



DIVING INJURIES RATES: RESULTS FROM AN ONLINE SURVEY

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INTRODUCTION

- ❖ Data about injury rates in recreational scuba diving are limited.
- ❖ The risk of injuries is suspected to be associated with certification levels, experience of divers and demographic factors but evidence based verification is not available.
- ❖ The aims of our study was to establish self-reported injury rates among DAN members and possible association of divers’ characteristics with risk of injury.

MATERIALS AND METHODS

- ❖ The study is based on a retrospective survey focused on participant’s annual exposure and diving-related injuries during the previous year, approved by IRB.
- ❖ Invitation was sent by email to 30,000 randomly selected DAN members.
- ❖ Invitees were 18 years or older and must have dove at least once during 2010-2011.
- ❖ Only invitees had survey access and each could respond only once.
- ❖ The respondents reported all of their injuries and the number of dives cumulatively over one year; hence the injury rates we estimated from this aggregated data are ecologic in nature.
- ❖ Only scuba diving-related injuries are reported here.
- ❖ Total self-reported DCS symptoms were computed by combining three symptoms: pain in joints and/or muscles, skin rash or marbling (several hours), and loss of muscular strength (paralysis).
- ❖ Descriptive statistics of the collected variables are discussed using tables and frequencies.
- ❖ Self- reported injury rates were expressed per 100 dives. The self-reported DCS symptom rates were expressed per 1000 dives. Rate of treated DCS was reported per 100,000 dives.
- ❖ Poisson regression models with scaled deviance were used to model self-reported dive-related injury rates for divers with different diving certification levels.

RESULTS

Table 1. Data Summary

Respondents		5514
Complete surveys		4859
Age (median; range)		52 (18-90)
Males (%)		75
BMI (mean, SD)		26.9 (4.51)
Dives	Total	160,288
	mean, SD	34.6 (43.9)
	median, 5-95 percentile	20 (3-100)
Injuries	Occurrences	5865
	n Injured Divers	1580
	Treated	665
	Claimed	38
	HBOT	16

Table 2. Characteristics of the participants by certification level

		Basic		Advanced		Instructor		Total	
		n	%	n	%	n	%	N	%
Sex	Male	573	65	2080	73.9	655	82	3388	73.5
	Female	308	35	735	26.1	144	18	1219	26.5
Age group	17-24	30	3.3	60	2.1	14	1.7	112	2.4
	25-34	125	13.9	290	10.1	68	8.4	491	10.5
	35-44	123	13.7	529	18.4	142	17.6	810	17.2
	45-54	246	27.3	870	30.3	229	28.3	1378	29.3
	55-64	260	28.9	814	28.3	267	33	1371	29.2
	65-74	100	11.1	282	9.8	80	9.9	481	10.2
Years of diving	75+	16	1.8	30	1	8	1	55	1.2
	0-5	393	42.7	732	24.5	69	8.3	1248	25.7
	6-10	136	14.8	561	18.8	123	14.7	840	17.3
	11-15	98	10.6	413	13.9	129	15.4	648	13.3
	16-20	85	9.2	337	11.3	106	12.7	535	11
	21-25	54	5.9	316	10.6	96	11.5	472	9.7
	26-30	47	5.1	224	7.5	86	10.3	362	7.5
	30+	108	11.7	400	13.4	227	27.2	754	15.5

