0	97	3,087 (100.0)	71	728 (100.0)	83	4,248 (100.0	65
Agric/fish/forest/cattle	65 (19.6)	91	85 (25.7)	74	21 (6.3)	87	160 (48.3)	60
Extraction industry	29 (22.5)	77	27 (20.9)	78	9 (7.0)	106	64 (49.6)	62
Manufacturing industries	689 (15.6)	91	1,335 (30.2)	66	456 (10.3)	78	1,946 (44.0)	62
Food/beverages	158 (14.7)	88	278 (25.9)	62	87 (8.1)	77	550 (51.3)	61
Textile/clothing/shoes	85 (15.6)	92	170 (31.1)	64	54 (9.9)	81	237 (43.4)	63
Logging	47 (13.3)	91	101 (28.5)	77	75 (21.2)	82	131 (37.0)	63
Metal mechanic	69 (13.4)	95	176 (34.3)	67	65 (12.7)	83	203 (39.6)	61
Other industries	330 (17.0)	89	611 (31.5)	67	175 (9.0)	76	826 (42.6)	62
Construction	146 (22.6)	96	196 (30.4)	72	35 (5.4)	92	268 (41.6)	71
Retail	702 (27.2)	106	819 (31.7)	77	124 (4.8)	90	937 (36.3)	68
Services	524 (24.9)	110	624(29.7)	75	83(4.0)	100	871 (41.4)	74
Food/lodging	74 (30.6)	109	62 (25.6)	71	6 (2.5)	76	100 (41.3)	67
Transport/communication	141 (30.5)	113	132 (28.5)	75	12 (2.6)	120	178 (38.4)	66
Other services	309 (22.1)	108	430 (30.8)	75	65 (4.7)	99	593 (42.4)	76

this industry) in the younger group and 75 (21.2%) in the older group. Though females experienced far fewer cases, the patterns were similar to males by age groups and with the majority of cases occurring in agriculture and logging.

DISCUSSION

Our findings reveal that severe non-fatal occupational injuries reflect a large disability burden for young workers in Brazil, especially males. For both sexes, the younger group (ages 16–19) appears to have more socioeconomic disparities in the number and proportion of workdays lost from occupational injuries, relative to salary, than the older group (age 20–24). However, only small differences by salary group were observed for the median and the 90th percentile of disability work time lost. Manufacturing industries, retail, and services together comprised the majority of compensated work injuries for young workers under age 25 of both sexes though few events were reported among females of ages 16–19 years in the agriculture/fishing/forestry/cattle and transport/warehouse/communications groups. However, these groups had the highest median compensated disability time for work-related injuries. Fractures of lower limbs, upper limbs and amputations were the three most common lesions among compensated injuries in all age–sex groups considered. Of note is the high median workdays lost for fracture of lower limbs in the service trade for males in both age groups,

TABLE V. Distribution of Compensation Claims by Major Type of Lesions, Proportions and Median Workdays Lost Among Females, Brazil, 2006

