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VIRAL HEPATITIS IN THE US NAVY, 1975–1984

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The epidemiology of viral hepatitis in US Navy enlisted personnel was reviewed for the years 1975–1984. Hospital discharge summaries of all active duty enlisted personnel admitted to a US Navy treatment facility were used for the study. From 1975 to 1984, total first hospitalizations for viral hepatitis declined from 128 per 100,000 personnel (95% confidence interval (CI) 118–139) to 56 per 100,000 personnel (95% CI 50–63). The highest incidence of acute viral hepatitis (115 per 100,000 personnel) was found in the youngest age groups aged 24 years and less. Risk factors for acute hepatitis included a previous hospitalization with either drug abuse (relative risk = 363) or a sexually transmitted disease (relative risk = 25) listed among the discharge diagnoses. Having a medical job classification was also associated with an increased risk of acute hepatitis. The steep decline in the incidence of viral hepatitis during this 10-year period may have been due to decreasing drug abuse in the US Navy. Immunization of high-risk groups in the US Navy with hepatitis B vaccine could be an effective policy for the prevention of acute viral hepatitis.

hepatitis; hepatitis A; hepatitis B; hepatitis, viral, non-A, non-B; military medicine

Viral hepatitis has historically been a common problem for the US Navy (1). Because the American military operates in many developing countries where viral hepatitis is endemic, the threat posed by this infectious disease is increased for military personnel (2, 3). In addition, other social and environmental factors, including communal living conditions, sexual contact with prostitutes, and parenteral drug abuse, have been shown to increase the risk of acute hepatitis in the military (4–8). Although numerous studies of viral hepatitis have been conducted by the US Army, there are few studies of viral hepatitis in US Navy personnel (1, 4, 9). The objective of this study was to review the epidemiology of viral hepatitis in US Navy enlisted personnel during the period 1975–1984 to identify long-term trends and risk factors which may be useful in developing prevention and control programs.

MATERIALS AND METHODS

The data available for study were hospital discharge records for all active duty enlisted personnel admitted to any US Navy medical treatment facility during the period January 1, 1975–December 31, 1984.

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These records, which contain a summary of discharge information, are collected and maintained in a computerized data base by the Navy Medical Data Services Center, Bethesda, Maryland. Only the first hospital admission for viral hepatitis was used for analysis when a patient was admitted more than once during the study period.

Diagnoses were categorized according to the *International Classification of Diseases, Adapted*, Ninth Revision (ICDA-9). Diagnoses based on the ICDA-8 classification system, which was used during the first half of the study period (1975–1979), were recoded according to the ICDA-9 system. There are eight categories of viral hepatitis in the ICDA-9 classification. For the purposes of this study, three ICDA-9 categories were independently analyzed: 1) hepatitis A, viral test positive (070.0); 2) hepatitis B, viral test positive (070.3); and 3) non-A, non-B hepatitis (070.6). ICDA-9 categories for hepatitis A and B based on no or negative diagnostic tests (serologically unconfirmed cases of hepatitis A and B) and the diagnostic category for "other" types of viral hepatitis were excluded from individual analysis. Only for evaluations involving total viral hepatitis incidence rates were all eight ICDA-9 categories included in analysis.

Although non-A, non-B hepatitis is a diagnosis of exclusion and the serologic tests used to arrive at this diagnosis were unknown, the diagnostic category for non-A, non-B hepatitis was individually analyzed because there was no other measure of this infection. In addition, from 1975 to 1979, the ICDA-8 category for "viral hepatitis—type not specified" was used to represent cases of non-A, non-B hepatitis.

Variables analyzed in this study included hepatitis diagnosis, age, sex, race, occupation, and year hospitalized. A record of prior hospitalization with either drug abuse or a sexually transmitted disease listed among the discharge diagnoses was included in analysis as a risk factor, even if these two diagnoses were secondary and not the primary discharge diagnosis. Occupational classifications were grouped into five categories based on similarity of assigned tasks and work environment (10). Persons in medical occupations were further divided into "occupations known to involve routine blood exposure" and "other medical occupations" (3). Medical personnel with a nonspecific job code (70 per cent of all medical personnel) were not included in the analysis of risk associated with blood exposure.

