DIVING ACCIDENTS: ANALYSES OF UNDERLYING VARIABLES

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SUMMARY

Problem

Navy diving encompasses many diverse activities and consequently is subject to numerous and distinct risks. Effective planning of diving operations is contingent upon awareness of those conditions that contribute to the success or failure of the dive mission.

Objectives

The objectives of this study were (1) to determine the most commonly occurring underwater mishaps and (2) to identify the underlying factors associated with diving accidents.

Approach

Underlying environmental conditions and diver-related factors were examined for 706,259 dives and 1,174 diving mishaps that occurred during the time frame of January 1968 through May 1981. Accident rates and depth-controlled accident rates were computed for various levels of the 12 factors examined and compared with overall mishap rates. The factors under investigation were dive depth, dive purpose, time of day, decompression schedule type, time submerged, air temperature, surface water temperature, bottom water temperature, age, height, weight, and recent diving experience.

Results

Decompression sickness and barotrauma were the most prevalent diving incidents, and the most common accompanying symptom was localized pain. Though accidents occurred at all subaqueous levels, mishap incidence was greatly influenced by dive depth. Dives performed at depths of less than 50 feet (75% of Navy diving) yielded accident rates significantly lower than the overall rate, while submergences at greater depths were at increased risk. Elevated mishap rates were observed for the subcategories of selection and experimental within the factor of dive purpose. Decompression schedules, utilized on 9% of Navy dives, represented an increased risk in general and, in particular, for saturation diving and surface decompressions. Older divers were disproportionately assigned to deep dives. The overall probability of any dive terminating in an accident was .0017. Ninety-eight percent of diving incidents ended in complete or substantial relief.

Conclusions

Of the 12 factors examined, the variable of dive depth yielded the most straightforward association with mishap incidence; the deeper the dive, the greater the risk. The results of this study also demonstrated the potency of this variable in overriding the influence of other factors. Risk of a mishap was greatest among the dive purposes of selection and experimental; among decompression schedules, the highest risk was for saturation and surface decompressions. Older divers were disproportionately and appropriately assigned to deep dives.

Recommendations

Findings indicated that all possible precautions should be taken on experimental and selection dives as well as all dives requiring a decompression schedule, particularly saturation diving. Investigation of diver-related variables other than those of the diving logs is warranted.

Diving Accidents: Analyses of Underlying Variables

Diving may be viewed as a complex activity in which many factors contribute to the success or failure of the dive mission. Each submergence takes place in a framework of certain environmental conditions, for a given purpose, by an individual with particular characteristics. Numerous environmental factors, such as water temperature, dive depth, and time of day as well as characteristics specific to the individual diver--age, recent diving experience, and weight--may contribute to the occurrence or avoidance of a diving mishap. Knowledge of these predisposing factors may serve to lessen mishap incidence.

Underlying factors contributing to diving accidents presumably could derive from two domains. First, they could be intrinsic to the environmental circumstances of the dive. Variables to examine in this regard include dive depth, dive purpose, time of day, decompression schedule type, time submerged, and temperature (air, surface water, and bottom water). Deeper, longer dives, for example, have been shown to be associated with an increased risk of decompression sickness (1-3) while water and air temperature also have been reported to influence accident rates (4). Second, individual diver characteristics may bear on the occurrence of accidents. Age, weight, height, recent diving experience, and previous mishaps might contribute to the risk of a diving accident. In a recent study of hospitalization rates among U.S. Navy divers (5), the lowest admission rates for decompression sickness and gas contamination were reported for divers 41 years of age and older.

The purpose of the present investigation was twofold: (1) to determine the most commonly occurring underwater mishaps and (2) to identify the underlying factors associated with diving accidents.

METHOD

Data

Since the late 1960s, the Naval Safety Center in Norfolk, Virginia, has collected descriptive data (Diving Log--Accident/Injury Report OPNAV 9940/1) on all dives performed as well as additional information on those dives that resulted in accidents. Computerized files containing information on all U.S. Navy dives (706,259) and accidents (1,174) that occurred during January 1968 through May 1981 were provided by the Naval Safety Center to the Naval Health Research Center, San Diego.

