
Implications for Prevention

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Objectives: To assess incidence rates of eye injuries in the US Armed Forces and to identify demographic and occupational correlates of risk.

Design: Retrospective population-based study.

Setting: US military medical facilities worldwide.

Participants: All individuals in the US Armed Forces during 1998.

Main Outcome Measures: Incidence rates of hospitalizations and ambulatory visits for eye injuries.

Results: The incidence rate of ambulatory visits (983 per 100,000 person-years) for eye injuries was 58 times higher than the incidence rate of hospitalizations (17 per 100,000 person-years) for eye injuries. Orbital floor fractures, contusions, and open wounds to the ocular adnexa and orbit accounted for 85% of eye injuries resulting in hospitalization, while 80% of ambulatory visits were for superficial wounds and foreign bodies. Hospitalization rates varied widely across demographic subgroups. Men had twice the incidence rate as women, and the youngest age group (17-24 years) had 6 times the incidence rate of the oldest age group (35-65 years). Together, motor vehicle crashes and fights caused nearly half of the hospitalizations. Ambulatory rates varied significantly in relation to occupation but not to demography. Tradespeople (eg, metal body machinist, welder, and metalworker) had incidence rates 3 to 4 times higher than the overall population rate.

Conclusions: Hospitalization and ambulatory data provide different views of the morbidity associated with eye injuries. General safety precautions and behavior modification, rather than eye-specific interventions, are indicated to prevent the most serious eye injuries. However, the consistent use of eye protection during known hazardous occupational activities could prevent much of the morbidity associated with the less serious, yet more common, eye injuries.


Eye injuries range from minor bruises and scratches to serious lacerations, fractures, and burns. Although eye injuries are considered an important cause of morbidity, there have been few epidemiological studies that have described the complete spectrum and incidence of eye injuries in an adult population. Most epidemiological studies of eye injuries have been narrowly focused on specific types of injuries, exposures, or settings. Also, they have been based on self-reported data, which may be unreliable, or on hospitalization, emergency department, or registry records, which only capture a subset of all eye injuries.

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POPULATION AND METHODS

DATA SOURCE

All data were contained in the Defense Medical Surveillance System. This database contains demographic and occupational information on each active duty member of the US Armed Forces. It also contains information from military hospitals and ambulatory clinics located on permanent military installations worldwide, which provide most of the health care for military personnel. This analysis does not include all combat or field-related injuries, because the system does not include data on health care that is provided in unit aid stations, aboard ships, during field training exercises, or on overseas deployments. Because there were no wars during the surveillance period, 1998, we assume there were a limited number of combat or field-related injuries. The surveillance system has been operating since 1990, and it is maintained, updated, and monitored for quality by the Army Medical Surveillance Activity, US Army Center for Health Promotion and Preventive Medicine, Washington, DC.

SURVEILLANCE POPULATION

The surveillance population included all persons who served on active duty in the US Armed Forces between January 1, 1998, and December 31, 1998.

CASE DEFINITION

All primary and secondary diagnoses reported on hospitalization and ambulatory visit records were searched for diagnostic codes specific to eye injuries. The primary diagnosis for ambulatory setting data represents the reason for seeking medical attention, while for hospitalizations it represents the principal discharge diagnosis. Secondary diagnoses include up to 7 additional contemporaneous diagnoses. As in other studies, eye injuries were specified using 53 diagnostic codes of the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM): 802.6 and 802.7 (orbital floor fractures); 870.0 through 871.9 (open wounds to ocular adnexa and orbit); 918.0 through 918.9 (superficial injuries); 921.0 through 921.9 (contusions); 930.0 through 930.9 (foreign bodies); 940.0 through 940.9, 941.02, 941.12, 941.22, 941.32, 941.42, and 941.52 (burns); and 950.0 through 950.9, 951.0, 951.1, and 951.3 (nerve injuries). Incident eye injuries were defined as the first hospitalization or ambulatory visit, per individual, per ICD-9-CM diagnosis code, that occurred between January 1, 1998, and December 31, 1998. Ambulatory visits for 74 individuals (0.5% of all ambulatory visits) having identical hospitalization diagnoses were not included in the analyses.

DEMOGRAPHIC VARIABLES

Demographic variables examined included sex, age (17-24, 25-34, or 35-65 years), educational level (high school diploma, some college, or college degree), and occupation. Occupational groups were classified according to the Department of Defense Occupational Conversion Index, which categorizes occupations of the military services by similarities of tasks. In 1998, there were 234 occupations in the index, including 64 officer and 170 enlisted specialties.

