

ORIGINAL ARTICLE

## Snakebite injuries: Contributing factors and intentionality of exposure

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The objective was to study the intent of exposure to snakes and other factors contributing to snakebite injuries in order to develop prevention strategies. We used a retrospective chart review and a follow-up telephone interview of snakebite victims who were admitted to a tertiary care center between 1985 and 1994. The data collected included demographics, intent of exposure and host and environmental factors. I performed descriptive analysis. Twenty-four males and six females ranging in age from 2 to 93 years sustained bites from a variety of snakes including rattlesnakes, copperheads, and Egyptian cobra, and others. Sixty-seven percent (20/30) of all bites resulted from intentional exposures to snakes: professional snake handlers (7), snake hunts (8), and playing with (aggravating) snakes in the wild (5). Sixty-five percent (13/20) of intentional exposures involved novices in a recreational/home setting, and 35% (7/20) occurred in an occupational setting. Unintentional exposures occurred while victims were walking in wooded areas, fishing by streams, gardening, and washing dishes indoors. Forty percent (12/30) of all victims had consumed alcohol before the snakebite, 92% (11/12) of whom were nonprofessionals with intentional exposures. Only eight victims (seven of whom were professional handlers) were using protective equipment. I concluded that the majority of snakebite injuries resulted from intentional exposures to snakes in which a variety of factors such as the use of alcohol and lack of protective equipment likely played a role.

*Key words:* snakes, snakebite, injury prevention, rattlesnake round-ups

### Introduction

Venomous snakebites account for approximately 8000 injuries each year in the United States [1]. Although snakebite injuries do not encompass a large part of the practice of most physicians, much has been written on the presentation and treatment of various types of snakebites [2]. However, as Curry et al. observed in 1989, little has been documented on the true etiology of snakebites [3]. The goals of this research were to delineate the intent of the snakebite victim at time of exposure and to describe major contributing factors surrounding the bite to indicate possible focuses for injury prevention.

### Methods

A retrospective chart review was conducted at a university-affiliated level I trauma center. Patients admitted with the principal diagnosis (ICD-9 N-code) of snakebite over a 10-year period (1985–1994) comprised the study group. Infor-

mation gathered included demographics, geographic locale, intent of exposure, and host and environmental factors. In addition, the lead author (N.M.) conducted follow-up telephone interviews with these snakebite victims to supplement and confirm data obtained through chart review. The study received approval from the University Institutional Review Board, and all data were kept confidentially and without patient identifiers.

No consideration was given as to whether the bite was a true envenomation because the focus was on intentionality of exposure and circumstances leading up to the bite. An intentional (illegitimate) exposure was defined as one in which the victim had voluntarily chosen to interact with a snake [3,4]. Unintentional exposures were defined as those exposures in which the subject had no intent to interact in any way with a snake [3,4].

The victims in the intentional-exposure group were subdivided further into the following: professional handlers, rattlesnake round-up participants, and those who chose to disturb (play with) snakes in the wild. Professional handlers were considered those who worked with snakes for a living or who claimed extensive experience in the proper handling of snakes during the telephone interviews. Rattlesnake

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round-up participants were those who stepped voluntarily into an enclosed screen cage containing a multitude of rattlesnakes for the sake of this unique contest in which a team of two people—one person the bag holder, the other the snake “retriever”—would attempt to catch and place as many rattlesnakes as possible into a burlap bag in a fixed period of time; all of these round-ups were done in the name of charity or fundraising and were usually sponsored by local fire departments. (Please see photographs)

Victims were considered to be under the influence of alcohol either if the patient admitted consuming alcohol before being bitten or if an alcohol level  $>0.1$  mg/dL was noted at the time of admission. Data from all of these encounters were subsequently analyzed using descriptive methods.

## Results

### GENERAL INFORMATION

Thirty individuals comprised the study group: 24 males (80%) and 6 females (20%). Ages ranged from 2 to 93 years, with nearly half (47%) being in the third decade of life. Four subjects (13%) were less than 10 years old (ages 2, 3, 4, and 8).

Rattlesnake species inflicted 50% of the bites, followed by copperheads (40%) and three “others,” of which two were surmised to be likely copperhead, and one was an Egyptian cobra imported in for sale by a local pet shop.

Of those cases from which it could be determined, 6 of 27 (22%) of the victims had been bitten previously. Moreover, 20% viewed the bite as a work-related injury.

Seventy percent of all bites were to the upper extremities, with 20 out of these 21 being either to the fingers or hand. Lower-extremity bites comprised the remainder of exposures at 30% (9/30). No other bite sites were recorded.

All but one of the upper-extremity bites (95%) were



Fig. 1. Sign announcing snake hunt and associated activities.

