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SHIP SIZE AS A FACTOR IN ILLNESS INCIDENCE

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## SUMMARY

Outpatient illnesses were examined in an effort to determine if disease and non-battle injury rates differ by ship size, and if so, whether the difference is constant across various operational theaters. Investigation of overall illness rates by ship size for East Asia, the Indian Ocean, and Europe revealed a lower rate for large ships (aircraft carriers) when compared with small ships (destroyers and frigates) for each of the theaters; these rate differences were significant for the East Asia deployment and the Indian Ocean region. Among major categories of disease, significantly higher rates aboard the small vessels were seen in at least two of the geographic regions for respiratory disorders, digestive diseases, and musculoskeletal problems. The diagnostic categories of infective and parasitic diseases, skin and subcutaneous disorders, as well as symptoms and ill-defined disorders were higher for small ships in two or more theaters with one of the rate differences reaching a level of significance. It was concluded that ship size is a factor in illness incidence and should be considered by medical resource planners when determining necessary medical supplies and required health care personnel. *Keywords: military medicine; health surveys; (RT)*

## SHIP SIZE AS A FACTOR IN ILLNESS INCIDENCE

### Introduction

Illness incidence is an important issue for the U.S. Navy due to its potential impact on operational readiness. The ability to predict illness rates for various operational scenarios allows projections to be made regarding the medical supplies needed as well as manpower requirements. Medical resource planning requires that information be available on all factors which influence illness incidence. A recent investigation delineated differences in shipboard illness rates for various operational theaters<sup>1</sup>. Outpatient rates of illness, as computed from two independent sources of data, clearly demonstrated a lower rate of health problems among ships deployed to Europe than with East Asia deployments.

Previous research by Gunderson and Erickson<sup>2</sup> investigating illness rates aboard destroyers and frigates indicated a similar influence of geographical region but found no systematic differences in morbidity rates between destroyers and frigates. Illnesses also have been examined aboard mid-sized ships (cruisers)<sup>3</sup> as well as larger-sized vessels (aircraft carrier)<sup>4</sup>. These previous studies have looked at various sized vessels but none have collectively surveyed illness rates across small, medium, and large ships while controlling for geographical region.

The present study investigates the hypothesis that the internal environments associated with different sized vessels have an impact on the health problems of the deployed crew members. Specifically, outpatient disease and non-battle injuries will be examined to ascertain if illness rates differ by ship size, and if so, whether the difference is constant across operational theaters.

### Method

Two separate sources of outpatient data were used in an effort to determine differences in illness rates by size of ship. The first set of sickcall data was from a series of deployments during 1967-1973 on which all outpatient visits were recorded<sup>5,6,7</sup>. Included in these East Asia deployments were 11 destroyers and frigates, 1 cruiser, and 4 aircraft

carriers. The second source of illness data was a product of the Medical Services and Outpatient Morbidity Reporting System<sup>8</sup>. The Monthly Morbidity reports, as they are commonly known, are completed by each ship and maintained at the Naval Medical Data Services Center, Bethesda, Maryland. Morbidity data collected during 1985 from two operational theaters were examined: Within the Indian Ocean the ships were 3 destroyer/frigates, 1 cruiser, and 2 carriers; the various sized ships deployed to the European theater were 5 destroyers/frigates, 3 cruisers, and 1 carrier. Illness data is reported in diagnostic categories corresponding to the International Classification of Diseases (ICD9). Command History data, maintained at the Naval Historical Center, Washington, D.C. were used to determine ship deployment locales and time frames. Only those illnesses occurring while the ships were within the specific theaters were used in the rate calculations.

Illness rates are computed per 1000 strength per day. For both data sources only the initial visit for a specific illness per individual enters into the rate calculations; no follow-ups or revisits for the same illness are used in the disease tallies. Illness rates for mid-sized ships (cruisers) are presented for comparison purposes, but, because destroyers/frigates and carriers represent the two extremes in ship size only these differences are tested. Ninety-five percent confidence limits based on the normal approximation to the poisson distribution were calculated to determine if the rates of the smallest ships (destroyers/frigates) differed significantly from the largest ships (carriers). The Dunn method of adjusting the significance level for multiple comparisons<sup>9</sup> has been applied.

#### Results

Frequencies and rates of medical disorders by ship size for East Asia, the Indian Ocean, and Europe are displayed in Tables 1-3, respectively. Also included are the number of man-days on which the rates were based.

In all three theaters respiratory disorders were higher on the smallest ships than on the largest ships; among the East Asia and Europe deployments these differences were significant. The subcategory contributing most prominently to these differences was upper respiratory infections.

The three geographical regions also yielded higher rates of digestive disorders aboard the small ships when compared with the carriers; these rate differences were significant for all theaters. Subcategories of illness were not recorded among the digestive disorders.

During the East Asia and Europe deployments the rates of musculoskeletal disorders were significantly higher among destroyers/frigates than carriers. Subcategories of musculoskeletal disorders occurring on these deployments were not available.

