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Original article

Occupational Eye Injury in the agricultural settings: a retrospective study from North-Eastern Italy

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Summary. *Background:* Occupational Eye Injury (OEI) represents a common world-wide event accounting for between 3.3% and 6.1% of all occupational compensation claims. In this retrospective study we evaluated all the recorded OEI which occurred in the Autonomous Province of Trento (APT) during the period 2000-2013. *Methods:* Data on OEI for all of APT were retrieved an institutional archive and the analysis included demographics of the injured, as well as characteristics and settings of the OEI. In order to assess the risk of OEI in Agricultural Workers (AWs) vs. all other Occupational groups, a multivariate analysis was eventually performed through a logistic regression analysis. *Results:* A total of 141,139 work-related injuries were recorded, including 5,065 (3.6%) OEI. 91.9% of all cases occurred in males, of Italian origin (77.2%), with a mean age of 38.4±11.7 years. The industrial sector reported the higher share of OEI (70.7%), whereas higher incidence rates were reported among AWs (6.04 vs. 3.85/1,000 workers/year). Agricultural OEI occurred in older workers (45.6±13.3 vs. 37.1±11.0 years), being more likely associated with "contusions" (OR 2.042, 95% 1.602-2.602) and "lacerations" (OR 2.386, 95%CI 1.877-3.033), and less frequently with exposures to chemicals, gases and vapours (OR 0.478, 95%CI 0.279-0.817). *Conclusions:* Despite a relatively low frequency of OEI, AWs were affected with a seemly higher incidence than that reported in other occupational groups. OEI in AWs exhibited a specific pattern, both in terms of lesion, and settings of the events, recommending tailored interventions in order to improve promotion strategies. (www.actabiomedica.it)

Key words: eye injuries, occupational injuries, farmers, wounds and injuries

Introduction

Even though the eye represents only 0.27% of the total body area and 4% of the facial area, Occupational Eye Injury (OEI) is a common world-wide event (1-12), with a share of subsequent residual visual loss (RVL) disproportionately high compared to non-work related eye injuries. As up to 5% of all blindness may be due to work related injuries (4, 10, 13), OEI remains a significant cause of visual morbidity, with a significant socioeconomic impact because of the subsequent impairment of life quality and the reduction of work ability, ultimately representing a global public health concern (1, 4, 8, 14, 15).

Global estimates are largely heterogeneous, but data from highly industrialized countries suggest that OEI accounts for between 3.3% and 6.1% of all workers compensation claims, and for 30% to 70% of all the accesses to the Ophthalmological Emergency Departments (1, 2, 5, 8, 14, 16), but these data may be under-

estimated, as many trivial OEIs are usually unreported (1, 17). Interestingly enough, available data suggest that OIE may involve not only the worker actually exposed to the risk factors, but also bystanders, stressing the importance of both personal and collective preventive measures (18).

As a significant share of cases apparently does not wear PPE at the time of injury (4, 10, 13, 17), potentially peaking to 80% in certain economic sectors such as construction industries (18), OEIs are reputed largely preventable through a strict compliance on the use of proper Personal Protective Equipment (PPE; i.e. safety goggles, face shields, helmets) (10, 13, 14, 18-20). Hence, prevention of OEI may represent a significant contribution to the Action Plan devised by the 66th World Health Assembly for the reduction of avoidable visual impairment (21).

Although available data are very heterogeneous, as the epidemiology of OEI is not consistently documented around the world (9, 15, 17), no occupational sector appears immune to the risk of OEI, and more than one half of total injuries would occur in the manufacturing and construction industries (9, 18): mechanics, particularly welders, are considered to be at particularly high risk due to the exposure to harsh working conditions and a number of risk factors (i.e. dusts, UV radiations, metal parts, and chemicals), and their life-long prevalence of OEIs may be up to 50% (13, 17). Also agricultural settings are usually considered at high risk (17), but available data are fragmentary (8), with a considerable lack of evidence from South-Western European regions where farming is highly developed and profitable, and occupational health and safety practices are strictly regulated. Therefore, specific epidemiological studies may be useful in order to improve our understanding of this occupational risk (15, 22).

For these reasons, we have retrospectively evaluated all the recorded OEIs which occurred in a North-Eastern Italian Region characterized by highly developed agricultural sector, namely the Autonomous Province of Trento (APT). As the available time spans 14 years (2000-2013), our analyses included further assessment on the trends of OEIs, as well on their frequency, type, and other relevant characteristics, in particular cases of OEI with significant RVS.