Variables common to both the diving and accident logs were dive depth, time of day, air temperature, surface water temperature, bottom water temperature, dive purpose, decompression schedule type, submergence time, age, height, weight, and number of dives in the previous 24 hours. Variables unique to the accident log included initial accident, most significant sign (symptom), initial sign occurrence, and accident outcome.

Procedure

In identifying the most prevalent underwater incidents and their concomitant physiological symptoms, two accident log items were examined, initial accident and most significiant sign. Frequencies of responses for these variables (24 descriptors for the former and 22 for the latter) were compiled, and percentages of all accidents were calculated. The severity of mishaps was in-

dicated by computing percentages corresponding to the four responses of accident outcome: complete relief, substantial relief, a recurrence, and a fatality.

To determine whether or not there were any underlying factors associated with diving mishaps, accidents rates per 1,000 dives were computed across all response categories of the 12 variables examined in this study which then were compared with the overall rate. The first step in this procedure was to compile a frequency distribution of each factor for all recorded dives on a 10% random sample of the 706,259 diving log records. The second step was to tabulate accident frequencies for the 12 variables from the 1,174 accident log records. Accident rates per 1,000 dives were computed by dividing the number of mishaps recorded for a particular response category by the overall number of dives occurring under the same condition and multiplying by 1,000. Ninety-five percent confidence limits based on the Poisson distribution were calculated for the overall rate and levels of each factor to determine if rate differences were significant. Because dive depth has been such a potent factor in mishap incidence (1,6), accident rates for the 11 other factors were depth adjusted using the direct method of adjustment (7). Confidence limits based on the more conservative normal distribution were calculated for the adjusted rates. These latter confidence limits provided a more stringent testing of rate differences than those of the nonadjusted rates.

In addition, the dive records of the accident log were sorted and categorized by identification number (Social Security/Service Number) to ascertain the reoccurrence of accidents among individual divers. One other variable selected from the accident log (initial sign occurrence) was analyzed in terms of response frequencies.

RESULTS

Of the information on the accident log, responses to the variables of initial accident and most significant sign pointed up the wide range of occurrences that qualified a dive for accident status. Table 1 provides a frequency and percentage distribution rank ordered by descriptors for both of these variables. As shown, decompression sickness and barotraumas were the most prevalent types of accidents while localized pain was the most common significant sign. Interactively, localized pain was the significant sign in 75% of the cases of decompression sickness and 81% of barptraumas. Additionally, 83% of the localized pain was accounted for by these two types of accidents.

Indicative of the severity of mishaps was the variable of accident outcome. Responses to this accident log item yielded the following percentage distribution: 80.7% experienced complete relief, 17.7% substantial relief, 0.9% a recurrence, and 0.7% a fatality.

Dive Conditions

In examining dive depth as a factor in accidents, the distribution showed that mishaps occurred at all subaqueous levels with the highest mishap rates observed at the greatest depths. As presented in Table 2, rates at the three shallowest depths (representing 75% of all dives) were significantly lower than the overall accident rate while the rates for the deepest dives were significantly higher. To be specific, accident rates increased from 0.54 per 1,000 dives at the shallowest depth to 20.63 per 1,000 dives at depths exceeding 200 feet.

