Short Communication

OCCUPATIONAL ACCIDENTS AND INJURIES: RESULTS OF A SAFETY PREVENTIVE PROGRAMME

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The purpose of this study was to establish and compare the number and the average annual rate of occupational accidents and traumatic injuries in two industrial plants (textile production, and manufacture of metal products) between 1993 and 2002 and to estimate the effects of a safety programme introduced in textile industry. Textile industry plant has been implementing a programme for the surveillance and prevention of occupational accidents and injuries since 1997. From 1998 to 2002, the average annual rates of accidents and injuries rates and the severity ratio of injuries in this plant dropped significantly, which was not the case with metal production plant. The safety training programme produced the best results with the youngest and the oldest workers with less than five years of job experience.

KEY WORDS: *manufacture of metal products, safety training programme, textile industry, transition, workers*

Injuries are the leading cause of morbidity and mortality among workers. Thousands of people are killed in industrial accidents every year, and the number of disabling injuries is staggering. Many workers suffer job-related injuries that result in lost working hours, medical treatment, loss of consciousness, restriction of work or motion, or transfer to another job. Today injuries continue to claim lives, inflict physical and psychological damage and consume the resources of workers and their families. The overall human, social, and financial toll of traumatic occupational injury is enormous, rivalling the burden imposed by such health threats as cancer and cardiovascular disease (1, 2). The direct cost (lost wages, medical and rehabilitation payments, insurance administrative costs, property loses, production loses) and indirect cost (cost associated with pain and suffering by workers and family members) of occupational injuries in the USA are estimated to about US$ 30 billion a year (3). Potential risks for work-related injuries include workload, psychosocial and organizational factors (4). Machinery-related injuries are the second leading cause of traumatic occupational fatalities (5). Reducing the risk of occupational accidents requires a combination of a safe work environment, comprehensive training for workers and implementation and enforcing systematic management. Implementation of preventive programmes is also an important task.

The purpose of this study was to establish and compare the number and average annual rate of occupational accidents and traumatic injuries in two industrial plants (textile industry and manufacture of metal products) between 1993 and 2002, and to estimate the effects of a preventive programme in one of them.

SUBJECTS AND METHODS

An injury was defined as occupational if it occurred while working for an employer for a salary or as a volunteer, on or off the employer's premises, while arriving or leaving work, or on a break if on the employer's premises. All injuries, which had resulted in at least one day's absence from work after the day of the injury, were included in the analysis. The injury

was recorded by safety department management and the plant's medical staff. The database includes personal information about employees (e.g. sex, age, education), characteristics of the workplace and the description of the event, injury (injury type and body part injured) and outcome (absence in days, days on which employees reported for work but were assigned to alternative, easier tasks). All analysed injuries meet one or more of the following conditions: medical treatment required restriction of work or motion, transfer to another job or the injury was fatal. The circumstances of each accident were reviewed using variables in the database, including the narrative description of "how the injury occurred", the nature of the injury, the injured worker's job title, and recommendations to prevent future occurrences. External cause of injury in database was based on codes from the International Classification of Diseases (6), excluding only suicide and medical misadventure. Injuries were classified in terms of the general environment in which they occurred, the general mechanisms of injury (motor vehicle collisions, falls etc.), or human factor. Annual rate of accidents was calculated by dividing the number of accidents by the average number of employees in corresponding year and multiplying the result by 1000. Injury rate was calculated by dividing the number of injured workers by the average number of employees in corresponding year and multiplying the result by 1000.

Severity ratio was calculated by dividing the number of lost calendar days by the total number of lost day cases.

The preventive safety programme which was introduced to textile plant in 1997 included screening of workers for vision, hearing and coordination, training in protection from injuries, training in machinery operation, engineering controls, protective equipment, regular controls, education, and the implementation and enforcement of systematic management. All new workers and workers with less than five-year work experience who had been transferred to another job were included in job training programmes.

Statistical analysis used the chi-square test for assessment of the results obtained.

