NON-FATAL WORK-RELATED INJURIES IN ABO KORKAS SUGAR FACTORY, EL-MINIA, EGYPT; TEN-YEAR SURVEILLANCE FROM 2002 TO 2011

By

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Abstract:

Background: Injuries kill and maim the people, often destroy families, devastate communities and do irreparable harm to society. We are concerned with work-related injuries that are mostly unintentional. Many of the injured workers suffer lifelong disabilities, physical disfigurement and financial ruin. Aim of the study: This study has two main objectives; firstly, surveillance of the non-fatal work-related injuries and secondly, studying the effect of preventive intervention on the occurrence of such injuries. Materials & Methods: Information regarding occupational injuries at Abo Korkas sugar factory was collected during a period of ten years, $2002 \sim 2011$ to get a clear image about the magnitude of the problem of non-fatal work-related injuries in this sugar factory. We collected these data through the medical section of Abo Korkas sugar factory in collaboration with the industrial safety department of the factory. The study included two phases; an appraisal phase of only surveillance during the period 2002~2006 that was followed by an intervention phase 2007~2011 during which we continued surveillance, in addition to interventional preventive program tailored according to data analysis of the appraisal phase. Results: Our results showed that workers in sugar industry are engaged with jobs that expose them to different non-fatal work-related injuries. Hands and feet were the most common body parts to get injured; with the falling objects and workers' falling comprised the frequently reported causes. The incidence rate of the non-fatal occupational injuries declined significantly, from

5.3% on 2002 to 2.3% on 2011, with significant reduction of the injuries-related annual rate of lost work-days from 0.18% on 2002 to 0.09% on 2011.

Conclusions: We conclude that occupational injuries must be considered by the society and policy makers, since much of the occurrence and severity of the injuries can be prevented with the existing technology and with little efforts for workers' safety, organization, education and training. We recommend that a national surveillance system for work-related injuries should be established. Studies that evaluate the available strategies for prevention or reduction of the incidence and severity of injuries in different industries should be implemented.

Key Words: Non-fatal work-related injuries, sugar industry, surveillance, industrial safety.

Introduction

Worldwide, workers are involved in a broad range of industries and occupational activities that render them at a higher risk for acquiring work-related injuries compared to the general population (Bener et al., 2012, Yu et al., 2012).

We are concerned with occupational injuries that are mostly unintentional.

Some work-related injuries can be serious enough to kill and maim the workers, often destroy families, devastate communities and do irreparable harm to the society.

Other injuries are less dangerous to life, and can be named as non-fatal injuries, from which many of the injured workers suffer life long disabilities, physical disfigurement and financial ruin (Zakaria et al., 2005; Alamgir et al., 2006a). To conceptualize the causes of injuries in some industries in Egypt, and demonstrate information on the magnitude and scope of work-related injuries problem we've chosen the sugar industry as a model to start with; and Abo Korkas sugar factory was assigned from amongst the other branches of the sugar company. The factory is located in Abu Korkas district, 20 km south to El-Minia city and about 250 km south to Cairo, Egypt.

Workers in sugar industry are engaged with jobs that expose them to work-related injuries as well as some other hazardous occupational exposures such as noise, heat and air pollutants with potential respiratory risks (Phoolchund, 1991).

As many other factories of sugar industry, Abo Korkas sugar factory processes sugar cane and sugar beet to manufacture edible sugar. Sugar canes are generally washed, after which juice is extracted from them.

The juice is clarified to remove mud, evaporated to prepare syrup, crystallized to separate out the liquor, and centrifuged to separate molasses from crystals. Sugar crystals are then dried and further refined before bagging (Phoolchund, 1991; Kamel et al., 1998).

At Abo Korkas sugar factory, data regarding occupational injuries and its related information were collected during ten years, from January, 2002 till December, 2011.

For this purpose, a brief surveillance format was prepared including, demographic data about the injured worker as well as occupational history and information about each injury and incident during the ten-year surveillance period from 2002 ~ 2011.

From 2002 till 2006 the surveillance data were collected and analyzed to study the trend, types, causes, body sites, workplace location, etc without any intervention. Therefore, we described this surveillance period as appraisal phase.

