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CASUALTY INCIDENCE DURING NAVAL COMBAT OPERATIONS A MATTER OF MEDICAL READINESS

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The Historical Data

In a step toward forecasting casualties that might be sustained in future operations, the present investigation examines casualty rates sustained during previous naval combat operations, the incidence of successful strikes on surface naval vessels, and the casualties resulting from individual hits. The operations examined were those of: U.S. forces during World War II; United Kingdom (UK) forces during World War II; U.S. forces during the Korean conflict; and UK forces during the Falklands War (Operation CORPORATE).

U.S.: *World War II*. At the Operational Archives Division of the Naval Historical Center in Washington, D.C., is a listing of all afloat combat operations and engagements, the ships involved in each, and the dates of each ship's participation. Because dates of combat engagements within larger operations sometimes overlap (for instance, in 1944 the battles of Surigao, Samar, and Cape Engano all were in progress 24-26 October, as was the overall Leyte operation of which these battles were components), casualty and ship hit rates were computed for the combined operation rather than individual engagements where there was a degree of uncertainty as to the particular battle in which a ship participated. Data on specific naval warfare incidents were obtained from *The Summary of War Damage* and the *Naval Chronology, World War II*. Combining the incident data with the dates of the ships' involvement in various operations allowed the computation of "ship hit rates per hundred ship-days," calculated as the number of ships struck divided by the number of ship days, multiplied by one hundred.

Casualty rates were computed using Bureau of Personnel casualty lists, which are also kept at the Naval Historical Center. Casualty incidence was computed as "rates of casualties per one thousand strength per day." Additionally, casualty frequencies from specific weapon strikes were obtained from the Medical Officer Reports and After-Action Reports maintained at the Naval Historical Center, as well as from deck logs at the National Archives.

UK: *World War II*. Ship hit rates were computed for Royal Navy ships and merchant vessels participating in specific convoy operations. Analyses of the attacks sustained during these operations were confined to the periods in which the British forces were engaged by the enemy, not the time leading up to the attacks, when travel was unfettered and the risk of attack was relatively small.

Specific naval operations examined included: Operation PEDESTAL, a convoy of fourteen merchant ships escorted through the Mediterranean Sea by sixty-four Royal Navy warships in August 1942; two eastbound arctic convoys (PQ-17 and JW51B) in July and December 1942, in which, four and ten Royal Navy ships, respectively, escorted thirty-four and fourteen merchant vessels; two eastbound convoys (HX229 and SC122) composed of thirteen naval vessels and ninety merchant ships, traversing the North Atlantic together in March 1943; two

Casualty Incidence during Naval Combat Operations A Matter of Medical Readiness

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MEDICAL RESOURCE PLANNING for military operations requires estimates of the casualties likely to be sustained by both shipboard forces and ground troops. These casualty projections are required inputs to models that forecast the beds, medical equipment, supplies, and health care personnel needed to support an operation. Given that shipboard casualties may require transfer to medical facilities farther away and across a more hostile topography than that required for casualties on land, evacuation and treatment conceivably pose greater logistical problems for maritime forces than for their ground-based counterparts.

Projections of casualties among forces afloat require two separate sets of forecasts. First, estimates must be made of the likely numbers of ships that will sustain hits by enemy forces, and second, the incidence of casualties aboard the individual ships must be projected. The numbers of ships hit during a naval combat scenario and the casualties incurred during specific ship strikes are functions of a complex set of dynamics that include shipboard defenses, combat tactics, weapons possessed by the adversary, crew readiness, ship structural design, and human performance.

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westbound convoys (ONS.18, ON.202), which left Liverpool and Milford Haven and jointly crossed to North America in September 1943; and a joint convoy (SL.139 and MKS.30) travelling from Gibraltar to the UK in November 1943.

Though incomplete data prohibited computation of personnel casualty rates for these operations, casualty frequencies were available for 137 attacks on British ships during the war. The mean wounded-in-action (WIA) and killed-in-action (KIA) were computed by weapon and ship type.

