United States Military Casualty Comparisons during the Persian Gulf War

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The United States undertook an extensive mobilization of military forces in Southwest Asia after the invasion of Kuwait by Iraq in August 1990. With this massive buildup and the short duration of the Persian Gulf War, an epidemiological comparison of military casualties was of interest. Information extracted from the Worldwide Casualty System maintained by the Department of Defense was used to describe the casualties. Of the 219 (212 men and 7 women) US casualties, 154 were killed in battle and 65 died from nonbattle causes. Thirty-five of the battle deaths were a result of friendly fire. Eighty-three percent of all casualties were white and the mean age at death for all casualties was 26.9 years. The Army had the highest proportion of both battle (58%) and nonbattle (71%) casualties and the Marine Corps had the highest battle casualty rate (0.52 per 1000 personnel) and nonbattle casualty rate (0.31).

As a result of the invasion of Kuwait by Iraq on Aug 2, 1990, the United States led an international mobilization of soldiers, planes, ships, and equipment in Southwest Asia described as the fastest buildup and movement of combat power across greater distances in less time than at any other point in history.[1] Nearly 50 countries contributed to the massive Coalition effort—either militarily, financially, or with valuable in-kind assistance including construction equipment, computers, heavy-equipment transporters, chemical detection vehicles, food, fuel, water, airlift, and sealift support. In addition to the United States, 38 other countries deployed air, sea, or ground forces to Southwest Asia. The logistics buildup included an estimated 110 naval vessels, 2000 tanks, 2,200 armed personnel carriers, 1,800 fixed-wing aircraft, and 1,700 helicopters.[1] The US land and sea force reached a maximum of nearly 540,000 active duty and reserve service personnel (called to active duty) in theater in January 1991.[2]

Personnel involved in the liberation and defense of Kuwait, which commenced on January 17, 1991, were continuously exposed to the hazards of war 24 hours a day for 6 weeks. A comparison of casualty rates across the four US military services during the Persian Gulf War was of interest, especially because the war was of such short duration. The following presents a summary of some of the epidemiological characteristics of America's casualties during this brief conflict, including distributions of casualties by geographical region and occupational group. A comparison of battle and nonbattle mortality of US mili-

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tary personnel in previous 20th century armed conflicts is also presented.

Methods

The Washington Headquarters Services' Directorate for Information, Operations, and Reports (DIOR), within the Department of Defense (DOD), maintains and operates the automated Worldwide Casualty System. The source of information for the WCS is the Report of Casualty (DD 1300).[3] The DD 1300 is the official military record of death for all officer and enlisted personnel who die while on active duty. Representatives from each service submit monthly casualty reports to DIOR and are responsible for the accuracy, validity, and timely reporting of their casualty information. The DIOR compiles casualty data from all the services on a fiscal-year basis, Oct 1 through Sept 30, and prepares consolidated casualty information reports for use by DOD, other federal agencies, and the general public.[4]

Data recorded on the DD 1300 includes demographic (date of birth, race, ethnicity, gender) and cause, date, and place of death information. The DD 1300 also contains military-specific information including casualty status (battle or nonbattle-related death, captured, etc), organizational assignment, pay data, and occupational codes. The DD 1300 has been shown to be a timely and valuable source of complete case ascertainment for active duty deaths.[5]

A subset of the Worldwide Casualty System data, developed by the author, consisted of all deaths that occurred in the Southwest Asia theater of operations (Persian Gulf, Red Sea, Gulf of Oman, Gulf of Aden, North Arabian Sea, Iraq, Kuwait, Saudi Arabia, Oman, Bahrain, Qatar, United Arab Emirates, Israel, Egypt, Turkey, Syria, and Jordan) during the 6-week period, Jan 17, 1991 through Feb 28, 1991. Included among these fatalities were both battle- and nonbattle-related deaths.

A summary of the military strength for each service in the Southwest Asia theater of operations and all services combined (including joint service staffs), as of Jan 17, 1991 and Feb 28, 1991, was provided by DOD's Joint Staff Manpower and Personnel Office.[2] The average military strength at the midpoint of that period, Feb 7, 1991, was used as the denominator to calculate crude casualty rates per 1000 personnel.