TABLE 1

FREQUENCY AND PERCENTAGE DISTRIBUTION OF TYPES OF ACCIDENTS AND SYMPTOMS AMONG U.S. NAVY DIVERS, 1968-1981

Accident	No.	%	Significant Sign	No.	%
Decompression sickness	426	41.1	Localized pain	604	58.5
Barotrauma	227	21.9	Dizziness	80	7.7
Other	76	7.3	Numbness	55	5.3
O_2 poisoning	49	4.7	Other	46	4.5
Mechanical injuries	49	4.7	Unconsciousness	44	4.3
Missed decompression	44	4.2	None	40	3.9
Air embolism	37	3.6	Bleeding	27	2.6
Unknown	23	2.2	Muscular weakness	24	2.3
CO_2 poisoning	20	1.9	Muscular twitching	16	1.5
Injured by marine organism	13	1.3	Nausea/vomiting	16	1.5
Mediastinal emphysema	8	0.8	Visual disturbances	15	1.5
Drowning	8	0.8	Rash	14	1.4
Disorders of consciousness	7	0.7	Convulsions	10	1.0
Hypoxia	7	0.7	Itching	8	0.8
Subcutaneous emphysema	7	0.7	Parasthesia	7	0.7
Near drowning	5	0.5	Swelling	7	0.7
Blow-up	5	0.5	Dyspnea	6	0.6
Hyperventilation	5	0.5	Paralysis	4	0.4
CO poisoning	4	0.4	Acoustic aura	4	0.4
Mental	4	0.4	Unknown	4	0.4
Pneumothorax	3	0.3	Drowsy	1	0.1
Non-pressure related	3	0.3	Restlessness	1	0.1
Nitrogen narcosis	3	0.3			
Bad gas	3	0.3			
Total	1,036	100.1		1,033	100.2

Another factor of potential relevance in mishap occurrence was the time of day (local time) of the accident. Mishap rates were computed on an hourly basis from 0600 through 1759 with the night dives (1800-2359) forming a composite rate. Table 3 shows that although accident rate fluctuations were not extreme, the dives occurring between 0700 and 0759 and 1700 and 1759 were at significantly greater risk of terminating in accidents. However, after these higher rates as well as the lower rate at 1300-1359 were depth adjusted, the rates for these time intervals did not differ significantly from the overall rate. When compared with nonadjusted rates, increases or decreases in adjusted rates indicated that a disproportionate distribution of dive depths occurred at these time intervals.

TABLE 2

DISTRIBUTION OF DIVES, ACCIDENTS, AND ACCIDENT RATES BY DIVE DEPTH AMONG U.S. NAVY DIVERS, 1968-1981

Dive Depth Feet (M)	No. Dives*	No. Accidents	Rate/1,000 Dives**
1-10 (< 3.0)	56,929	31	0.54†
11-25 (3.3-7.6)	176,111	125	0.71†
26-50 (7.9-15.2)	295,704	210	0.71†
51-100 (15.5-30.5)	90,868	211	2.32†
101-200 (30.7-61.0)	77,440	418	5.40†
≥201 (> 61.3)	8,143	168	20.63†
Total	705,195	1,163	1.65

*Number of dives is based on 10% random sample. **Significance levels of rates are based on Poisson distribution. †Rate differs significantly ($p < .05$) from overall rate as determined by nonoverlapping confidence intervals.

TABLE 3

DISTRIBUTION OF DIVES, ACCIDENTS, ACCIDENT RATES, AND DEPTH-ADJUSTED ACCIDENT RATES BY LOCAL TIME AMONG U.S. NAVY DIVERS, 1968-1981

Local Time	No. Dives*	No. Accidents	Rate/ 1,000 Dives**	Depth-Adjusted Rate/1,000 Dives†
0600-0659	3,067	9	2.93	1.55
0700-0759	16,755	42	2.51§	1.08
0800-0859	72,565	137	1.89	1.56
0900-0959	108,602	149	1.37	1.43
1000-1059	91,068	143	1.57	1.62
1100-1159	48,726	76	1.56	1.48
1200-1259	40,504	78	1.93	1.96
1300-1359	81,507	94	1.15§	1.42
1400-1459	59,147	104	1.76	2.39
1500-1559	25,907	39	1.50	1.61
1600-1659	12,499	26	2.08	2.26
1700-1759	7,563	24	3.17§	3.49
1800-2359	33,850	47	1.39	2.88
Total	601,760	968	1.61	1.64

*Number of dives is based on 10% random sample. **Significance levels of rates are based on Poisson distribution. †Significance levels of depth-adjusted rates are based on normal distribution. §Rate differs significantly ($p < .05$) from overall rate as determined by nonoverlapping intervals.

