

# Work-related injuries in young workers: an Italian multicentric epidemiological survey

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**Summary.** Emergency departments records from 33 hospitals were reviewed to disclose work-related injuries occurred in teen-subjects living in 14 Italian cities. During January-June 2000, 317 work-related injuries were reported. Male subjects, 17 year old, working in the industrial field, resulted the most affected, probably due to the fact that among young workers this sex and age class is the most represented one. Cluster analysis identified two groups of work-related injuries: one includes mainly transportation injuries causing lower extremities or multiple body sites traumas. The other is more strictly related to specific working tasks and includes mostly traumas and cut wounds in hand/wrist and head, together with eye lesions. A more intensive supervision on the use of protective equipment, a more appropriate training in hazard recognition and safe work practices, including operation of vehicles in the work site, must be implemented to reduce work-related injuries.

**Key words:** work-related injuries, young workers, epidemiology, prevention.

**Riassunto** (*Infortuni lavorativi in minori: risultati di una indagine epidemiologica multicentrica*). Il fenomeno relativo agli infortuni lavorativi in minori è stato valutato consultando i dati dell'attività di Pronto Soccorso di 33 Ospedali distribuiti in 14 città italiane. Nel periodo gennaio-giugno 2000, si sono verificati 317 infortuni lavorativi (19 casi per 1000 minori lavoratori) prevalentemente a carico di soggetti diciassetenni, di sesso maschile, impiegati nel comparto industriale. Una *cluster analysis* ha permesso di identificare due diverse tipologie di infortunio: i casi avvenuti *in itinere*, prevalentemente traumi multipli o alle estremità, e gli infortuni più specificamente legati alle attività lavorative caratterizzati da lesioni al polso, mano, capo e occhi. Il fenomeno degli infortuni lavorativi in minori è apparso di entità non trascurabile e richiede l'identificazione e l'implementazione di adeguate misure di controllo e di prevenzione.

**Parole chiave:** infortuni lavorativi, minori, epidemiologia, prevenzione.

## INTRODUCTION

Many adolescents are somehow involved in working activities all over the world. In USA between 1996-98 a monthly average of about 3 million young workers during school months and of 4 million during summer time was estimated; in the 12 member states of the European Union in 2001 there were about 1,5 million of teen workers and in Italy 68 workers per 1000 aged 14 to 17 years were observed in the period 1994-97 [1-3]. These numbers probably underestimate the actual amount of the problem, since some Italian surveys highlighted that more than 14% of teens have work

experiences before the age of 15, and that irregular or illegal work positions in minors are very common and completely replace the regular forms of work in some fields and regions [4, 5].

Work related injuries in 14-17 teens represent a main issue in public health, even though too often neglected, as they are an important cause of premature mortality and disability. Young workers are injured more frequently than adults for several reasons, including inexperience, insecurity, absent-mindedness; the damage suffered by young worker implies heavier human, social and economic consequences compared

to an adult worker [6-12]. Between 1992 and 2000 in USA an annual average of 67 workers under the age of 18 died from work related injuries; 77 000 young workers required treatment in hospital emergency rooms during 1998 [1, 8]. In Italy 16 596 work related injuries in 14-17 year old subjects were reported, in 2000, for compensation claims, to the Italian Workers' Compensation Authority (INAIL), moreover, a survey carried out in 15 Italian provinces, evaluating data collected by INAIL, reported 10 351 work related injuries among 14-17 year old adolescents during the period 1994-1998, with a rate of 24.8 injuries per 10<sup>4</sup> residents of the same age and a rate of 80 events per 1000 14-17 years old workers [3, 13].

Initiatives aimed at preventing injuries and improving minors working condition have been undertaken all over the world: in 1999 the International Labour Organisation (ILO) set up the International Program on the Elimination of Child Labour (IPEC) and adopted the "Worst Forms of Child Labour Convention", ratified in Italy by the Law 148/2000, that prohibits the worst forms of labour among young workers and declares the need of an immediate action for their elimination [14-16].

In 2003 the National Institute for Occupational Safety and Health (NIOSH) in USA published an alert document, directed to young workers, to their employers, educators and parents, that underlined the importance of preventing deaths, injuries and occupational illnesses among young workers [1]. The European Commission highlighted that a continuous decrease of injuries and professional diseases has an essential role in the Community strategy on health and safety at work (2002-2006), and the Italian Government set up a national plan of action and intervention in defence of minors rights during growth and in protection of young workers [17-19].