However, starting from 2007 till 2011, besides the above surveillance system, we implemented an interventional preventive program for controlling non-fatal workrelated injuries. The preventive program was tailored according to the analysis of the surveillance data of the appraisal phase.

In this report, we will present a study regarding the non-fatal work-related injuries in Abo Korkas sugar factory as resulted from ten-year surveillance. Additionally, comparison of the surveillance data before and after applying the interventional preventive program will also be demonstrated.

Aim of the study: This study has two main objectives; firstly, surveillance of the non-fatal work-related injuries and secondly, studying the effect of preventive intervention on the occurrence of such injuries.

Methodology:

In this study, we performed a surveillance of the non-fatal work-related injuries at Abo Korkas sugar factory for a ten-year period from 2002 ~ 2011. The surveillance period was performed on two phases; surveillance with the purpose of appraisal only during the first five years, and surveillance with preventive intervention during the rest of the period.

For this purpose, a brief surveillance format was prepared including,

demographic data about the injured worker as well as occupational history and information about the injury and incident.

The surveillance data included the following items: time, date and location of the incident, action taken by the employer during the incident, opinion of cause by the safety officers, as well as other information specific to the injured person including personal/demographic data and occupational history, nature of injury, loss of work time, and the outcome of the injury (disability or recovery). Also, we collected information about the possible property damage (including machines) with the economic impact on the company.

The number of workers of Abo Korkas sugar factory is kept for the last decade to be around 1400 workers. However, the number is a bit changeable due to inclusion of part-time workers during the working seasons.

Appraisal phase:

During the period from 2002 till 2006 the role of our study was only surveillance and documenting each work-related injury.

Intervention phase:

From the beginning of the year 2007 till 2011 we implemented the surveillance system with additional preventive intervention. The intervention program was designed after analyzing the data of the appraisal phase. Therefore, together with the medical department and the occupational safety department in the factory, we arranged training sessions for the workers that concentrated on safety measures for injuries prevention, checking for the boilers sections to avoid burns as well as regular checking for the slippery floor of the hind portion of the factory and mechanic wards that resulted in workers falling during the appraisal phase.

Then we studied the effect of preventive intervention on the occurrence of the work-related injuries.

The number of injuries during the period from $2002 \sim 2011$ was calculated and the number of lost work-days due to injuries was estimated, then the rate of annual lost work-days was calculated as follows = Number of lost-days 100 ÷ the number of workers 300 days (300 is the average number of work-days per year after subtracting Fridays and national holidays).

Statistical analysis:

Data of the ten-year injuries records were checked, coded, entered and analyzed using SPSS (the statistical package for social sciences) version 19.0 software. Descriptive statistics and frequency distributions as well as tests of significance were performed for the data of the two phases of the study; appraisal and intervention.

P value of less than 0.05 was considered as the cut off value for the probability of chance to consider the existence of a significant difference.

Results

At Abo Korkas sugar factory, during the ten-year surveillance period a total number of 411 workers got injured with various non-fatal work-related injuries. The injury rate ranged from 2.3% to 5.3% with a mean of 3.1%.

The mean age of the 411 injured workers was 43.3 + 9.6 (range: 25 - 58) years old, which had shown no significant difference when compared with the age of the total workers of Abo Korkas sugar factory (42.9 + 10.1).

The pattern of injuries throughout the ten-year surveillance period was a declining trend (Figure 1). The difference between the injury rate of 2002 (5.3%) and that of 2011 (2.3%) was significant (P<0.005). The rate of the lost work-days varied significantly from 0.18% at the year 2002 to 0.09% by 2011 (Table 1).

The mean rate of lost work-days during the appraisal period was 0.126 that decreased significantly to 0.094 during the intervention period (Table 2).

Except for those workers whose ages were below 30 years, the number of injured workers in all other age groups decreased significantly in the intervention than appraisal phase. However, most of the injured workers (66.7%) throughout the ten-year surveillance period were in their forties and fifties, (Table 3).

As regards the injury type, contusions constituted 26% of the total injuries during the 10-years followed by incisions (24.8%) and fractures (22.2%), while burns constituted about 17.5%. Except for cut injuries, all other types of injuries significantly declined during the intervention than the appraisal phase (Table 4).

