Estimation of Dog-Bite Risk and Related Morbidity Among Personnel Working With Military Dogs

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ABSTRACT

Background: Soldiers serving in the Israel Defense Force Military Working Dogs (MWD) Unit spend many hours taming dogs’ special skills, taking them on combat missions, and performing various dogkeeping activities. During this intensive work with the aggressive military dogs, bites are common, and some of them result in permanent disability. However, this phenomenon has not been quantified or reported as an occupational hazard. Methods: This was a retrospective cohort study based on self-administered questionnaires. Information was collected about soldiers’ baseline demographics, duration of the experience of working with dogs, total number of bites they had, circumstances of bite events, and complications and medical treatment of each bite. Bite risk was quantified by incidence, mean time to first bite, and a Cox proportional hazards model. Rates of complications and the medical burden of bites were compared between combat soldiers and noncombat dogkeepers. Bite locations were presented graphically. Results: Seventy-eight soldiers participated and reported on 139 bites. Mean time of working with dogs was 16 months (standard deviation, ±9.4 months). Overall bite incidence was 11 bites per 100 person-months; the mean time to first bite event was 6.3 months. The Cox proportional hazards model showed that none of baseline characteristics significantly increased bite hazard. About 90% of bites occurred during routine activities, and 3.3% occurred on combat missions. Only in 9% of bite events did soldiers observed the safety precautions code. Bite complications included fractures, need for intravenous antibiotic treatment and surgical repair, prominent scarring, diminished sensation, and stiffness of proximal joints. Bite complications were similar between combat soldiers and dogkeepers. Most bites (57%) were located on hands and arms. Conclusion: MWD bites are an occupational hazard resulting in significant medical burden. Hands and arms were most common bite locations. Observance of safety precautions may be the most appropriate first-line preventive intervention. Barrier protection of upper extremities may reduce bite severity and complication rates.

Keywords: canine; combat; bites, dog; dogs, military working; Israeli Army; dog keepers

Introduction

Military working dogs (MWDs) are increasingly used in Army, police, and antidrug units.1–3 Scientific literature addressing dog bites in these units is scarce. The existing studies focus on victims who were intentionally injured by law-enforcement dogs,4–7 and do not discuss the occupational risk of unintentional bites of police officers or soldiers by MWDs.

The Israeli Defense Forces MWD Unit is an elite unit, specializing in taming dogs’ special skills and using them in various settings of limited conflict. The demand for MWDs is high; thus, training and work are extremely intense. Everyday activities such as walking a dog, feeding it, and taking it to health check-ups are combined with combat missions.8,9 Combat soldiers are responsible for their partner MWDs, whereas dogkeepers care for temporarily unemployed MWDs. Dog bites are by far the most significant occupational hazard in this unit. A code of safety precautions exists but is violated often. The soldiers perceive bites as an inevitable outcome of work with dogs (i.e., “part of the deal”). Obviously, for those who sustain more severe injuries and suffer from residual disability, the price is too high.

This article focuses on soldiers who suffered bites while working with dogs. Its goals are to present dog-bite-related morbidity, including measures of risk, rates of complications, and the distribution of bite locations, and to identify points for preventive intervention. Special attention is dedicated to comparison of the risk for bites and complication rates between combat soldiers and dog keepers.

Methods

A questionnaire-based retrospective cohort study was conducted in the MWD unit. Participating subjects were men and women 18 to 21 years old, serving either as combat soldiers or as noncombat dog keepers for at least 3 months. All soldiers visiting the unit clinic for any medical problem other than a dog bite were offered the opportunity to participate. After providing an informed consent, they completed a short baseline characteristics’ questionnaire that requested information on age, sex, type of service, height, weight, smoking status, number of bites, and total duration of working with dogs; and a separate form for each bite they had received, which asked about characteristics of the event and of the bite medical treatment and complications. Event-specific information included time of the bite since the beginning of working with dogs, bite location, whether it was a soldier’s own dog, the biting dog’s breed (Belgian Malinois versus other types), whether safety

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precautions were observed, and the type of activity during which the bite occurred. Medical bite-specific information included bite severity (superficial versus deep), serious bleeding, fracture, need for intravenous (IV) antibiotic course, necessity of a surgical procedure (from approximation sutures to nerve repair), and such complications as loss of sensation (in the area proximal to bite), stiffness (in the joint proximal to bite), and prominent scarring. In addition, participants were asked to designate each bite location on a human body diagram.