In Italy, minors' work activity is regulated by law (L 977/1967, DL 345/1999): from 2002 teen workers must be 15 years old at least, except special derogation for show business and sport activities [19, 20]. However, the Law on the School Reformation promulgated in 2003 establishes the compulsory schooling until the age of 14, even though it guarantees the right to receive education until the age of 18. Fourteens, therefore, have to wait one year between the scholastic giving up and the possibility to be regularly employed: this could favour adolescents involvement in different forms of illegal job [21].

This study is aimed to describe the work related injuries phenomenon in Italian minors and it is an integrating part of a multicentric survey funded by Italian Ministry of Labour and Welfare in 1999 (DM 20.10.1998; research project n. 1045). At the moment this survey is one of the few Italian epidemiological studies on this subject covering large areas with different social and economic characteristics. Data *ad hoc* about work related injuries requiring medical assistance at emergency departments, occurred in 14-17 year old subjects in several municipalities located all over Italy, were collected and then analysed in order to

highlight the main characteristics of the work related injuries in Italian teens and to identify the most important preventive intervention areas and policies.

## METHODS

Information concerning injuries occurred from January and June 2000 among adolescents living in 14 Italian cities distributed all over the Italian territory (Catania, Catanzaro, Ferrara, Frosinone, L'Aquila, Macerata, Modena, Monza, Napoli, Perugia, Roma, Rovigo, Sassari, Verona) was collected by reviewing the general and specialist First Aid/emergency records archives in 33 different hospitals. Data were recorded by a trained staff who operated in collaboration with hospital management teams and in accordance with the current Italian legislation on privacy and health data treatment [22, 23].

All injuries occurred in 14-17 year old subjects in the period January-June 2000 were selected from hospital records. Injuries were defined as events caused by a violent external cause producing one or more lesions [24]. Work-related injuries were easily identified as they were routinely specified in the medical records when occurring during working activities or *in itinere*, that is during the way to or back from the working place.

Information was reported in a specifically designed form composed of three different sections. In the first part personal data of the injured subject, according to privacy law, and the main characteristics of injury occurrence were collected. In the second part data about procedures carried out in emergency departments were recorded; finally, in the third part diagnoses, body sites involved in the accident, and days of prognosis were reported and the injury was classified according to the International Classification of Diseases (10<sup>th</sup>-revision) [25].

All information was codified in a database and subsequently analysed using the statistical package SPSS ver. 10.0 for Windows [26]. Bivariate association between qualitative variables was estimated using  $\chi^2$  test. Finally, a cluster analysis was carried out in order to identify subgroups sharing similar traits within the entire work related injuries group. The cluster analysis was performed including only qualitative variables and applying the aggregating hierarchic methodology and the mean link within groups algorithm.

Incidence rates have been calculated using two different denominators: the 14-17 years old population resident in the 14 municipalities involved in the study in 2000 (approximately 250 000 subjects), and 14-17 year old working population (approximately 17 000 subjects). The latter was calculated taking into account a prevalence of young workers equal to 6.8 per 100 adolescents observed in previous surveys carried out in the same areas [3, 27].

## RESULTS

During January-June 2000, among 14-17 year old subjects living in 14 Italian cities (about 250 000

subjects) 13 423 injuries requiring hospital assistance occurred (6-month incidence: 54 events per 1000 subjects). Occupational injuries were 317 (2.4% of all injuries), with a 6-month incidence rate of 1.5 cases per 1000 resident adolescents and 19 cases per 1000 working adolescents.

