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Injury among cavers: results of a preliminary national survey

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Background. **To estimate the frequency of and risk factors for caving-associated injuries.**
Methods. **A standardized questionnaire covering demographics, caving exposure, and injury history was distributed to all members of the National Speleological Society by inclusion in the monthly newsletter.**
Results. **Of 9,532 members sent a questionnaire, 301 responded (3.2%). Respondents had an average of 18 years of caving experience, and 37% had sustained one or more injuries while caving. Hypothermia was the most frequent injury, followed by fractures, animal bites, and concussions. The rate of injury was about 1 per 1,990 hours in a cave. Injury rates for females were about twice those of males; older persons and those with more than 5 years of caving experience seemed to have lower injury rates.**
Conclusions. **Many caving injuries appear potentially preventable. Proper technique for safe climbing should be a part of exploration training. There is a need for proper belaying or rappelling for even short ascents or descents. Helmet use should be stressed, as should adequate protection from hypothermia.**

KEY WORDS: Caving - Rabies - Athletic injuries.

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The risk of histoplasmosis from cave exploring has long been known.[1] However, the injury risks from caving appear less well understood. Although the potential injury risks have been itemized[2] and some cave-associated injuries have been described,[3] to our knowledge, there has been no systematic survey to quantify the risk and examine risk factors for injury from caving. As part of a survey of members of the National Speleological Society (NSS) stimulated by an outbreak of histoplasmosis among cavers attending the national convention (to be reported elsewhere), we included questions about injury to help fill this information gap.

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Materials and methods

A standardized questionnaire was distributed by the NSS to members by inclusion in the January 1995 NSS monthly newsletter. Readers were asked to complete the survey and return it to the society headquarters. Beyond the data collected to investigate the histoplasmosis outbreak (*e.g.*, symptoms and specific exposures at the convention), data collected included demographics (age and sex), caving exposures since October 1993, and injuries both since October 1993 and ever while caving. We used October 1993 to facilitate

TABLE I.—*Number and rate per 100,000 hours of reported caving-associated injuries.*

Type of injury	No of persons injured		Rate/100,000 hours caving*
	In lifetime	Since Oct 1993	
Hypothermia	72	15	39.7
Fracture	30	3	7.9
Animal bite	12	5	13.2
Concussion	12	1	2.6
Frost bite	11	2	5.3
Any injury	113°	19^	50.3

°) There were 137 total injures: 15 persons had 2 injuries, 3 had 3, and 1 had 4 injuries; ^) There were 26 total injures: 3 persons had 2 injuries and 1 person had 5 injuries; *) Since October 1993.

TABLE II.—*Rate of reported injury since October 1993 per 100,000 hours, by characteristic.*

Characteristic	No. persons	No. injured*	No. hours caving*	Rate/100,000 hours caving
Total	290	19	37,790	50.3
Gender				
Female	60	6	6,955	86.3
Male	230	13	30,835	42.2
Age				
Under 35	96	8	15,080	53.1
35-44	101	8	12,639	63.3
45 and over	93	3	10,071	24.3
Years of caving				
≤4	41	6	4,957	121.0
5-9	62	3	6,936	43.3
10-19	64	4	9,054	44.2
20-29	66	3	9,232	32.5
30 and over	57	3	7,611	39.4

*Since October 1993.

respondent's recall. An injury was defined as any one of the following: hypothermia, concussion, fracture, animal bite, or frost bite.

Data from the questionnaires were entered in Epi-Info software.[4] To calculate injury rates, the numerator included all injuries reported since October 1993 divided by the total hours of caving from October 1993 until the completion of the questionnaire for all respondents who reported caving during that time period.

Results

Of the 9,532 members estimated to have received the questionnaire, 301 responded (3.2%). Of the respondents, 237 (79%) were male. The mean age of respondents was 41, and the total number of years of caving experience was 5,428 (mean= 18 years).