Methods

1. Settings. APT is located in the Italy's North East, covers a total area of 6,214 km^2 (2,399 sq. mi) and has a population of 537,416 habitants (2015 census). The territory is overwhelming mountainous (70% over 1,000 m, and 20% is over 2,000 m), and APT may be ultimately defined as a cluster of side valleys "held together" by the Adige river and Trento-Rovereto road, which is the main communication route within the area and with the outside world. In the last decade, economic performances of APT have outperformed that of Italy, with a limited decrease of its GDP per capita (-3% in 2009 compared to Italy's -5%), that significantly exceed national (+22% in 2010) average. Despite a recent rise, unemployment rate in APT remains significantly lower than national average (2.9% in 2007, 6.9% in 2012). Although APT is characterized by a large public sector, employing almost 20% of the province's workforce, economic setting is characterized by small private firms: not only the average size is 3.7 employees, but around 90.0% of the firms has less than 10 employees, and more than two-fifths (43.5%) of employees work in firms with less than 10 employees. According to labor force statistics, services represent the cornerstone of economic development (about 53% of firms in 2010), followed by agriculture and tourism-related industries (23,24).

2. Occupational Injuries. Data on occupational injuries for all of APT from 2000 to 2013 were retrieved from the archive of the Operative Unit for Health and Safety in the Workplaces (UOPSAL, Italian acronym), including data from Emergency Departments, Public and Private Health Insurances, General Practitioners. UOPSAL is the institutional service representing the local governmental structure for the management and prevention of occupational injuries, occupational diseases, and work-related diseases in the workplaces. Retrieved data included any OEI defined as any injury occurring to the eye(s) and/or adnexa that occurred at the workplace, either as a part of the job, or on work-related assignment (25), whereas OEI occurring in (1) patients with major polytrauma, (2) students, (3) on route home to work place and vice-versa, were excluded from the study. Data were preventively

anonymized in order to include only: patients' age, gender, country of birth, injury diagnosis, body part included, product(s) involved, days of indemnity, and prognosis.

Data on work-force in APT were similarly obtained from the Statistical Institute of the Autonomous Province of Trento (ISPAT; http://www.statistica.provincia.tn.it/dati_online/), and included the number of active workers by age, sex, occupational groups, the latter being summarized for the categories: agriculture, manufacture and other industries, construction, and services.

2. Data Analyses. Injuries characteristics were initially summarized by means of descriptive statistics. Chi squared analyses were used to compare proportions for OEIs occurring in Agriculture vs. all other Occupational Groups. In the analyses, data were compared as follows: by gender (males vs. females); age groups (reference category: 25-39 years); migration background (Italian-born people vs. Foreign born people); day of the event (i.e. Monday to Friday vs. Weekend; Holiday vs. Regular day; April to September vs. October to March); reported hour of the events (06.00 to 12.00; 12.00 to 18.00; 18.00 to 06.00), with afternoon (12.00 to 18.00) assumed as the referent category; and characteristics of the OEI (i.e. associated with foreign objects; following eye contusions; eye lacerations; following exposure to chemicals, gas, and vapours; following exposure to other causes such as biological liquids, radiations, heat etc.), assuming OEIs by foreign objects as reference category.

Continuous variables were initially tested for normal distribution (D'Agostino & Pearson omnibus normality test): where the corresponding p value was < 0.10, normality distribution was assumed as rejected, and variables were compared through Mann-Whitney or Kruskal-Wallis test for multiple independent samples. On the other hand, variables passing the normality check (p value ≥ 0.10) were compared using the Student's t test or ANOVA, where appropriate.

Estimates of the numbers and rates (per 1,000 workers) of OEI were obtained by gender, age and occupational groups. As previously suggested (26,27), injury rates per 1,000 workers during the 2000-2013 period were calculated using the formula:

$$R=1{,}000 \times (I / N),$$

where I is the number of OEI claims over the 2000-2013 period and N equals the number of APT worker-years for all workers in the APT.

Injury rates by year were calculated using the formula:

$$Ry=1{,}000 \times (Iy / Ny),$$

where Iy is the number of OEI that occurred in a given year y and Ny equals the number of APT employees who worked in a given year y, y=2000, 2001, … 2013. Similarly, injury rates per 1,000 workers were obtained for gender, demographic groups (i.e. 15-24 years; 25-39 years; 40-54 years; 55-64 years; ≥65 years) and occupational groups.

Ninety-five per cent Confidence Intervals (95%CI) estimates were based on standard error estimates of R and Ry. Mantel-Haenszel combined estimates of the incidence-rate ratios (IRR) were then calculated for age and occupational groups by gender of the workers.