Analyzing accident rates by various temperature ranges of air, surface water, and bottom water yielded few significant differences. Higher temperature ranges--71°-80° for air temperature and 81°-90° for surface and bottom water temperature--exhibited an increased incidence of mishaps, as shown in Table 4. The significance of these rate differences as well as that of the reduced rate for the bottom water temperature range of 51°-60° were not evidenced in the depth-adjusted rates.

TABLE 4

DISTRIBUTION OF ACCIDENT RATES AND DEPTH-ADJUSTED ACCIDENT RATES BY AIR TEMPERATURE, SURFACE WATER TEMPERATURE, AND BOTTOM WATER TEMPERATURE AMONG U.S. NAVY DIVERS, 1968-1981

Temperature Range °Fahr. (°C)	Air Temp* Rate/1,000 Dives	Air Temp** Depth-Adjusted Rate/1,000 Dives	Surface Water Temp Rate/ 1,000 Dives	Surface Water Temp Depth-Adjusted Rate/1,000 Dives	Bottom Water Temp Rate/ 1,000 Dives	Bottom Water Temp Depth-Adjusted Rate/1,000 Dives
≤32 (≤0)	2.61	3.96	1.44	1.82	1.83	2.20
33-40 (1-4)	1.28	1.94	1.80	2.33	1.55	2.08
41-50 (5-10)	1.24	1.57	0.94	1.30	1.20	1.38
51-60 (11-16)	1.35	1.59	0.82	0.86	1.00†	1.11
61-70 (16-21)	1.28	1.35	0.82	0.91	1.26	1.63
71-80 (22-27)	1.88†	1.80	1.37	1.34	1.45	1.44
81-90 (27-32)	1.64	1.59	3.18†	2.32	4.03†	2.96
≥91 (≥ 33)	1.07	1.04	1.20	1.25	1.39	1.52
Total	1.59	1.62	1.22	1.26	1.43	1.50

*Significance levels of rates are based on Poisson distribution. **Significance levels of depth-adjusted rates are based on normal distribution. †Rate differs significantly ($p \leq .05$) from overall rate as determined by nonoverlapping confidence intervals.

Widely diverse activities were recorded for the variable of dive purpose which included such subcategories as recreation, work, and medical treatment. The values presented in Table 5 indicate that work dives (comprising 51% of all submergences) and requalification dives had significantly lower accident rates than the overall rate while those dives with an objective of medical treatment, experimental, selection, equipment testing, other reasons, and tender had significantly higher rates. Depth of dive again influenced these rate differences; when depth adjusted, only selection and experimental dives had rates significantly higher than the overall accident rate.

The final variable to be examined in the domain of dive conditions, decompression schedule type, also varied considerably in accident rates across categories, as presented in Table 6. Saturation diving accounted for the highest accident rate (111.6 accidents per 1,000 dives), followed by surface decompressions. The rate for dives requiring no decompression (91% of all dives) was significantly lower than the overall rate, while all other decompression schedules except the repetitive dive tables yielded rates significantly higher than the total. Because decompression schedule type is depth dependent, an adjustment for depth would be inappropriate.

Accident rates were not computed by duration of submergence because dive time was an interrupted measure; that is, those dives on which accidents occurred were not scheduled to end when

they did. Figure 1 shows that more than one-half of all accidents occurred within 25 minutes of submergence.

TABLE 5

DISTRIBUTION OF DIVES, ACCIDENTS, ACCIDENT RATES, AND DEPTH-ADJUSTED ACCIDENT RATES BY PURPOSE OF DIVE AMONG U.S. NAVY DIVERS, 1968-1981

Dive Purpose	No. Dives*	No. Accidents	Rate/1,000 Dives**	Depth-Adjusted Rate/1,000 Dives†
Work	351,763	360	1.02§	1.64
Training	218,173	353	1.62§	1.67
Requalification	80,677	87	1.08§	0.63
Other	12,459	41	3.29§	2.71
Sport/Recreation	6,774	18	2.66	4.18
Tender	6,574	21	3.19§	1.45
Equipment testing	5,995	24	4.00§	3.74
Experimental	5,195	142	27.33§	12.66§
Selection	2,857	67	23.45§	38.70§
Medical treatment	1,069	35	32.74§	31.44
Total	691,536	1,148	1.66	1.62

*Number of dives is based on 10% random sample. **Significance levels of rates are based on Poisson distribution. †Significance levels of depth-adjusted rates are based on normal distribution. §Rate differs significantly ($p < .05$) from overall rate as determined by nonoverlapping confidence intervals.