U.S.: Korean Conflict. Ship hit rates were calculated from two major operations during the Korean conflict: the Chinese spring offensive of 22 April–8 July 1951 and the Chinese summer-fall offensive of 9 July–27 November 1951. U.S. Navy afloat casualty rates per thousand personnel per day were also computed for the two campaigns. Additionally, the mean casualties were computed by weapon and ship type for the ships sunk or damaged during all Korea operations.

UK: Falklands War. Ship hit rates per hundred ship-days were computed for the United Kingdom naval forces during the Falklands War. Casualty rates per thousand personnel per day were computed for Royal Navy warships and Royal Fleet Auxiliary (RFA) vessels. The numbers of WIA and KIA were extracted from Operation CORPORATE medical records maintained during the 1982 conflict, and mean casualties were computed by weapon and ship type.

Ship Hit Rates and Casualty Incidence

U.S.: World War II. Table 1 is a presentation of the number of hits, total ship-days, rate of hits per hundred ship-days, and WIA and KIA rates sustained aboard surface ships during thirty-six World War II operations. These data indicate a wide variability in the casualty and hit rates. The overall hit rates across Pacific and Atlantic operations were 0.32 and 0.20 hits per hundred ship-days; the daily WIA and KIA rates across Pacific operations were 0.30 and 0.26 per thousand strength, respectively. In the European theater, the WIA and KIA rates were 0.53 and 0.31 per thousand strength per day.

The mean casualties sustained aboard major combatants by weapon type are shown in Table 2. The "multiple weapon" category, which represents strikes by two or more different weapon systems, had the highest average number of both wounded and killed; kamikazes yielded the second-highest mean number of WIA, while torpedoes ranked second in KIA inflicted. The mean wounded and killed, respectively, for each weapon type were: kamikaze 39.0, 23.3; gunfire 22.5, 19.0; bomb 30.3, 33.3; torpedo 37.3, 78.1; mine 24.2, 24.0; and multiple 71.5, 135.2. The overall mean WIA and KIA across all weapon types for the 513 attacks on major combatants were 34.8 and 38.1.

Table 3 displays the mean WIA and KIA sustained on auxiliary ships by weapon type. The average number of wounded and killed across the 355 attacks were 16.4

and 10.8, respectively. The mean total casualties (WIA and KIA combined) by weapon types were: kamikaze 26.7; gunfire 8.6; bomb 31.6; mine 27.5; and torpedo 52.7.

UK: World War II. Ship hit rates for Operation PEDESTAL are shown in Table 4 for both naval vessels and the merchant ships being escorted. While the Mediterranean Sea segment of this operation was only two days in duration, there were nineteen hits on the seventy-eight ships in this convoy, yielding an overall hit rate of 14.7 hits per hundred ship-days. Also presented are the hit rates for two eastbound arctic convoys, one in July 1942 (PQ-17) and one in December 1942 (JW51B); the overall rates for these two operations were 12.4 and 4.3, respectively. Hit rates for two eastbound convoys that crossed the North Atlantic together (HX229, SC122) in 1943 are also shown in Table 4. While no naval vessels were struck during this operation, the twenty-nine hits on merchant vessels yielded an overall rate of 7.7 hits per hundred ship-days. Lastly, Table 4 displays the hit rates for a joint westbound convoy (ONS.18, ON.202) traversing the North Atlantic from the United Kingdom to North America, as well as a joint convoy (SL.139, MKS.30) traveling from Gibraltar to Britain. The overall hit rates for these two operations were 1.95 and 0.89, respectively.

Additionally, Table 5 shows the mean frequencies of WIA and KIA incurred during various attacks on Royal Navy battleships, carriers, cruisers, and destroyers. The mean number of wounded across the 137 shipboard attacks was 13.2, while the average killed-in-action per incident was 51.7.