	Fractures of lower limbs		Fractures of upper limbs		Amputations		Other	
Variables	N (%)	Median workdays lost per claim	N (%)	Median workdays lost per claim	N (%)	Median workdays lost per claim	N (%)	Median workdays lost per claim
16–19 years of age	91 (100.0)	92	91 (100.0)	61	21	55	165 (100.0	61
Agric/fish/forest/cattle	—	—	—	—	1 (33.3)	204	2 (66.7)	106
Extraction industry	1 (33.3)	92	—	—	—	—	2 (66.7)	76
Manufacturing industries	19 (15.5)	91	42 (34.2)	59	13 (10.6)	48	49 (39.8)	60
Food/beverages	5 (11.6)	177	15 (34.9)	59	2 (4.7)	113	21 (48.8)	77
Textile/clothing/shoes	9 (22.0)	69	11 (26.8)	50	6 (14.6)	48	15 (36.6)	57
Logging	1 (14.3)	138	3 (42.9)	63	2 (28.6)	61	1 (14.3)	81
Metal mechanic	—	—	1 (50.0)	89	—	—	1 (50.0)	82
Other industries	4 (12.9)	52	12 (38.7)	61	3 (9.7)	55	12 (38.7)	50
Construction	5 (62.5)	50	1 (12.5)	64	1 (12.5)	30	1 (12.5)	54
Retail	42 (31.6)	106	26 (19.6)	83	6 (4.5)	83	59 (44.4)	58
Services	24 (24.7)	81	22 (22.7)	61	—	—	51 (52.6)	74
Food/lodging	2 (7.1)	77	5 (17.9)	61	—	—	21 (75.0)	66
Transport/communication	1 (50.0)	165	—	—	—	—	1 (50.0)	92
Other services	21 (31.3)	74	17 (25.4)	60	—	—	29 (43.3)	79
20–24 years of age	398 (100.0)	85	354 (100.0)	75	65	79	806 (100.0)	64
Agric/fish/forest/cattle	4 (19.1)	58	1 (4.8)	42	3 (14.3)	58	13 (61.9)	46
Extraction industry	1 (7.7)	202	4 (30.8)	70	1 (7.8)	68	7 (53.9)	59
Manufacturing industries	57 (13.0)	81	120 (27.3)	65	35 (8.0)	78	227 (51.7)	63
Food/beverages	19 (13.0)	81	39 (26.7)	62	9 (6.2)	68	79 (54.1)	60
Textile/clothing/shoes	15 (14.6)	100	23 (22.3)	65	3 (2.9)	78	62 (60.2)	60
Logging	3 (10.7)	45	9 (32.1)	69	7 (25.1)	73	9 (32.1)	61
Metal mechanic	3 (13.0)	90	5 (21.7)	51	4 (17.4)	70	11 (47.8)	61
Other industries	17 (12.2)	77	44 (31.7)	73	12 (8.6)	83	66 (47.5)	78
Construction	8 (40.0)	94	6 (30.0)	90	—	—	6 (30.0	55
Retail	162 (31.8)	92	100 (19.7)	80	12 (2.4)	113	235 (46.2)	64
Services	166 (26.7)	75	123 (19.8)	78	14 (2.2)	92	318 (51.2)	67
Food/lodging	23 (19.0)	77	21 (17.4)	66	5 (4.1)	106	72 (59.5)	73
Transport/communication	8 (21.1)	103	3 (7.9)	78	—	—	27 (71.1)	63
Other services	135 (29.2)	73	99 (21.4)	78	9 (2.0)	83	219 (47.4)	67

and males' elevated number of amputations (n = 941), with a high proportion in the logging industry. Among females, the patterns were less clear.

The examination of the burden of work-related injuries among young workers contributes to understanding the potential impact on productivity and on education, particularly among the group of workers between ages 16 and 19 who are expected to be in high school through age 18. In this group, there were over 200,000 workdays lost, which probably also represents missed school attendance. We estimated a total of more than 1.28 million workdays lost in just 1 year, though this likely reflects only a fraction of the problem because these data are limited to the most severe cases and to formally hired workers.

The Labor and Employment Ministry in Brazil only registers formal occupations, and safety and legal standards are only enforced and measured in these settings. Consequently, little data exist in regards to informal settings and the magnitude of the problem is likely bigger. Nevertheless, this study shows how important occupational injuries can be for both the economy and also to education, regardless of the health care-related costs, compensation and indemnities, and other direct and indirect costs. Youth labor may also represent poor health indicators at a national level. A study of 83 middle- and low-income countries found that the proportion of youth employment was positively correlated with worse health indicators among youth [Roggero et al., 2007]. It is conceivable that work-related disability can increase school dropout rates. The male burden exceeds female estimates, which is consistent with higher school dropout rates among Brazilian males [Souza et al., 2011], who also had

the largest burden of workdays lost by occupational injuries. However, there are other factors such as hazardous work exposures and poor access to schools or health services that can modulate school attendance [Hesketh et al., 2006].