An Enlisted Master Record File, maintained by the Naval Health Research Center, San Diego, California, provided average annual population estimates for all active duty enlisted personnel. Age-specific and age-adjusted incidence rates were calculated for the study population (4,686,133 person-years). Age adjustment was carried out by the direct method, using as the standard population all active duty enlisted personnel in the US Navy during the study period (11). The relative risk for hepatitis associated with variables of interest was determined on the basis of ratios of age-adjusted rates (11). Statistical significance of relative risk estimates was determined using the Mantel-Haenszel chi-square procedure (12). Ninety-five per cent confidence intervals were calculated assuming a normal distribution.

Results

The number of active duty enlisted personnel in the US Navy during the years 1975–1984 averaged 469,000 per year. During this period, there were an average of 45,000 hospital admissions annually of Navy enlisted personnel worldwide; an annual average of 447 (1.0 per cent) of these admissions were for viral hepatitis. The mean incidence of hospitalizations for viral hepatitis during this 10-year period was 93 per 100,000 person-years.

From 1975 to 1984, total first hospitalizations for viral hepatitis declined from 128 per 100,000 personnel (95 per cent confidence interval (CI) 118–139) to 56 per 100,000 personnel (95 per cent CI 50–63) (table 1). A significant decrease in the incidence of confirmed cases of hepatitis B

TABLE 1

Age-adjusted viral hepatitis hospital admission rates per 100,000 enlisted personnel, US Navy, 1975–1984

Year	Hepatitis A			Hepatitis B			Non-A, non-B hepatitis			Total hepatitis*		
	No	Rate	95% CI†	No	Rate	95% CI	No	Rate	95% CI	No	Rate	95% CI
1975	0	0		195	43	37–50	73	15	12–19	605	128	118–139
1976	0	0		126	28	23–33	62	13	10–17	509	110	101–120
1977	0	0		131	27	23–32	105	23	19–28	512	113	103–122
1978	0	0		137	29	24–34	116	25	21–30	416	91	82–99
1979	0	0		117	25	21–30	84	18	14–22	376	82	74–90
1980	0	0		111	24	19–28	55	12	9–15	456	99	90–108
1981	21	5	3–6	125	27	22–32	55	12	9–15	391	83	75–91
1982	28	6	4–8	106	23	18–27	50	10	7–13	393	82	74–90
1983	34	8	5–10	105	22	18–27	56	11	8–14	406	81	74–89
1984	35	8	5–10	63	14	11–17	33	6	4–8	283	56	50–63
Total	118	3	2–4	1,215	26	25–27	689	15	14–16	4,347	93	90–96

* Includes all eight categories of viral hepatitis in the *International Classification of Diseases, Adapted,* Ninth Revision.

† CI, confidence interval.

and cases of non-A, non-B hepatitis was also found. In contrast, the incidence of confirmed cases of hepatitis A increased after 1980 when a commercial serologic test for acute hepatitis A became available. During each of the 10 study years, confirmed cases of hepatitis B were the most frequent hepatitis diagnosis overall, representing 28 per cent of all hospitalizations (table 1).

For total hepatitis admissions, the highest incidence (115 per 100,000 personnel) was found in the youngest age groups aged 24 years and less (figure 1). After age 24 years, a sharp decline in hepatitis incidence rates occurred. The same trend of decreasing incidence with advancing age was observed for hepatitis B and non-A, non-B hepatitis. Too few cases of confirmed hepatitis A were reported to determine whether incidence rates were related to age.

Analysis of incidence rates by sex demonstrated a significantly higher age-adjusted incidence rate for men (95 per 100,000 personnel; 95 per cent CI 92–98) than for women (70 per 100,000 personnel; 95 per cent CI 60–80) for total hospital admissions for viral hepatitis (table 2). A significantly increased rate for men was found for hepatitis B but not for non-A, non-B hepatitis or hepatitis A.

Analysis of incidence rates by race demonstrated similar total hepatitis hospitalization rates for whites, blacks, and all other racial groups (table 2). Analysis of individual types of hepatitis showed a higher risk of hepatitis B but a lower risk of non-A, non-B hepatitis for blacks as compared with whites.

