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DISEASE AND NON-BATTLE INJURIES AMONG U.S. MARINES IN VIETNAM

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Disease and Non-Battle Injuries Among U.S. Marines in Vietnam

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This paper examines disease and non-battle injuries among U.S. Marines stationed in Vietnam between 1965 and 1972. Computerized records were searched for all hospital admissions among male U.S. Marines throughout the world during the study period, and rates of first hospitalization for Marines stationed in Vietnam were compared with rates of Marines stationed elsewhere. In all but two diagnostic categories, the risk of first hospitalizations among U.S. Marines stationed in Vietnam was significantly higher than it was for Marines stationed elsewhere. This was particularly true for infective and parasitic diseases, and symptoms and ill-defined conditions.

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The role of the medical commands of the armed services is to support the operating forces and requires the provision of early effective care to the sick, injured, and wounded; return of recuperated patients to duty; prompt and orderly evacuation of casualties; and technical measures that safeguard the health of military personnel. During wartime, the major focus of these commands is on the care and treatment of patients wounded in battle. However, diseases and non-battle injuries (DNBIs) also represent a significant loss of manpower during military conflicts. Hoeffler and Melton,¹ for instance, report that during the last four major military conflicts involving U.S. military personnel (World Wars I and II, Korea, and Vietnam), the ratio of Navy and Marine Corps hospital admissions for DNBIs to admissions for combat-related wounds and injuries ranged from a low of 16:1 in World War I to a high of 88:1 in World War II. Nevertheless, while much has been learned of the kinds of combat casualties and their distribution within military units,²⁻⁴ relatively little is known of the frequency and risk of hospitalization for DNBIs in military theatres of operations. Numerous studies of specific forms of disease morbidity among U.S. military personnel in Vietnam, such as diseases of the

skin^{5,6}, malaria,^{7,8} and mental disorders.⁹⁻¹² have been conducted, but these studies are, for the most part, clinical in their orientation. Information on the agent, host, and environment of disease and non-battle injury risk is critical for effective planning for the logistics of medical treatment and facilities to support personnel in combat.

The object of this paper is to describe DNBI among U.S. Marine Corps personnel stationed in Vietnam between 1965 and 1972. Specifically we examined: (1) the population characteristics of those hospitalized for these conditions while serving in Vietnam; (2) the rates of first hospitalization for these conditions among personnel stationed in Vietnam and among personnel stationed elsewhere throughout the world; (3) the relationship between DNBI hospitalization and combat-related wounds and injuries; and (4) the disposition of those hospitalized for DNBI.

Methods

The Naval Health Research Center maintains an Inpatient Medical Data File on all hospitalizations recorded for active duty U.S. Marine Corps personnel for the period July 1965-1972. This file was searched for all first hospital admissions among personnel while serving in Vietnam and personnel serving elsewhere throughout the world. Diagnoses prior to 1970 were in accordance with the Department of Defense Disease and Injury Codes (DDDIC). Diagnoses between 1970 and 1972 were in accordance with the Eighth Revision, International Classification of Disease Adapted for Use in the United States (ICDA-8). Diagnoses from the two classification systems were grouped into 16 categories of comparable diagnoses. Combat casualties were defined as those first hospitalizations with a diagnosis of accidents, poisonings, and violence (APV) and a cause code of battle wound or injury. Cause code refers to class of trauma (battle wound or injury, intentionally inflicted non-battle injury, and accidental injury) for APV. Age, sex, pay grade, length of service, race, military occupational specialty (MOS), and year hospitalized were also identified from this file. As only a small number of women Marine Corps personnel were present in Vietnam during this period, only men were considered in this study. Military occupational specialties or job codes were grouped into major categories such as infantry, artillery, administrative, and air support. Age, pay grade, and length of service categories also were grouped for statistical analyses.