TABLE 6

DISTRIBUTION OF DIVES, ACCIDENTS AND ACCIDENT RATES BY DECOMPRESSION SCHEDULE TYPE AMONG U.S. NAVY DIVERS, 1968-1981

Decompression Schedule Type	No. Dives*	No. Accidents	Rate/1,000 Dives**
No decompression	631,022	545	0.86†
Standard air tables	32,670	238	7.28†
Standard MeO_2	11,100	56	5.04†
Other	5,635	160	28.39†
Repetitive dive tables	5,515	17	3.08
Exceptional exposure air	3,916	60	15.32†
Surface decompression O_2	1,019	27	26.50†
Saturation	430	48	111.63†
Surface decompression air	240	11	45.83†
N_2O_2 equivalent air	210	4	19.05†
Total	691,757	1,166	1.69

*Number of dives is based on 10% random sample. **Significance levels of rates are based on Poisson distribution. †Rate differs significantly ($p < .05$) from overall rate as determined by nonoverlapping confidence intervals.

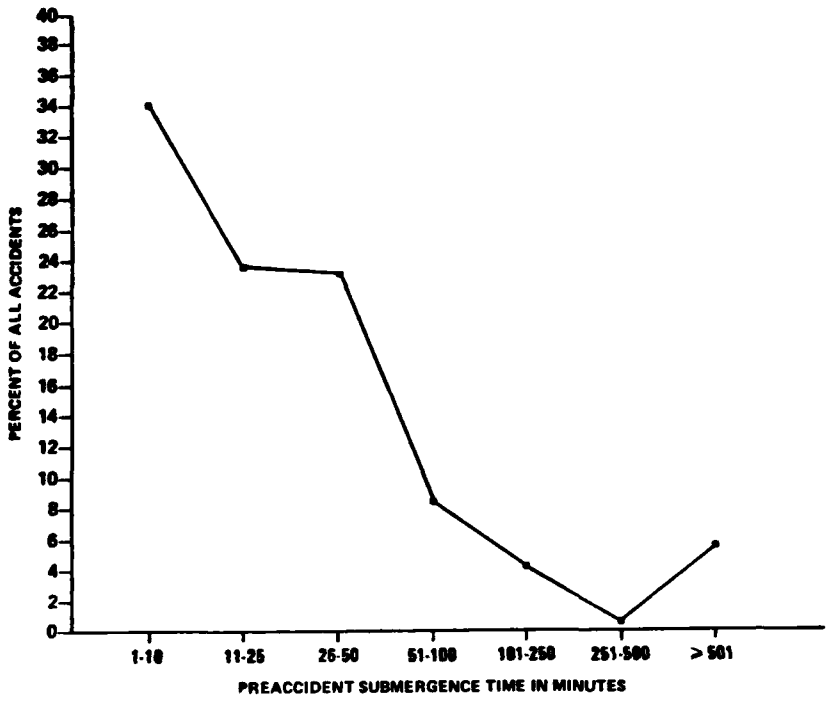

Fig. 1. Percent of all accidents by submergence times among U. S. Navy divers, 1968 - 1981.

Closely associated with duration of dive was the variable of initial sign occurrence which delineated when imperiling complications were first detected. Twenty percent of mishaps occurred during descent, 12% while on the bottom, 14% during ascent, and 47% after surfacing and/or completed decompression. The remaining 7% occurred either prior to descent or during interrupted or surface decompression.