RESULTS

Between 1993 and 2002, 132 occupational accidents were recorded in textile plant. The highest average annual accident rates were recorded in 1995 (13.9 ‰) and 1997 (13.8 ‰). Meanwhile in the manufacture of metal products plant, 247 occupational accidents were recorded. From 1993 to 1997 average annual accident rate was similar in both industries. However, from 1998 to 2002 the average rate of occupational accidents in textile industry plant dropped significantly and was statistically significantly lower than in the manufacture of metal products (Table 1).

Table 1 *Absolute and average annual rates of occupational accidents by industry plants and year. Statistical significance of differences between the textile industry and manufacture of metal products is set at $p<0.05$ and marked by an asterisk.*

Year	Textile industry			Manufacture of metal products		
	Number of accidents	Number of workers	Rate per 1000	Number of accidents	Number of workers	Rate per 1000
1993	18	1408	12.8	25	1957	12.8
1994	23	1687	13.6	26	1954	13.3
1995	22	1586	13.9	27	1931	13.9
1996	21	1546	13.7	25	1895	13.2
1997	20	1454	13.8	24	1732	13.8
1998	6	1649	3.6	25	1854	13.5*
1999	6	1667	3.6	26	1938	13.4*
2000	6	1692	3.5	27	2002	13.5*
2001	5	1386	3.6	26	1945	13.4*
2002	5	1463	3.4	16	1200	13.3*

Table 2 *Absolute and average annual rates of occupational injuries by industry plants and year for the period 1993-2002. Statistical significance of differences between the textile industry and manufacture of metal products is set at $p<0.05$ and marked by an asterisk.*

Year	Textile industry			Manufacture of metal products		
	Number of injured workers	Number of exposed workers	Rate per 1000	Number of injured workers	Number of exposed workers	Rate per 1000
1993	25	1408	17.7	35	1957	17.9
1994	31	1687	18.4	39	1954	19.9
1995	30	1586	18.9	40	1931	20.7
1996	28	1546	18.1	38	1895	20.1
1997	25	1454	17.2	37	1732	21.4
1998	9	1649	5.5	38	1854	20.5*
1999	8	1667	4.8	39	1938	20.1*
2000	7	1692	4.1	42	2002	20.9*
2001	6	1386	4.3	40	1945	20.6*
2002	5	1463	3.4	25	1200	20.8*

Between 1993 and 2002, textile industry recorded 103 occupational accidents at the workplace, 17

Table 3 *Rate of accidents by the type of occurrence and industry plants. Statistical significance of differences in accidents at workplaces between the textile industry and manufacture of metal products is set at p<0.05 and marked by an asterisk.*

Year	Textile industry						Manufacture of metal products					
	Accidents at workplaces		Accidents in traffic at work		Commuting accidents		Accidents at workplaces		Accidents in traffic at work		Commuting accidents	
	N	Rates per 1000	N	Rates per 1000	N	Rates per 1000	N	Rates per 1000	N	Rates per 1000	N	Rates per 1000
1993	16	11.4	1	0.7	1	0.7	22	11.2	1	0.5	2	1.0
1994	18	10.7	3	1.8	2	1.2	22	11.3	2	1.0	2	1.0
1995	18	11.3	2	1.3	2	1.3	23	11.9	2	1.0	2	1.0
1996	17	10.9	3	1.9	1	0.6	22	11.6	2	1.1	1	0.5
1997	16	11.0	3	2.1	1	0.7	20	11.5	3	1.7	1	0.6
1998	4	2.4	1	0.6	1	0.6	22	11.9*	2	1.1	1	0.6
1999	4	2.4	1	0.6	1	0.6	23	11.9*	2	1.0	1	0.5
2000	4	2.4	1	0.6	1	0.6	24	11.9*	1	0.5	2	1.0
2001	3	2.2	1	0.7	1	0.7	23	11.8*	1	0.5	2	1.0
2002	3	2.1	1	0.7	1	0.7	14	11.7*	1	0.8	1	0.8

were traffic accidents which occurred at work and 12 were traffic accidents related to commuting. The differences in accident rates between the textile industry plant and the manufacture of metal products for the period 1998-2002 were statistically significant (Table 3). In the recorded period between 1993 and 2002, 174 workers were occupationally injured in the textile industry plant and 373 in the manufacture of metal products. The number of injured workers in the period from 1998 to 2002 was statistically significantly lower in the textile industry than in the manufacture of metal products (Table 2).