Statistical analysis was performed using R 3.3.0 open-source software. Baseline characteristics and bite-specific risk factors of combat soldiers and dogkeepers were compared using the χ² test for categorical variables and Welch t test for continuous variables. Significance level was set at $p < .05$. The information about time working with dogs and timing of each bite was transcribed in a counting process format for survival analysis. Subjects with missing data on any of the variables were excluded. Proportional hazard ratios (HRs) with 95% confidence intervals (CIs) were estimated using a Cox model for recurrent events. The model included only constant risk factors, assessed by the general questionnaire. Distribution of bite locations was presented graphically on a human body diagram.

Results

General
A total of 150 soldiers were proposed to participate in the study, 78 (52%) consented and reported on a total of 139 bite events (mean, 1.8 bites per person). Mean (± standard deviation [SD]) follow-up time was 16 months (±9.4 months). Mean time to the first bite was 6.3 months.

Bite Incidence
Overall bite incidence was 11 bites per 100 person-months, with a higher rate among dogkeepers (14.9 per 100 person-months; $p = .06$).

Baseline Characteristics
Combat soldiers and dogkeepers represented different populations. There were more female soldiers ($p < .001$) among the latter group, and they were younger ($p = .002$) and had less mean experience with dogs ($p = .02$) than combat soldiers. Dogkeepers had, on mean, shorter time from beginning of working with dogs until the first bite than combat soldiers. However, there was no difference in mean number of bites per person ($p = .945$) and the rate of those having no bites between two groups ($p = .085$; power = 0.47; Table 1).

Survival Analysis
Kaplan-Meier curves demonstrated similar survival to first bite between combat soldiers and dogkeepers (Figure 1). Cox proportional HR of recurrent bites was 1.2 for dogkeepers ($p = .429$). There was no significant difference in proportional HR for bites by soldier’s sex, age, smoking status, height, or weight.

Bite Event Characteristics
Belgian Malinois were involved in most (80%) of the 139 bite events. In 51% of cases, soldiers were bitten by their own dogs. About 58% of bites occurred during training; only 3.6% occurred on combat missions (Figure 2). Safety precautions were observed in 9% of the events. Multiple bites constituted about 7% of all bite events.

### Table 1 Study Subjects’ Baseline Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Combat Soldiers (n = 64)</th>
<th>Dogkeepers (n = 14)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age, years</td>
<td>20.72</td>
<td>19.75</td>
<td>.002*</td>
</tr>
<tr>
<td>Female subjects, %</td>
<td>10.4</td>
<td>57</td>
<td>.000*</td>
</tr>
<tr>
<td>Smokers, %</td>
<td>18%</td>
<td>29</td>
<td>.351</td>
</tr>
<tr>
<td>Mean height, cm</td>
<td>176</td>
<td>170</td>
<td>.032*</td>
</tr>
<tr>
<td>Mean weight, kg</td>
<td>73</td>
<td>67</td>
<td>.092</td>
</tr>
<tr>
<td>Mean time working with dogs, months</td>
<td>17.3</td>
<td>11.5</td>
<td>.023*</td>
</tr>
<tr>
<td>Mean time to the first bite, months</td>
<td>6.7</td>
<td>3.9</td>
<td>.027*</td>
</tr>
<tr>
<td>Mean number of bites per person</td>
<td>1.89</td>
<td>1.85</td>
<td>.945</td>
</tr>
<tr>
<td>Persons having no bites, %</td>
<td>10.94</td>
<td>28.57</td>
<td>.085</td>
</tr>
</tbody>
</table>

*Statistically significant at α of 0.05.

Figure 1 Kaplan-Meier curves comparing time to first bite of combat soldiers and dogkeepers.

Bite Locations
A total of 169 were marked on 139 bite-event diagrams. Eighty bites (57%) occurred on hands and arms (Figure 3). Medical treatment and complications of bites among combat soldiers and dogkeepers are presented in Table 2.

Discussion
This study was initiated upon noticing high dog-bite incidence within the MWD unit. Its goals were to describe the epidemiology of bites, to identify soldiers at greatest risk, and to estimate the associated medical burden. Construction of questionnaires was guided mainly by in-unit experience and perception of what could represent risk factors for bites, because literature regarding domestic and police dog bites provided only a limited perspective.4–7,10 The most important question was whether dogkeepers are at increased risk of bites compared with combat soldiers.