Diver Characteristics

In the domain of variables associated with the diver rather than the dive, accident rates were computed by age, height, weight, and recent diving experience. Rates presented in Table 7 showed that those dives performed by individuals in the 21 to 24 age range terminated in accidents significantly less often than dives in general, and divers between the ages of 33 and 36 had a significantly higher accident rate. Accident rate differences by age were based, at least in

part, on the propensity to assign older personnel to deeper dives; mishap rates among all the older groups (≥ 24 years) decreased with depth adjustment. Accident rates were computed by height (using 3-inch intervals starting at 5 feet) and weight (using 20-pound intervals beginning at 100 pounds). There were no significant differences in mishap rates for these measures with or without depth adjustment.

TABLE 7
DISTRIBUTION OF DIVES, ACCIDENTS, ACCIDENT RATES, AND DEPTH-ADJUSTED ACCIDENT RATES BY AGE AMONG U.S. NAVY DIVERS, 1968-1981

Age	No. Dives*	No. Accidents	Rate/1,000 Dives**	Depth-adjusted Rate/1,000 Dives†
17-20	81,546	152	1.86	2.62
21-24	236,487	319	1.35§	1.56
25-28	154,001	263	1.71	1.66
29-32	106,404	198	1.86	1.59
33-36	77,250	169	2.19§	1.78
37-40	34,549	47	1.36	0.99
≥ 41	15,756	21	1.33	1.10
Total	705,993	1,169	1.66	1.65

*Number of dives is based on 10% random sample. **Significance levels of rates are based on Poisson distribution. †Significance levels of depth-adjusted rates are based on normal distribution. §Rate differs significantly ($p < .05$) from overall rate as determined by nonoverlapping confidence intervals.

Analysis of accident rates by the individual's recent diving experience was based on the number of prior dives in the previous 24 hours. As indicated in Table 8, divers performing their first dive of the day had a significantly lower accident rate than divers in general. Divers with five or more previous submergences that day had the highest, albeit nonsignificant, accident rate. No significant differences were observed after adjusting for depth.

TABLE 8
DISTRIBUTION OF DIVES, ACCIDENTS, ACCIDENT RATES, AND DEPTH-ADJUSTED ACCIDENT RATES BY NUMBER OF DIVES IN PREVIOUS 24 HOURS

Dives in Previous 24 hours	No. Dives**	No. Accidents	Rate/1,000 Dives**	Depth-adjusted Dives†
0	454,930	683	1.50§	1.38
1	177,670	398	2.24	2.57
2	49,785	55	1.10	1.40
3	14,747	13	0.88	1.55
4	4,856	9	1.85	1.66
>5	4,246	12	2.83	5.18
Total	706,234	1,170	1.60	1.65

*Number of dives is based on 10% random sample. **Significance levels of rates are based on Poisson distribution. †Significance levels of depth-adjusted rates are based on normal distribution. §Rate differs significantly ($p < .05$) from overall rate as determined by nonoverlapping confidence intervals.

The previous mishaps variable was examined to determine the distribution of repeated mishaps among individual divers and the relationship to future accidents. Table 9 shows that the probability of another accident at some time in the future was greatest among those divers previously involved in four mishaps.

TABLE 9

NUMBER OF PREVIOUS ACCIDENTS AS A PREDICTOR OF FUTURE ACCIDENTS AMONG U.S. NAVY DIVERS, 1968-1981

Previous Mishaps	No. DIVERS ~~Accidents~~	Proportion of Divers Involved in a Future Accident
One	1,009	.12
Two	120	.18
Three	22	.23
Four	5	.60

DISCUSSION

Given the high volume of Navy diving, complexity of diving activities, and the nature of the underwater environment, some mishaps are certain to occur. U.S. Navy diving records indicated that 1,174 diving incidents occurred during the course of 706,259 submergences, yielding a probability of .0017 that any dive would result in a mishap. Decompression sickness and barotrauma were the most prevalent accidents and accounted for 63% of the defined mishaps. Eight-one percent of the diving accidents ended in complete relief for the diver while 18% terminated with substantial relief. The intent of the present investigation was to ascertain if there were any identifiable factors (dive conditions or diver characteristics) that may have contributed to the occurrence of accidents.