Comparisons with other studies are difficult because criteria for occupational injuries and illnesses compensation practices and recording differ across countries. In the US, there are state variations that make national comparisons impossible [Walters et al., 2010]. The average workdays lost reported in Rhode Island [Horwitz and McCall, 2005], is different from those in Oregon [McCall et al., 2007]. In addition, some authors group musculoskeletal disorders with injuries as they assume the former can be related the latter. Our data show an overall median of 74 workdays lost per occupational injury benefit, much longer than the 22.3 days [McCall et al., 2007] and 13.0 days per claim [Horwitz and McCall, 2005] reported in the US literature and also longer than the estimate reported by Serinken et al. [2008] of only 10 days among adolescents age 15–24 in Turkey seeking emergency care. However, these cases are likely not as severe as those from our compensation database. We could find no data about disability work time by sex. However, overall, an increased trend on the average duration of disability time reported by McCall et al. [2007] is similar to our findings, though different from the inverse found by Horwitz and McCall [2005].

We observed a positive relationship between wages and disability work loss duration among males from 16 to 19 years of age; a pattern not clearly seen in older age groups. This could be due to an effect of stronger pressures to return to work promptly among the poor who are disproportionately represented in the young age group where threats of job loss are prevalent within a context of high unemployment among youth [ILO, 2010]. Low wage young workers also have less bargaining power to negotiate with employers who may withhold their salaries, rather than pay compensation benefits.

Regarding the distribution of workdays lost by trade, our results differ from other studies that found the longest to be in the logging/mill [Horwitz and McCall, 2005; McCall et al., 2007], and construction trades [McCall et al., 2007], However, our comparisons are limited because rather than using means, we used medians as they are more appropriate given the skewed distribution of the variable. Extended lost workdays have also been reported in the trucking/warehousing/storage and in the services industries, as exemplified by personnel supply services [Horwitz and McCall, 2005]. Differences in work-related injury severity may be a result of variations in young workers labor protection laws or uneven enforcement across trades and geographic regions and jurisdictions.

The occurrence of severe work-related injuries among teenagers 16–19 years, such as amputations, is a worrisome trend. Although we do not have data to confirm the extension of functional disability among them, these injuries could potentially have life-long emotional effects [Eggert, 2010]. Though work injuries are known to cause several financial, occupational, and family consequences [Brown et al., 2007], the majority of studies examine only adults. However, Koehoorn et al. [2008], using a large community-based cohort and examining compensation data from British Columbia, Canada, reported that adolescent workers suffering work-related injuries were more likely to have medical visits, particularly females, caused by clinical signs, symptoms, and ill-defined health problems, as late as 9 years after the event.

A few female cases from the agriculture/fishing/forestry/cattle and logging industries had very long work absence times. This may be the result of poor access to insurance benefits, and limited knowledge and awareness about compensation benefit rights, helplessness facing the long bureaucratic pathway required to file a compensation claim, or the limited number of INSS agencies in regions where these workers are placed [Fehlberg et al., 2001]. Furthermore, underreporting of work-relatedness of less severe injuries may be more likely to occur in areas where health services are scanty or of poor quality [Fehlberg et al., 2001].

Finally, the use of a large administrative database poses several challenges for epidemiological analyses, but also presents many advantages. In Brazil, annual reports based on compensation data are available in the INSS website but no information on workdays lost is provided. This large database requires complex data cleaning, handling of missing or unusual data, and there were no ICD-10th Rev Chapter XX codes, limiting the ability to point to preventive interventions. Future qualitative or epidemiological studies focusing on injured young workers and addressing consequences of these events could help clarify causes and potential pathways to establish prevention programs. Our data are useful for considering policy priorities and other prevention efforts and for addressing the types of behavioral norms that may affect adolescent engagement in hazardous jobs. For instance, norms regarding jobs in the agriculture/fishing/cattle/forestry for females <19 years need to be urgently reviewed. In addition, jobs in service trades, though usually considered safe, are not necessarily safe. Consequently, the actual activities that young populations are doing in these settings and their work environments need to be better understood modified accordingly.

ACKNOWLEDGMENTS

Funding: National Council of Scientific and Technologic Development of Brazil, (CNPq), Health Ministry, Dept of Science and Technology, DECIT 400896/2005-6,

and CNPq award grant to Vilma Sousa Santana (No. 301533/2008-3). Partial funding from the National Center for Injury Prevention and Control through grant R149 CE000196 to the University of North Carolina Injury Prevention Research Center.

REFERENCES

Brown JA, Shannon HS, Mustard CA, McDonough P. 2007. Social and economic consequences of workplace injury: A population-based study of workers in British Columbia, Canada. Am J Ind Med 50(9):633–645.