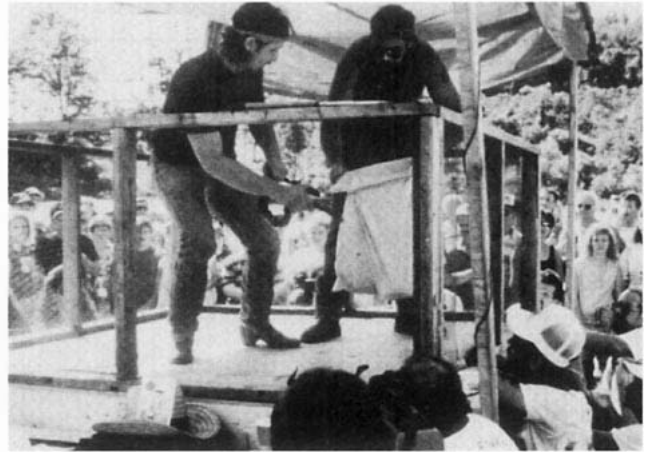


Fig. 2. Round-up participants attempted to catch and place as many rattlesnakes as possible into a burlap bag in a fixed period of time.

the result of an intentional exposure, whereas all lower-extremity bites (9/9) were from unintentional exposures.

### INTENTIONALITY OF EXPOSURE

Intentional exposures accounted for 67% (20/30) of all snakebites in the study group. Of these, rattlesnake round-up participants accounted for 40% (8/20) of the injuries. Professional handlers in a work-related environment incurred 35% (7/20) of these bites. Finally, 25% (5/20) of these subjects were deemed to have been aggravating the snake in some way before being bitten; most commonly they were trying to pick up the snake in the wild (see Table 1).

The unintentional exposures included a variety of events and are summarized in Table 2.

### ALCOHOL USE AND SNAKE BITES

Alcohol use was analyzed and found to have an overwhelming prevalence in the intentional-exposure group. Forty percent (12/30) of all subjects were noted to have alcohol use as a factor that preceded the bite. Of these, 92% (11/12) occurred in the intentional-exposure category. All were amateurs either participating in the rattlesnake round-ups or disturbing a snake in the wild. No professional handler was

Table 1. Intentional snakebite exposures

Circumstance	Frequency*
Rattlesnake round-up	40% (8)†
Professional handlers	35% (7)
Disturbed snake in wild	25% (5)†

\*Percent of total. Numbers in parentheses indicate occurrences.

†Sixty-five percent (13 of 20) of intentional exposures were easily avoidable.

**Table 2.** Unintentional snakebite exposures

<i>Circumstance</i>	<i>Frequency</i>
Walking by stream	2
Sitting in grass	2
Playing in woods	2
Sitting by campfire	2
Doing dishes in kitchen	1
Walking in yard	1

reported to be under the influence of alcohol when the injury occurred (see Table 3).

#### USE OF PROTECTIVE EQUIPMENT

Only 27% (8/30) of the subjects stated that they were using some form of protective equipment at the time of the bite. Seven of these eight (88%) were the professionals. Only one layman was noted to be using protective gear (boots and tongs) while on a snakehunt. Of the 73% (22/30) not using proper equipment, 10 subjects were in the intentional-exposure category. No professional interacted with a snake without at least the use of a stick and/or tongs.

#### Discussion

Snakebites are a significant injury that physicians will encounter occasionally in their practices. Much of the earlier literature on snakebites does not focus specifically on mechanisms of injury, intent, risk factors, or protective equipment use at time of the exposure [3–5]. In fact, Curry, in 1989, was one of the first to address some of these issues specifically, and subsequently to observe the shifting etiology of snakebites in this country. Our data lend support to this trend and offer several suggestions for injury prevention.

Fortunately, it seems that overall incidence of snakebites in the United States is on the decline as society becomes progressively more urban, limiting exposures to snakes.

**Table 3.** Snakebites and alcohol use

<i>Group with ETOH involvement</i>	<i>Frequency</i>
This work	12 (40%)
Intentional	
Nonprofessionals	11
Professionals	0
Curry study (Ref. 3)	18 (60%)
Intentional	
Nonprofessionals	2
Professionals	7
Unintentional	9

However, the incidence may not be as low as one might hope, mostly because of a continued interest in snakes by a segment of the population. Because of this, there appears to be an evolution toward the majority of snakebites now being from intentional exposures rather than accidental [3–6].

#### INTENT AT TIME OF EXPOSURE

The intention of the victims at the time of exposure varied greatly. Two thirds of our study group were deemed to have an intentional exposure to a snake. Rattlesnake round-up participants and those simply disturbing a snake in the wild accounted for the majority of these (43% of the total study group), whereas 35% were considered the work-related injuries of professional handlers.