Dive depth was shown to exert considerable influence on mishap incidence. Accident rates for each dive depth interval differed significantly from the overall rate. While mishaps occurred at all depths, accident rates increased significantly at depths beyond 50 feet. Accident rates also fluctuated considerably by dive purpose, which pointed up the wide variation in activities that Navy divers perform. After adjusting for depth, two categories of dive purpose, selection and experimental dives, yielded accident rates significantly higher than the overall rate. A selection dive represented the first time the potential Navy diver was suited up and observed by a qualified officer. Experimental dives were those submergences on which recent technological developments were tested for the first time in a nonartificial environment. The nature of these two dive purposes portends an increased risk, and elevated accident rates would be understandable if not anticipated. Decompression schedule type, a highly depth-dependent factor, also showed marked variability in accident rates. The lowest rate in this variable was observed for dives requiring no decompression (91% of all Navy dives) and the highest rate was for saturation dives which represented .06% of all dives and averaged 610 feet in depth. Though also constituting small percentages of Navy diving, submergences involving surface decompressions (air and oxygen), exceptional exposure air, and nitrogen-oxygen equivalent air were all at relatively high risk of terminating in a mishap. Accident rates for the other variables in the domain of dive conditions

(time of day, and the three different temperature measures) did not differ significantly from the overall rates when depth adjusted.

In the domain of diver-dependent variables, accident rates for two age ranges differed significantly from the overall rate, but the differences for these ranges did not attain a level of statistical significance for the depth-adjusted values. The finding that accident rates among the four oldest age ranges declined with depth adjustment implied that divers over the age of 24 were disporportionately assigned to deeper dives. That these assignments are sound policy was evidenced by the low mishap rates of the oldest divers in the present study. Such assignments are further supported by Biersner et al., (3) who reported a lower accident rate among older divers and by Hoiberg and Blood (5) who showed that the lowest hospital admission rates for environmentally induced disorders were among the oldest divers.

The variables of height and weight were noninfluential in mishap incidence. Likewise, no significant differences were obtained after depth adjustment of the variable denoting recent diving experience (number of dives performed in previous 24 hours). The variable of previous mishaps was analyzed to determine whether there were repeated mishap occurrences among individual divers. Eighty-eight percent of accidents were the first recorded for the diver involved. While future accident probability increased with number of previous mishaps, it should be noted that only five individuals had more than three mishaps.

To summarize, of the 12 factors examined, the variable of dive depth yielded the most straightforward association with mishap incidence; the deeper the dive, the greater the risk. The results of this study also demonstrated the potency of this variable in overriding the influence of other factors. Other findings indicated that all possible precautions should be taken on experimental and selection dives as well as dives requiring a decompression schedule, particularly saturation diving. The prudence of assigning older divers to perform deep dives also was apparent.

Research planned for the future includes a more comprehensive analysis of the factors underlying the most prevalent type of accident--decompression sickness--in which service history variables will be examined in addition to information found on the diving logs. A longitudinal study of the long-term health consequences of diving mishaps also is being conducted. Knowledge gained concerning the causes and consequences of underwater mishaps will be beneficial to the individual diver in delineating conditions of greatest risk and to the Navy in the planning of diving operations.

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Barotrauma

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The purpose was to ascertain the most frequent Navy diving mishaps and to identify underlying factors associated with accidents. Of the 1,174 incidents occurring during the course of 706,259 dives from January 1968 through May 1981, decompression sickness and barotraumas were the most prevalent. In comparing accident rates and depth-controlled accident rates of environmental factors and diver-related variables, results showed that mishap

