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ANALYSES OF BATTLE CASUALTIES BY WEAPON TYPE ABOARD U.S. NAVY WARSHIPS

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ABOARD U.S. NAVY WARSHIPS**

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SUMMARY

Problem

Medical resource planning requires projections of the numbers of casualties expected under different combat scenarios as well as the types of wounds likely to be incurred. Much emphasis has been placed on training military physicians in the treatment of battlefield traumas. It is important that physicians be equally prepared for casualties occurring among our forces afloat.

Objective

The present investigation seeks to determine the numbers of casualties and types of wounds that occurred among various types of warships and attacks during World War II.

Approach

Numbers of casualties were determined by accessing the Bureau of Personnel casualty lists for 513 incidents in which major combatant vessels were sunk or damaged. Medical Officer Reports, After Action Reports, and Deck Logs were examined, and information on the types of wounds and anatomical region of injury was extracted. Numbers and types of wounds were analyzed by ship type and weapon involved in attack.

Results

Weapon type and ship type were both significant factors in determining both the number of WIA and KIA. Kamikazes and multiple weapon attacks yielded significantly more wounded in action than did other weapon types. Penetrating wounds and burns were the most prevalent types of injuries.

Conclusions

Medical resource projections for naval operations will vary depending on the most likely types of attacks. These projections must also incorporate the differences in casualty incidence expected as a result of changes to ships and armaments since World War II.

ANALYSES OF BATTLE CASUALTIES BY WEAPON TYPE ABOARD U.S. NAVY WARSHIPS

Introduction

In recent years much emphasis has been placed on training military physicians in advanced trauma life support (ATLS) in order to enhance medical readiness.^{1,2,3} This education is a necessary component of medical training because wounds incurred by ground troops are likely to be substantially different than those ordinarily seen by peacetime trauma surgeons. While these courses address the demands of battlefield medical care, it is important that medical preparedness for casualties occurring among forces afloat not lag behind.

The Department of Defense has undertaken a quad-service initiative designed to project, and make readily deployable, the equipment and supplies needed to establish treatment facilities within operational theaters. Deployable Medical Systems (DEPMEDS) is a modular system which involves the prepositioning of medical materiel using data on the expected battle injuries and illnesses⁴. A set of algorithms have been developed and incorporated into a computer program to calculate the quantity of various supplies needed to support a given operation. The DEPMEDS algorithms require not only the anticipated overall rates of incidence of battle wounds, but also projections of the specific types of injuries likely to be incurred by each service branch.

A recent investigation indicated that shipboard battle casualties in the last major conflict occurred at a rate of 0.60 per 1000 strength per day⁵. Among the casualties, 48% were either 'missing in action' or killed outright, and therefore would not have impacted the medical resource system. Wounded shipboard personnel, nevertheless, represent a substantial and continuous expenditure of resources in terms of supplies and health care personnel. In order to accurately project the types of medical equipment, supplies, and personnel needed to treat Navy afloat casualties, it is necessary to determine the most probable types of wounds.

The objective of the present investigation is to determine the types of battle injuries which occurred among forces afloat in the last major

conflict with U.S. Navy involvement. Injury types will be analyzed by weaponry involved as well as by the types of vessels which were attacked. Medical resource planning is a critical element of operational readiness and essential to the saving of numerous lives and, indeed, the success of the mission. Knowledge of casualty incidence and likely types of wounds should better enable medical logisticians to gauge the medical requirements of future combat operations. While both ships and armaments have changed since World War II, the real-life statistics of past naval warfare provide the starting point from which future casualties can be projected.

Method

Determination of the warships that were sunk or damaged during World War II operations was made using two historical sources. The Summary of War Damage⁶ and the United States Naval Chronology, World War II⁷ were examined to obtain a list of major afloat combatants which were attacked, and on which casualties may have been sustained. Because the most detailed information was limited to battleships, carriers, cruisers, and destroyers, the current investigation was restricted to these types of warships. Data collected from these two sources included the ship name, hull number, date of incident, location, the weapon involved in the attack, and whether the ship was sunk or damaged.

The Medical Officer Reports and After Action Reports maintained at the the Navy Operational Archives division of the Navy Historical Center in Washington, D.C. were examined and BUMED diagnoses⁸ were extracted for casualty incidents corresponding to those found in the War Damage Summary and Naval Chronology. When the medical information on these incidents was not available from the Historical Center, the deck logs of these ships, housed at the National Archives in Washington, D.C., were analyzed and the relevant information extracted. Medical data collected from these three sources included the service number of the casualty, BuMed injury code, and the anatomical region of the injury. The injury codes were collapsed into the following wound categories: Fractures, Burns, Penetrating Wounds, Concussions, Contusions/Abrasions, Traumatic Amputations, Sprains/Strains/Dislocations, Asphyxiations, Non-fatal Immersions, Multiple Wounds, and Other/Unspecified. Anatomical locations were grouped as Head,

Back, Chest, Shoulder, Abdomen, Arm, Hand, Leg, Foot, Multiple, and Other/Unspecified.