CAUSES OF INJURY

Causes of all eye injuries resulting in hospitalization are coded in accordance with North Atlantic Treaty Organization Standardization Agreement 2050. The codes are analogous, but not identical, to the ICD-9-CM external cause-of-injury codes. Using these injury codes, the following categories were used to characterize the causes of eye injury hospitalizations: machinery or tools, motor vehicle crashes, fights, athletics, guns or explosives, falls, and "not classifiable." Causes of injuries treated in ambulatory settings were not reported.

INCIDENCE RATES

Incidence rates were calculated by dividing the number of injuries by the person-years that the surveillance population was at risk. All rates were expressed per 100000 person-years. Ninety-five percent confidence intervals for incidence rates were calculated based on the Poisson distribution.

CAUSES OF HOSPITALIZED CASES

Together, motor vehicle crashes (23%) and fights (21%) caused nearly half of the hospitalizations for eye injuries (Table 2). Other major causes (≥10% each) were machinery or tools, athletics, and falls. Fights were the leading cause of hospitalizations for eye injuries among men, the youngest age group, and those with the least educational attainment.
AMBULATORY VISITS BY OCCUPATION

Within the 234 occupational specialties, the most ambulatory visits for eye injuries occurred in the largest occupational groups (Table 3). The 3 occupations with the most ambulatory visits were infantry, aircraft repair, and trainees. In contrast, the 10 occupations with the highest incidence rates of ambulatory visits were all trades with inherent exposures to small, projectile objects, such as metal or wood. The 3 occupations with the highest incidence rates, metal body repair, welding, and metalworking, had rates 3 to 4 times higher than the overall population rate. Automotive repair workers were the only occupational group among the top 10 in both number (450 visits) and rate (1853 per 100000 person-years) of ambulatory visits.

HOSPITALIZATIONS BY OCCUPATION

Similar to ambulatory visits, the most hospitalizations for eye injuries occurred in the largest occupational groups. However, unlike ambulatory visits, the highest hospitalization rates also occurred in the largest occupational groups. For example, infantry, the largest occupational group, experienced the most hospitalizations (n=26) and had the highest incidence rate (35.8 per 100000 person-years) as well.

COMMENT

In 1998, approximately 1% of all members of the US Armed Forces were treated for eye injuries. The hospitalization and ambulatory visit incidence rates docu-
In summary, eye injuries are an important source of morbidity among military personnel. Hospitalization and ambulatory data provide different views of the morbidity associated with eye injuries. Because hospitalized eye injuries were mostly related to motor vehicle crashes and fighting, general safety precautions and behavior modification, rather than eye-specific interventions, will have the greatest impact in preventing these injuries. In contrast, eye injuries treated in an ambulatory setting were mostly related to inherently hazardous occupational activities. Therefore, the consistent use of eye protection during such activities could significantly prevent a high proportion of all eye injuries in the military.

In general, studies that rely on hospital or ambulatory-based data alone are unlikely to completely characterize the nature, incidence, and impact of injuries. Clearly, this is true for eye injuries among military personnel. In our study, there were 58 times more ambulatory visits than there were hospitalizations. In addition, the type, severity, and risk correlates of eye injuries treated in ambulatory settings significantly varied from those treated in hospitals. In this regard, US military medical surveillance data are uniquely informative because they document the hospitalization and ambulatory experiences of a healthy, fully employed, adult population that has universal access to medical care. Still, the data have limitations for injury research. For example, they do not document the causes of injuries treated in ambulatory settings or the specific circumstances or settings in which the injuries occurred (eg, on-duty or off-duty, relationships to occupational or recreational activities, or relationship to alcohol use).

In this study, the more serious eye injuries that required hospital care tended to result from nonmilitary motor vehicle crashes and fights. Recent studies in nonmilitary settings have also found that motor vehicle crashes and assaults were leading causes of eye injury–related hospitalizations. In addition, recent surveys have documented that physical fighting is common among US adolescents, and that male sex, a history of fighting, and alcohol use were related to physical fighting and associated injury risk. Because US military personnel are predominantly young men who volunteer to be trained and to fight as warriors, it is not surprising that physical fighting and associated injuries are relatively common among military personnel. These findings suggest that, at least during peacetime, serious eye injuries of military personnel may be more related to “leisure time” than to military or occupation-specific activities. Therefore, in the absence of more detailed information regarding injury-related circumstances and settings, general safety precautions and behavior modification initiatives (eg, driving safety, seat belt use, alcohol use, interpersonal violence prevention, and stress control) appear to be more appropriate than eye injury–specific interventions.