Falling objects and workers' falling constituted 76.9% of the 10-year non-fatal work injuries while flying objects and burns were 19.7% (Table 5).

Table 6 shows that during the 10-years, hands and feet were the most common body sites to acquire work-related injuries (26.0% for each), then, head and upper limbs come next comprising 15.1% and 10.5%, respectively. The significant

reductions during the intervention phase were observed in the percentages of hands, feet and back injuries when compared with that of the appraisal phase of the surveillance (Table 6).

When analyzed by department of the factory, the hind portion of the factory had the highest rate of injuries (16.2% of total injuries), followed by boilers then

squeezers where 11.9% and 11.7% of the injuries occurred, respectively. Distillation and production sections showed the least percentage of injuries, 6.3% and 5.4%, respectively.

However, during the intervention phase, significant reductions in the injuries rate were observed only in boilers, schamander section and mechanic wards (Table 7).

Year	Total number of workers	No. of injured workers in a year (% from total workers)	No. (%) of lost work-days /year	Rate of lost work-days/year
2002	1195	63 (5.3%)*	646 (15.1)*	0.18*
2003	1378	45 (3.3%)	465 (10.9)	0.11
2004	1203	42 (3.5%)	463 (10.8)	0.13
2005	1504	51 (3.4%)	437 (10.3)	0.10
2006	1214	39 (3.2%)	403 (9.4)	0.11
2007	1368	39 (2.9%)	391 (9.2)	0.10
2008	1296	34 (2.6%)	373 (8.7)	0.10
2009	1484	38 (2.6%)	364 (8.5)	0.08
2010	1165	28 (2.4%)	362 (8.5)	0.10
2011	1376	32 (2.3%)*	365 (8.6)*	0.09*
Total	13183	411 (3.1%)	4269 (100.0)	0.11

Table 1: A ten-year surveillance of non-fatal work-related injuries and lost work-days at Abo Korkas sugar factory, El-Minia, Egypt, 2002 ~ 2011.

* = P-value is <0.05 (Significant) i.e., there is a significant decline between 2002 and 2011 regarding annual incidence rate of work-related injuries as well as rate of lost work-days.

Table 2 : Comparison between the appraisal and interventional surveillance phasesregarding the non-fatal work-related injuries, number and rate of lost work-days at Abo Korkas sugar factory, El-Minia, Egypt, 2002 ~ 2011.

Work-related Injuries and lost work-days	2002 ~ 2006 (Appraisal Phase) No. (%)	2007 ~ 2011 (Interventional Phase) No. (%)	Total No. (%)
No. (%) of injured workers	240 (3.7%)	171 (2.6%)*	411 (3.1%)
No. (%) of non-injured workers	6254 (96.3%)	6518 (97.4%)	12772 (96.9%)
Total number of lost work-days	2414	1855*	4269
Mean number of lost work-days	483	371*	
Mean rate of lost work-days	0.124%	0.09%*	0.11%

* = P-value is <0.05 (Significant)

Table 3: Distribution of the non-fatal work-related injuries among the age groupsduring the appraisal and interventional phases of the ten-year surveillance atAbo Korkas sugar factory, El-Minia, Egypt.

Workers> age	2002 ~ 2006 (Appraisal Phase)	2007 ~ 2011 (Intervention Phase)	Total (%) No. (%)	P-value
~ 30	35 (14.6)	32 (18.7)	67 (16.3)	0.35
31~40	82 (34.2)	61 (35.7)	143 (34.8)	0.038*
41 ~ 50	78 (32.5)	53 (31.0)	131 (31.9)	0.013*
51 ~ 60	45 (18.7)	25 (14.6)	70 (17.0)	0.006*
Total	240 (100.0)	171 (100.0)	411 (100.0)	0.001*

Turingu tama	2002 ~ 2006 (Appraisal	2007 ~ 2011 (Intervention	Total (%)	Dyahua
injury type	Phase)	Phase)	No. (%)	r-value
	No. (%)	No. (%)		
Incision/cut	55 (22.9)	47 (27.5)	102 (24.8)	0.07
Contusion/bruise	67 (27.9)	40 (23.4)	107 (26.0)	0.003*
Burn	42 (17.5)	30 (17.5)	72 (17.5)	0.01*
Fracture	51 (21.3)	40 (23.4)	91 (22.2)	0.03*
Amputation	4 (1.6)	1 (0.6)	5 (1.2)	0.001*
Face / Head injury	21 (8.8)	13 (7.6)	34 (8.3)	0.0001*
Total	240 (100.0)	171 (100.0)	411 (100.0)	0.001*

Table 4: Comparison between the appraisal and interventional phases of the ten-yearsurveillance at Abo Korkas sugar factory, regarding the injuries type.