The number of accidents peaked on Mondays and Tuesdays in both industries. The distribution of accidents by months showed four peaks in both industries: January, February, May and September.

The greatest number of accidents occurred between 8 and 10 a.m. (12.9 % in textile industry and 12.1 % in the manufacture of metal products), and between 4 and 6 p.m. (12.9 % in textile industry and 11.3 % in manufacture of metal products) (Figure 1).

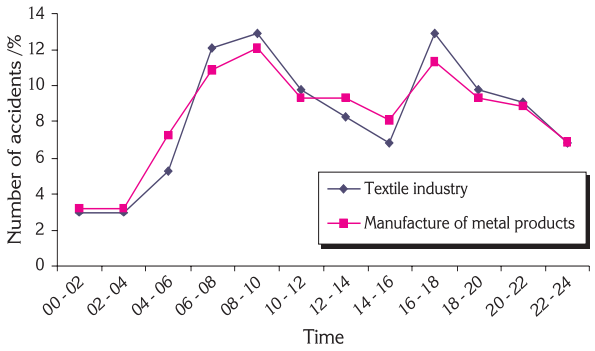

Figure 1 *Distribution of accidents by the time of day*

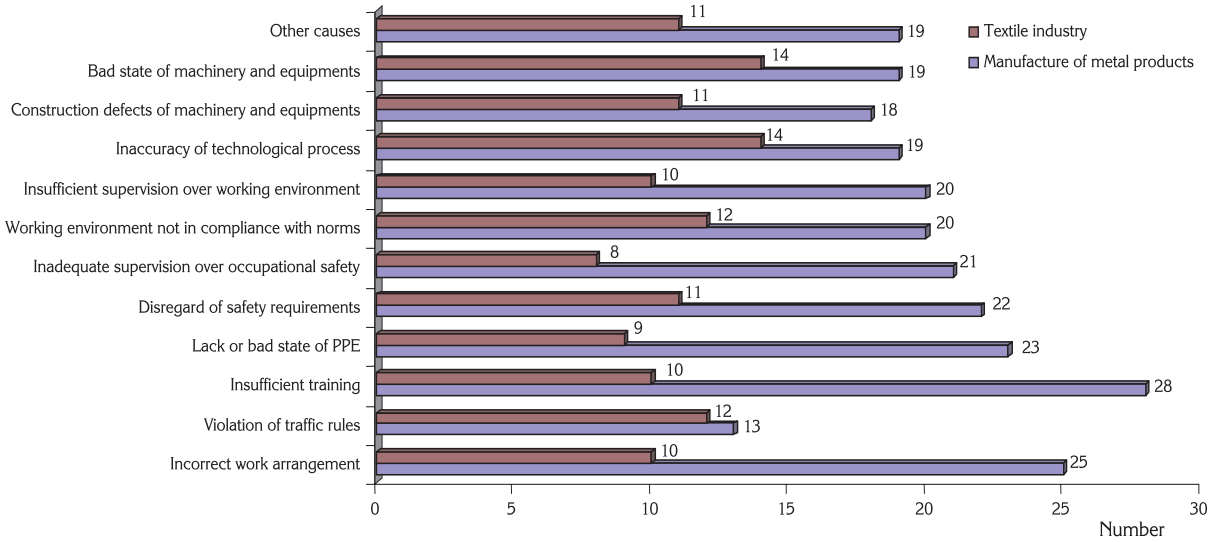

Figure 2 *Distribution of occupational accidents by causes in the manufacture of metal products and in textile industry*

The leading causes of accidents in textile industry plant were the bad state of machinery and equipments (10.6 %) and inaccuracy of technological process (10.6 %) (Figure 2). After the year 1998, the number of accidents caused by inadequate work organization, lack of training, lack or bad state of personal protective equipment, inadequate monitoring of occupational safety and working environment dropped significantly.

The leading causes of accidents in the manufacture of metal products were insufficient training (11.3 %), inadequate work organization (10.1 %) and the lack or bad state of personal protective equipment (9.3 %) (Figure 2). Unlike textile, this industry did not show a drop in the number of accidents due to any of other causes throughout 1998-2002.