Additionally, Bureau of Personnel casualty lists kept at the Operational Archives were examined to determine the numbers of casualties aboard ships when partial or no information was available from the medical sources. Crew complements of the sunk/damaged ships were collected from the muster rolls housed at the National Archives.

Total casualties, both 'wounded in action' (WIA) and 'killed in action' (KIA), were examined by weapon and type of ship separately, as well as by weapon and ship combined. Analyses of covariance were performed to test the significance of differences in casualties among the ship types and weapons involved while controlling for size of crew complement. Battle injury frequencies and percentages were calculated for the various wound categories and anatomical regions. Injury category frequencies and percentages were also tabulated by type of weapon involved in the attacks. The Dunn-Bonferroni method of adjusting the significance level for multiple comparisons⁹ was used when calculating analyses of variance for the effect of weapon type on the eleven injury categories. Chi squares were calculated to determine if there were systematic differences in the percentages of ships sunk by either weapon type or ship type.

Analyses

There were 513 incidents in which major combatants were either sunk or damaged, and on which causal information was available. Battleships (BB) were involved in 43 of these incidents, heavy cruisers (CA) in 32, light cruisers (CL) in 40, carriers (CV) in 39, escort carriers (CVE) in 29, light carriers (CVL) in 7, destroyers (DD) in 283, and destroyer escorts (DE) in 48. These attacks involved 22 separate battleships, 17 heavy cruisers, 22 light cruisers, 16 carriers, 21 carrier escorts, 7 light carriers, 206 destroyers, and 45 destroyer escorts. The average crew complements for these ships were BB: 1,932, CA: 1,075, CL: 1,104, CV: 2,538, CVE: 859, CVL: 1,404, DD: 298, and DE: 216. In 190 incidents the weapon in the attack was kamikaze; Another 118 incidents involved gunfire, 83 were bombings, 75 attacks were torpedos, 19 incidents were the result of mines, and 28 of the incidents involved multiple weapons. The distribution of incidents by ship

type and weapon are displayed in Table 1.

Analyses of covariance were computed to determine the relative significance of weapon type and type of ship as they relate to the numbers and types of casualties sustained; to prevent spurious results associated with the relationship between ship type and size of crew complement, the effect of crew size was controlled for by using it as a covariate. It can be seen from Table 2 that both weapon and ship type were significant factors in accounting for the variance in the number of WIA. Similarly, Table 3 indicates that the effects of weapon type and ship type were significant factors in the number of personnel killed.

The effect of weapon type on number of casualties is presented in Table 4, which shows the mean WIA, KIA, and total casualties by weapon for the 513 incidents. The "multiple weapon" category had the highest average number of both wounded and killed; kamikazes yielded the second highest number of WIA while torpedos ranked behind the multiple weapon category in KIA. The means adjusted for crew size were nearly identical to the observed means.

Multiple contrasts among the individual weapon types were performed using the least-significant differences (LSD) range test. Multiple comparisons of WIA by the individual weapon types indicated that an attack by multiple weapons yielded a significantly greater number of wounded than did bombs, gunfire, kamikaze, mines, or torpedos. Additionally, kamikaze attacks produced a larger number of WIA than did gunfire incidents. Examination of KIA by weapon types indicated that attacks by multiple weapons yielded significantly more killed than incidents involving bombs, gunfire, kamikazes, mines, or torpedos; attacks by torpedos caused significantly more KIA than bombs, gunfire, kamikazes, or mines.

Analyses of casualties incurred with respect to ship types indicated that heavy cruisers had the highest mean casualties across all incidents. Table 5 is a presentation of KIA, WIA, and total casualties by each ship type. Though heavy cruisers had the highest average KIA and total casualties, it can be seen that carriers, light carriers, and escort carriers all averaged higher frequencies of WIA. While the numbers of WIA were nearly identical for the observed means and the crew size-adjusted means, the adjusted means for KIA differed in magnitude from the observed means due to a negative relationship between KIA and crew size within three ship types (BB,CL,DD).