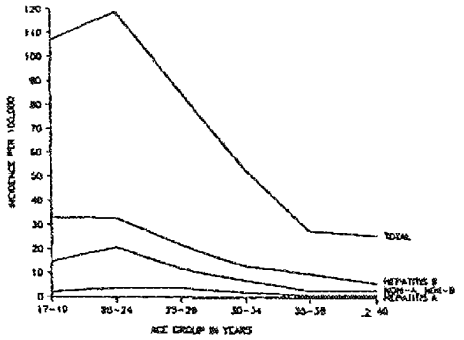

FIGURE 1. Incidence of viral hepatitis, by age group, in active duty US Navy enlisted personnel, 1975–1984

Two risk factors for hepatitis transmission, drug abuse and sexual activity, were both found to be highly associated with increased hepatitis incidence rates. The relative risk of developing any type of acute hepatitis was 363 for persons who had been hospitalized with a diagnosis of drug abuse (table 3) and 25 for persons previously hos-

TABLE 2

Incidence rates of viral hepatitis per 100,000 enlisted personnel, by sex and by race, US Navy, 1975–1984

Population (*n*)	Hepatitis A			Hepatitis B			Non-A, non-B hepatitis			Total hepatitis*		
	No	Rate	95% CI†	No	Rate	95% CI	No	Rate	95% CI	No	Rate	95% CI
Men (*n* = 4,406,239)	136	3	3–4	1,157	26	25–28	650	15	14–16	4,143	95	92–98
Women (*n* = 279,894)	10	3	1–5	58	18	14–23	39	14	10–19	204	70	60–80
Whites (*n* = 3,892,975)	124	3	3–4	942	25	24–27	561	15	14–16	3,713	95	92–98
Blacks (*n* = 496,922)	8	2	1–3	159	32	27–37	53	11	8–13	455	88	80–96
Other‡ (*n* = 296,206)	4	2	0–5	55	23	17–29	35	19	13–25	178	84	72–97

* Includes all eight categories of viral hepatitis in the *International Classification of Diseases, Adapted,* Ninth Revision.

† CI, confidence interval.

‡ Includes Filipinos, Asian Americans, and Native Americans

TABLE 3

Age-adjusted incidence rates and relative risk of viral hepatitis, by previous history of hospitalization for drug abuse, US Navy enlisted personnel, 1975–1984

Diagnosis	History*		No history†		Relative risk	95% confidence interval
	No	Rate/100,000 personnel	No	Rate/100,000 personnel		
Hepatitis A	129	785	17	<1	1,960	970–2,950
Hepatitis B	697	4,635	518	11	421	370–465
Non-A, non-B hepatitis	365	2,298	322	7	328	283–393
Total hepatitis‡	2,370	15,258	1,973	42	363	340–383

* Person-years at risk = 15,719.

† Person-years at risk = 4,670,414.

‡ Includes all eight categories of viral hepatitis in the *International Classification of Diseases, Adapted,* Ninth Revision.

TABLE 4

Age-adjusted incidence rates and relative risk of viral hepatitis, by previous history of hospitalization with a discharge diagnosis of a sexually transmitted disease, US Navy enlisted personnel, 1975–1984

Diagnosis	History*		No history†		Relative risk	95% confidence interval
	No	Rate/100,000 personnel	No	Rate/100,000 personnel		
Hepatitis A	2	34	144	3	11	0–26
Hepatitis B	25	620	1,190	25	25	15–34
Non-A, non-B hepatitis	18	500	669	14	36	19–51
Total hepatitis‡	87	2,284	4,255	91	25	20–30

* Person-years at risk = 4,261.

† Person-years at risk = 4,401,978.

‡ Includes all eight categories of viral hepatitis in the *International Classification of Diseases, Adapted,* Ninth Revision

pitalized with a discharge diagnosis of a sexually transmitted disease (table 4). A prior hospitalization with either drug abuse or a sexually transmitted disease listed among the discharge diagnoses was found in 57 per cent of all persons admitted to the hospital for acute viral hepatitis. An increased incidence of all three types of viral hepatitis was associated with these two risk factors.

Analysis of risk associated with various occupations demonstrated a significant increase in age-adjusted hospital admissions for enlisted personnel classified as "recruit/apprentice" or as working in the medical field compared with other job categories (table 5). The incidence rate for all types of hepatitis in medical personnel was 217 per 100,000 personnel (95 per cent CI 199–235) compared with 96 per 100,000 personnel (95 per cent CI 90–103) for other occupational groups. Increased rates were observed for both hepatitis B and non-A, non-B hepatitis among medical personnel (figure 2).

Division of medical personnel into occupational groups based on blood exposure showed a trend toward higher hospitalization rates in occupations involving contact with blood (table 6). Higher rates for hepatitis B and non-A, non-B hepatitis were found in blood-exposed medical personnel, but the numbers of patients involved in these comparisons were small.