U.S.: Korean Conflict. Of the fifteen casualty-producing incidents during the two major Chinese offensives, thirteen were attacks by shore batteries and two were mine detonations. The number of hits per hundred ship-days were 0.13 and 0.09, respectively, for the spring and summer-fall offensives, while the total casualty rates were 0.045 and 0.02 per thousand strength per day. Table 6 displays the mean WIA and KIA aboard all U.S. ships attacked during the Korean War (attacks occurred between September 1950 and July 1953). The mean WIA across these 93 incidents was 4.66, while the mean KIA was 1.58.

UK: Falklands Conflict. The casualty statistics for the Falklands data are based upon thirty-six Royal Navy surface warships and twenty-three RFA ships that participated in the conflict. Because the focus of this paper is on surface ships, submarines have been excluded from these analyses, as have the thirty-six merchant "ships taken up from trade" (STUFF) for use in Operation CORPORATE. (Note that while there were several attacks on the merchant ships, casualties were sustained aboard only one.)

Seventeen Royal Navy warships were successfully attacked, as were six of the RFA units. The rate of WIA was 0.32 per thousand strength per day, while the KIA rate was 0.22. During the period of 30 April through 16 June, a total of 1,723

ship-days and twenty-three attacks yielded a ship hit rate of 1.34 per hundred ship-days.

Of these twenty-three attacks on British warships and auxiliary vessels, sixteen were bomb attacks, five were cannon fire, and two were air-launched Exocet missiles. The mean WIA across all attacks was 8.26, and the mean KIA was 5.78. Table 7 displays the mean casualties by weapon and ship type for the twenty-three incidents. The mean WIA for bombs, cannon fire, and missiles were 8.9, 1.8, and 19.0, respectively. The average number of KIA for the three weapon types were 6.2, 0.0, and 16.5.

"A Formidable Undertaking"

Planning for naval combat operations must ensure that sufficient medical resources and evacuation assets are allocated for the casualties that may be sustained. As a preliminary step toward projecting casualties afloat in future operations, the authors examined hit rates of previous combat operations and also the casualties resulting from such attacks.

While the World War II British convoys had the highest incidence of ships hit of all the naval operations examined, these rates were based on the time periods in which escort ships and merchant vessels were particularly vulnerable to attack by German forces—that is, when the distances between the convoys and land were not great. The notion that littoral operations place naval vessels at heightened risk is supported by the fact that the highest hit rates occurred among the convoys that were approaching land or were within restricted waters. Also, though some U.S. amphibious operations in World War II exhibited high ship hit rates, the large numbers of ships involved and the extended lengths of some littoral and landing operations (e.g., Leyte, Okinawa, and Iwo Jima) yielded relatively low ship hit rates even though substantial numbers of ships were struck. The ship hit rate for the Falkland Island conflict, a relatively brief operation, was comparatively high, again indicative of the heightened risks of littoral operations. Ship hit rates of U.S. coastal forces during the Chinese offensives in the Korean War were low, reflecting the Navy's supporting rather than direct role, and the fact that opposition attacks were limited mainly to mines and shore batteries.

Interestingly, the United Kingdom's rate of casualties per thousand personnel in the Falklands operation were similar to the overall WIA and KIA rates for U.S. World War II Pacific operations, which suggests that contemporary changes to ships may not make much difference in the number of casualties sustained when an adversary is able to penetrate air defenses.

The mean numbers of casualties sustained in various attacks against surface ships are lower for more recent data (Korea and the Falklands) than for data from World War II (U.S. and the UK). It needs to be emphasized that the average

numbers of casualties seen in more recent bomb and mine incidents are based on smaller numbers of observations, which in turn yields greater uncertainty as to their predictive validity.

This investigation has focused on operations and ship strikes for which official documentation exists. It is noted, however, that a number of ships were attacked, particularly among forces in World War II, for which the exact numbers of casualties is not available; these consequently have not been included as a basis for future projections. Nevertheless, understanding the casualties suffered during previous operations and engagements may provide insight into future naval combat scenarios. While U.S. surface, subsurface, and air superiority over potential adversaries is widely recognized and respected, the formidable undertaking of treating and evacuating seriously wounded personnel from a potentially hostile marine environment must be recognized and respected as well.