The severity ratio of injuries in textile industry plant dropped significantly after 1998, which was not the case with the manufacture of metal products (Table 4). About one third of the injuries in the manufacture of metal products in the period 1993-2002 and in the textile industry in the period 1993-1997 involved young employees with less than five years of work experience.

Table 4 *Severity ratio of injuries in textile industry and manufacture of metal products by year*

Years	Textile industry	Manufacture of metal products
1993	76.9	76.0
1994	76.0	76.1
1995	76.1	76.1
1996	75.9	76.1
1997*	76.6	75.9
1998	59.2	75.0
1999	59.2	76.0
2000	58.4	75.0
2001	59.2	74.9
2002	59.4	74.9

* - introducting of preventive safety program in textile industry

The annual average injury rate in these workers in textile industry dropped significantly after 1998 (Fig 3 and Fig 4) and was statistically significantly lower than in their metal manufacture counterparts ($P<0.05$).

The annual average injury rate in the manufacture of metal products in the period from 1993 to 2002 and in the textile industry in the period from 1993 to 1997 was the highest among workers younger than 30 years. The annual average injury rate in workers under 30 in textile industry dropped significantly after

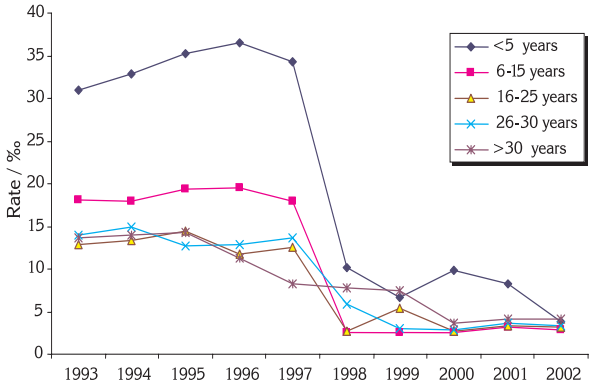

Figure 3 *Annual injury rate by work experience in textile industry, 1993-2002*

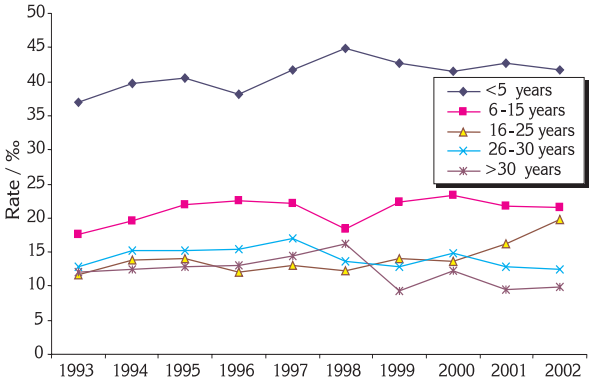

Figure 4 *Annual injury rate by work experience in the manufacture of metal products, 1993-2002*

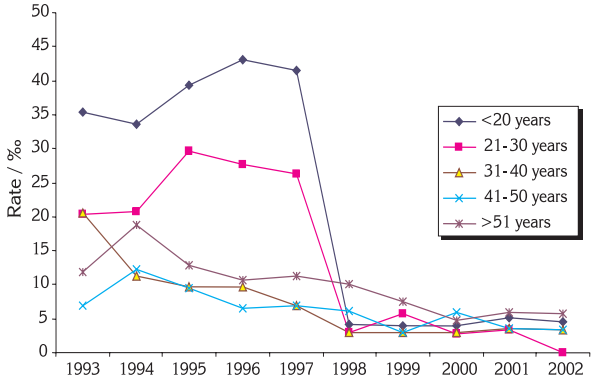

Figure 5 *Annual injury rate by age in textile industry, 1993-2002*

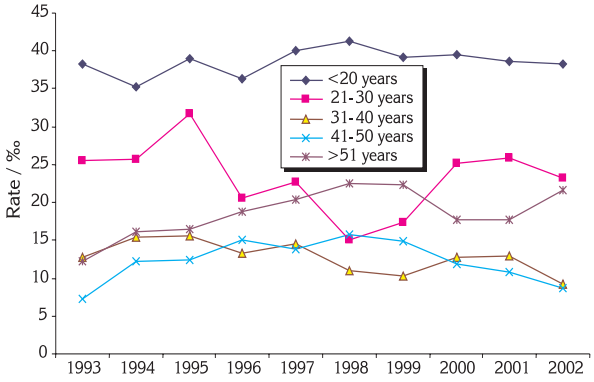

Figure 6 *Annual injury rate by age in the manufacture of metal products, 1993-2002*