As reported in *Table 1* occupational injuries recorded in the investigated areas mostly occurred at the working place (85.5%) while *in itinere* injuries, road crashes during commuting, either while driving or on-board vehicles, represent the 14.5% of all events. Only in less than a half of the episodes the work compartment

**Table 1** | Main characteristics of work-related injuries occurred in 14 Italian provinces in 14-17 year old subjects (January-June 2000)

Work related injuries (no. = 317)			Work related injuries (no. = 317)		
	no.	%		no.	%
<b>Location</b>			<b>Hour</b>		
<i>In itinere</i>	46	14.5	9-17	135	61.6
Working place	271	85.5	Other	84	38.4
<b>Work field</b>			Missing	98	-
Industry	100	70.9	<b>Diagnosis*</b>		
Manufacturing	16	11.3	Trauma	120	38.1
Public administration	11	7.8	Open cut wound	70	22.2
Construction	8	5.7	Dislocation, sprain, strain	49	15.6
Other	6	4.3	Lesion/foreign body in the eye	37	11.7
Missing	176	-	Fracture	26	8.3
<b>Sex</b>			Excoriation, abrasion	18	5.7
Males	286	90.2	Other	24	7.6
Females	31	9.8	<b>Body site*</b>		
<b>Age</b>			Hand/wrist	123	39.0
14	19	6.0	Upper extremity (arm, elbow, forearm)	36	11.4
15	27	8.5	Head/neck	50	15.8
16	100	31.5	Eye	37	11.7
17	171	53.9	Ankle/foot	29	9.2
<b>Geographic area</b>			Lower extremity (leg, thigh, knee)	37	11.7
North Italy	213	67.2	Multiple body sites	20	6.3
Centre Italy	61	19.2	Trunk	12	3.8
South Italy and Islands	43	13.6	<b>Days of prognosis</b>		
<b>Month</b>			1-3	69	23.2
January	26	8.2	4-7	120	40.4
February	56	17.7	8-21	92	31.0
March	56	17.7	>21	16	5.4
April	48	15.1	missing	20	-
May	51	16.1	<b>Hospital admission</b>	14	4.6
June	80	25.2	<b>Life danger</b>	2	0.6
<b>Day</b>			<b>Fatalities</b>	0	-
Monday	44	15.5	<b>Injury classification</b>		
Tuesday	63	22.3	Active injuries	79	34.3
Wednesday	60	21.2	Passive injuries	50	21.7
Thursday	48	17.0	Transportation accident	56	24.3
Friday	53	18.7	Contact with dangerous materials and/or substances	24	10.4
Saturday	11	3.9	Falls	12	5.2
Sunday	4	1.4	Other	9	3.9
Missing	34	-	Missing	87	-

\*multiple diagnoses and affected body sites per subject were sometimes reported.

**Table 2** | Main characteristics of work-related injuries occurred in 14 Italian provinces in two groups of 14-17 year old subjects identified by a cluster analysis (January-June 2000)

	Group A (no. = 207)	Group B (no. = 88)	no. %	$\chi^2$ Test	
	no.	%			
<b>Sex</b>					
Males	183	88.4	82	93.2	
Females	24	11.6	6	6.8	P = n.s.
<b>Age</b>					
14-15	31	15.0	11	12.5	
16-17	176	85.0	77	87.5	P = n.s.
<b>Geographic area</b>					
North Italy	136	65.7	62	70.5	
Centre Italy	43	20.8	13	14.8	
South Italy and Islands	28	13.5	13	14.8	P = n.s.
<b>Location</b>					
In itinere	18	8.7	27	30.7	
Working place	189	91.3	61	69.3	P < 0.001
<b>Injury classification</b>					
Transportation accident	19	12.5	36	53.7	
Active injuries	60	39.5	14	20.9	
Passive injuries	40	26.3	7	10.4	
Contact with dangerous materials and/or substances	19	12.5	5	7.5	
Falls	5	3.3	5	7.5	
Other	9	5.9	-	-	P < 0.001
Missing	55	-	21	-	
<b>Diagnosis*</b>					
Contused, lacerated contused					
cranial-concussional trauma	60	29.0	52	59.1	
Open cut wound	54	26.1	9	10.2	
Dislocation, sprain, strain	31	15.0	15	17.0	
Lesion/foreign body in the eye	37	17.9	-	-	
Fracture	14	6.8	8	9.1	
Excoriation, abrasion	11	5.3	6	6.8	
Other	15	7.2	7	7.9	P < 0.001
<b>Body site*</b>					
Hand/wrist	113	54.6	1	1.1	
Head/neck	46	22.2	1	1.1	
Eye	37	17.9	-	-	
Ankle/foot	16	7.7	12	13.6	
Lower extremity	-	-	34	38.6	
Upper extremity	4	1.9	27	30.7	
Multiple body sites	1	0.5	19	21.6	
Trunk	5	2.4	3	6.8	P < 0.001
<b>Prognosis</b>					
≤ 15 days	188	90.8	78	88.6	
> 15 days	19	9.2	10	11.4	P = n.s.