The population at risk used in the calculation of crude incidence rates was obtained from monthly strength figures provided to the Naval Health Research Center by Headquarters, U.S. Marines Corps during this period. Strength figures of U.S. Marines in Vietnam were obtained from annual reports of the Secretary of Defense.¹³ Calculation of age-adjusted incidence rates was not possible because of the lack of age-specific population data on U.S. Marines in Vietnam. Incidence rates were expressed as the number of first hospital admissions for new diagnoses per 1000 men per year. Rates were computed for each of the 16 major diagnostic categories as well as total hospitalizations. The rates for the personnel assigned to Vietnam and personnel assigned elsewhere were compared to obtain an estimate of

relative risk by taking the ratio of rates for Vietnam personnel to rates for non-Vietnam personnel. Levels of significance of these associations were obtained using 95% confidence intervals.¹⁴ The relationship between DNBI and combat casualties was examined by using ratios of the number of individuals hospitalized for a DNBI to the number of individuals hospitalized for a combat-related wound or injury (WIA). This ratio (DNBI:WIA) was also examined by age, race, pay grade, length of service, MOS, and year hospitalized. Comparisons of ratios by these variables were made using chi-square tests to determine if differences were statistically significant.

In addition, each patient record indicated whether the hospital admissions of Vietnam personnel were direct from the battlefield or a transfer from another medical facility. The type of medical facility reporting the hospitalization and the destination of the patient after leaving the reporting facility also were available from the inpatient record.

Results

A comparison of the DNBI rates of first hospitalization by diagnostic category between U.S. Marines stationed in Vietnam and Marines stationed elsewhere is provided in Table 1. With the exception of two categories, the rates of first hospitalizations among Vietnam personnel were significantly higher than the rates among the non-Vietnam personnel. Vietnam personnel displayed the highest risk of first hospitalization, relative to non-Vietnam personnel, for infective and parasitic diseases, followed by symptoms and ill-defined conditions, diseases of the blood and blood-forming organs, and diseases of the nervous system and sense organs. No significant differences in rates of first hospitalization for congenital anomalies were observed between the two groups. With respect to diseases of the respiratory system, non-Vietnam personnel had a significantly higher rate of first hospitalization than Vietnam personnel. Overall, the risk of first hospitalization for all DNBI was 2.6 times greater for Vietnam personnel than for personnel stationed elsewhere.

Table 2 provides a comparison of total rates of first hospitalization for these conditions and for combat-related wounds and injuries by year. Because of incomplete population counts of personnel stationed in Vietnam in 1972, only the rates for the period from July 1965 to 1971 are included. The rate of first hospitalization for DNBI among Vietnam personnel rose steadily, reaching a peak in 1969, and then declined, while the rates among non-Vietnam personnel remained relatively constant throughout the period. The first hospitalization rate of WIA men per 1000 men per year also displayed a bell curve but peaked in 1968.

A comparison of the number of individuals hospitalized one or more times for a DNBI and for the WIA is provided in Table 3. Among all Marine Corps personnel in Vietnam, for every 100 men wounded in action, there were 128 men who were hospitalized for a non-combat-related condition. When this ratio is examined by selected demographic and service history conditions, some significant variations in this figure appear. For example, the DNBI:WIA ratio increases with age and length of service. With the exception of officers who display the smallest ratio, an increase of the ratio with

TABLE 1
DISEASE AND NON-BATTLE INJURY RATES OF FIRST HOSPITALIZATION (PER 1000 PERSON YEARS) BY COMBAT STATUS
AND DIAGNOSTIC CATEGORY, U.S. MARINES 1965-1971