Eggert S. 2010. Psychosocial factors affecting employees' abilities to return to work. AAOHN J 58(2):51–55.

Ehrlich PF, McClellan WT, Hemkamp JC, Islam SS, Ducatman AM. 2004. Understanding work-related injuries in children: A perspective in West Virginia using the state-managed workers' compensation system. J Pediatr Surg 39(5):768–772.

Fehlberg MF, dos Santos IS, Tomasi E. 2001. Acidentes de trabalho na zona rural de Pelotas, Rio Grande do Sul, Brasil: Um estudo transversal de base populacional. Cad Saúde Pública 17(6):1375–1381.

Hesketh T, Gamlin J, Woodhead M. 2006. Policy in child labour. Arch Dis Child 91(9):721–723.

Horwitz IB, McCall BP. 2005. Occupational injury among Rhode Island adolescents: An analysis of workers' compensation claims, 1998–2002. JOEM 47(5):473–481.

International Labour Office. 2010. Global employment trends for youth: Special issue on the impact of the global economic crisis on youth. Geneva: International Labour Office.

Koehoorn M, Breslin FC, Xu F. 2008. Investigating the longer-term health consequences of work-related injuries among youth. J Adolesc Health 43(5):466–473.

Laflamme L, Menckel E, Lundholm L. 1996. The age-related risk of occupational accidents: The case of Swedish iron-ore miners. Accid Anal and Prev 28(3):349–357.

Lewko JH, Runyan CW, Tremblay CL, Staley JA, Volpe R. 2010. Workplace experiences of young workers in Ontario. Can J Public Health 101(5):380–384.

Margolis KA. 2010. Underground coal mining injury: A look at how age and experience relate to days lost from work following an injury. Saf Sci 48:417–421.

McCall BP, Horwitz IB, Carr BS. 2007. Adolescent occupational injuries and workplace risks: An analysis of Oregon workers' compensation data 1990–1997. J Adolesc Health 41(3):248–255.

Mujuru P, Singla L, Helmkamp J, Bell J, Hu W. 2006. Evaluation of the burden of logging injuries using West Virginia workers' compensation claims data from 1996 to 2001. Amer J Ind Med 49:1039–1045.

Roggero P, Mangiaterra V, Bustreo F, Rosati F. 2007. The health impact of child labor in developing countries: Evidence from cross-country data. Am J Public Health 97(2):271–275.

Runyan CW, Schulman MD, Ta M. 2006. Adolescent employment: Relationships to injury and violence. In: Liller K, editor. Injury prevention for children and adolescents: Integration of research, practice, and advocacy. Washington, DC: American Public Health Association, p 163–190.

Salminen S. 2004. Have young workers more injuries than older ones? An international literature review. J Saf Res 35(5):513–521.

Santana VS, Xavier CS, Moura MCP, Oliveira R, Espirito-Santo JS, Araujo G. 2009. Severity of occupational injuries treated in emergency services. Rev Saude Publica 43:5–10.

Santana VS, Villaveces A, Runyan CW, Bangdiwala SI. 2011. Oliveira PRA 2011 incidence of severe work-related injuries among young adult workers in Brazil—Analysis of compensation data. Inj Prev. DOI: 10.1136/injuryprev-2011-040113.

Serinken M, Karcioglu O, Zencir M, Turkcuer I. 2008. Direct medical costs and working days lost due to non-fatal occupational injuries in Denizli, Turkey. J Occup Health 50:70–74.

Souza AP, Ponczec V, Rocha BO. 2011. Os Determinantes do Fluxo Escolar entre o Ensino Fundamental e o Ensino Médio. Fundação Getúlio Vargas, C-Micro Working Paper Series No. 286.

US Department of Labor. 2000. Report on the Youth Labor Force, 2000: Chapter 6. Occupational injuries, illnesses and fatalities. Revised November, 2000 ed. Washington, DC: US Department of Labor, 56–67.

Walters JK, Christensen KA, Green MK, Karam LE, Kinci LD. 2010. Occupational injries to Oregon workers 24 years and younger: An analysis of workers' compensation claims, 2000–2007. Amer J Ind Med 53:984–994.