Table 3. Self-reported diving-related injuries by participant’s gender

Injuries	Males n (%)	Females n (%)	Total N (%)
Ear problems (other than hearing loss)	733 (19.4)	371 (21.7)	1180 (20.1)
Headache	543 (14.3)	285 (16.7)	906 (15.4)
Sinus troubles	425 (11.2)	180 (10.5)	655 (11.2)
Puncture, cut wound	375 (9.9)	110 (6.4)	528 (9.0)
Overexertion, low back pain, sprain or strain	390 (10.3)	155 (9.1)	497 (8.5)
Squeeze	302 (8.0)	142 (8.3)	490 (8.4)
Pain in joints and/or muscles ¹	175 (4.6)	66 (3.9)	256 (4.4)
Itching, after diving (<20 min)	140 (3.7)	66 (3.9)	212 (3.6)
Allergic contact dermatitis	86 (2.3)	103 (6.0)	203 (3.5)
Tooth pain	98 (2.6)	30 (1.8)	142 (2.4)
Hearing loss	84 (2.2)	36 (2.1)	136 (2.3)
Dizziness and giddiness	81 (2.1)	35 (2.0)	129 (2.2)
Skin rash or marbling (several hours) ²	79 (1.9)	40 (2.3)	129 (2.2)
Shortness of breath	71 (1.5)	21 (1.2)	100 (1.7)
Animal bites	55 (1.7)	31 (1.8)	96 (1.6)
Crushing injury and fractures	64 (1.0)	8 (0.5)	78 (1.3)
Burns	37 (0.8)	15 (0.9)	56 (1.0)
Sprain and strain of ankle	31 (0.4)	13 (0.8)	49 (0.8)
Loss of muscular strength (paralysis) ³	14 (0.1)	1 (0.1)	16 (0.3)
Unconsciousness	3()	0 (0)	7 (0.1)
TOTAL	3786	1708	5865
Decompression Sickness ⁽¹⁺²⁺³⁾	192	73	282