Service-specific occupation codes recorded on the DD 1300 were converted to DOD occupation codes for both enlisted and officer personnel.[6] The DOD occupation codes provide a structured hierarchial grouping of occupation classifications. This coding scheme is designed to group similar occupations from each of the services into a logical and consistent format. The second-level of structured coding provided here, for both officer and enlisted personnel, facilitated comparisons between the four services.

Results

Two hundred and nineteen (212 men and 7 women) active duty and reserve military personnel were killed during the 43-day Persian Gulf War. Of these, 154 (148 men and 6 women) were killed in battle and 65 (64 men and 1 woman) died as a result of nonbattle causes. Eighty-three percent of all the casualties were white and 14% were black. The mean age at death for all casualties was 26.9 years; those in the Air Force were significantly older than either the Army or Marine Corps casualties—31.5 years ($P < .05$). Table 1 summarizes several of the epidemiological characteristics of the US military casualties during the Persian Gulf War.

Fifty-eight percent (90) of the battle and 71% (46) of the nonbattle casualties were Army personnel. All seven women who died in the conflict were in the Army.

Half (14) of the Air Force battle casualties occurred as a result of the crash of an AC-130H modified gunship, one-half mile off the coast of Kuwait in the Persian Gulf on Jan 31, 1991. Crashes of Air Force helicopters claimed the lives of the pilot and co-pilot in two separate incidents. In the single most catastrophic incident of the conflict, 28 soldiers (25 men and 3 women) were killed on Feb 25, 1991, when fragments of an Iraqi SCUD missile struck a barracks in Dhahran, Saudi Arabia. Nearly 100 more personnel were wounded.

The Figure describes the proportion of US casualties attributed to fire from friendly forces. Two-thirds (24) of these were due to ground-to-ground action and one-third (11) from air-to-ground fire. Twenty-one soldiers were

TABLE 1
Numbers, Rates, and Demographic Characteristics of US Military Casualties in the Persian Gulf War, Jan 17–Feb 28, 1991

Category	Army	Navy	Marine Corps	Air Force	All Services
Mean strength*	278,732	79,111	52,103	89,730	504,825†
Total casualties	136	10	43	30	219
Male	129	10	43	30	212
Female	7	0	0	0	7
White	106	10	38	28	182
Black	27	0	3	1	31
Other/unknown	3	0	2	1	6
Mean age, y	26.2‡	29.5	25.3	31.5	26.9‡
SD	6.4	3.2	6.3	5.6	6.4
Range	18–52	25–35	19–46	21–43	18–52
Battle casualties	90	9	27	28	154
Rate§	0.32	0.11	0.52	0.31	0.31
Nonbattle casualties	46	1	16	2	65
Rate§	0.17	0.01	0.31	0.02	0.13

* As of Feb 7, 1991, midpoint in the Persian Gulf War.
† Includes joint service staffs.
‡ Missing age on 2 persons.
§ Rate per 1000.