Easily then, nearly one half of all snakebites in our population could have been avoided simply by the victim choosing not to interact with the snake. And only the exposures incurred by the professionals, although intentional, could be considered valid as part of the inherent risk of their livelihood.

#### ROLE OF ALCOHOL

Alcohol use was found in the majority of subjects comprising the intentional-exposure group. All alcohol-related snakebite victims were “unskilled” handlers (nonprofessionals), participating in some form of recreational snakehandling. Only one of the unintentional-exposure subjects coincidentally consumed alcohol before being bitten. No professional consumed alcohol before working with snakes.

It therefore seems apparent from these data that alcohol is a preexposure factor leading to a likely increased risk of snakebite. Curry also found that 56.5% of his study group consumed alcohol before being bitten, whereas earlier studies demonstrated very little alcohol use in their subjects, nor did the studies cite alcohol as a major risk factor for snakebite [4–7].

#### ROLE OF PROTECTIVE EQUIPMENT

Protective equipment could have been used more effectively throughout all subsegments of our study group. Very few of the subjects (27%) used protective gear, with the professional handlers accounting for all but one person in this category.

It was expected that those in the unintentional group would not be using protective equipment because they did not anticipate encountering a snake on the day of their exposure. However, it is surprising that only one person with an intentional, recreational exposure to a snake chose to use even the most basic of protective gear. None of the rattlesnake round-up participants used any form of protection during the contests.

The vast majority of victims with unintentional exposures sustained bites to the lower extremities (9/10). Although by

definition an encounter with a snake was unplanned, some of these bites may have been avoidable through the use of protective footwear by those individuals in known high-risk areas.

#### EVOLVING ETIOLOGY OF SNAKEBITES

Snakebites and exposure to snakes seem to be an evolving event in the United States as society itself evolves. Data from the early 20th century describe snakebites as more accidental events and involving the lower extremities. Indeed, Hutchison in 1927 noted that only 4.9% of his study group ( $n = 455$ ) incurred a snakebite while intentionally trying to capture a snake or handle a captive one. Further, 58% of victims in his study were bitten on the lower extremity, and only 41% sustained upper-extremity bites; he noted that most of the upper-extremity bites were still accidental from activities such as berry picking, gathering wood, or gardening/farming duties [3,6].

In 1966, Parrish, with a large population of 2756, again noted that approximately 60% of the victims suffered snakebites to the lower extremities, but he failed to comment on the intent of his subjects at the time of injury.

Further, Russell, in a nationwide review in 1983 believed that approximately 75% of all venomous snakebites were legitimate (unintentional) exposures.

However, more recent research seems to indicate that intentional exposure to snakes (and subsequent bites) is on the rise. Wingert and Chan in 1988 reviewed 292 cases of snakebites, with 87% being to the upper extremity, 57% believed intentional exposures, and 28% with associated alcohol use [7]. Similarly in 1989, Curry reported that 74.4% of his study group sustained bites to the upper extremity, and more than 56% of all bites in the study population were from intentional exposure to snakes. However, no breakdown between professional handlers and amateurs in recreational settings was made in either study.

Our data do seem to support this trend toward a higher incidence of intentional exposures to snakes; again, with 67% of our study group incurring snakebites from intentional exposures, and 70% suffering upper extremity bites.

#### LIMITATIONS OF STUDY

Our study may be biased because of the unique subpopulation of rattlesnake round-up participants factoring into our data. To date, we do not know of any other sites in the country where such sanctioned snake contests occur. In fact, people traveled from as far as Canada to participate in this unique event. Because of this unusual contest, it is possible that our data may not be representative of snakebite incidence throughout the remainder of the United States. How-

ever, the data of Curry and of Wingert and Chan may indicate otherwise [3,7].

Further, data collected from phone interviews are subject to the recall bias of the participant. Because of the subject matter of this study, it is possible the participants did not always report the circumstances surrounding their injury accurately because of the behavior that might be perceived as socially unacceptable.

Moreover, this is a retrospective study design with a relatively small sample size.

#### FUTURE RESEARCH NEEDS

The prevention of snakebite injuries, like any disease process, requires research to identify risk factors, develop interventions, and evaluate the effectiveness of preventive strategies. Thus, studies in other geographic areas are needed to confirm our findings and to obtain more accurate and detailed data on the etiology of snakebites.

#### Conclusion

Although snakebite injuries account for a small part of the patient population of a physician the circumstances surrounding these injuries seem to be evolving. Our data suggest that nearly half of all snakebites in this study population (65% of intentional exposures) could have been prevented simply by curtailing planned events and spontaneous actions that intentionally bring humans in contact with snakes. Further, limiting the use of alcoholic beverages and implementing standard protective equipment during intentional exposures to snakes may help reduce the overall incidence and severity of snakebite injuries.

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