The association of medical job classification with acute hepatitis may have been confounded to some extent by increased drug abuse in persons in medical occupations. A higher percentage of medical personnel hospitalized for acute hepatitis had been previously hospitalized with a diagnosis of drug abuse compared with all nonmedical personnel (64.5 per cent vs. 52.5 per cent $\chi^2 = 27.99$, $p < 0.001$). There was no association, however, between medical job classification and a previous hospitalization with a discharge diagnosis of a sexually transmitted disease.

There were four deaths attributed to viral hepatitis during the study period. None of

TABLE 6

Comparison of age-adjusted hospital admission rates for viral hepatitis, by occupational group, US Navy enlisted personnel, 1975–1984

Occupation (n)	Hepatitis A			Hepatitis B			Non-A, non-B hepatitis			Total hepatitis*		
	No	Rate/100,000 personnel	95% CI†	No.	Rate/100,000 personnel	95% CI	No	Rate/100,000 personnel	95% CI	No	Rate/100,000 personnel	95% CI
Recruit/apprentice (n = 981,631)	29	4	2–5	369	33	30–37	168	14	12–16	1,122	121	114–128
Blue collar (n = 1,447,248)	52	4	3–5	341	25	22–27	233	17	15–19	1,395	100	95–105
Administrative/clerical (n = 708,039)	16	3	1–4	161	26	22–31	85	14	11–18	541	91	83–98
Electrical/technical (n = 766,920)	26	3	2–5	175	26	22–30	100	14	11–17	690	96	89–104
Medical (n = 266,293)	21	8	4–11	156	62	52–71	111	42	34–49	569	217	199–235

* Includes all eight categories of viral hepatitis in the *International Classification of Diseases, Adapted*, Ninth Revision

† CI, confidence interval.

the four deaths was due to serologically confirmed hepatitis A or hepatitis B. In one death, non-A, non-B hepatitis was diagnosed.

Discussion

Between 1974 and 1985, a 56 per cent decrease in hospital admissions for acute viral hepatitis occurred in US Navy enlisted personnel. Although several possible factors could account for this steep decline in the incidence of acute hepatitis, a reduction in drug abuse among Navy personnel is the most likely explanation. As both this study and previous studies of Army populations found, drug abuse is highly correlated with hospital admissions for viral hepatitis (6, 7). Consequently, the decrease in drug abuse which has occurred in Navy personnel during this period would be expected to result in a decrease in viral hepatitis (13, 14). A corresponding downward trend in drug abuse and hepatitis morbidity has also been reported in the US Army (15).

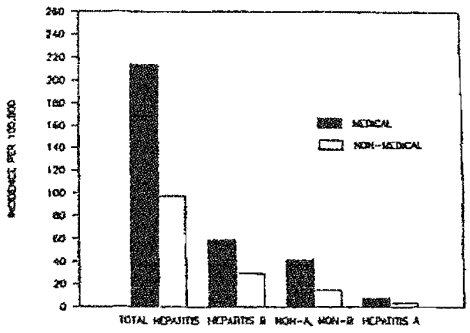

FIGURE 2. Comparison of age-adjusted viral hepatitis incidence rates between enlisted personnel working in medical occupations and those working in nonmedical occupations, US Navy, 1975–1984.

Drug abuse was associated in this study with an increased incidence of all three types of viral hepatitis, including hepatitis A. Although drug abuse is not usually associated with hepatitis A, outbreaks of hepatitis A among drug users have been reported both in the US civilian population and in Europe (16, 17).

Other noteworthy findings in this study include the observation that hepatitis incidence rates are increased in medical personnel and in persons classified as "recruit/apprentice." These associations have been found in previous studies of military populations (1, 3, 9, 18). The finding of a higher incidence of acute hepatitis in persons with a history of a sexually transmitted disease indicates another risk factor for viral hepatitis transmission in this military population (19).

The observation that hepatitis B is the most frequently confirmed cause of acute hepatitis in US Navy enlisted personnel corresponds to patterns of hepatitis infection in US Army and US civilian populations (20–22). The finding that hepatitis B is more common in men and in blacks contrasts with that of an earlier study which reported no sex or racial differences

TABLE 6

Comparison of age-adjusted incidence and relative risk of acute hepatitis between blood-exposed and non-blood-exposed medical personnel, US Navy, 1975–1984

Diagnosis	Blood-exposed*		Non-blood-exposed†		Relative risk	95% confidence interval
	No	Rate/100,000 personnel	No	Rate/100,000 personnel		
Hepatitis A	2	2	3	10	0.2	0.0–0.6
Hepatitis B	37	47	10	31	1.5	0.5–2.5
Non-A, non-B hepatitis	25	33	5	15	2.2	0.1–4.4
Total hepatitis‡	128	163	42	129	1.3	0.8–1.7

* Person-years at risk = 81,386.