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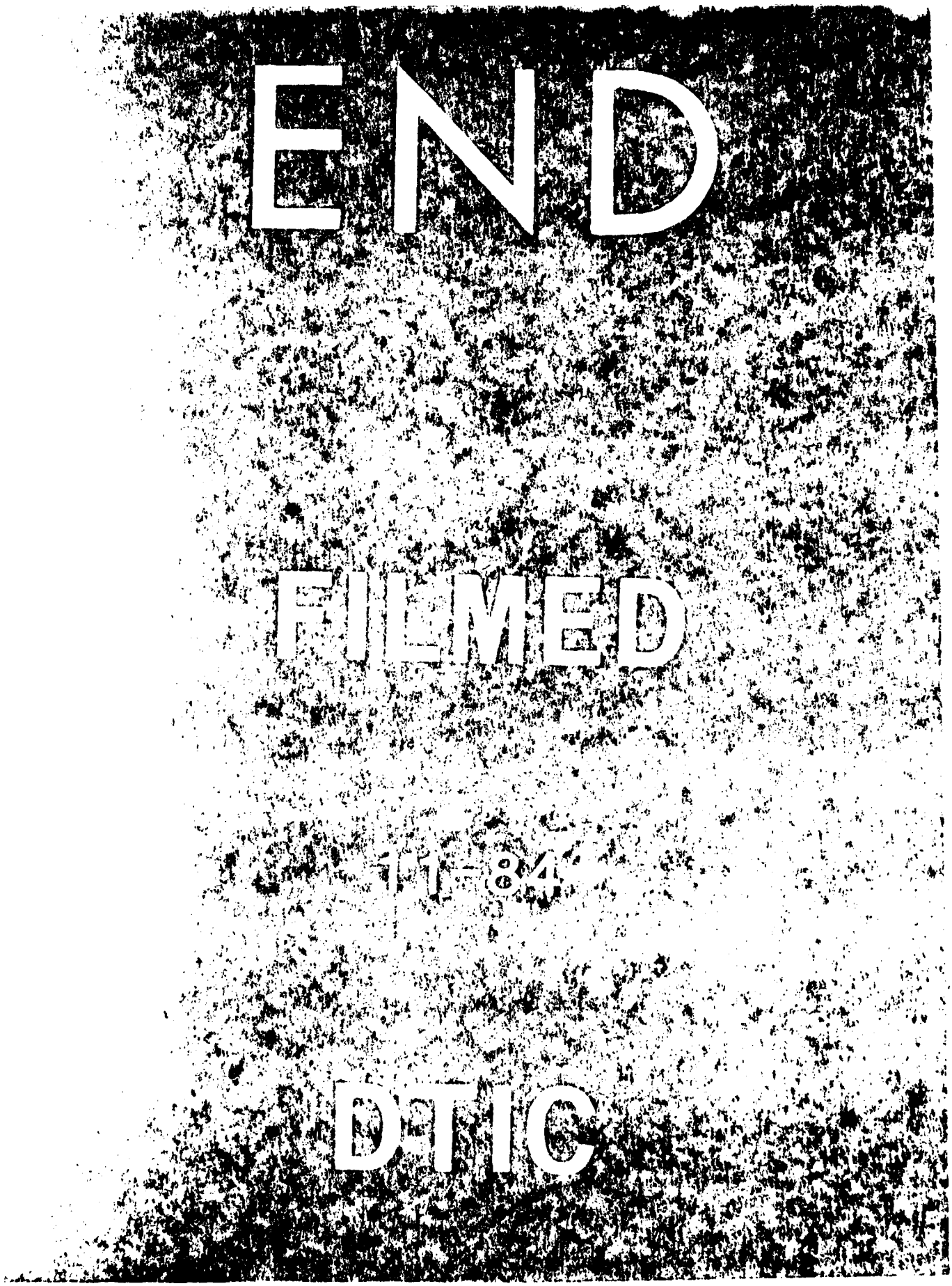
incidence increased significantly with dive depth. Dives for selection or experimental purposes were at an elevated risk of terminating in an accident, and saturation diving and surface decompressions yielded the highest mishap rates among decompression schedule types. Older divers were disproportionately and appropriately assigned to deep dives. Eighty-one percent of diving mishaps ended in complete relief for the diver while 18% terminated in substantial relief. Awareness of conditions influencing accident probability will aid in the planning of diving operations and in further protecting the health and safety of the individual diver.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