Diagnostic Category	Combat Status								
	Vietnam				Non-Vietnam				Relative Risk
	N	Rate	Confidence Limits		N	Rate	Confidence Limits		
Infective and parasitic diseases	31.777	93.1	94.1	92.1	17.456	14.1	14.3	13.9	6.6
Neoplasms	2,226	6.5	6.8	6.2	4,510	3.6	3.7	3.5	1.8
Endocrine, nutritional and metabolic diseases	1,258	3.7	3.9	3.5	2,765	2.2	2.3	2.1	1.7
Diseases of blood and blood-forming organs	1,595	4.7	4.9	4.5	1,301	1.0	1.1	0.9	4.7
Mental disorders	12,046	35.3	38.1	36.9	24,863	20.0	20.2	19.8	1.8
Diseases of the nervous system and sense organs	12,794	37.5	38.1	36.9	12,852	10.4	10.6	10.2	3.6
Diseases of the circulatory system	3,740	10.9	11.3	10.5	8,860	7.1	7.3	6.9	1.5
Diseases of the respiratory system	8,813	25.8	26.3	25.3	43,574	35.1	35.4	34.8	0.7
Diseases of the digestive system	11,256	33.0	33.6	32.4	19,375	15.6	15.8	15.4	2.1
Diseases of the genitourinary system	5,889	17.3	17.7	16.9	9,855	7.9	8.1	7.7	2.2
Diseases of the skin and subcutaneous tissue	16,113	47.2	47.9	46.5	19,405	15.6	15.8	15.4	3.0
Diseases of the musculoskeletal system	14,855	43.5	44.2	42.8	24,319	19.6	19.8	19.4	2.2
Congenital anomalies	1,307	3.8	4.0	3.6	5,026	4.0	4.1	3.9	1.0
Symptoms and ill-defined conditions	22,997	67.4	68.3	66.5	14,852	12.0	12.2	11.8	5.6
Non-combat accidents, poisonings and violence	39,896	116.9	118.1	115.7	58,530	47.1	47.5	46.7	2.5
Special conditions	6,092	17.9	18.3	17.5	6,582	5.3	5.4	5.2	3.4
Total first hospitalizations	192,654	564.7	567.2	562.2	274,125	220.8	221.6	220.0	2.6
Population at risk (person years)	341,176				1,241,649				

pay grade also is observed. A wide variation of ratios exists with respect to military occupations, with infantry, pilots, and artillery personnel displaying the smallest ratios and administrative and aviation support personnel the largest ratios. Finally, there is an inverse relationship between the ratio and the year hospitalized. The year of greatest combat activity as measured by the numbers of personnel wounded in action, 1968, had the smallest DNBI:WIA ratio.

Information on the flow of individuals hospitalized for DNBI is provided in Table 4. The largest percentage of these individuals were treated at Naval hospitals and hos-

pital ships such as the USS REPOSE and the USS SANC-TUARY, which were stationed off the coast of South Vietnam. Marine medical companies accounted for almost one-third of the hospital admissions of these individuals. Two-thirds of these individuals were admitted directly to the reporting facility, while the remainder were transferred from other facilities such as Army hospitals. Of those treated at the reporting facilities, most were discharged upon completion of treatment and returned to their units. More than 7% were evacuated to Navy medical facilities in the U.S. for further treatment or medical board hearings, while another

TABLE 2
WOUNDED IN ACTION, DISEASE AND NON-BATTLE INJURY RATES OF TOTAL FIRST HOSPITALIZATIONS (PER 1,000 PERSON YEARS) BY COMBAT STATUS AND YEAR HOSPITALIZED, U.S. MARINES 1965-1971