\*multiple diagnoses and affected body sites per subject were sometimes reported.

had been recorded: industry was the most frequently involved field (70.9%), followed by manufacturing (11.3%), retail trade and services (7.8%) and construc-

tion (5.7%). In less than 20% of the cases the specific task of injured subjects was reported: among them about 40% were labourer/warehousemen.

Most occupational injuries occurred in males (90.2%), in 17 year old teens (53.9%), and among the municipalities involved in the study, in those located in Northern Italy (67.2%). Considering temporal distribution, most work related injuries were observed in June (25.2%), during the week days, above all on Tuesdays (22.3%) and Wednesdays (21.2%), and during the typical working-time (about 62% between 9 am and 5 pm).

Trauma (contused, lacerated-contused, cranial-concussional trauma) was the most frequent diagnosis (38.1%), followed by open cut wound (22.2%) and sprain, dislocation and strain, (15.6%). The diagnosis of lesion/foreign body in the eye was quite common (11.7%) with a frequency ten times higher than in non occupational injuries occurred in the same areas and period.

The mainly affected body sites were hand and wrist (39.0%), head and neck (15.8%), eye (11.7%), lower extremity (11.7%) and upper extremity - except for hand and wrist - (11.4%).

Regarding to injury severity, estimated by the number of days of prognosis, most injuries were minimally severe (within 7 days of prognosis 63.6%), and only 5.4% had more than 21 days of prognosis. Hospital admissions occurred in 4.6% of the episodes only and luckily none fatality was observed.

In order to identify the main characteristics of occurrence, injuries were classified, whenever enough information was available, as suggested by the National Institute of Occupational Safety and Prevention (ISPESL) and by the Italian Workers' Compensation Authority (INAIL) as: "events occurred in an active way ("to hit him/herself with", "to stumble", ...), events occurred in a passive way ("to be crushed" or "to be hit by objects", ...), transportation incidents (crashes during the way to or back from workplace or during work activities involving vehicles), events due to a contact with harmful materials and/or substances and falls" [28].

"Active mode" injuries represent the 34.3% of the events: it suggests an active personal involvement of the adolescent in the episodes due to mistakes or carelessness of the subject. "Passive mode" injuries represent the 21.7% of the cases and indicate both distraction of the individual and a probable involvement in not suitable work activities (too dangerous), together with a defective information on potential hazards related to the performed task. Transportation incidents are also very frequent (24.3%) and are followed by contact with harmful materials and/or substances (10.4%), and falls (5.2%).

In order to disclose environmental and occupational factors contributing to injury occurrence and to identify subgroups with similar traits, a cluster analysis was conducted considering age, sex, place of occurrence, geographic region, prognosis below or above 15 days, diagnosis and body site as clustering variables. The results (Table 2) suggest the presence of 2 main groups of different size: in the first group (Group A), composed by more than 200 subjects, injuries during working ac-

tivities are prevailing (91.3%) and the most frequent diagnoses are: trauma (29.0%), open cut wound (26.1%) and lesion/foreign body in the eye (17.9%). The mainly affected body sites are hand and wrist (54.6%), head and neck (22.2%) and eye (17.9%); in the 9.2% of the cases the prognosis is longer than 15 days.

The second group (Group B) is smaller and includes transportation incidents mainly (53,7%); trauma represents the most prevailing diagnosis (59.1%) followed by dislocation, sprain and strain (17.0%). The body sites more frequently involved are lower extremities (38.6%), upper extremities (30.7%), - except for hand and wrist - and multiple body sites (21.6%). In this subgroup injuries tend to be more severe as the prognosis is longer than 15 days in the 11.4% of the episodes.

Among this second group, moreover, it has been identified a small cluster of severe injuries occurred in the South of Italy within younger subjects (14-15 years old), presenting fractures and dislocations with prognoses longer than 15 days in half of the cases: all injuries occurred in agriculture belong to this group.