In order to assess the risk of OEI in Agricultural workers vs. all other Occupational groups, a multivariate analysis was eventually performed through a logistic regression analysis. The model included as outcome variable OEIs occurring in Agricultural workers compared to non-agricultural workers, and included all variables that had a p value <0.05 at univariate analysis, with calculation of respective Odds Ratios (OR) and correspondent 95% CI.

Significance level was p <0.05 for all statistical test. All analyses were conducted by using SPSS 24.0 (IBM Corp: Arkmon, NY).

3. Ethics. The study included only a retrospective assessment of data available through an Institutional Database, and the analysis was performed as a part of the official duties of the Occupational Health and Safety Unit (UOPSAL). Personal data were restricted to information about the OEIs, and were treated in order to guarantee the respect of privacy of the involved workers, as specifically stated by Italian Law n.674 of 1996 about personal data protection. Therefore, the study did not require preliminary evaluation by the local Ethical Committee.

Results

1. Demographics (Table 1). From 1 January 2000 to 31 December 2014, an estimated of 141,139 work-related injuries were recorded. Of them, 5065 (3.6%) were OEIs from 4802 workers, with an annual mean of 361.8 claims (range: 224-523; see Figure 1), 257 recurring cases (5.1% of all OEI injuries), and 160 episodes that eventually resulted in a RVL (3.2%). In around a third of RVL cases (1.3% of all events), reported binocular visual loss was higher than 4/20.

Overall, 91.9% of all cases occurred in males, of Italian origin (77.2%). OEI were most commonly seen in the age group of 25-39 year-old and 40-54 year-old years, that constitute 41.9% and 33.4% of all patients, respectively, whereas only 11.0% (n=457) of the cases occurred in workers older than 55 years. The mean age at injury was 38.4±11.7 years in all patients (range, 15 to 75), with 38.3±11.8 years in males, and 39.1±11.3 years in females, and no significant difference was found between males and females with regard to age at injury (p=0.230).

The industrial sector reported the higher share of OEI (70.7%), including 1487 cases (29.4%) from the construction sector, whereas 748 (14.8%) accounted to the agricultural settings. Overall, the majority of cases occurred Monday to Friday (70.9%), in winter months (October to March, 52.1%), during the afternoon (h 12:00 to h 18:00; 51.6%), with two peaks corresponding to hours 10:00 to 13:00 and 15:00 to 18:00 (Figure 2). Around half of total OEI cases were associated with a diagnosis of foreign body (50.2%), followed by eye contusions (21.8%), and lacerations (20.0%). Eventually, 6.8% of reported injuries followed the contact with chemicals, including irritating gases and vapours, whereas less than 1% was associated with the occupational exposure to heat and/or radiations (e.g. UV radiations, 0.7%), and biological fluids (0.3%).

The overall OEI rate was 1.66 / 1,000 person-year, 95%CI 1.45-1.87, being significantly greater in males (2.61/1,000 person-year, IC95% 2.30-2.93) than in females (0.35/1,000 person-year, IC95% 0.30-0.45; IRR 8.009 95%CI 7.244-8.684; p=0.0097) (Table 2).

As shown in Figure 1, even though a certain heterogeneity was reported over the assessed time frame, annual rates eventually decreased over time from

Table 1. Characteristics of 5065 Occupational Eye Injuries (OEI) occurring over the time period 2000 to 2013 in the Autonomous Province of Trento (APT).

	N/5065, %
Gender	
Males	4654, 91.9%
Females	411, 8.1%
Age group (years)	
15-24	694, 13.7%
25-39	2122, 41.9%
40-54	1692, 33.4%
55-64	486, 9.6%
≥65	71, 1.4%
Migration background	
No (Italian-born)	3912, 77.2%
Yes (Foreign-born)	1153, 22.8%
Working Sector	
Agriculture	748, 14.8%
Industry	3579, 70.7%
Construction	1487, 29.4%
Manufacture and other industries	2092, 41.3%
Services	738, 14.6%
Eye involvement	
Right	2490, 49.2%
Left	2544, 50.2%
Bilateral	31, 0.6%
Day of the week	
Monday to Friday	3591, 70.9%
Weekend	1474, 29.1%
Holidays	
Holiday	4982, 98.4%
Regular day	83. 1.6%
Calendar month	
April to September	2424, 47.9%
October to March	2641, 52.1%
Hour of the day	
Morning (06:00 to 12:00)	2148. 42.4%
Afternoon (12:00 to 18:00)	2613, 51.6%
Evening/Night (18:00 to 06:00	304, 6.0%
Diagnoses	
Foreign Bodies	2553, 50.4%
Contusions	1103, 21.8%
Lacerations	1013, 20.0%
Chemicals, gas, vapours, etc.	346, 6.8%
Heat, radiation (e.g. UV radiation, etc.)	33, 0.7%
Biological fluids	17, 0.3%
Outcome	
Residual visual loss, any	160, 3.2%
Residual visual loss > 4/20	68, 1.3%
Recurring events	257, 5.1%