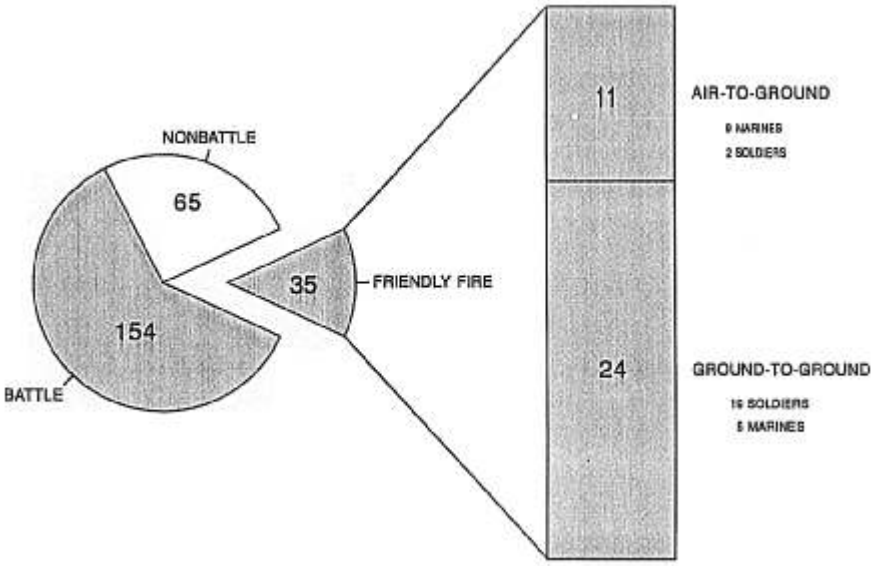

Figure. US military casualties attributable to friendly fire during the Persian Gulf War.

victims of friendly fire; 6 of these soldiers were killed (and 25 wounded) on Feb 27, 1991, when five M1A1 Abrams tanks and 5 Bradley fighting vehicles engaging enemy forces were incorrectly identified at night in reduced visibility and engaged by other M1A1 tanks.[1,7]

Fourteen marines were killed from friendly fire. Eleven died in two separate incidents on Jan 29, 1991: 4 died when their light armored vehicle (LAV) was struck by a ground-to-ground missile fired from another LAV, and 7 marines were killed and 2 wounded when an Air Force A-10 attack aircraft fired an air-to-ground missile, which malfunctioned in flight and hit an LAV.[1,7]

The Marine Corps had the fewest personnel in theater but experienced the highest battle casualty rate: 0.52 per 1000. Although the Army had more than three times as many battle casualties as the Air Force, 90 and 28, respectively, their battle casualty rates were similar (0.32).

Multiple-victim incidents characterized a majority of the nonbattle casualties in the Marine Corps; two helicopter crashes resulted in 4 and 2 deaths, respectively, and an accident involving an LAV killed 3.

Fifty-five of 65 nonbattle deaths resulted from accidental injuries; other causes included illness (6), suicide (2), and homicide (1).

The Marine Corps also experienced the highest nonbattle casualty rate of the four services: 0.31 per 1000. The Army had nearly three times as many nonbattle casualties compared with the Marine Corps, but at a rate 45% less than the Marine Corps rate (0.17).

Table 2 provides a summary of the geographic distribution of casualties during the Persian Gulf War. Although the Southwest Asia theater of operations incorporated a large land and sea area, all 154 battle casualties occurred in the contiguous area of Saudi Arabia (67), Iraq (51), Kuwait (19), and the Persian Gulf (17). All 17 Persian Gulf casualties and about one-quarter of the remaining battle casualties involved aircraft. Ninety-two percent of the 65 nonbattle casualties occurred in Saudi Arabia and the remainder in Iraq; no American military personnel died of nonbattle injuries in Kuwait.

More than 41% of the Army's enlisted casualties worked in occupations relating to infantry, combat engineering, and combat operations (Table 3). An additional 21% were involved with the driving or maintenance of motorized vehicles. In the Marine Corps, 13 of 20 enlisted battle casualties were in infantry, artillery, or combat engineering occupational specialties. In the Air Force, 5 of 9 enlisted battle casualties worked in armament or munitions specialties and three others were members of air crews. There were no enlisted battle casualties in the Navy.

All 9 Navy officers and 17 of 19 Air Force officers killed in battle were pilots or crew of fixed-wing aircraft. Eight of 13 Army officers who died in battle were helicopter pilots; 3 other Army helicopter pilots died of nonbattle injuries. An Air Force aerospace medicine physician/pilot died in battle and two Army physicians died of nonbattle wounds. Two Army health services support officers died in the

TABLE 2
Geographic Distribution of US Military Casualties by Service during the Persian Gulf War

Location	Army		Navy		Marine Corps		Air Force		All Services	
	Battle	Nonbattle	Battle	Nonbattle	Battle	Nonbattle	Battle	Nonbattle	Battle	Nonbattle
Persian Gulf	0	0	3	0	0	0	14	0	17	0
Iraq	38	5	6	0	0	0	7	0	51	5
Kuwait	2	0	0	0	13	0	4	0	19	0
Saudi Arabia	50	41	0	0	14	15	3	1	67	57
Other*	0	0	0	1	0	1	0	1	0	3
Total	90	46	9	1	27	16	28	2	154	65

* Other includes North Arabian Sea, Red Sea, Egypt, Israel, Turkey, and United Arab Emirates.