† Person-years at risk = 32,005.

‡ Includes all eight categories of viral hepatitis in the *International Classification of Diseases, Adapted*, Ninth Revision

in hepatitis incidence in the US Navy (1). A more recent study of Navy and Marine Corps personnel, however, found an increased risk of hepatitis B among both men and blacks (9).

It is noteworthy that there are many similarities between the Navy and Army populations with regard to viral hepatitis, despite basic differences in lifestyle (ship vs. land basing) and location of duty stations. Both populations have experienced a decline in the incidence of viral hepatitis, and in both populations, drug abuse, sexual promiscuity, and medical job classification have been found to be risk factors for acute hepatitis (3, 5, 6, 15). Apparently, these factors are more important in hepatitis transmission than the separate operational characteristics of these two branches of the military.

Two potential sources of bias should be considered when evaluating the findings of this study. First, subclinical and anicteric cases of hepatitis would not have been included in this data base. This is an inherent limitation of all studies dealing with hospital admissions for viral hepatitis, but there is no reason to suspect a difference in the epidemiologic pattern of infection between clinical and subclinical cases. For the evaluation of symptomatic hepatitis, however, the data base used in this study should have been fairly complete, because the policy of the US Navy during the 10-year study period was to admit all cases of acute hepatitis to the hospital, and active duty personnel are rarely admitted to civilian hospitals.

Another potential source of bias arises from the large percentage of admissions without a serologically confirmed diagnosis. Specific diagnoses were frequently not included in hospital records because the results of diagnostic tests were not available prior to discharge of a patient from the hospital. In addition, a definitive diagnostic test for hepatitis A was not readily available until 1981, and a specific diagnostic test for non-A, non-B hepatitis is still not available (22). Further imprecision in diagnosis would have resulted from the usual practice of diagnosing acute hepatitis B solely from a positive serologic test for hepatitis B surface antigen (23, 24).

Because of these limitations in diagnosis, evaluations of individual types of hepatitis are less reliable than evaluations involving the total incidence of acute hepatitis. As an example, the decline in reported cases of non-A, non-B hepatitis, which was most pronounced after a test for acute hepatitis A became available, was probably due in part to more accurate diagnosis of hepatitis A (table 1). No new policies in the administration of immune serum globulin, which is generally given only to key personnel or to persons at high risk of hepatitis A, were implemented in the US Navy during the period of this study to account for increases in the diagnosis of hepatitis A.

Despite these potential limitations, the basic trends found in this study are important. The data indicate that acute viral hepatitis is frequently preceded by high-risk sexual and drug abuse behavior. Consequently, transmission of viral hepatitis may be prevented through programs, like drug screening, designed to modify personal behavior.

The data additionally suggest that immunization with the recently developed hepatitis B vaccine could prevent many cases of acute hepatitis in this population. Twenty-eight per cent of acute hepatitis cases per year in enlisted personnel were due to serologically confirmed hepatitis B. In addition, a significant percentage of undiagnosed cases of hepatitis were undoubtedly due to hepatitis B as well. Most of these acute cases of hepatitis B could be prevented by effectively immunizing all Navy personnel with hepatitis B vaccine (25). Furthermore, subclinical cases of hepatitis B, which can progress to chronic infection, could be prevented (26).

At the present time, immunization of all US Navy personnel would be very expensive and would provide protection only for the small number of persons exposed to hepatitis B. However, an effective but less

expensive vaccine policy could be developed by targeting high-risk groups within the Navy. Vaccination of medical personnel alone could potentially prevent as much as 10 per cent of confirmed cases of hepatitis B each year. Because the US Navy began vaccinating all blood-exposed medical and laboratory personnel in 1986, it should be possible to evaluate the efficacy of immunization in this high-risk group when current incidence data become available.

Besides medical personnel, there are other high-risk groups that could benefit from the hepatitis B vaccine. Immunization of persons who abuse drugs would be beneficial. In addition, in areas of deployment where sexually transmitted diseases are prevalent and the carriage rate of hepatitis B in the community is high, immunization of the youngest enlisted personnel, who are at the highest risk of infection, could potentially be an effective vaccine policy. In the future, immunization schedules using lower vaccine doses or less expensive vaccines may make it cost-effective to immunize military populations that are at lower risk (27).

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