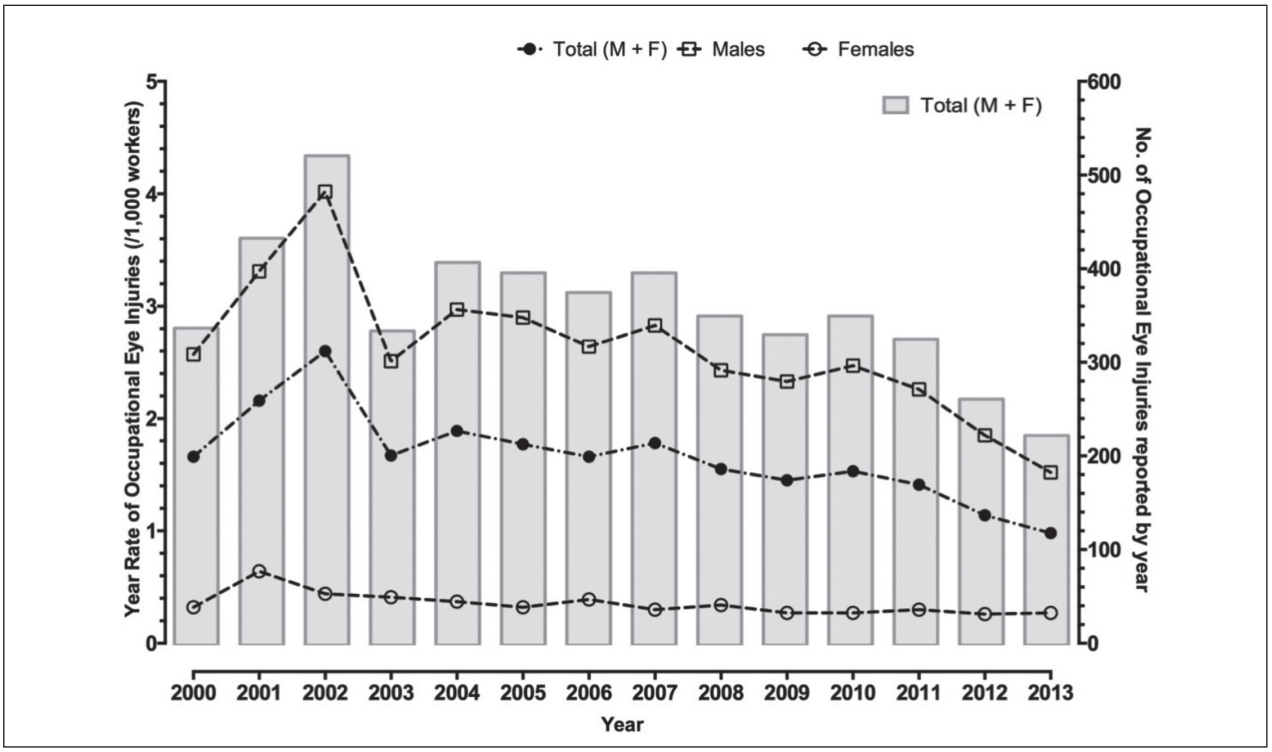

Figure 1. Yearly frequency of Occupational Eye Injuries (OEIs) over the assessed time period (2000 – 2013), both as incident cases (Males + Females; right y axis) and incidence rates (Males, Females, Males + Females; left y axis).

1.66/1,000 person-year in males and 0.32/1,000 person-year in females of 2000 to the lower rates of 2013 (1.52/1,000 person-year and 0.27/1,000 person-year, respectively). Also stratifying by age groups, the rates for OEI remained higher in males than in females for all age group: more specifically, males 15-24 years of age had the highest eye injury rate (4.44/1,000 person-year, 95%CI 3.67-5.21), whereas the lowest was found in females 40-54 years (0.29/1,000 person-year, 95%CI 0.24-0.33 person-year).

Focusing on the Occupational Groups, higher rates were reported from the Agricultural Settings (6.04/1,000 person-year, 95%CI 5.04-7.04), both for males (6.99/1,000 person-year, 95%CI 5.96-8.02) and females (2.26/1,000 person-year, 95%CI 1.49-3.03), and again the IRR was significantly greater for males than for females (3.373, 95%CI 2.490-4.377, p<0.001).