Within East Asia and the Indian Ocean, the infective and parasitic illness rates were higher on the destroyers/frigates when contrasted with the carriers; this difference was significant for the East Asia theater. The differences in this diagnostic category were mainly attributable to elevated rates of sexually transmitted diseases aboard the small ships. A significantly higher rate of incidence for the subcategory consisting of diarrhea, dysentery, and enteritis was seen on small ships in East Asia and large vessels in the Indian Ocean and European theater.

Within the East Asia and Indian Ocean regions, the category of Skin and Subcutaneous Tissue disorders yielded higher rates on the small ships when compared with the large vessels; this difference was significant for ships deployed to East Asia. Though not reaching a level of significance, rates of cellulitis were higher aboard destroyers/frigates for the two eastern theaters.

While only significant for the Indian Ocean region, the diagnostic category of symptoms and ill-defined disorders indicated higher rates for the small ships when contrasted with the carriers in all regions. Contributing to the rate differences in this category was the sub-grouping of headaches.

A nonsignificant trend of higher genitourinary disorder rates among destroyers and frigates than on carriers was witnessed across the three operational regions. The subcategory of urethritis was largely responsible for the differences within this diagnostic category.

The category of Accidents, Poisonings, and Violence yielded incongruous results across deployments. The rate for this category was significantly higher among small ships than for carriers in East Asia while the opposite held true for the ships deployed to Europe. Though unsubstantiated in other regions, two other significant results were found for a single theater among the major diagnostic categories. A higher rate of behavioral (mental)

disorders was evident on the small ships deployed to East Asia and carriers in the European theater yielded a higher rate within the diagnostic category of Endocrine, Nutritional, and Metabolic disorders.

The overall rates, composed of the total of the fifteen diagnostic categories, indicated a lower rate for the carriers when compared with the destroyers/frigates for each geographical theater; within East Asia and the Indian Ocean region these rate differences were significant.

#### Discussion

Overall illness incidence within East Asia and the Indian Ocean showed an inverse relationship between ship size and illness rate across the three ship groupings—the smaller the ship, the greater was the total illness rate. For the European theater, the largest ships exhibited a slightly lower rate than the smallest ships, however, the mid-sized ships were higher than both other sizes. The explanation for cruisers having a higher rate in this particular theater is not immediately apparent.

There were several significant findings apparent in contrasting health problems aboard destroyers/frigates with those occurring aboard carriers. Foremost was the trend of higher rates of infectious disease aboard the smaller ships. Most apparent were the elevated respiratory rates and digestive disorders but substantial differences also were seen for infective and parasitic rates, as well as skin disorders. These higher rates may be a result of working and living within a more closed environment as the spread of communicable diseases is facilitated by restricted environs. It should be noted, however, that this relationship between illness and ship size may not be one of direct linkage per se. Rather, higher rates of infectious disease may result from differing ventilation or air circulation system aboard the smaller vessels. Beyond the physical determinants of disease proliferation, Rahe has linked psychosocial stressors with various illnesses, including infections<sup>10</sup>. Similarly, research investigating health and satisfaction aboard Navy ships found a positive correlation between perceived crowding and dispensary visits<sup>11</sup>.

Also, it is very possible that the increased rates of small ships for the category of symptoms and ill-defined, which is substantially accounted for by a higher rate of headaches, is partially due to living and working in a more closed environment.

Within the infective and parasitic disease category it must be noted that much of the variance was due to sexually transmitted diseases. It is likely that the higher rate of this type of disorder is due to the greater length of time the smaller ships in this study stayed when visiting foreign ports. This factor may also explain the elevated rates of genitourinary disorders, much of which is accounted for by urethritis.

The last trend to be considered is that of higher rates of musculoskeletal disorders seen on the small ships. While this too may be related to the constrained space aboard destroyers and frigates, this restrictiveness might have been expected to manifest itself with higher accident rates aboard the small ships. In fact, carriers had higher accident rates in two theaters than did the small ships. Higher rates of hospitalization for accidents aboard carriers have been previously documented<sup>12</sup> and this may be due to the tempo of operations and nature of work aboard these ships rather than linked directly to the ship size. Also, likelihood of off-duty accidents aboard carriers would be greater because of an increase in recreational areas accessible to crew members.

Medical resource planning requires that all relevant factors in illness incidence be taken into account. In addition to theater of operation it is apparent that illness rates vary with size of ship. Determinations of medical supplies needed and health care personnel required should be made with ship size considered as well as any other pertinent factors.