TABLE 3
Distribution of Persian Gulf War Casualties by Service and Occupational Group

Occupational Group	Army		Navy		Marine Corps		Air Force	
	Battle	Nonbattle	Battle	Nonbattle	Battle	Nonbattle	Battle	Nonbattle
			Enlisted					
Infantry, gun crews, seamanship								
Infantry	12	5	0	0	9	5	0	0
Armor/amphibious	2	0	0	0	2	1	0	0
Combat engineering	9	2	0	0	2	0	0	0
Artillery/gunnery	1	1	0	0	2	0	0	0
Air crew	0	0	0	0	0	0	3	0
Electronic equipment								
Radio/radar	2	0	0	0	1	0	0	0
Communications/intelligence								
Radio coding	0	4	0	0	0	1	0	0
Signal intelligence/electronic warfare	1	0	0	0	0	0	0	0
Combat operations	11	2	0	0	0	0	0	0
Health care								
Medical care	1	2	0	0	0	0	0	1
Other technical and allied support								
Technical NEC*	1	1	0	0	0	0	0	0
Other	3	4	0	0	0	0	0	0
Electrical/mechanical equipment								
Aircraft related	3	2	0	1	0	2	1	0
Automotive	8	6	0	0	3	0	0	0
Armament/munitions	0	0	0	0	0	0	5	0
Precision equipment	0	1	0	0	0	0	0	0
Power generation equipment	0	1	0	0	0	0	0	0
Service and supply								
Food service	2	0	0	0	0	0	0	0
Motor transport	8	4	0	0	1	0	0	0
Material receipt, storage, issue	5	0	0	0	0	0	0	0
Law enforcement	2	0	0	0	0	0	0	0
Craftsman								
Construction	0	2	0	0	0	0	0	0
Utilities	5	1	0	0	0	0	0	0
Nonoccupational/unknown	1	1	0	0	0	0	0	0
Subtotal	77	40	0	1	20	10	9	1
			Officer					
Tactical operations								
Fixed-wing aircraft	0	0	5	0	1	1	12	1
Helicopters	8	3	0	0	0	4	0	0
Aircraft crews	0	0	4	0	1	0	5	0
Operations staff	0	0	0	0	0	0	1	0
Intelligence								
General	0	0	0	0	0	1	0	0
Engineering and maintenance								
Construct/utilities	2	0	0	0	0	0	0	0
Ordnance	1	0	0	0	0	0	0	0
Health care								
Physician	0	2	0	0	0	0	1	0
Health services administration	1	1	0	0	0	0	0	0
Nonoccupational/unknown	1	0	0	0	5	0	0	0
Subtotal	13	6	9	0	7	6	19	1

* Not elsewhere classified.

Persian Gulf War, 1 in battle and 1 of nonbattle injuries. Occupational information on 5 of the 7 Marine Corps officers who died in battle was unknown.

While world attention was clearly and continuously focused on Southwest Asia during the short but intense Persian Gulf War, other military deaths were occurring in the United States as well as in many other locations around the globe. The 219 casualties during this conflict accounted for 63% of all active duty military deaths that occurred worldwide during the 6 weeks of the war.

One may question the scope of the casualties during the Persian Gulf War in light of the massive mobilization and its short duration. Table 4 provides a comparison of service-specific, battle and nonbattle casualties and casualty rates of the Persian Gulf War with those in other major armed conflicts in which the United States was engaged during the 20th century.[8] These rates are average rates for the defined period of the conflict and provide only broad comparisons. Efforts to annualize the casualty rates of the Persian Gulf War were determined to be not feasible because of the large and precipitous fluctuation in the military population. Troop strength began to decrease immediately after the cessation of hostilities, from a high of 540,000 in February 1991 to about 73,000 by the end of May 1991.