Incidence
Incidence of bites from MWDs was 10.9 per 100 person-months, which corresponds to annual incidence of 1,312 bites per 1,000 population. This is high, compared with the reported population-wide annual incidence of 8.3 per 1,000 in the Netherlands and 0.71 per 1,000 in areas of low population
Medical Burden of Bites

There is considerable medical burden associated with dog bites (Table 2). Every soldier bitten is routinely evacuated for examination in the emergency department and receives a regimen of oral amoxicillin with clavulanic acid for 1 week. The reported number of sick days is probably an underestimation because some soldiers returned to the unit despite incomplete recovery and impaired function. Some bites left such residual complications as stiffness and reduced sensation. At the time of questionnaire introduction, these signs had persisted for a mean of 11 and 6 months, respectively. This implies that some motion and sensation disturbances could still improve on subsequent follow-up.

Soldiers with severe bites who had to leave active service were not represented by the study population. The unit physician (H.S.) recalled four such cases that occurred during 6 months preceding this study: one case of fifth-finger near amputation, which required re-implantation; a case of index-finger bite with extensor tendon injury treated conservatively; one case of trapezium fracture with severe bone loss and poor healing prognosis; and one case of index-finger bite and infection that required hospital admission.

Injury severity, however, was lower than that inflicted by police dogs in other reports. Hutson et al.\textsuperscript{4} presented a series of 790 patients who were bitten by K-9 law enforcement dogs between 1988 and 1993.\textsuperscript{4} The population included individuals who were pursued and attacked by German Shepherds. About 57% were multiple-bite events, and the complication rates were higher: 7% were vascular injuries, 5% were infections, 4% were open fractures and cortical violations, 1.9% were nerve injuries, 1.1% were tendon injuries, and 0.9% were open-joint injuries.\textsuperscript{4} Treatment included sutures in 34.5% of the cases and grafting in 0.6% of the cases, whereas 6.7% of wounds were treated in the operating room. Meade et al.\textsuperscript{5} compared police records regarding law enforcement dog victims and emergency department visits for domestic dog bites. They obtained information about 595 and 1,109 patients in each group, respectively. Police victims suffered more severe injuries: 42% of them were admitted to the hospital (7%), and 73% had multiple bites (16% for domestic dogs). Operations were performed in 4% of police victims and 2.3% of domestic victims.\textsuperscript{5} It appears that by injury severity, occupational bites reported by Meade et al.\textsuperscript{5} are closer to domestic dog bites than to “purposeful” bites by police dogs.
Bite Locations
The human body diagram (Figure 3) demonstrates that no part of the body surface is spared from dog bites; however, 57% of bites by MWDs were confined to hands and arms, compared with 20% to 34% of hand and arm bites by police dogs and domestic dogs. This can probably be explained by different dog training techniques. Hutson et al. reported similar bite locations among police-dog victims. 57.2% of whom sustained multiple bites: 62.5% were injured in an upper extremity, 62% in a lower extremity, 11.9% in the torso, 6.6% in the head and neck, 5.3% in the face, and 0.3% sustained injuries in the perineum. Distribution of domestic dog bites in children was different: 39% for lower leg injuries, 27.5% on hands and forearms, 19.3% on thigh and knee, 8.5% on head and neck, and 3% of injuries occurred in the upper arm and shoulder.

Limitations
The study has several limitations. It is based on self-reported questionnaires and thus may be prone to recall bias. Most participants admitted to having many mild bites, the timing and circumstances of which they did not remember well. This, however, is more reliable than the official registries. For example, in the community setting in United States, 20% of dog bites are treated in emergency departments, whereas 80% are treated nonmedically, and are not reported. Bidirectional selection bias could have taken place in our study: On the one hand, most severe cases were not available for participation in the study; on the other hand, among those soldiers who refused to participate, bite occurrences and complications could follow a different distribution. Our study sample was not sufficient to demonstrate statistically significant effect of baseline risk factors on bite hazard. Finally, the major risk factor for the amount of exposure to bites may not be reliably represented by the duration of experience of working with dogs. Patterns of work may vary within the groups of dogkeepers and combat soldiers, and may depend on a soldier's individual manner.

Conclusion
Dog bites are an occupational hazard of working with dogs. We found high bite rates among soldiers working with dogs, regardless of their role. A considerable percentage of soldiers reported having some degree of residual disability. Observance of safety precautions could reduce bite rates, emergency room evacuations, antibiotic treatment, and sick days, whereas barrier protection over hands and arms may reduce bite severity and rates of complications.

Disclosures
The authors have nothing to disclose.

References
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