Year	Vietnam						Non-Vietnam						
	Popula- tion at Risk	Wounded in Action	Rate	Hospital Admis- sions	Rate	95 Percent Confidence Limits		Popula- tion at Risk	Hospital Admis- sions	Rate	95 Percent Confidence Limits		Relative Risk
						Upper	Lower				Upper	Lower	
1965*	9,800	806	82.2	3,047	310.9	321.9	299.9	85,173	18,877	221.6	224.8	218.4	1.4
1966	53,260	7,883	148.0	21,263	399.2	404.6	393.9	185,901	40,498	217.8	220.0	215.7	1.8
1967	75,500	20,501	271.5	37,779	500.4	505.4	495.3	188,187	39,485	209.8	211.9	207.7	2.4
1968	81,700	26,287	321.7	50,117	613.4	618.8	608.1	196,033	45,058	229.8	232.0	227.7	2.7
1969	68,233	17,410	255.1	53,485	783.9	790.5	777.2	214,382	49,094	229.0	231.0	227.0	3.4
1970	40,114	5,639	140.6	22,963	572.4	579.8	565.0	195,152	42,996	220.3	222.4	218.2	2.6
1971	12,569	485	38.6	4,000	318.2	328.1	308.4	176,820	38,047	215.2	217.3	213.0	1.5

* July through December only.

TABLE 3

RATIOS OF DISEASE AND NON-BATTLE INJURY CASUALTIES TO WOUNDED IN ACTION BY SELECTED DEMOGRAPHIC AND SERVICE HISTORY VARIABLES, U.S. MARINES IN VIETNAM, 1965-1972

	Disease and Non-battle Injury Casualties (N)	Wounded in Action (N)	Ratio
Total	100,830	78,756	128:100
Age			
17-19	23,730	20,574	115:100
20-24	62,768	50,233	125:100
25-29	5,515	3,889	142:100
30-34	2,570	1,255	205:100
35-39	2,002	595	336:100
40+	1,500	311	482:100
Missing Data	2,745	1,899	
$\chi^2 = 1.335.23, df = 5, p < 0.0001$			
Pay Grade			
E-1 to E-3	69,347	57,462	121:100
E-4 to E-6	25,548	17,589	145:100
E-7 to WO-4	2,351	631	373:100
Officer	3,358	2,911	115:100
Missing Data	226	163	
$\chi^2 = 916.53, df = 3, p < 0.0001$			
Years Served			
1 year or less	51,265	47,176	109:100
2 years	24,221	16,897	143:100
3 years	8,788	5,729	153:100
4-5 years	4,413	2,790	158:100
6-7 years	1,806	1,160	156:100
8-9 years	1,244	783	159:100
10 years or more	6,322	2,215	285:100
Missing Data	2,771	2,006	
$\chi^2 = 2,140.31, df = 6, p < 0.0001$			
Military Occupation			
Administration	6,241	867	720:100
Intelligence	1,281	726	176:100
Infantry	59,525	62,071	96:100
Artillery	4,928	3,090	159:100
Utilities	2,506	763	328:100
Construction	9,301	3,491	266:100
Operations	6,661	2,709	246:100
Aviation Support	1,941	352	551:100
Pilots	380	248	153:100
Missing Data	6,255	4,439	
$\chi^2 = 7,354.43, df = 8, p < 0.0001$			
Race			
White	87,198	67,955	128:100
Black	13,102	10,329	127:100
All other	530	472	112:100
$\chi^2 = 6.14, df = 2, p < 0.05$			
Year Wounded			
1965 (July-December only)	1,758	806	218:100
1966	12,647	7,883	160:100
1967	20,299	20,501	99:100
1968	25,342	26,287	96:100
1969	27,048	17,410	155:100
1970	11,582	5,639	205:100
1971	2,052	485	423:100
1972	102	8	1275:100
$\chi^2 = 4,352.94, df = 7, p < 0.0001$			

TABLE 4

TREATMENT FACILITIES, TYPE OF ADMISSION, AND DISPOSITION OF U.S. MARINE DISEASE AND NON-BATTLE INJURY CASUALTIES IN VIETNAM, 1965-1972

	N	%
Treatment Facility		
Naval Hospital Hospital Ship	44,376	44.0
Naval Support Activity, Da Nang	20,012	19.8
Dispensaries	212	0.3
Helicopter Ships	2,579	2.6
Marine Medical Companies	31,433	31.2
Unknown	2,215	2.2
Type of Admission		
Direct	66,446	66.0
Transferred from Another Facility	34,290	34.0
Unknown	94	0.0
Disposition		
Evacuated to CONUS	7,315	7.3
Transferred to Navy Hospital	9,204	9.1
Transferred to Army Hospital	797	0.8
Transferred to Air Force Hospital	11,340	11.2
Transferred to VA Hospital	985	1.0
Discharged from Hospital	70,798	70.2
Died of Wounds (DOW)	364	0.4

12% were transferred to other service medical facilities in the Pacific such as the hospital at Clark Air Force Base in the Philippines.