Table 5 *Number of injured workers in textile industry after 1998 by work experience (n.s. – difference not significant)*

Work experience years	Included in training			Not included in training			P
	Number of workers	Number of injured workers	Injury rate per 1000	Number of workers	Number of injured workers	Injury rate per 1000	
Under 5	158	1	6.3	104	10	96.2	<0.01
6-15	172	1	5.8	163	4	24.5	n.s.
16-25	149	2	13.4	172	5	29.1	n.s.
26-35	131	2	15.3	160	3	18.8	n.s.
Over 36	115	3	26.1	130	4	30.8	n.s.
Total	725	9	12.4	729	26	35.7	<0.01

Table 6 *Number of injured workers in textile industry after 1998 by age*

Age years	Included in training			Not included in training			P
	Number of workers	Number of injured workers	Injury rate per 1000	Number of workers	Number of injured workers	Injury rate per 1000	
Under 20	185	1	5.4	32	4	125.0	<0.01
21-30	254	1	3.9	50	4	80.0	<0.01
31-40	151	2	13.2	138	3	21.7	n.s.
41-50	147	2	13.6	144	5	34.7	n.s.
Over 51	154	1	6.5	199	12	60.3	<0.05
Total	891	7	7.8	563	28	49.7	<0.001

the year 1998 (Fig 5 and Fig 6) and was significantly lower than in workers of the same age in metal manufacture ($P<0.05$).

The safety training programme introduced in the textile industry significantly improved the safety of workers with less than five years of experience (Table 5) as well as in the youngest and the oldest workers (Table 6).

DISCUSSION

Learning from past occupational accidents and injuries is essential to understanding the risks they carry, to developing prevention and control strategies and to estimating the results of preventive measures. This paper reports on the epidemiology of occupational accidents and injuries which were recorded in a textile industry plant and in a manufacture of metal products in the period of transition in our country, that is, from 1993 to 2002. Safety training and preventive programme has been implemented in the textile industry plant, as described earlier, since the 1997. The transition has seen many workers lose their job and be transferred to another. This change is challenging for all and especially for older workers. The safety training programme included all new workers and workers with job experience under five years, as well as those who were transferred to another job. The training was carried out through small workshops within companies and were generally conducted by foremen.

The circumstances under which injuries occurred provide valuable information that can be used to prevent occupational accidents and injuries. This knowledge based on our previous experience has already been included in the safety programme implemented in the textile industry which has led to a significant drop in the rate of occupational accidents and the resulting number and severity of injuries.

The most common location of the accidents was the workplace. Transport to and from work accounted for many of the accidents. Therefore, work-related passenger transport should be included in occupational health and safety considerations and programmes.

Most accidents occurred on Mondays and Tuesdays. The distribution of accidents by month showed four peaks in both industries. These results are similar to those of other authors (7).

Daily accident peaks were between 8 and 10 a.m. and between 4 and 6 p.m. The peak injury times are similar to the peak injury times from another study

of work injuries and time of day at an industrial worksite (8) and for the peak accident times in the other industries (9). These daily peaks may simply reflect the fact that more persons work on particular working hours than that the relative accident rate has changed during a day. The peaks could also be the result of different operations being performed at different times of day. Without information about the number of workers involved in production at particular times of day or information about the exact operations performed at different hours of the day, it is difficult to relate time of day with the rate of accidents and injuries (10).

One third of the workers studied had one or more occupational accidents and injuries in the first five years of employment. These results are similar to the results of other authors (11). The lack of work experience can contribute to the rate of occupational injuries. To prevent them, new workers require timely effective training (12). Efforts to prevent occupational injuries among new workers will bring benefit to employers, regulatory agencies, the community at large, and young workers themselves. Employers can develop safety training programmes that address young workers' potential lack of experience and skills in recognizing and responding to hazards. To become a skilled worker, one has to meet physical requirements for vision, hearing and coordination, be trained in driving industrial vehicles where required, and pass knowledge tests. Within safety training, each employee should become aware of the hazards associated with that job. Safe working practices and rules should be clearly explained to workers and enforced when appropriate. Senior staff should know and understand the safety rules they are responsible for enforcing.