## DISCUSSION

The aim of this study was to estimate and describe the work-related injuries occurring in adolescents (14-17 year old) by collecting data from hospital emergency records taking into account 33 hospitals in 14 Italian municipalities. The 14-17 year old population resident in the surveyed areas in 2000, about 250 000 subjects, include approximately 17 000 young workers. Among them, between January and June 2000, 317 nonfatal work-related injuries requiring hospital assistance occurred, with an estimated 6-month incidence equal to 1.5 per 1000 residents of the same age and equal to 19 cases per 1000 young workers.

Even though this value refers to a 6-month surveillance period, it appears lower than the annual incidence of 80 injuries per 1000 young workers observed in a previous survey, carried out in the same areas, based on routine data collected by the Italian Workers' Compensation Authority (INAIL) and referring to the period 1994-98 [3]. Studies based on hospital records probably underestimate the dimensions of the problem due to the fact that not all injuries are reported to emergency departments; this phenomenon has been observed in USA as well, where NIOSH has recently estimated that only one third of the work related injuries can be highlighted in First Aid sites [1].

Within the surveyed areas male subjects, 17 year old, working mainly in the industrial field, are the most affected by work-related injuries, probably due to the fact that industry is the most prevalent activity in the surveyed areas.

Sex and age distribution of the young workers in the areas was not available: however, presumably male subjects, 17 year old are the most involved in working activities.

This situation could be explained by the fact that scholastic giving up is greater in males than in females, which are more likely to be employed in jobs suit-

able to their psycho-physical attitudes than males, as recently highlighted by some national surveys carried out by appointed institutions [4, 5].

Considering the characteristics of the events, the differences in monthly distribution seem to reflect the typical numerical fluctuations of adolescents workers, as most injuries occur in June, probably because of the frequent enrollment in working activities after school term.

The high number of injuries occurring in municipalities located in Northern Italy can be ascribed to two main factors: first, the number of working places in the North is greater than everywhere else in Italy. Second, perhaps reporting of work related injuries among adolescents is more reliable in Northern Italy than in other parts of the Italian territory, where illegal work, specially for adolescents, is a much more widespread reality [4, 5, 29]. Actually, this type of study can identify injuries occurred among regular workers only, and it was not possible to collect information about the different attitudes towards illegal work in different Italian areas.

Injury description suggests that most of the occupational injuries occur within the working place because of careless or decreased attention, a typical phenomenon in adolescents requiring special care to be reduced in working place, but also because adolescents are often involved in dangerous, not appropriate, tasks with inadequate preparation and instructions about safe operating procedures. Also injuries caused by transportation incidents during working activities involving the use of mobile machinery and during the way to or back from the working place (vehicle crashes) are very frequent.

Cluster analysis identifies two groups of work-related injuries among young workers: one group includes transportation injuries mainly, with a high percentage of traumas involving lower extremities or multiple body sites and has similar features to road accidents. Preventive actions towards these injuries are similar to those that must be implemented to reduce road crashes: however, special care should be paid to ensure safe operation of vehicles on the job in the work site, as young

employers are often new to driving and therefore at increased risk of injuries.

The other group of injuries is more strictly related to the specific working tasks and includes traumas and cut wounds mostly involving mainly hand, wrist and head, and many eye lesions. To be noted that during working time these body parts should require special personal protective equipment, and their use should be compulsory. A more intensive supervision on their actual use must be implemented by employers and by external inspectors; above all, more appropriate training in hazard recognition and safe work practices to sensitize young workers must be provided.

Even though the problem could be underestimated, the hospital emergency department records have often been usefully consulted to estimate occupational injuries by a number of researchers [1, 8, 30-32].

It is however important to underline that many hospital records were lacking in details not only on job information but also on injury description and diagnosis. Obviously, hospital records are not designed to collect specific information on job related issues, which could be obtained only by means of *ad hoc* investigations, carried out directly at workplaces during working time. However, hospital sources provide suitable data to gain an overall view of the size of the general problem of injuries in minors. In order to have a better understanding of the phenomenon and to suggest the right preventive actions it would be necessary to improve data quality by sensitizing emergency department staff to collect more detailed information. Some items, indeed, could help in disentangling illegal work related injuries in minors and in identifying the areas in which illegal work is widespread.

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