Discussion

In all but two diagnostic categories, the risk of first hospitalization among U.S. Marines in Vietnam was significantly greater than it was for Marines stationed elsewhere. Much of this excess risk is understandable, given the circumstances of military conflict in this particular environment. Infective and parasitic diseases such as malaria, tuberculosis, diarrheal diseases, dengue, Japanese encephalitis, leptospirosis, melioidosis, and scrub typhus are endemic to Southeast Asia.¹⁵⁻¹⁷ Malaria and respiratory, diarrheal, and skin diseases were the most common causes of hospital admissions among U.S. Army personnel in Vietnam during this period.⁶ U.S. Army personnel also displayed high rates of venereal diseases.¹⁶ Several studies have noted the relatively high prevalence of mental disorders among Marine Corps personnel during this period.^{12,18} Much of this has been attributed to combat-related stress and the particular nature of U.S. military involvement in Vietnam.^{19,20} The high rates of non-combat-related accidents, poisonings, and violence may also be due to the combination of high levels of stress and operation in unfamiliar environments. Somatic manifestations of stress and the necessity for treatment expediency in order to handle more serious casualties may also account for the high rate of symptoms and ill-defined conditions among Marine Corps personnel in Vietnam. Hoeffler and Melton¹ found symptoms and ill-defined conditions to be the fourth leading cause of hospital admissions among all Navy and Marine Corps personnel during this period.

Other studies^{1,5} have pointed to the high risk of respiratory diseases among military personnel during wartime. While our results indicated that diseases of the respiratory system was the second leading cause of first hospitalizations among all Marine Corps personnel during the study period, it was much less of a problem among personnel stationed in Vietnam than it was for personnel stationed elsewhere. This is because the greatest risk for respiratory diseases typically occurs during the recruit training period.²¹ As such training takes place in the U.S., we would expect to find a higher rate among the non-Vietnam personnel. The results of this study conform to this expectation.

A rank ordering of disease categories by the number of first hospitalizations among all Marine Corps personnel in the study approximates the ranking of Hoeffler and Melton¹ for all Navy and Marine Corps personnel during this period. However, our results also indicated that most disease categories assumed greater importance in Vietnam than they did elsewhere. This was particularly true of infective and parasitic diseases and symptoms and ill-defined conditions. Thus, combat casualty care should include provisions for the treatment of these conditions in addition to combat-related wounds and injuries.

The high relative risks in most diagnostic categories indicate that the risk for almost all forms of morbidity increases under combat conditions. This association is further strengthened by comparing the rates of first hospitalization by year. As noted above, the rates of total first hospitalizations for DNBI and for combat-related wounds and injuries among Vietnam personnel both assumed a bell curve with a difference in highest rates of one year. Based on this evidence, there appears to be a linear relationship between combat casualties and DNBI.

However, when examining the ratios of diseases and non-battle injuries to combat casualties, the relationship becomes less clear. Actually, two different DNBI:WIA ratios may be utilized in providing information for combat casualty care. The ratio of the number of personnel hospitalized for a DNBI to the number of personnel wounded in action is useful for military planners in making decisions about anticipated loss of manpower under certain combat conditions. The ratio of hospital admissions for DNBI to hospital admissions for combat-related wounds and injuries has relevance for health care administrators in making decisions about how to effectively allocate medical personnel and resources in order to provide optimum care.