Table 1

Rates of Hits on U.S. Vessels during World War II Operations

Operation	Asiatic-Pacific Area			Hit Rate*	WIA Rate**	KIA Rate
	Ship Hits	Total Ship Days	Hit Rate*			
Philippine Islands operation	40	4,489	0.89	0.44	2.56	
Netherlands East Indies	1	24	4.17	0.92	0.15	
Coral Sea	6	102	5.88	2.17	8.90	
Midway	2	160	1.25	1.81	1.71	
Guadalcanal-Tulagi landings	14	220	6.36	6.63	11.55	
Capture/Defense of Guadalcanal	26	2,903	0.90	0.48	0.70	
Eastern Solomons	2	57	3.51	2.04	2.04	
Cape Esperance	4	18	22.22	13.82	17.24	
Santa Cruz Islands	8	24	33.33	18.77	13.51	
Guadalcanal (3d Savo)	19	141	13.48	8.84	21.34	

* Hit Rates are per 100 ship days.

** Casualty rates are per 1,000 strength per day.

Table 1 (cont.)

Rates of Hits on U.S. Vessels during World War II Operations

Operation	Asiatic-Pacific Area				European-African-Middle Eastern Area					
	Ship Hits	Total Ship Days	Hit Rate*	WIA Rate**	KIA Rate	Ship Hits	Total Ship Days	Hit Rate*	WIA Rate**	KIA Rate
Tassafaronga (4th Savo)	4	22	18.18	14.06	36.44	20	13,907	0.14	0.34	0.21
Rennell Island	2	52	3.85	2.25	2.90	29	4,834	0.60	1.14	0.64
Consolidation Solomon Islands	12	7,456	0.16	0.13	0.05	15	3,771	0.40	0.77	1.41
Aleutians operation	3	1,095	0.27	0.07	0.02	13	5,103	0.25	0.84	0.56
New Georgia Group operation	21	2,444	0.86	1.28	1.73	39	15,125	0.26	1.11	0.46
Bismarck Archipelago operation	13	3,451	0.38	0.29	0.24	10	21,495	0.05	0.11	0.02
Treasury-Bougainville operation	19	2,086	0.91	0.53	0.32					
Gilbert Islands operation	13	3,541	0.37	0.24	0.32					
Marshall Islands operation	5	4,776	0.10	0.08	0.02					
Western New Guinea operation	8	5,801	0.14	0.12	0.05					
Marianas operation	37	26,275	0.14	0.08	0.02					
Western Caroline Islands operation	11	22,076	0.05	0.02	0.01					
Leyte operation	91	18,529	0.49	0.85	0.49					
Luzon operation	76	9,362	0.81	1.24	0.52					
Iwo Jima operation	56	10,936	0.51	0.23	0.13					
Okinawa Gunto operation	290	118,912	0.24	0.25	0.16					
Kurile Islands operation	1	169	0.59	0.02	0.00					
Borneo operations	21	4,723	0.44	0.24	0.04					
Tinian capture	2	1,654	0.12	0.62	0.16					
Consolidation So. Philippines	2	4,745	0.04	0.15	0.05					

* Hit Rates are per 100 ship days.