Discussion

Although overall rates for battle casualties have generally decreased during the century, there have been several periods when rates increased, in the Army and Navy between the two World Wars and in the Marine Corps between the Korean War and Vietnam. The trends noted for the Navy and Marine Corps agree with Hoeffler and Melton's description[9] of the changes in the distribution of Navy and Marine Corps casualties from World War I through the Vietnam conflict.

Nonbattle casualty rates have decreased consistently for the Army, Navy, and Air Force throughout the century. In the Marine Corps, rates increased between the World Wars then steadily decreased thereafter. Both battle and nonbattle casualty rates noted in Table 4 for the Army during World Wars I and II generally agree with the Army Surgeon General's report on the (Army) medical statistics of World War II.[10]

The battle and nonbattle casualty rates observed during the Persian Gulf War were considerably less, for each military service, than in any previous major global conflict in which the United States was engaged. One might suggest that advanced weapon systems and allied technologies, the short duration of the conflict, environmental conditions, and other factors may have contributed to the low number of casualties.

One could also argue that battle casualty rates would have been significantly lower had there been no deaths due to friendly fire. In the Army, for example, if the 24 soldiers who died from friendly fire in 15 incidents had lived, then the battle casualty rate would have been 0.24 per 1000, a decrease of 25% from the established rate of 0.32 (Table 1 and Figure). Similarly, the battle casualty rate in the Marine Corps would have been reduced 52% from 0.52 per 1000 to 0.25, if 14 marines had not been vic-

TABLE 4
Comparative Mortality Among the US Armed Forces during 20th Century Conflicts

Conflict	Army		Navy		Marine Corps		Air Force	
	Battle	Nonbattle	Battle	Nonbattle	Battle	Nonbattle	Battle	Nonbattle
World War I* (Apr 1917–Nov 1918)								
Casualties	50,510	55,868	431	6,856	2,461	390	–	–
Rate†	12.45	13.77	0.72	11.44	31.22	4.95	–	–
World War II‡ (Dec 1941–Dec 1946)								
Casualties	234,874	83,400	36,950	25,664	19,733	4,778	–	–
Rate†	20.86	7.41	8.83	6.13	29.49	7.14	–	–
Korean War (June 1950–July 1953)								
Casualties	27,704	9,429	458	4,043	4,267	1,261	1,200	5,884
Rate†	9.78	3.33	0.39	3.44	10.06	2.97	0.93	4.58
Vietnam (Aug 1964–Jan 1973)								
Casualties	30,904	7,274	1,626	923	13,082	1,754	1,739	842
Rate†	7.08	1.67	0.88	0.50	16.48	2.21	1.00	0.48
Persian Gulf								
Casualties	90	46	9	1	27	16	28	2
Rate†	0.32	0.17	0.11	0.01	0.52	0.31	0.31	0.02

* Includes Air Service battle deaths.
† Rate per 1000.
‡ Includes Army Air Forces.

tims of friendly fire in 7 incidents (Table 1 and Figure).

Military experts, however, maintain that casualties from friendly fire were not unique to the Persian Gulf War. An Army study (published in the 1980s) analyzing the causes of friendly fire related-deaths in previous major United States conflicts reported that 45% were caused by coordination problems, 26% by target misidentification, 19% by inexperienced personnel, and 10% by unknown causes.[1] In contrast, during the Persian Gulf War, approximately 39% of the incidents (11 of 28) appeared to be the result of target misidentification; weather and battlefield conditions were the most predominant reasons. Coordination problems also accounted for about 29% (8 of 28) of the friendly fire incidents. Of the remaining 9 incidents, 6 were due to technical and/or ordnance malfunctions; 3 incidents had insufficient or inconclusive findings to determine cause.[1]