TABLE III.—*Membership, fatal, and non-fatal incident reported to the National Speleological Society, 1986 to 1993.*[3]

Year	Membership	Fatal	Non-fatal	Total	Incident/1,000 members
1986	6811	4	41	45	6.6
1987	7298	3	45	48	6.6
1988	7986	4	45	49	6.1
1989	8469	1	50	51	6.0
1990	9056	4	51	55	6.1
1991	9823	6	48	54	5.5
1992	10544	5	56	61	5.8
1993	11164	5	59	64	5.7

Of the respondents, 113 (37.5%) reported a total of 137 injuries during their past explorations (Table I). The most frequent injury was hypothermia, followed by fractures. Of the 30 persons reporting fractures, 11 were to the hand, nine to the ribs, eight foot, five arm, four leg, three spine, and two skull fractures.

Based on the caving experience of 290 persons since October 1993, the overall rate of injury was 50.3 per 100,000 hours caving. Hypothermia had the highest risk (Table I). Injury rates for females were about twice those for males and persons older than 35 and those with more than 5 years of caving experience seemed to have lower rates (Table II).

Forty-four (15%) of the 301 respondents reported having been vaccinated for rabies virus. Seven of those 44 were post-exposure vaccinations resulting from animal bite injury while caving. Only 37 (12%) of the respondents reported having received pre-exposure vaccination against rabies.

The respondents reported a very high usage of helmets: 284 reported always wearing one while caving, 13 reported usually wearing one, three sometimes and one rarely.

Discussion and conclusions

Our results suggest that the rate of injury was about 1 per 1,990 hours in a cave. Injury rates for persons older than 35 years and those with more than 5 years of caving experience seemed to be lower than rates for younger persons and those with less caving experience, respectively. Unlike most injuries,[5] females appeared to have injury rates well above males.

These results are somewhat difficult to place in per-

spective given the lack of prior studies and the limitations of our survey. First, our response rate was very low (3.2%). However, the demographics of this sample appeared similar to the entire membership of the NSS (David Luckins, NSS, personal communication). Secondly, previously injured persons may have been more likely to respond, thereby inflating the rate of injury, or those who were badly injured might have quit caving and not have been reached by the survey. Also, injuries reported may not have occurred within the time period of interest. Remembering an event as being more recent than it actually was ("telescoping") is a potential problem in surveys,[6] and this recall issue may have inflated our estimates, as well. On the other hand, serious cavers may be more likely to belong to NSS than "amateurs" and they may be more careful than less dedicated cavers. The distribution of years of caving in our sample (Table II) suggests a well-experienced group. The higher injury rate among the less experienced cavers suggests that a sample of more experienced cavers may underestimate the injury rate for all cavers.

The only perspective we can offer on our estimates comes from caving-associated injuries that are voluntarily reported to the NSS by members.[3] NSS data from 1986 to 1993 suggest an injury rate of about 6 per 1,000 members per year and that the rate may be decreasing over time. Our rate data from October 1993 (Table II) represent roughly a year for most respondents for a rate of 65.5 per 1,000 members per year (19 injuries in 290 members in a year). Our estimates are thus an order of magnitude higher than the voluntarily reported information.

NSS data suggest that the ratio of fatal to nonfatal incidents is about 1:12 (Table III).

Eleven (34%) of 32 fatalities were due to drowning while caving. Of the reports to the NSS, 40%-50% of injuries were related to falls and an equal percentage were related to equipment failure. Although helmet use is nearly universal among cavers, reports of injuries to the NSS reveal that proper use of ropes and climbing equipment is frequently inadequate.

Thus, caving involves many potentially preventable injuries. Cave exploration often requires climbing of some sort, and proper technique for safe climbing should be a part of cave exploration training. Serious injuries can occur from even short falls; thus, it is important to emphasize the need for proper belaying or rappelling for even short ascents or descents. Helmet use should be stressed, as should adequate protection from hypothermia. Hypothermia protection involves not only staying warm, but staying dry.

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