Multiple contrasts of WIA for each ship type with all others indicated that: carriers and escort carriers had significantly more wounded per incident than destroyers, destroyer escorts, battleships, and light cruisers; battleships and heavy cruisers had significantly more wounded than destroyers; heavy cruisers had significantly more wounded than destroyer escorts. Multiple comparisons of KIA by the ship types indicated that attacks on heavy cruisers yielded significantly more killed than attacks on battleships, light cruisers, destroyers and destroyer escorts; attacks on carriers yielded significantly more deaths than incidents involving destroyers and destroyer escorts.

The analyses of covariance also indicated that there was a significant interaction between weapon and ship type in determining the number of personnel killed. Mean WIA and KIA by weapon type and type of ship are shown in Table 6. It should be noted that some 'ship by weapon' casualty averages are based on small numbers of observations and therefore are not as reliable for future projections as those based on relatively large numbers of incidents.

Chi squares were computed to examine whether weapon type or ship type were factors in determining if the ship remained afloat or was sunk as a result of the attack. The chi square for weapon type was highly significant ($\chi^2=69.59$, $df=5$; $sig=.0001$). The percentages of ships sunk by each weapon type were: bomb, 12%; gunfire, 11%; kamikaze, 8%; mine, 26%; torpedo, 44%; and multiple weapon, 46%. The chi square for sunk/damaged status by ship type was nonsignificant.

Further analyses were conducted on the WIA to more specifically detail the types of wounds which were incurred. Figure 1 is a graphic display of the percentage each injury category represents of the total number of known diagnoses. Penetrating wounds and burns constituted over sixty percent of the battle wounds incurred among these ship incidents. Figure 2 is a similar chart of the percentages of overall wounds represented by each anatomical region. The "multiple region" category represents the largest proportion among all anatomical locations while the second most prevalent wound site was the leg.

Table 7 displays the distribution of wounds for anatomical regions within each injury category. The 'wound by anatomical region' categories making up the two largest percentages were multiple burns and multiple

penetrating wounds, together representing almost a quarter of the injuries.

Analyses of variance were computed for each injury category to determine if there were significant differences by weapon type. The number of burns varied significantly with weapon type ($F=6.22$, $df=5$, $p < .001$); multiple contrasts indicated that the numbers of burns was significantly greater in incidents involving kamikazes when compared with gunfire attacks. The numbers of strains, sprains, and dislocations also differed significantly by weapon type ($F=4.85$, $df=5$, $p < .001$); multiple comparisons indicated that mine incidents yielded significantly more wounds within this injury category than attacks with bombs, kamikazes, or gunfire. Table 8 indicates the frequencies and percentages of each injury type by the weapons causing the injuries. This table shows that while kamikaze attacks were responsible for 51% of the injuries, almost 71% of the burns resulted from this type of attack. Additionally, while strains, sprains, and dislocations represented 2.4% of the total known injuries they constituted 15.8% of the wounds resulting from mine attacks.

DISCUSSION

Trauma medicine training needs to incorporate the types of wounds expected among shipboard casualties as well as those anticipated on the battlefield. Among warships sunk or damaged in World War II, there were an average of 35 crew members wounded in each attack. Additionally, 4.9% of shipboard deaths were classified as 'died of wounds',⁵ indicating that these personnel received some treatment before succumbing to their wounds. Clearly, in prolonged Naval warfare a large expenditure of medical resources would be required to save lives, minimize maiming, and ensure the success of the operational mission.

The analyses indicated that types of weapon and ship types both played statistically significant roles in the numbers of wounded and killed in the attacks. While both weapon and ship type were factors in influencing the numbers of casualties, type of weapon played a highly significant role in determining the number of personnel killed and percentage of ships sunk. Attacks by torpedos were significantly more lethal than gunfire, kamikaze, and bombs while incidents falling within the multiple weapon category yielded significantly more deaths than those attacks involving bombs,

gunfire, mines, or kamikazes alone. Closer examination indicated that in 18 of the 28 multiple weapon incidents torpedos were one of the two weapons involved--again attesting to the enhanced lethality of torpedos over the other weapon systems. This higher incidence of mortality among torpedo and multiple weapon attacks is tied to the fact that these two types of assaults were more likely to cause the sinking of a ship than bombs, gunfire, or kamikazes.

Like their counterparts on the battlefield, a large percentage of the casualties aboard ships resulted from penetrating wounds. However, casualties among forces afloat were much more likely to be burn victims than were ground troops. Also, the incidence of two or more types of wounds in combination with each other accounted for more than one tenth of the shipboard injuries. The sizable numbers of penetrating wounds, burns, and multiple wounds likely result from a combination of factors, including: 1) the large amounts of shrapnel yielded by explosions occurring within the relatively confined spaces of ships, 2) the fires imminent when fuel laden aircraft, bombs, and torpedos are used prominently as weapons, and 3) the need to fight these fires immediately, even in the face of continuing combat.