* = P-value is <0.05 (Significant)

Table 5: Distribution of the causes of the non-fatal work-related injuries during the appraisal and interventional phases of the ten-year surveillance at Abo Korkas sugar factory, El-Minia, Egypt.

Course of injumy	2002 ~ 2006 (Appraisal	2007 ~ 2011 (Intervention	Total (%) No. (%)	P-value
	Phase) No. (%)	Phase) No. (%)		
Cutting object	5 (2.1)	4 (2.3)	9 (2.2)	0.37
Blunt objects	3 (1.2)	2 (1.2)	5 (1.2)	0.32
Flying objects	27 (11.3)	18 (10.5)	45 (10.9)	0.0001*
Falling objects	102 (42.5)	73 (42.7)	175 (42.6)	0.013*
Worker's falling	80 (33.3)	61 (35.7)	141 (34.3)	0.053
Burn	23 (9.6)	13 (7.6)	36 (8.8)	0.009*
Total	240 (100.0)	171 (100.0)	411 (100.0)	0.001*

Table 6:	Distribution of the injuries site of the non-fatal work-related injuries during
th	e appraisal and interventional phases of the ten-year surveillance at Abo
K	orkas sugar factory, El-Minia, Egypt.

Site of injury	2002 ~ 2006 (Appraisal Phase) No. (%)	2007 ~ 2011 (Intervention Phase) No. (%)	Total (%) No. (%)	P-value
Upper limb	21 (8.8)	22 (12.9)	43 (10.5)	0.44
Lower limb	19 (7.9)	16 (9.4)	35 (8.5)	0.31
Hand	72 (30.0)	35 (20.5)	107 (26.0)	0.0001*
Feet	63 (26.3)	44 (25.7)	107 (26.0)	0.03*
Head	31 (12.9)	31 (18.1)	62 (15.1)	0.50
Chest	7 (2.9)	6 (3.5)	13 (3.2)	0.39
Eye	13 (5.4)	10 (5.8)	23 (5.6)	0.26
Back	14 (5.8)	7 (4.1)	21 (5.1)	0.0001*
Total	240 (100.0)	171 (100.0)	411 (100.0)	0.001*

Table 7: Distribution of the non-fatal work-related injuries among the differentfactory departments during the appraisal and interventional phases of the ten-year surveillance at Abo Korkas sugar factory, El-Minia, Egypt.

Department of	2002 ~ 2006 (Appraisal	2007 ~ 2011 (Intervention	Total	
the factory	Phase) No. (%)	Phase) No. (%)	No. (%)	P-value
Distillation	12 (5.0)	14 (8.2)	26 (6.3%)	0.35
Hind portion	35 (14.5)	31 (18.2)	66 (16.2%)	0.31
Squeezers	29 (12.1)	19 (11.1)	48 (11.7%)	0.07
Schamander	17 (7.1)	7 (4.1)	24 (5.8%)	0.02*
Production	11 (4.6)	11 (6.4)	22 (5.4%)	0.05
Boilers	35 (14.6)	14 (8.2)	49 (11.9%)	0.001*
Transportations	15 (6.3)	17 (9.9)	32 (7.8%)	0.36
Factory yard	19 (7.9)	12 (7.0)	31 (7.5%)	0.09
Front portion	26 (10.8)	19 (11.1)	45 (10.9%)	0.14
Outside factory	17 (7.1)	14 (8.2)	31 (7.5%)	0.29
Mechanic wards	24 (10.0)	13 (7.6)	37 (9.0%)	0.035*
Total	240 (100.0)	171 (100.0)	411 (100.0%)	0.001*



Figure 1: Trend of the annual rate of non-fatal work-related injuries among workers of Abo Korkas sugar factory, El-Minia, Egypt during the ten-year surveillance, 2002 ~ 2011.