One of the key findings in this study indicates that the injury rate is the highest among the youngest workers. More than 75 % of injuries involved workers of 40 years of age or younger. The risk of occupational injuries is inversely related to the worker's age (13, 14). Young workers may be at increased risk of injuries occurring at the workplace because they are often inexperienced and unaware of their legal rights as workers. Compared with older workers, young workers tend to move in and out of the workforce and are usually employed on part time (15). Youth employment also tends to be seasonal, peaking in the summer months (16, 17). The seasonal and sporadic nature of youth employment, along with frequent job changes, make it difficult for young workers to obtain the sustained mentoring and experience needed to perform their job safely. It is well known that age is associated specifically with job satisfaction (18). In general, older workers tend to better adjust to work, which is reflected in job satisfaction. Older workers could be more knowledgeable and experienced, displaying more positive attitude to safety, and be more committed to work and willing to comply with safety regulations than younger workers. In transitional countries such as Serbia and Montenegro, older workers in industries, as analysed also in this study, lost their jobs or were transferred to another job. As new workers on another job, older workers showed positive attitude toward safety training programmes.

CONCLUSION

Traumatic occupational accidents and injuries are a significant problem in industry, especially in transitional period. The implementation of safety training programmes may lead to a significant drop in occupational accidents and traumatic injuries. They are most effective among the youngest and the oldest workers and among workers with little experience, as confirmed by this study. Inexperience and lack of training are risk factors for occupational accidents. Passenger, mainly commuter transport accounted for many accidents and should be included in occupational safety programmes.

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Sažetak

NESREĆE I OZLJEDE NA RADU: UČINCI PREVENTIVNIH PROGRAMA SIGURNOSTI NA RADU

Ozljede na radu vodeći su uzrok morbiditeta i mortaliteta radnika. Opći, humani, socijalni i financijski gubici izrazito su visoki. Ozljede na radu odgovornije su za značajniji broj izgubljenih radnih sati, smanjenje produktivnosti i gubitke godina radnog staža nego i jedno drugo bolesno stanje radnika.
Stoga je zakonska obveza provođenje preventivnih programa zaštite i sigurnosti na radu. Međutim, zemlje u tranziciji obilježava izostanak nadzora nad provođenjem zakonskih obveza zaštite na radu pa tako i u vezi s osposobljavanjem radnika za rad na siguran način.
U desetogodišnjem razdoblju od 1993. do 2002. godine u dva poduzeća (tekstilna industrija, obrada metalnih proizvoda) praćen je prosječni godišnji broj nesreća i ozljeda na radu. Od 1993. do 1997. godišnja stopa nesreća koje su za posljedicu imale ozljedu bila je slična u oba poduzeća (od 12,8 ‰ do 13,9 ‰). Od 1997. godine u poduzeću tekstilne industrije počinju se provoditi programi nadzora i prevencije nesreća i ozljeda na radu. Od 1998. do 2002. godine prosječna godišnja stopa nesreća i ozljeda, kao i težina ozljeda u tom kolektivu značajno se smanjuju ($p<0,05$) u odnosu na prethodno razdoblje, što nije slučaj u ručnoj obradi metalnih proizvoda. Godišnja stopa incidencije nesreća koje su za posljedicu imale ozljedu u razdoblju od 1998. do 2002. godine u poduzeću tekstilne industrije iznosila je od 3,4 ‰ do 3,6 ‰, dok se u ručnoj obradi metala i dalje kretala od 13,3 ‰ do 13,5 ‰ ($p<0,05$). Programi obučavanja za rad na siguran način najznačajnije su učinke imali u najmlađih i najstarijih radnika s manje od 5 godina radnog iskustva.

KLJUČNE RIJEČI: *industrija tekstila, radnici, ručna obrada metalnih predmeta, tranzicija*

REQUESTS FOR REPRINTS:

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