In examining the anatomical regions of the wounds, the most prevalent sites were the head, arm, hand, and leg. While the leg, the site of one-fifth of all injuries, was the most prominent individual region, 28% of the total number of wounds were inflicted upon multiple regions. The high frequency of wounds to multiple sites, again, likely resulted from the large quantities of shrapnel associated with explosions as well as the extensive burns that crew members sustained in the initial attacks and fighting the fires.

Proportional distributions of wound types varied greatly with the weapons used in the attacks. The wounds resulting from kamikaze attacks were predominantly penetrating wounds and burns (67%), as might be expected with the massive destruction caused by using aircraft as weapons against ships. Nearly sixty percent of the injuries caused by gunfire/shellfire were penetrating wounds. Bombs, like kamikazes, yielded high percentages of penetrating wounds and burns (52%), as well as a large percentage of multiple wounds (18%), indicating the increased likelihood of sustaining combinations of wounds such as burns, penetrating wounds, and fractures in

this type of attack. The wounds occurring in torpedo attacks were more likely to be concussions (10%) than for the other weapon types, and were otherwise mainly distributed over fractures, penetrating wounds, burns, and contusions/abrasions. This distribution attests to the wound variability associated with blast/overpressure. Like torpedos, mines also yielded substantial percentages for a number of different wound categories: 17% fractures, 22% penetrating wounds, 14% contusions, and 16% strains, sprains, and dislocations.

Rates of shipboard casualties will vary with the type of operation, the types of ships involved, and the weapons used by our adversaries. Armed with the types of wounds anticipated, Navy medical planners will be better equipped to project the types of health care personnel and resources needed to save lives and limbs and restore wounded sailors to a level of military effectiveness.

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TABLE 1. WWII AFLOAT INCIDENTS BY SHIP TYPE TYPE AND WEAPON INVOLVED;
NUMBER OF INCIDENTS, ROW PERCENTAGE, AND COLUMN PERCENTAGE

	<u>BB</u>	<u>CA</u>	<u>CL</u>	<u>CV</u>	<u>CVE</u>	<u>CVL</u>	<u>DD</u>	<u>DE</u>	<u>TOTAL</u>
KAMIKAZE	16	5	8	16	17	4	100	24	190
	8.4	2.6	4.2	8.4	8.9	2.1	52.6	12.6	37.0
	37.2	15.6	20.0	41.0	65.4	57.1	36.0	50.0	
GUNFIRE	14	10	7	2	2	1	78	4	118
	11.9	8.5	5.9	1.7	1.7	0.8	66.1	3.4	23.0
	32.6	31.3	17.5	5.1	7.7	14.3	28.1	8.3	
BOMB	4	4	11	13	2	1	46	2	83
	4.8	4.8	13.3	15.7	2.4	1.2	55.4	2.4	16.0
	9.3	12.5	27.5	33.3	7.7	14.3	16.5	4.2	
TORPEDO	6	9	10	5	2	1	28	14	75
	8.0	12.0	13.3	6.7	2.7	1.3	37.3	18.7	14.6
	14.0	28.1	25.0	12.8	7.7	14.3	10.1	29.2	
MINE	0	0	1	0	0	0	15	3	19
	0.0	0.0	5.3	0.0	0.0	0.0	78.9	15.8	3.7
	0.0	0.0	2.5	0.0	0.0	0.0	5.4	6.3	
MULTIPLE	3	4	3	3	3	0	11	1	28
	10.7	14.3	10.7	10.7	10.7	0.0	39.3	3.6	5.5
	7.0	12.5	7.5	7.7	11.5	0.0	4.0	2.1	
TOTAL	43	32	40	39	26	7	278	48	513
	8.4	6.2	7.8	7.6	5.1	1.4	54.2	9.4	100.0

TABLE 2.

ANALYSIS OF COVARIANCE EXAMINING INFLUENCE OF WEAPON AND
SHIP ON THE NUMBER OF PEOPLE WOUNDED IN ACTION (WIA)
ON SUNK AND DAMAGED WARSHIPS DURING WORLD WAR II

<u>EFFECTS</u>	<u>SUM OF SQUARES</u>	<u>DF</u>	<u>MEAN SQUARE</u>	<u>F</u>	<u>SIGNIF.</u>
WEAPON	41,565.62	5	8,313.12	3.45	.005
SHIP TYPE	42,474.14	7	6,067.74	2.52	.05
WEAPON X SHIP	97,311.78	29	3,355.58	1.39	NS

TABLE 3.