In contrast to hospitalizations, eye injuries treated in ambulatory settings were more common but less serious in nature. Ambulatory incidence rates for eye injuries were highest among inherently hazardous occupations (eg, metal body repair, welding, metalworking, machinist, and dental laboratory). Therefore, a high proportion of all eye injuries in the military could be prevented by the consistent use of protective equipment by personnel working in these trades. Strict adherence to eye protection guidelines by workers and strict enforcement by supervisors is indicated. Moreover, because skilled military workers often pursue their trades on their own time, training should emphasize the importance of using eye protection during those times as well.

### Table 3. Incidence of Ambulatory Visits for Eye Injuries by Occupation Among US Military Personnel in 1998

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Person-years</th>
<th>Patients</th>
<th>Rate (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>1,390,038</td>
<td>13,664</td>
<td>983 (962-995)</td>
</tr>
<tr>
<td>Occupations with highest amount of injuries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infantry</td>
<td>72,575</td>
<td>777</td>
<td>1071 (987-1139)</td>
</tr>
<tr>
<td>Aircraft repair</td>
<td>55,195</td>
<td>735</td>
<td>1332 (1228-1422)</td>
</tr>
<tr>
<td>Training</td>
<td>41,319</td>
<td>520</td>
<td>857 (784-933)</td>
</tr>
<tr>
<td>Medical care</td>
<td>60,711</td>
<td>519</td>
<td>1256 (1130-1346)</td>
</tr>
<tr>
<td>Supply administration</td>
<td>57,533</td>
<td>493</td>
<td>857 (778-931)</td>
</tr>
<tr>
<td>Automotive repair</td>
<td>24,291</td>
<td>450</td>
<td>1853 (1685-2032)</td>
</tr>
<tr>
<td>Administration</td>
<td>34,803</td>
<td>290</td>
<td>833 (740-935)</td>
</tr>
<tr>
<td>Navigation</td>
<td>31,607</td>
<td>284</td>
<td>899 (785-996)</td>
</tr>
<tr>
<td>Food service</td>
<td>27,439</td>
<td>279</td>
<td>1017 (870-1109)</td>
</tr>
<tr>
<td>Aircraft accessories</td>
<td>21,615</td>
<td>254</td>
<td>1175 (1018-1309)</td>
</tr>
<tr>
<td>Occupations with lowest rate of injuries†</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communications</td>
<td>1151</td>
<td>46</td>
<td>3998 (2926-5331)</td>
</tr>
<tr>
<td>Welding</td>
<td>3049</td>
<td>114</td>
<td>3739 (2965-4349)</td>
</tr>
<tr>
<td>Metalworking</td>
<td>1686</td>
<td>55</td>
<td>3262 (2457-4246)</td>
</tr>
<tr>
<td>Machinists</td>
<td>1705</td>
<td>36</td>
<td>2111 (1479-2923)</td>
</tr>
<tr>
<td>Dental laboratory</td>
<td>819</td>
<td>17</td>
<td>2077 (1209-3323)</td>
</tr>
<tr>
<td>Construction</td>
<td>8154</td>
<td>163</td>
<td>1999 (1670-2291)</td>
</tr>
<tr>
<td>Automotive repair</td>
<td>24,291</td>
<td>450</td>
<td>1853 (1685-2032)</td>
</tr>
<tr>
<td>Small boat operators</td>
<td>1531</td>
<td>28</td>
<td>1528 (1215-2643)</td>
</tr>
<tr>
<td>Woodworking</td>
<td>1060</td>
<td>18</td>
<td>1698 (1006-2684)</td>
</tr>
<tr>
<td>Craft-working</td>
<td>3923</td>
<td>64</td>
<td>1631 (1256-2083)</td>
</tr>
</tbody>
</table>

*Rates are given per 100,000 person-years. CI indicates confidence interval.
†Excludes occupations having <10 cases.
Accepted for publication December 1, 2000.
The opinions or assertions herein are the private views of the authors and should not be construed as official or as reflecting the views of the US Department of Defense or the Department of the Army.

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REFERENCES


Announcement

The American Academy of Ophthalmology is preparing to revise the Preferred Practice Patterns (PPPs) on pediatric eye evaluations, amblyopia, esotropia, and refractive errors (including refractive surgery). If you are interested in bringing to the Academy’s attention pertinent, scientifically sound, and evidence-based reports, references, and articles (other than those that are readily available in the scientific literature) for these PPPs, please forward by Thursday, January 31, 2002, to Nancy Collins, Department of Quality and Clinical Care, American Academy of Ophthalmology, PO Box 7424, San Francisco, CA 94120-7424.