Discussion

There is a lack of information in the literature regarding the work-related injuries encountered for workers in the sugar industry in Egypt.

Therefore, we performed this study that aimed at having ten-year surveillance for the non-fatal work-related injuries in the sugar industry; taking Abo Korkas sugar factory at El-Minia prefecture as a model that represents the sugar industry in Egypt. The sugar factory of Abo Korkas with other 8 branches constitutes the main company of sugar industry in Egypt.

In this surveillance, we recorded the non-fatal work-related injuries at Abo Korkas sugar factory for 10 years during the period from 2002 to 2011.

From 2002 till 2006 was an "appraisal phase" but from the beginning of the year 2007 till the end of 2011, an additional preventive intervention program was

introduced together with continuing the surveillance system, "intervention phase".

For this purpose, we used a brief surveillance format to be filled out for each incident of occupation-related injuries that occurred in Abo Korkas sugar factory during the ten-year period. Data regarding non-fatal occupational injuries can be obtained from different sources including the Ministry of Manpower and Training (Youssef et al., 1994; Egyptian Social Insurance Law, 1999); however, in our study; we've chosen to depend primarily on our surveillance system for collecting these data from Abo Korkas sugar factory. The numbers and rates derived from the data reported to the Ministry of Manpower Training should be considered and underestimates because they are based on self-reporting by the companies and may not include minor injuries. Also, different industries vary in reporting their workers' injuries (Youssef et al., 1994). On the other hand, workers may over present and magnify the non-fatal injury incidents for purposes of having paid vacations and/or compensations (Alamgir et al., 2006b).

To avoid such reporting and/or data collection bias, we collected these data through the medical section of Abo Korkas sugar factory in collaboration with the industrial safety department of the factory, independently from any other sources.

During our ten-year surveillance period a total number of 411 workers got injured with various non-fatal work-related injuries. The injury rate ranged from 5.3% on 2002 to 2.3% on 2011.

The causes of injuries during the appraisal phase were related to several aspects as follows:

- a) The floors were soiled with oils and grease and/or lubricant oils that are used mainly in mechanic wards and hind portion of the factory.
- b) For some machines the internal running parts were exposed forming risks for injury.
- c) The waste-drainage points were exposed as holes in the ground, where several workers had fallen.
- d) The tubes transmitting the hot water and water vapor were exposed and lie above the ground disturbing workers' movement.
- e) The zero level of the hind portion of the factory is too low, something that was a direct reason for head striking of many workers.

f) For many injuries, the workers were accused of being unacquainted with their work, misconducts or losing concentration while dealing with machines.

The intervention program was designed after analyzing the data of the appraisal phase. Therefore, the preventive measures included training lectures that concentrated on safety measures for injuries prevention, regular checking for the boilers sections to avoid burns as well as regular checking for the slippery floor of the hind portion of the factory and mechanic wards to avoid workers falling. The preventive intervention program was implemented with the help of the medical team of the factory together with the occupational safety department.

Our surveillance data showed that the incidence rate of work-related injuries in the intervention phase was significantly lower than that of the appraisal phase, indicating the effectiveness of the preventive interventional program (Table 1, and Fig.1).

Reduction of the injuries rate that showed a declining trend during the intervention phase of the study was accompanied by reduction in severity of injuries as well as the rate of lost work-days (Table 2). Similar findings were observed by previous studies which attributed the high rates of incidence of injuries, its severity and lost work days to the unsafe workplace conditions which could be controlled by simple intervention measures (Kamel et al., 1998 ; Mock et al., 2005 ; Coleman and Kerkering, 2007; Keyserling and Smith, 2007).

Regarding the age of workers, there were significant differences between the injuries rates in the appraisal and interventional non-fatal surveillance phases for all workers in the age groups above the age of 30 years. However, for those workers whose ages were below and up to 30 years, no significant difference was detected (Table 3). This difference can be explained by the annual recruitment of unskilled workers as seasonal part time workers. Those workers are mostly untrained, un-skilled and un-acquainted with the surroundings; therefore they get many injuries compared to the older experienced workers. Studies from different countries and different occupations confirm such findings and consider younger employees are more prone to counter more injuries (Kamel et al., 1998 ; Lehtola et al., 2008a; Abas et al., 2011).