⁽¹⁺²⁺³⁾Self-reported DCS symptoms

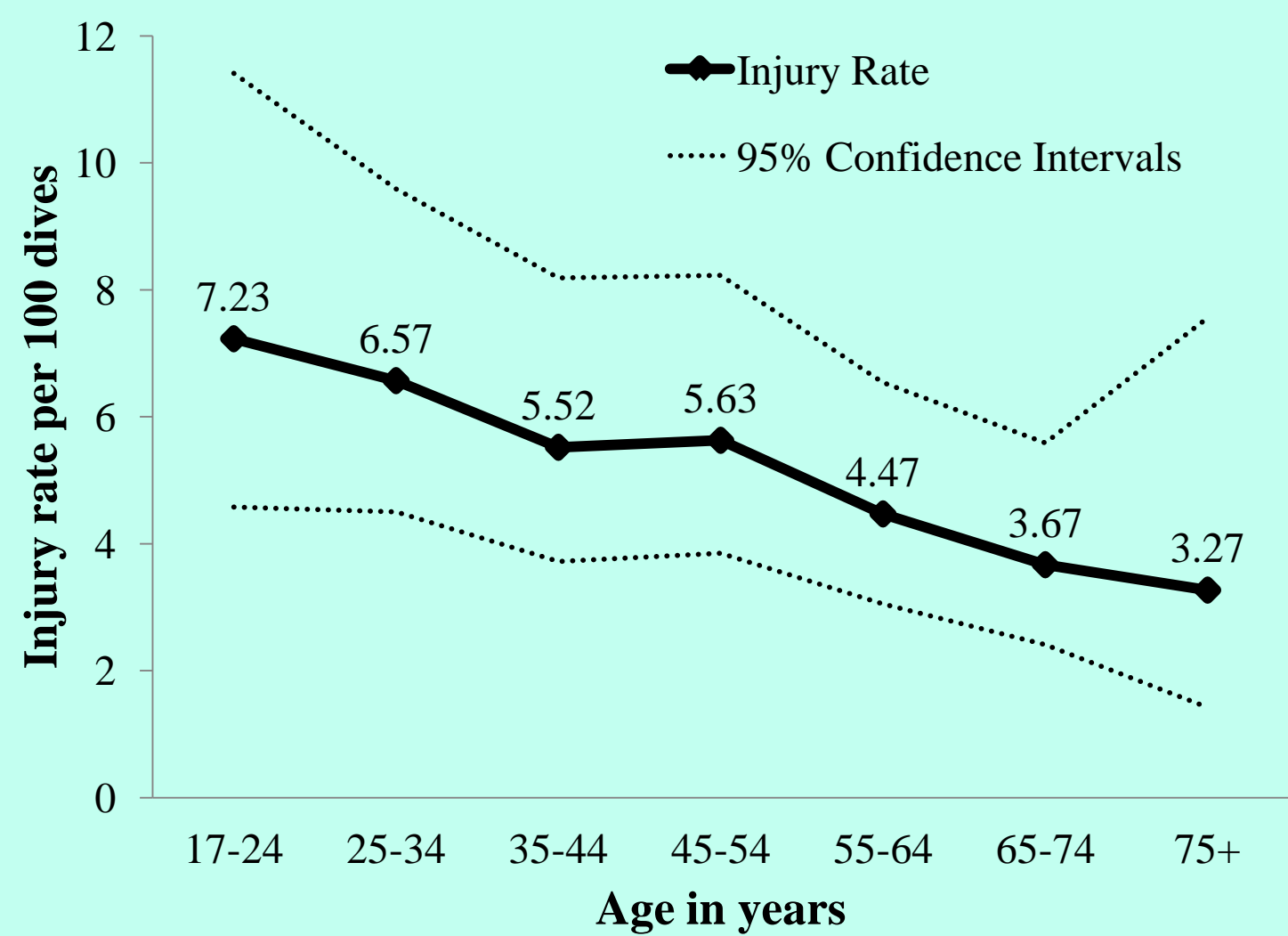
Injury Rates

- ❖ The crude rate for all diving-related injuries was 3.48 per 100 dives (95% CI: 3.30, 3.68). The adjusted injury rates decreased with increasing age (see Figure 1). Table 4 suggests that divers with instructor level diving certification reported lower injury rates as compared to divers with advanced or basic level diving certifications.
- ❖ The adjusted injury rate for males was 5.00 per 100 dives (95% CI: 3.33, 7.50) and for females was 6.57 per 100 dives (95% CI: 4.50, 9.59), for a male to female rate ratio of 0.76 (95% CI: 0.67, 0.87).
- ❖ Overall crude self-reported DCS symptom rate was 1.62 per 1000 dives (95% CI: 1.50, 1.74). Adjusted rates (adjusted for age and years of diving experience) were lower in divers with instructor level certification as compared to divers with advanced or basic level diving certifications (Table 3).

Table 4. Adjusted rate ratios and overall rates for all measured outcomes

		Rate Ratio (95% Confidence Interval)		
Variables	Categories	All injuries	DCS symptoms	Treated DCS
Diver certification level (ref=basic)	Advanced	0.60 (0.51,0.70)	0.56 (0.45, 0.71)	-
	Instructor	0.31 (0.26, 0.38)	0.29 (0.22, 0.38)	-
Gender (ref=female)	Male	0.76 (0.67, 0.87)	0.74 (0.61, 0.91)	1.84 (1.36, 2.49)
Age (ref=17-24)	10 years increase	0.88 (0.83, 0.93)	0.85 (0.80, 0.93)	1.09 (0.96, 1.19)
BMI (ref=Normal)	Overweight	1.15 (1.01, 1.32)	2.02 (1.63, 2.51)	-
	Obese	1.18 (1.01, 1.38)	2.16 (1.70, 2.73)	-
Years of diving	5 years increase	1.03 (1.00, 1.06)	1.05 (1.01, 1.09)	-
		Rate per 100,000 dives (95% Confidence Interval)		
Overall rates		3480 (3300,3680)	162 (150, 174)	7.35 (6.62, 8.16)

Figure 1: Adjusted injury rates by age of the participants adjusted for gender, BMI, years of diving, and diving certification level



SUMMARY

- ❖ Incidence of dive related injuries may be higher than previously thought.
- ❖ DCS type symptoms account for 6% of reported injuries.
- ❖ Number of divers reporting DCS type symptoms was 20x higher than the number of divers who received treatment.
- ❖ DCS rates decrease with age.
- ❖ Males reported injuries more often than females
- ❖ Divers with advanced and instructor level certifications reported fewer injuries than divers with basic certification.