2. Characteristics of the Agricultural OEI. As shown in Table 3, 92.5% of OEIs from agricultural settings were reported in males, compared to 91.8% from other economic sectors, and the difference was not statistically significant (p=0.496). On the contrary, agricultural settings had a significantly higher share of OEIs from Italian-born people than other economic sectors (89.2% vs.75.2%, p<0.001), and the difference was significant also at multivariate analysis (OR 2.435, 95%CI 1.796-3.303).

Focusing on the age at the event, agricultural OEIs occurred in significantly older workers (mean age 45.6±13.3 years vs. 37.1±11.0 years in non-agricultural workers; p<0.001), and assuming 25-39 years group as the referent one, the association was significant for all older groups (OR 1.457, 95% 1.154-1.840 for age group 40-54 years; OR 3.749, 95% 2.819-4.985 for age group 55-64 years), and in particular for subjects older than 65 years (8.2% of all agricultural cases, vs. 0.3% in other occupational groups; OR 23.762, 95%CI 11.422-49.435), whereas younger subjects (15-24 year group) had a significantly lower risk (OR 0.579, 95% 0.388-0.863).

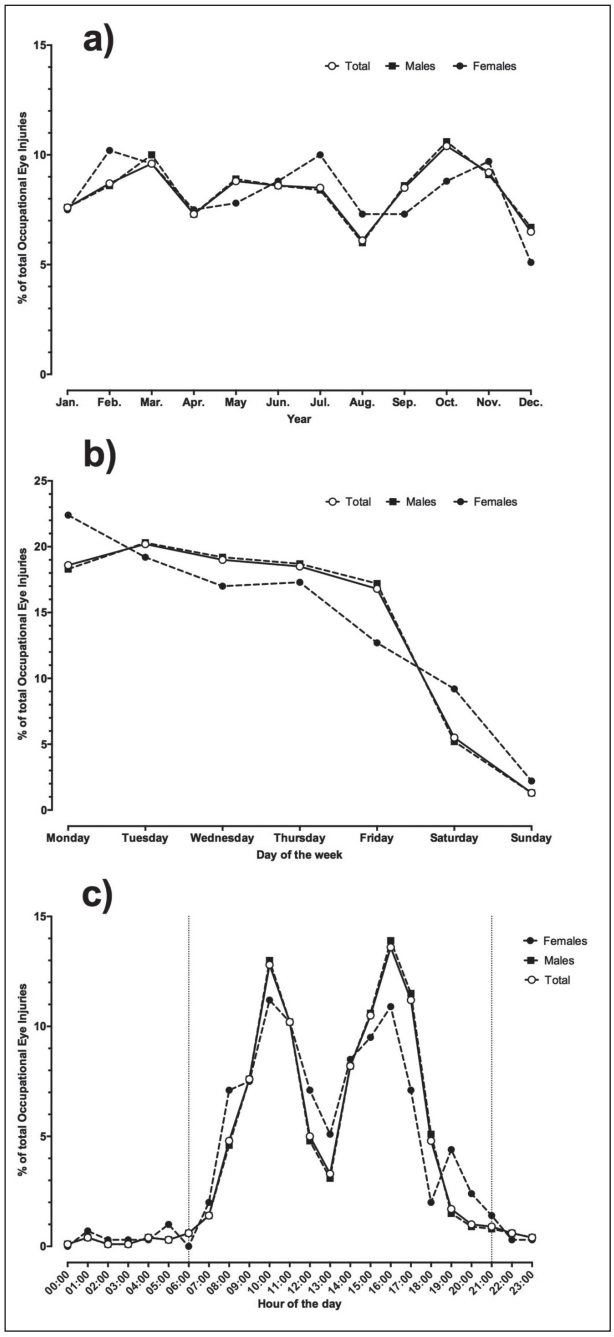

Figure 2. Share of incident Occupational Eye Injury (OEI) cases over the year (a), the week (b), and a one-day period (c)

Regarding the settings of the injury (Figure 2), no differences were found regarding the annual distribution, with similar share of events during winter months (44.8% vs. 48.4%, p=0.069), whereas OEIs in agriculture were more likely to be reported during the Week End (14.8% vs. 5.4%, p<0.001) and during Holidays (4.3% vs. 1.2%, p<0.001; OR 2.430, 95%CI 1.249-4.725) than in other occupational groups. Again, agricultural OEIs were more likely reported at morning (45.4% vs. 41.8%), and less frequently reported in the late hours of the day, at afternoon (50.6% vs. 51.8%), and in particular at night (4.0% vs. 6.4%) where-assuming the share of the afternoon OEIs as the referent category, an OR 0.510, 95%CI 0.312-0.836 was ultimately calculated.