** Casualty rates are per 1,000 strength per day.

Table 2

Mean Casualties Sustained on Major Combatants by Weapon; World War II

Weapon	Ship Type	No. of Incidents	Mean WIA	Mean KIA	
Kamikaze	Battleship (BB)	16	47.7	16.2	
	Cruiser (CA)	5	35.2	11.0	
	Cruiser (CL)	8	54.6	26.6	
	Carrier (CV)	16	88.6	59.8	
	Carrier (CVB)	17	63.1	36.2	
	Carrier (CVL)	4	42.2	32.2	
	Destroyer (DD)	100	30.4	20.3	
	Destroyer (DE)	24	14.2	6.8	
	Gunfire	Battleship (BB)	14	30.9	8.4
		Cruiser (CA)	10	48.5	33.2
Cruiser (CL)		7	9.3	14.6	
Carrier (CV)		2	21.5	4.0	
Carrier (CVB)		2	140.0	63.0	
Carrier (CVL)		1	28.0	7.0	
Destroyer (DD)		78	15.0	18.6	
Destroyer (DE)		4	37.8	25.0	
Bomb		Battleship (BB)	4	34.0	13.8
		Cruiser (CA)	4	12.0	18.8
	Cruiser (CL)	11	53.1	44.0	
	Carrier (CV)	13	72.6	76.2	
	Carrier (CVB)	2	11.5	7.0	
	Carrier (CVL)	1	182.0	101.0	
	Destroyer (DD)	46	12.9	22.8	
	Destroyer (DE)	2	1.5	00.0	
	Torpedo	Battleship (BB)	6	26.7	91.8
		Cruiser (CA)	9	67.3	149.6
Cruiser (CL)		10	29.4	108.1	
Carrier (CV)		5	50.0	39.4	
Carrier (CVB)		2	106.0	232.5	
Carrier (CVL)		1	44.0	17.0	
Destroyer (DD)		28	24.1	61.2	
Destroyer (DE)		14	40.0	34.6	
Mine		Cruiser (CL)	1	00.0	00.0
		Destroyer (DD)	15	23.1	24.2
	Destroyer (DE)	3	44.0	31.3	
Multiple	Battleship (BB)	3	82.0	415.7	
	Cruiser (CA)	4	129.8	344.8	
	Cruiser (CL)	3	47.7	56.7	
	Carrier (CV)	3	97.7	84.3	
	Carrier (CVB)	3	65.0	28.0	
	Destroyer (DD)	11	51.1	57.6	

Table 4

Ship Hit Rates during World War II Royal Navy Convoy Operations

	Total Ships	Ship Days	Hits	Hit Rate*
Operation PEDESTAL (11-13 Aug. 1942)				
Naval ships	64	103	9	8.74
Merchant ships	14	26	10	38.46
Convoy PQ-17 (4-10 July 1942)				
Naval ships	4	28	0	0.00
Merchant ships	34	158	23	14.56
Convoy JW51B (29-31 Dec. 1942)				
Naval ships	10	28	3	10.71
Merchant ships	14	42	0	0.00
Convoy HX229/SC122 (16-19 Mar. 1943)				
Naval ships	13	52	0	0.00
Merchant ships	90	326	29	8.90
Convoy ONS.18/ON.202 (18-23 Sept. 1943)				
Naval ships	20	112	4	3.57
Merchant ships	67	402	6	1.49
Convoy SL.139/MKS.30 (18-21 Nov. 1943)				
Naval ships	19	73	1	1.37
Merchant ships	66	264	2	0.76

* Hit rates are per 100 ship days, for periods in which convoys were at greatest risk.