ANALYSIS OF COVARIANCE EXAMINING INFLUENCE OF WEAPON AND
SHIP ON THE NUMBER OF PEOPLE KILLED IN ACTION (KIA)
ON SUNK AND DAMAGED WARSHIPS DURING WORLD WAR II

<u>EFFECTS</u>	<u>SUM OF SQUARES</u>	<u>DF</u>	<u>MEAN SQUARE</u>	<u>F</u>	<u>SIGNIF.</u>
WEAPON	292,627.31	5	58,525.46	7.53	.001
SHIP TYPE	136,552.75	7	19,507.54	2.51	.05
WEAPON X SHIP	629,567.44	29	21,709.22	2.80	.001

TABLE 4. MEAN CASUALTIES OF SHIPBOARD ATTACKS BY TYPE OF WEAPON INVOLVED

<u>WEAPON</u>	<u>NUMBER OF INCIDENTS</u>	<u>MEAN WIA</u>	<u>MEAN KIA</u>	<u>MEAN CASUALTIES</u>
KAMIKAZE	190	39.04	23.30	62.34
GUNFIRE	118	22.52	19.02	41.54
BOMB	83	30.31	33.34	63.65
TORPEDO	75	37.33	78.09	115.42
MINE	19	25.16	24.05	49.21
MULTIPLE	28	71.54	135.21	206.75
TOTAL	513	34.84	38.08	72.92

TABLE 5. MEAN CASUALTIES OF SHIPBOARD ATTACKS BY TYPE OF SHIP

<u>SHIPTYPE</u>	<u>NUMBER OF INCIDENTS</u>	<u>MEAN WIA</u>	<u>MEAN KIA</u>	<u>MEAN CASUALTIES</u>
BATTLESHIPS (BB)	43	40.42	51.86	92.28
HEAVY CRUISERS (CA)	32	57.31	99.59	156.91
LIGHT CRUISERS (CL)	40	38.08	51.25	89.32
AIRCRAFT CARRIERS (CV)	39	75.56	61.67	137.23
ESCORT CARRIERS (CVE)	26	68.58	50.23	118.81
LIGHT CARRIERS (CVL)	7	60.43	36.29	96.71
DESTROYERS (DD)	278	23.00	26.05	49.05
DESTROYER ESCORTS (DE)	48	25.65	17.96	43.60
ALL SHIPS	513	34.84	38.08	72.92

TABLE 6. MEAN CASUALTIES SUSTAINED BY WEAPON AND TYPE OF SHIP

WEAPON	SHIP TYPE	NO. OF INCIDENTS	MEAN WIA	MEAN KIA
I KAZE	BB	16	47.69	16.25
	CA	5	35.20	11.00
	CL	8	54.62	26.62
	CV	16	88.56	59.81
	CVE	17	63.12	36.24
	CVL	4	42.25	32.25
	DD	100	30.43	20.32
	DE	24	14.17	6.83
GUNFIRE	BB	14	30.93	8.36
	CA	10	48.50	33.20
	CL	7	9.29	14.57
	CV	2	21.50	4.00
	CVE	2	140.00	63.00
	CVL	1	28.00	7.00
	DD	78	15.04	18.62
	DE	4	37.75	25.00
BOMB	BB	4	34.00	13.75
	CA	4	12.00	18.75
	CL	11	53.09	44.00
	CV	13	72.61	76.15
	CVE	2	11.50	7.00
	CVL	1	182.00	101.00
	DD	46	12.96	22.78
	DE	2	1.50	00.00
TORPEDO	BB	6	26.67	91.83
	CA	9	67.33	149.55
	CL	10	29.40	108.10
	CV	5	50.00	39.40
	CVE	2	106.00	233.00
	CVL	1	44.00	17.00
	DD	28	24.07	61.21
	DE	14	40.00	34.64
MINE	CL	1	00.00	00.00
	DD	15	23.07	24.20
	DE	3	44.00	31.33
MULTIPLE	BB	3	82.00	415.67
	CA	4	129.75	344.75
	CL	3	47.67	56.67
	CV	3	97.67	84.33
	CVE	3	65.00	28.00
	DD	11	51.09	57.64
	DE	1	45.00	19.00

TABLE 7. FREQUENCIES AND PERCENTAGES OF KNOWN BATTLE WOUNDS BY INJURY CATEGORY AND ANATOMICAL REGION; WWII SUNK/DAMAGED WARSHIPS