Even though that of "foreign bodies" was the most frequently reported diagnosis both in agricultural and in non-agricultural OEIs, the shares were significantly different, being reported in 33.2% of all agricultural events and in 53.4% of all non-agricultural events (p<0.001). Assuming such diagnosis as the referent one, agricultural OEIs were more likely associated with "contusions" (OR 2.042, 95% 1.602-2.602) and "lacerations" (OR 2.386, 95%CI 1.877-3.033), and less frequently with exposures to chemicals, gases and vapours (OR 0.478, 95%CI 0.279-0.817) than non-agricultural OEI.

Eventually, when the final outcome of the OEI was put in consideration, agricultural injuries were apparently associated with a worse prognosis, as 5.9% resulted in a RVL vs. 2.7% in non-agricultural claims, and 2.1% of total agricultural OEI were followed by a RVL>4/20 compared to 1.2% in non-agricultural ones (p<0.001 and p=0.040, respectively). However, multivariate analysis did not confirm results of the univariate analysis (OR 1.175, 95%CI 0.667-2.070 for any RVL, and OR 1.068, 95%CI 0.449-2.450 for a RVL>4/20).

Discussion

OEIs are largely preventable, but their incidence remains strikingly high, not only in developing countries, but also in highly developed countries, with significant heterogeneity both in annual rates and in settings of the injuries (1,14,16). Since such differences have been explained as direct consequences of the work activities performed, also preventive measures have to be specifically adapted, underscoring the importance for all intervention that may improve our understand-

Table 2. Mean annual frequencies and respective 95% Confidence Intervals (95%CI) of Occupational Eye Injuries per 1,000 workers employed in the Autonomous Province of Trento by age groups and working sector, as broken down by sex, with calculation of respective Incidence Rate Ratios IRR)

	Mean Incidence (N/1,000 worker-years) (95%CI)			IRR (95%CI)	P value
	Total	Males	Females		
Overall	1.66 (1.45-1.87)	2.61 (2.30-2.93)	0.35 (0.30-0.40)	8.009 (7.237-8.864)	<0.0001
Age group (years)					
15-24	2.82 (2.32-3.32)	4.44 (3.67-5.21)	0.45 (0.31-0.58)	10.027 (7.383-13.939)	0.0097
25-39	1.60 (1.44-1.77)	2.54 (2.31-2.76)	0.30 (0.26-0.34)	8.748 (7.462-10.314)	
40-54	1.34 (1.18-1.49)	2.06 (1.84-2.28)	0.29 (0.24-0.33)	7.348 (6.200-8.746)	
55-64	1.66 (1.47-1.85)	2.31 (1.96-2.79)	0.34 (0.24-0.45)	6.571 (4.766-9.287)	
≥65	1.65 (1.09-2.21)	1.99 (1.20-2.79)	0.66 (0.29-1.03)	2.675 (1.228-6.911)	
Working Sector					
Agriculture	6.04 (5.04-7.04)	6.99 (5.96-8.02)	2.26 (1.49-3.03)	3.272 (2.490-4.377)	<0.0001
Construction	5.27 (4.65-5.89)	5.59 (4.99-6.19)	0.42 (0.14-0.69)	101.8 (51.530-236.2)	
Manufacture and other industries	3.85 (3.06-4.64)	4.58 (3.75-5.41)	0.96 (0.69-1.13)	5.421 (4.514-72.699)	
Services	0.36 (0.30-0.43)	0.53 (0.43-0.63)	0.23 (0.20-0.27)	2.283 (1.956-2.671)	

ing of the OEI epidemiology in all economic sectors, even at a local level (1, 4, 14).

In our study, OEI represented the 3.6% of all claims, with a relatively share of cases with RVL, <5% of all reported events. Such figures appear significantly lower to most other studies, suggesting rates up to 20% of all occupational claims, but it should be stressed that the rates significantly varies worldwide (3, 4, 10, 16, 19, 28, 29). Moreover, the cases we retrospectively evaluated were retrieved from an institutional database: despite we included several sources of information, it may fail to include minor injuries and illnesses, in particular those not requiring a medical treatment. On the contrary, hospital-based studied tend to underestimate the true impact of ocular trauma, biasing the results towards the more serious cases of ocular trauma (1, 15).