Table 3

Mean Casualties Sustained on Auxiliary Ships by Weapon; World War II

Weapon	Ship Type	No. of Incidents	Mean WIA	Mean KIA	
Kamikaze	Mine craft	45	14.6	7.8	
	Tank landing ship	16	12.5	5.6	
	Transport	36	29.2	11.2	
	Motor torpedo boat	2	7.5	4.0	
	Subchaser	4	11.8	3.0	
	Cargo	5	8.8	1.2	
	Oiler	2	8.5	1.0	
	Tender	5	20.6	13.8	
	Tug	2	18.5	4.0	
	Gunfire	Mine craft	14	4.9	3.2
		Tank landing ship	33	5.9	0.7
		Transport	7	15.7	12.7
		Motor torpedo boat	11	1.6	4.6
Subchaser		2	6.0	2.5	
Cargo		3	1.0	0.0	
Oiler		1	0.0	0.0	
Tender		1	0.0	0.0	
Tug		2	4.0	0.5	
Bomb		Mine craft	15	8.7	4.1
	Tank landing ship	17	16.6	6.3	
	Transport	13	13.9	15.2	
	Motor torpedo boat	6	5.0	5.7	
	Subchaser	3	20.3	9.7	
	Cargo	3	10.0	5.7	
	Oiler	7	20.3	54.1	
	Tender	5	24.6	68.6	
	Tug	1	49.0	18.0	
	Mine	Mine craft	35	15.7	5.7
Tank landing ship		7	51.3	12.4	
Transport		1	53.0	0.0	
Motor torpedo boat		1	6.3	0.0	
Subchaser		3	7.3	6.7	
Tender		1	62.0	16.0	
Tug		1	10.0	7.0	
Torpedo		Mine craft	3	57.3	39.3
		Tank landing ship	16	29.1	37.6
		Transport	10	18.2	22.2
	Subchaser	1	8.0	29.0	
	Cargo	7	22.4	4.3	
	Oiler	5	22.8	23.8	
	Tug	2	23.5	25.5	

Table 5

Mean Casualties Sustained by Weapon and Ship Type among UK Forces during World War II

Weapon	Ship Type	Number of Incidents	Mean WIA	Mean KIA
Bomb	Battleship	7	15.4	7.4
	Carrier	3	59.3	54.3
	Cruiser	25	22.9	42.4
	Destroyer	54	9.6	22.8
Gunfire	Battleship	1	3.0	1,421.0
	Carrier	1	34.0	1,204.0
	Cruiser	3	4.0	1.3
	Destroyer	15	5.3	39.0
Mine	Destroyer	1	23.0	59.0
	Cruiser	2	1.5	6.0
Torpedo	Destroyer	10	8.7	45.1
	Battleship	3	9.0	251.3
Multiple	Cruiser	2	4.0	1.0
	Destroyer	10	14.9	8.5

Table 6

Casualties Sustained on U.S. Ships during Korean Conflict

	Shore Battery			Mine		
	No. of Incidents	Mean WIA	Mean KIA	No. of Incidents	Mean WIA	Mean KIA
Minesweeper (AM)	6	1.0	0.3	2	39.5	6.5
Motor minesweeper (AMS)	7	0.8	0.3	2	9.0	15.5
Salvage ship (ARS)	1	0.0	0.0			
Fleet ocean tug (ATF)				1	5.0	2.0
Battleship (BB)	2	2.5	1.0			
Heavy cruiser (CA)	6	3.3	0.3			
Light cruiser (CL)	1	0.0	0.0			
Destroyer (DD)	40	2.9	0.6	4	26.0	11.0
Antisubmarine destroyer (DDE)	1	1.0	0.0			
Radar picket destroyer (DDR)	3	5.7	0.3	1	18.0	9.0
Destroyer escort (DE)	3	0.7	2.3			
Destroyer minesweeper (DMS)	6	2.3	1.2			
Dock landing ship (LSD)	2	2.0	1.0			
Landing ship (rocket) (LSMR)	1	4.0	1.0			
Tank landing ship (LST)	1	0.0	0.0			
Patrol escort (PF)	3	6.3	0.7			

Table 7

Mean Casualties Sustained by Weapon and Ship Type among UK Forces during the Falklands Conflict

Weapon	Ship Type	Number of Incidents		Mean WIA	Mean KIA
		Number of Incidents	Mean WIA		
Bomb	Destroyer	2	11.0	9.5	
	Frigate	6	8.8	4.3	
	Landing ship	6	10.2	9.2	
	Light cruiser	2	3.5	0.0	
Cannon	Frigate	3	3.0	0.0	
	Landing ship	2	0.0	0.0	
Exocet (ALCM)	Destroyer	1	24.0	20.0	
	Light cruiser	1	14.0	13.0	

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