<u>INJURY CATEGORY</u>	<u>N</u>	<u>%</u>
FRACTURE WOUNDS	818	6.78
HEAD	67	0.56
BACK	7	0.06
CHEST	51	0.42
SHOULDER	12	0.10
ARM	171	1.42
HAND	30	0.25
LEG	361	2.99
FOOT	55	0.46
UNSPECIFIED	46	0.38
MULTIPLE	18	0.15
PENETRATING WOUNDS	4717	39.09
HEAD	686	5.68
BACK	159	1.32
CHEST	115	0.95
SHOULDER	166	1.38
ABDOMEN	73	0.60
ARM	455	3.77
HAND	221	1.83
LEG	1154	9.56
FOOT	110	0.91
UNSPECIFIED	332	2.75
MULTIPLE	1246	10.33
BURNS	2622	21.73
HEAD	236	1.96
BACK	25	0.21
CHEST	3	0.03
SHOULDER	10	0.08
ABDOMEN	5	0.04
ARM	219	1.82
HAND	318	2.64
LEG	86	0.71
FOOT	16	0.13
UNSPECIFIED	171	1.42
MULTIPLE	1533	12.70
CONCUSSIONS	413	3.42
HEAD	53	0.44
ABDOMEN	84	0.70
UNSPECIFIED	276	2.29

TABLE 7. Continued
INJURY CATEGORY

	<u>N</u>	<u>%</u>
CONTUSIONS/ABRASIONS	933	7.73
HEAD	83	0.69
BACK	67	0.56
CHEST	45	0.37
SHOULDER	32	0.26
ABDOMEN	51	0.42
ARM	58	0.48
HAND	32	0.26
LEG	268	2.22
FOOT	30	0.25
UNSPECIFIED	117	0.97
MULTIPLE	150	1.24
AMPUTATIONS	58	0.48
ARM	19	0.08
HAND	16	0.13
LEG	21	0.17
FOOT	11	0.09
UNSPECIFIED	0	0.00
STRAINS, SPRAINS, & DISLOCATIONS	287	2.38
BACK	68	0.56
SHOULDER	21	0.17
ABDOMEN	1	0.01
ARM	9	0.08
HAND	2	0.02
LEG	138	1.14
FOOT	10	0.08
UNSPECIFIED	34	0.28
MULTIPLE	4	0.03
MULTIPLE WOUNDS	1369	11.34
MISCELLANEOUS WOUNDS	644	5.34
HEAD	138	1.14
BACK	5	0.04
CHEST	11	0.09
SHOULDER	5	0.04
ABDOMEN	38	0.31
ARM	10	0.08
HAND	7	0.06
LEG	25	0.21
FOOT	6	0.05
UNSPECIFIED	385	3.19
MULTIPLE	14	0.12
ASPHYXIATIONS	168	1.39
NON-FATAL IMMERSIONS	38	0.32
TOTAL	12,067	100.00

TABLE 8. INJURY CATEGORIES BY WEAPON TYPE ABOARD SUNK/DAMAGED WARSHIPS;
FREQUENCIES, ROW PERCENTAGES, COLUMN PERCENTAGES

INJURY CATEGORY	KAMIKAZE	GUNFIRE	BOMB	TORPEDO	MINE	MULTIPLE	TOTAL
FRACTURES	370 45.23 6.01	99 12.10 4.96	139 16.99 7.98	103 12.59 9.81	42 5.13 17.50	65 7.95 7.32	813 -- 6.78
PENETRATING WOUNDS	2277 48.27 37.00	1182 25.06 59.28	615 13.04 35.32	206 4.37 19.62	52 1.10 21.67	385 8.16 43.36	4717 -- 39.09
BURNS	1855 70.75 30.14	147 5.61 7.37	295 11.25 16.94	175 6.67 16.67	15 0.57 6.25	135 5.15 15.20	2622 -- 21.73
CONCUSSIONS	192 46.49 3.12	42 10.17 2.11	25 6.05 1.44	111 26.88 10.57	6 1.45 2.50	37 8.96 4.17	413 -- 3.42
CONTUSIONS	415 44.48 6.74	37 3.97 1.86	189 20.26 10.86	171 18.33 16.29	34 3.64 14.17	87 9.32 9.60	933 -- 7.73
AMPUTATIONS	32 55.17 0.52	16 27.59 0.80	7 12.07 0.40	0 0.00 0.00	0 0.00 0.00	3 5.17 0.34	58 -- 0.48
STRAINS	126 43.90 2.05	13 4.53 0.65	34 11.85 1.95	47 16.38 4.48	38 13.24 15.83	29 10.10 3.27	287 -- 2.38
ASPHYXIATIONS	71 42.26 1.15	1 0.60 0.05	50 29.76 2.87	24 14.29 2.29	20 11.90 8.33	2 1.19 0.23	168 -- 1.39
NON-FATAL IMMERSIONS	20 52.63 0.32	16 42.11 0.80	2 5.26 0.11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	38 -- 0.31
MISCELLANEOUS WOUNDS	229 35.56 3.72	151 23.45 7.57	70 10.87 4.02	134 20.81 12.76	18 2.30 7.50	42 6.52 4.73	644 -- 5.34
MULTIPLE WOUNDS	567 41.42 9.21	290 21.18 14.54	315 23.01 18.09	79 5.77 7.52	15 1.10 6.25	103 7.52 11.60	1369 -- 11.34
TOTAL	6154 51.00	1994 16.52	1741 14.43	1050 8.70	240 1.99	888 7.36	12,067 100.00