In other words, our figures are not fully comparable with previous reports from previous studies from Northern Italy, where data were retrieved from hospital department databases, and included as reference group all ophthalmological emergencies rather than occupational injuries and trauma as in our analysis (1, 14). On the other hand, frequency estimates appear substantially consistent with aforementioned reports: even though we estimated an incidence rate of 1.66/1,000 person-years, compared to 3/1,000 person-years reported by Gobba et al (2017) (14), and 6.5/1,000 person-years from Fea et al (2008) (1), our data refer to a 14-year time period, including annual rates that were quite similar to such estimates. As otherwise suggested, Italian figures should be interpreted as a consequence of the very large share of the total workforce involved in economic sector at low or very low risk for OEIs, such as that of services: economic data, suggest that during the assessed time-frame around 68% of all workforce of APT was actually employed in the tertiary sector, a share even higher than that reported by other Italian regions (e.g. around 50% in Emilia Romagna Region and 55% in Piemonte Region) (1,14,23,24). Not coincidentally, in our sample incidence estimates for OEI in services were 0.36/1,000 person-years (95%CI 0.30-0.43), that is 10 times lower than that for manufacture and other industries (3.85 1,000 person-years; 95%CI 3.06-4.64), the latter being usually reported as the highest risk groups alongside construction (1, 2, 11, 12, 3-10).

Similarly, specificities of both demographics and APT local economy may also explain some of the significant differences that emerge when our results are compared to other Italian data as well as to available international reports.

First at all, the large majority of our sample included workers of male sex, whose mean age was around 38 years. Male predominance is a common report from available studies, and may be attributed to

Table 3. Characteristic of occupational eye trauma occurring in agricultural workers compared to that reported from other economic sectors. Odds Ratios (OR) and respective 95% Confidence Intervals (95%CI) were calculated through a multivariate analysis that included demographic factors and characteristics of the event that, at univariate analysis, had a p value < 0.05.

	Agriculture N/748, %	Other Economic Sectors N/4317, %	Chi squared P value	OR (95%CI)
Gender				
Males	692, 92.5%	3962, 91.8%	0.496	-
Females	56, 7.5%	355, 8.2%		-
Age group (years)				
15-24	44, 5.9%	648, 15.0%	<0.001	0.579 (0.388; 0.863)
25-39	212, 28.3%	1908, 44.2%		-
40-54	269, 35.9%	1420, 32.9%		1.457 (1.154; 1.840)
55-64	162, 21.7%	328, 7.6%		3.749 (2.819; 4.985)
≥ 65	61, 8.2%	13, 0.3%		23.762 (11.422; 49.435)
Migration background				
Italian-born	667, 89.2%	3245, 75.2%	<0.001	2.435 (1.796; 3.303)
Foreign-born	81, 10.8%	1072, 24.8%		-
Eye involvement				
Right	356, 47.6%	2134, 49.4%	0.249	-
Left	390, 52.1%	2154, 49.9%		-
Bilateral	2, 0.3%	29, 0.7%		-
Day of the week				
Monday to Friday	637, 85.2%	4082, 94.6%	<0.001	0.364 (0.260; 0.511)
Weekend	111, 14.8%	235, 5.4%		-
Holiday	32, 4.3%	51, 1.2%	<0.001	2.430 (1.249; 4.725)
Calendar month				
April to September	335, 44.8%	2089, 48.4%	0.069	-
October to March	413, 55.2%	2228, 51.6%		-
Hour of the day				
06:00 to 12:00	340, 45.4%	1805, 41.8%	0.048	0.960 (0.787; 1.171)
12:00 to 18:00	378, 50.6%	2236, 51.8%		-
18:00 to 06:00	30, 4.0%	276, 6.4%		0.510 (0.312; 0.836)
Diagnoses				
Foreign Bodies	248, 33.2%	2305, 53.4%	<0.001	-
Contusions	232, 31.0%	871, 20.2%		2.042 (1.602; 2.602)
Lacerations	245, 32.8%	768, 17.8%		2.386 (1.877; 3.033)
Chemicals, gas, vapours, etc	22, 2.9%	324, 7.5%		0.478 (0.279; 0.817)
Other	1, 0.1%	49, 1.1%		0.175 (0.024; 1.307)
Outcome				
Residual visual loss, any	44, 5.9%	116, 2.7%	<0.001	1.175 (0.667; 2.070)
Residual visual loss >4/20	16, 2.1%	52, 1.2%	0.040	1.068 (0.449; 2.540)
Recurring events	65, 8.7%	292, 6.8%	0.057	-

the traditional occupational differences, with a disproportionate number of males working in occupations with a higher risk for ocular trauma (1, 2, 11, 12, 14, 15, 18, 20, 3-10).