Only one type of ratio was examined here. A comparison of the number of personnel hospitalized for a DNBI with the number of personnel hospitalized for a combat-related wound or injury revealed that for each 100 persons hospitalized for the latter condition, 128 were hospitalized for the former condition. This ratio is much less than that reported by Hoeffler and Melton.¹ However, our analyses took into consideration only hospitalizations of Marine Corps personnel and specifically those hospitalized while in Vietnam, whereas the Hoeffler and Melton study¹ included cases of DNBI among both Navy and Marine Corps personnel stationed in Vietnam and elsewhere. Nevertheless, the ratio reflects the necessity of planning for the treatment of conditions not directly related to combat. Moreover, when ex-

amined in terms of specific demographic and service history characteristics, a wide range in the DNBI:WIA ratios was found. The increase in ratios by age, years served, and pay grade would appear to suggest an inverse relationship between the two conditions. However, a comparison of the rates of DNBI with the rates of combat casualties by year would suggest a direct relationship. A third possibility is that the results obtained from this method of analysis may be due to the fact that the risk for DNBI and the risk for the combat-related wounds and injuries are not related at all. In any case, previous research has indicated that the ratio serves as a poor indicator of disease risk.¹² Variable-specific rates which could be employed to examine each of these three possibilities were not calculated because of the lack of information on the demographic and service characteristics of the population of Marines at risk in Vietnam.

With respect to the patterns of treatment and care provided to personnel hospitalized for a DNBI, we found a higher percentage of personnel treated in Marine medical company facilities than was the case among personnel treated for a combat-related wound or injury,² reflecting the differences in degree of severity between combat and non-combat-related medical problems. There was also a much higher percentage of direct admissions for DNBI casualties than there was for combat casualties. The relatively high percentage of discharge from the reporting facility reflects the high quality of medical care given to Marine Corps personnel by medical facilities in Vietnam during this period.

While this study is based on comprehensive inpatient medical data, some limitations to the conclusions derived from these results should be noted. First, the data do not include the numbers of personnel treated on an outpatient basis at Navy and Marine Corps medical facilities. As Hoeffler and Melton¹ note, much of the major impact of musculoskeletal disease; accidents, poisonings, and violence; mental disorders; respiratory illness; and dermatologic illness is not reflected in hospitalizations alone. They conclude that "it is obvious that outpatient morbidity must be added to hospitalizations and mortality, if accurate planning is to result." This suggests the need for automated data processing capabilities of the type now under development for the Fleet Marine Force²².

It is also conceivable that not all Marines who were treated on an inpatient basis were included in the Naval Health Research Center Inpatient Medical Data File, resulting in further under-enumeration of first hospitalizations. This file is comprised of medical information collected from Navy and Marine Corps medical facilities only. Marines who were treated and discharged from facilities of other branches of the military service (such as U.S. Army field hospitals) would not be included in our estimates of incidence rates or ratios.

Despite these limitations, however, our results do indicate that the risk of DNBI increases in a combat environment, whether or not that risk is directly related to the intensity of combat and the number of combat-related wounds and injuries. Combat casualty medical care resource allocation and planning should take into consideration the scope and nature of these requirements, especially for infective and parasitic diseases and symptoms and ill-defined conditions. Further research also is required to identify the reasons for

increased risk of first hospitalizations for diagnostic categories such as neoplasms, diseases of the blood and blood-forming organs, and diseases of the circulatory and digestive systems.

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higher than it was for Marines stationed elsewhere. This was particularly true for infective and parasitic diseases, and symptoms and ill-defined conditions. The high relative risks also indicated that almost all forms of disease and injury morbidity increased under combat conditions. For every 100 persons hospitalized for a combat-related wound or injury in Vietnam, 128 were hospitalized for a disease and non-battle injury. Combat casualty medical care resource allocation and planning should take into consideration the scope and nature of these medical conditions in a combat environment.

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