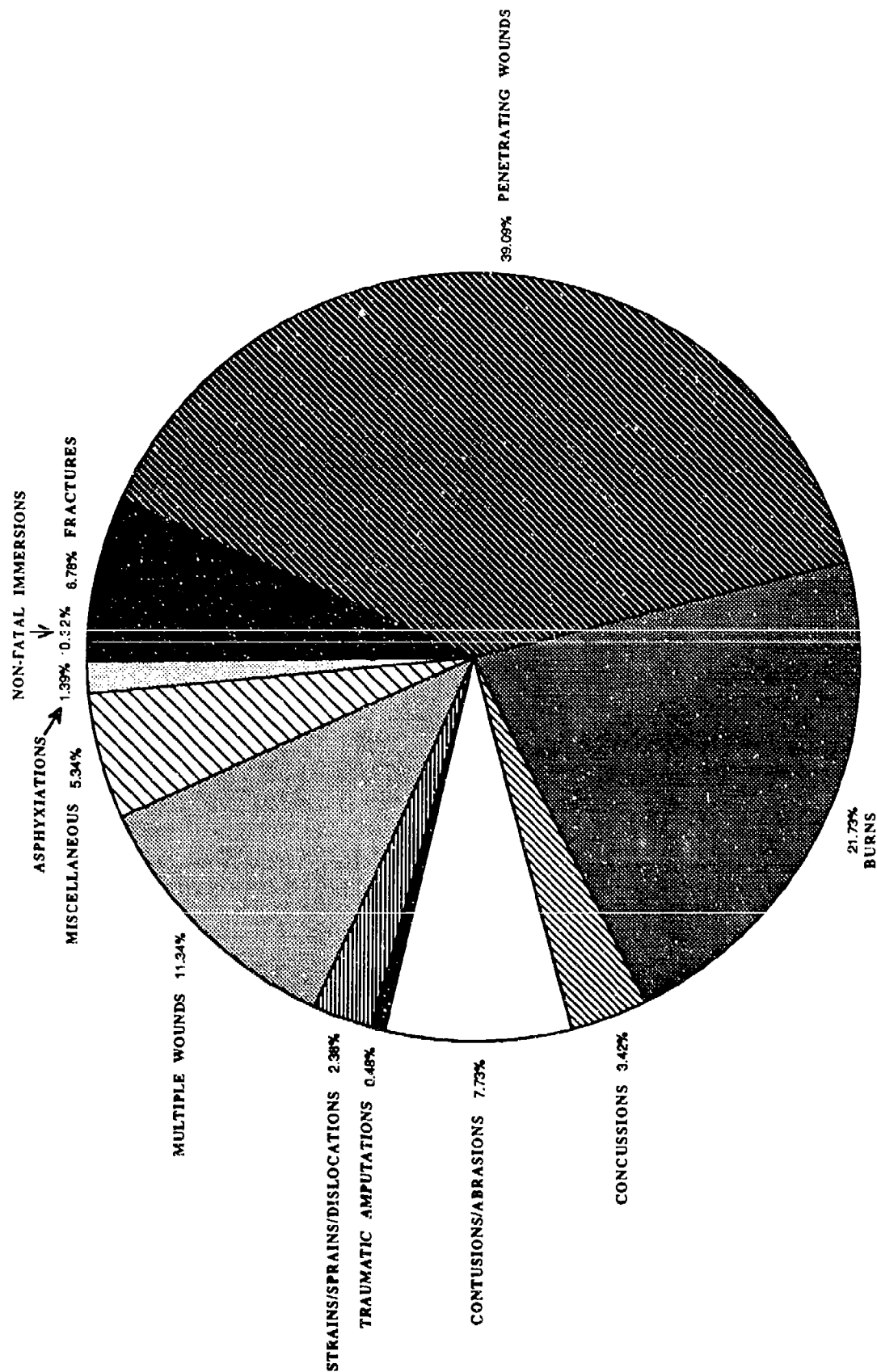
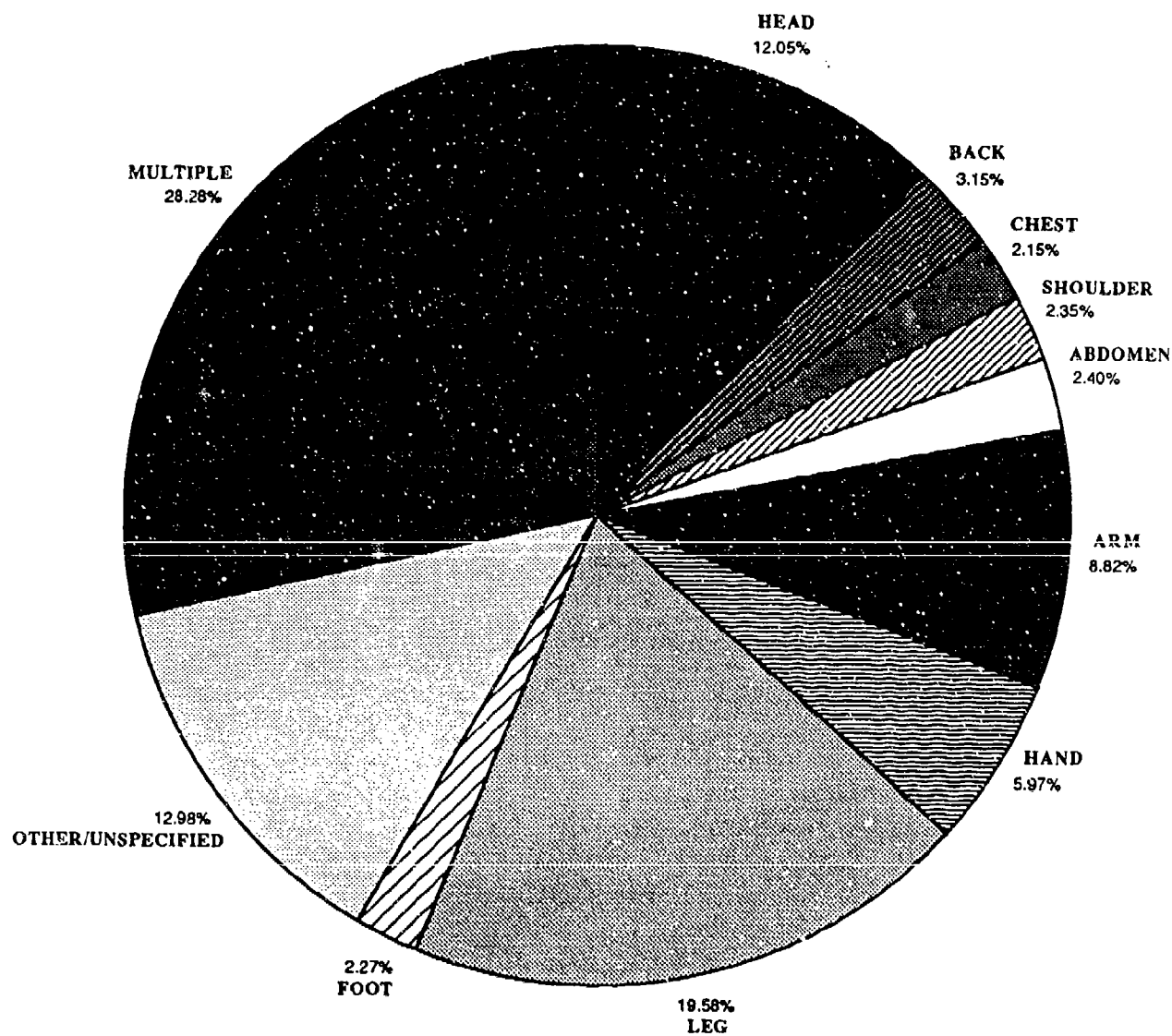


FIGURE 1. INJURY TYPES AS PERCENTAGES OF TOTAL WOUNDS; WWII WARSHIPS



**FIGURE 2. ANATOMICAL REGIONS AS
PERCENTAGES OF TOTAL WOUNDS;
WWII SUNK/DAMAGED WARSHIPS**

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The number of casualties was determined for 513 incidents involving U.S. Navy warships sunk or damaged during World War II. Ship type and weapon were significant factors in determining the numbers of wounded and killed. Multiple weapon attacks and kamikazes yielded more WIA than other weapon types. Multiple weapons and torpedos resulted in a higher incidence of KIA than other weapons. Penetrating wounds and burns were the most prominent injury types. Kamikaze attacks yielded significantly more burns than incidents involving bombs, gunfire, torpedos, mines, and multiple weapons. Mine explosions were responsible for more strains, sprains, and dislocations than the other weapon types. Torpedo attacks were more likely to sink the vessel than other weapon attacks.			
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