Despite such data are somehow consistent with certain reports, suggesting higher risk for male subjects between 25 and 44 years of age (9, 18, 20), mean age remains relatively lower than that otherwise reported by Gobba et al (2017), and relatively high compared to other studies from comparable settings (1, 2, 11, 12, 14, 15, 3-10). Again, even though higher rates were reported from younger workers (2.82/1,000 person-years for 15-24 years age group), consistently with the evidence of higher OEI risk for workers <40 year-old, rates remained substantially stable over the various age groups. Such differences may be explained as our esti-

mates included only occupational injuries, and demographic figures from other Italian studies are therefore only limitedly comparable (1, 14, 15).

On the contrary, the specific characteristics of the recorded events are somewhat comparable with available reports. First at all, the main cause of OEI was identified in foreign bodies (50.4%), followed by contusions and lacerations. Also in previous reports from Northern Italy, the large majority of injuries were due to a trauma (around 90% of all occupational injuries), being associated with foreign body in nearly half of reported cases (1, 14). This was not unexpected, as the occupational injuries usually reflect the economic and industrial development of the referent population (4, 10, 11, 19). For instance, while OEIs associated with chemicals, gas, vapours, but also with tasks usually reported in the heavy industry such as welding, drilling and cutting, are relatively rare in our study, in Zakrewski et al (2017) chemical exposure and subsequent chemical lesions of the cornea were among the main aetiologies of injury (4), whereas in Chen et al (2009) welding was a common cause of a work-related eye injury (30.4%), as well as the splashing of chemicals (11.7%), being photokeratitis (33.2%), and lesions characterized by chemical burns and corneal abrasions (collectively 26.5%) more frequently reported than eyeball penetration/laceration (22.3%) (10). Also in Yu et al study (2003), still reporting flying objects (59.4%) as the main causes of OEIs, chemical substances (18.4%), and hazardous radiations (2.5%) were significantly more frequent than in our report (11).

Focusing on the specificities of agricultural OEIs, events occurred more frequently in subjects of Italian origin and older age groups. Moreover, agricultural OEIs exhibited several specificities in terms of clinical characteristics, with higher representation of trauma and laceration over foreign bodies, and regarding settings of the events. Such remarks may be seemly explained as a consequence of the specificities of the agricultural activities.

First at all, there is sound evidence that primary sector employs older from older age groups, as more than half of farm managers across EU are usually older than 55 years, being close or beyond the regular retirement age (30). Reflecting the demography of rural population, patients reporting OEIs in agricultural settings are therefore usually older than those from other economic sectors (31).

Moreover, in Trentino region, a large share of farm managers performs agricultural activities as hobby farmers, in holding of small extent (23, 24), eventually explaining the relatively low share of events recorded in subjects from a migrant background. Such remarks contribute to the interpretation of the specific time-frame of the OEIs in agricultural settings. On the one hand, it should be stressed that many agricultural activities are not always very flexible, having to be performed in a restricted time window, not allowing the agricultural workers to usually spare holidays and weekend (23). On the other hand, as many agricultural workers are actually hobby farmers, a significant share of their tasks cannot be performed during the working week, being forcedly clustered during weekend or holydays (23, 24, 30).

Focusing on the reported diagnoses, OEIs in agricultural settings exhibited higher share of trauma-related event, with a significantly lower risk for injuries following the exposure to chemicals, gas and vapors, the latter being even lower than in other similar reports (14). Actually, agricultural workers are exposed to strenuous physical activities, therefore explaining a higher proportion for blunt trauma (23, 24, 30, 32). On the other hand, available reports about the use of pesticides and chemicals in Trentino region suggest a diffuse understanding of appropriate preventive practices during pesticide handling, including the proper use of PPE during tasks at higher risks (33, 34).

Unfortunately, the main limit of our study may be found in the lack of information about the use of PPE at the time of the event. Nearly all available reports consistently associate the inappropriate use of PPE with OEI, with shares of patients who did not wear any PPE at the time of injury ranging from 66.9% to 85.4% (4, 10, 11, 14, 35). More specifically, Bureau of Labour Statistics of US estimates that as many as 60% of workers within the US who sustain an occupational eye injury had failed to use eye PPE (9, 26, 28).

In conclusion, our results show a relatively lower frequency of OEIs compared to other studies previously published, with a relatively lower proportion of RVL. In our study, agricultural activities were associated with a seemly higher incidence than that reported in

other occupational groups. OEIs in agricultural workers exhibited a specific pattern, both in terms of lesion, and settings of the events, recommending tailored interventions in order to improve promotion strategies. More specifically, even though our study lack data about the use of PPE at the time of the event, our data speculatively suggest the advocacy for improved use and appropriate selection of eye PPE not only during activities requiring the handling of chemicals or irritating substances, but also during strenuous physical activities potentially eliciting blunt trauma of the eye.

Conflict of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

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