Most of the Persian Gulf War casualties (35) and wounded (72) that resulted from friendly fire involved crews of armored vehicles struck by high-velocity, nonexplosive tank rounds that rely on the force of impact to destroy the target.[1,7] United States military commanders indicated that the number of deaths and injuries would have been higher had it not been for the built-in safety and survivability features of the Abrams M1A1 tank and the M2/M3 Bradley fighting vehicles, such as fire suppression systems, blow-out panels, hardened armor, and protective liners.[1]

Battlefield and environmental conditions may have played a role in the casualty rates during the Persian Gulf War. Rates cited in Table 4 for the Army in World War II cover eight major theaters of operation. The battle and nonbattle casualty rates for the African-Middle East theater—an area most similar to the Southwest Asia theater of operations in the Persian Gulf War—were 2.63 per 1000 and 4.04, respectively.[10] Army casualty rates during the Persian Gulf War were significantly lower than the rates observed for this selective but similar theater of operations.

Comparisons between mortality rates in the US civilian work force and those resulting from an armed conflict such as the Persian Gulf War would be difficult to make. Most of the technical occupations in the armed forces are either service-, weapon-, or platform-specific and no comparable occupations exist in the civilian sector. Current sources available for civilian work force mortality data generally do not contain military information. Leigh[11] used the Bureau of Labor Statistics Supplementary Data System (SDS) to estimate the probability of job-related death in 347 occupations. The SDS data Leigh used were derived from 11 state workers' compensation files over a period of 4 years and were not representative of the country and of all occupations. Persons on active duty service in the military would not have been contained in the SDS files because they are not subject to state workers' compensation payments. Although several of the occupations Leigh describes may loosely fit some military occupational specialties (eg, heavy equipment mechanics, machinists, aircraft workers), they are not comparable, in general, with military occupations.

The National Institute for Occupational Safety and Health National Traumatic Occupational Fatalities surveillance system has used death certificates that meet specific criteria to provide a national census of work-related fatalities for the decade 1980 to 1989.[12] Fewer than 2% of the 63,589 workers killed on the job during this period were identified as military. As with the SDS data, the occupations analyzed in the National Traumatic Occupational Fatalities surveillance system only generally relate to a few military occupations. Therefore, comparisons of mortality rates between civilian worker populations and the military populations involved in an armed conflict were not feasible.

Clustering of casualties, however, is common to both civilian and military work settings. It is interesting to note that the four US industries (mining, construction, transportation/communication/public utilities, and agriculture/forestry/fishing) with the highest occupational-related fatality rates during the 1980s[12] can often be characterized by clusters of casualties from sudden, catastrophic events, such as mine explosions, the collapse of buildings under construction, and ship sinkings. Similarly, clustering of Persian Gulf War—the SCUD strike on a barracks inflicted more US casualties (28 deaths and 100 injured) than any single engagement and was the only such strike fatal to US personnel, and an Air Force plane was shot down with 14 crew aboard.

Conclusions

This paper has provided an epidemiologic profile of US military casualties during the brief Persian Gulf War in 1991. Battle and nonbattle casualty rates were the lowest experienced by the United States in any major 20th century conflict. Advanced technologies and safer weapon systems contributed to these low rates. Comparisons of these rates with job-related mortality rates in the civilian work force were problematic. Although both combat operations and employment in certain civilian occupations are hazardous, the circumstances of death differ between the civilian workplace and the military battlefield. Methods of reducing these risks and developing preventive strategies present both a formidable and continuing challenge in both environments.

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Sexual Discrimination of Closures

Time out for a Henry Petroski engineering-history footnote: button evolution was partly gender-driven. Women button up on the opposite side from men. Long ago gents tended to dress themselves, while well-off ladies had maids to help them. Most maids were right-handed. So buttons on ladies' outfits migrated to the side where right-handed maids could best manipulate them.

From "A Chronicler of Our Thingamabobs and Doohickeys," by R. Wolkomir in *Smithsonian,* October 1993, pp 133–142