Moreover, almost all types of injuries significantly, declined during

the intervention than the appraisal phase (Table 4). These significant reductions were observed in the percentages of hands, feet and back injuries (Table 6), as well as the causes of injuries such as flying objects or burns (Table 5). These results are consistent with other researches that applied preventive intervention programs to control occupational injuries (Rivara and Thompson 2000 ; Mock et al., 2008b; Lehtola et al., 2008b).

When analyzed by factory departments, significant reductions in the injuries rate during the intervention phase were observed in boilers, schamander "beet" section and mechanic wards (Table 7).

Our study confirmed that much of the work-related injuries and its severity can be prevented with the existing preventive measures with little efforts for workers' safety, organization, education and training. But our occupational health and safety system and our society through its policy makers have chosen not to give the attention and resources to the problem.

Surveillance is proved necessary to determine the exposure involved, the hazardous processes, and the risky departments. It could also direct us to develop or maintain counter measures to reduce or eliminate injuries when the exposures are determined and wellrecognized (Perry et al., 2005; Patterson and Shappell 2010).

Workers' characteristics are considered as a determinant factor for work-related injuries (Ghaffar et al., 1999; Ghosh et al., 2004). In most of the official reports of injuries, we found that the workers were accused of being unacquainted with their work, and the causes included workers' misconduct, negligence or losing attention when dealing with machines,...etc.

However, at Abo Korkas sugar factory, injuries were not that dangerous, but we have to recognize that, in some instances injuries represent a greater direct threat to the human well-being than does AIDS or cancer. Many of the injured workers suffer lifelong disabilities, physical disfigurement and financial ruin (Krug et al., 2000; Coleman and Kerkering 2007).

This lack of concern probably reflects the failure to appreciate the means available to reduce injuries, plus the widely held view that injuries stem from personal behavior or irresponsible acts. However, it is ironic that the same view has not been openly expressed for the AIDS epidemic, which, in fact, is connected directly to personal behaviors. The incidence rate of injuries among the non-formal "seasonal" workers was about 16%, which indicates that the untrained workers were at risk for workrelated injuries. However, their jobs are mostly related to loading/unloading but they are still exposed to a considerable risk of injury that can be attributed to their being un-trained. In the same regard, a study by Abas and co-workers showed that the nongovernmental employees and unskilled workers were confirmed to have a high risk of work-related injuries (Abas et al., 2011)

About 9% of injuries were recurrent during the 10-year surveillance period. However, the percentage of recurrence of injuries decreased from 23 (9.6%) during the appraisal phase to 14 (8.2%) during the intervention phase, which was not significant.

Based upon the 10-year surveillance study with its appraisal and intervention phases we can recommend that:

 Workers must be educated about the potential hazards in working with machines. Adequate training programs for workers have to be implemented to improve their working skills. Training programs should include safety measures and orientation regarding work hazards and how to avoid workrelated injuries as well as first aid measures.

- Injuries related to certain machines and equipment can be prevented by using machine guards and safety devices, which will prevent workers from being exposed to the moving and dangerous parts.
- Providing posters for training about the operating steps and safe handling of the machines as well as warning about the faulty and dangerous handling of different machines is beneficial as a preventive tool for work-related injuries.
- Avoiding recruiting unskilled and untrained workers will reduce the potential high incidence of workrelated injuries. Since short-term employment workers and informal employees will not have enough skills, appropriate experience or personal protective equipment and they may be unaware of the hazards associated with their work activities. These concerns are very important for prevention of work related injuries (Mahmud et al., 2010).
- Industrial-employed physicians should be encouraged to share in workers'

safety programs, join the postgraduate courses for master and doctor degrees of Occupational and Industrial Medicine and search for opportunities that improve their knowledge through the continuous medical education programs, e-learning and scientific meetings, workshops and conferences of Occupational Medicine.

Finally, we conclude that occupational injuries must be considered by the society and policy and decision-makers, since much of the occurrence and severity of the injuries can be prevented with the existing technology with little efforts for workers' safety, organization, education and training. Our recommendation is that a national system for surveillance work-related injuries should be established. Studies that evaluate the available strategies for prevention or reduction of the incidence and severity of injuries in different industries should be implemented.

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