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TABLE 1. ILLNESS INCIDENCE BY SHIP SIZE FOR EAST ASIA DEPLOYMENT, 1967-1973

	SMALL		MEDIUM		LARGE	
	FREQUENCY	RATE	FREQUENCY	RATE	FREQUENCY	RATE
<b>INFECTIVE AND PARASITIC</b>	1112	2.976*	145	1.776	895	1.176
DIARRHEA/DYSENTERY/ENTERITIS	169	0.506*	26	0.318	158	0.208
SEXUALLY TRANSMITTED DISEASES	720	1.927*	72	0.882	554	0.723
DERMATOPHYTOSIS	138	0.369*	17	0.208	90	0.118
<b>NEOPLASMS</b>	0	0.000	1	0.012	9	0.012
<b>ENDOCRINE, NUTRITIONAL &amp; METABOLIC</b>	2	0.005	3	0.037	19	0.025
<b>BLOOD &amp; BLOOD FORMING ORGANS</b>	3	0.008	0	0.000	9	0.012
<b>RESPIRATORY</b>	109	0.292*	16	0.196	113	0.148
ALCOHOL ABUSE	2	0.005	7	0.086	5	0.007
<b>NERVOUS SYSTEM &amp; SENSE ORGANS</b>	167	0.447	39	0.478	295	0.388
<b>CIRCULATORY SYSTEM</b>	0	0.000	9	0.110	25	0.033
<b>RESPIRATORY SYSTEM</b>	1786	4.780*	159	1.948	1373	1.804
UPPER RESPIRATORY INFECTION	1013	2.711*	27	0.331	403	0.529
INFLUENZA	68	0.132	13	0.159	219	0.288
<b>DIGESTIVE SYSTEM</b>	330	0.883*	30	0.368	247	0.325
<b>GENITOURINARY SYSTEM</b>	519	1.389	80	0.980	309	1.194
URETHRITIS	332	0.889	59	0.723	555	0.729
<b>SKIN &amp; SUBCUTANEOUS TISSUE</b>	604	1.617*	90	1.103	912	1.198
CELLULITIS	49	0.131	10	0.123	58	0.076
DERMATITIS	71	0.190	52	0.637	242	0.318
<b>MUSCULOSKELETAL SYSTEM</b>	276	0.739*	5	0.061	325	0.427
<b>CONGENITAL ANOMALIES</b>	0	0.000	2	0.025	3	0.004
<b>SYMPTOMS &amp; ILL-DEFINED</b>	84	0.225	27	0.331	129	0.169
HEADACHE	35	0.094	16	0.196	62	0.081
<b>ACCIDENTS, POISONINGS, &amp; VIOLENCE</b>	661	1.769*	168	2.058	987	1.297
<b>TOTAL OF MAJOR CATEGORIES</b>	5653	15.131*	774	9.482	6250	8.211
<b>NUMBER OF MAN-DAYS</b>	373,616		81,630		761,157	

RATES ARE PER 1,000 STRENGTH PER DAY

\* RATE IS SIGNIFICANTLY HIGHER (95% CONFIDENCE LEVEL) THAN FOR LARGE SHIPS

TABLE 2. ILLNESS INCIDENCE BY SHIP SIZE FOR INDIAN OCEAN DEPLOYMENT, 1965

	SMALL		MEDIUM		LARGE	
	FREQUENCY	RATE	FREQUENCY	RATE	FREQUENCY	RATE
INFECTIVE AND PARASITIC	151	3.193	44	2.456	1061	2.349
DIARRHEA/D/SENTERY/ENTERITIS	2	0.042	32	1.786	338	0.748**
SEXUALLY TRANSMITTED DISEASES	97	2.051*	2	0.112	194	0.430
DERMATOPHYTOSIS	45	0.952	7	0.391	303	0.671
NEOPLASMS	0	0.000	0	0.000	3	0.007
ENDOCRINE, NUTRITIONAL & METABOLIC	0	0.000	0	0.000	4	0.009
BLOOD & BLOOD FORMING ORGANS	0	0.000	0	0.000	6	0.013
HEPATO/BILIAL	7	0.148	4	0.223	78	0.173
ALCOHOL ABUSE	2	0.042	2	0.112	12	0.027
NERVOUS SYSTEM & SENSE ORGANS	21	0.444	9	0.502	183	0.405
CIRCULATORY SYSTEM	2	0.042	5	0.279	52	0.115
RESPIRATORY SYSTEM	115	2.432	34	1.898	1008	2.232
UPPER RESPIRATORY INFECTION	106	2.242	34	1.898	650	1.439
INFLUENZA	5	0.106	0	0.000	323	0.715**
DIGESTIVE SYSTEM	37	0.782*	9	0.502	81	0.179
GENITOURINARY SYSTEM	72	1.523	8	0.446	475	1.052
URETHRITIS	70	1.480	7	0.391	381	0.844
SKIN & SUBCUTANEOUS TISSUE	114	2.411	27	1.507	739	1.636
CELLULITIS	18	0.381	9	0.502	51	0.113
DERMATITIS	43	0.909	0	0.000	229	0.507
MUSCULOSKELETAL SYSTEM	45	0.952	36	2.009	509	1.127
CONGENITAL ANOMALIES	0	0.000	0	0.000	0	0.000
SYMPTOMS & ILL-DEFINED	46	0.973*	0	0.000	167	0.370
HEADACHE	16	0.338	0	0.000	66	0.146
ACCIDENTS, POISONINGS, & VIOLENCE	48	1.015	39	2.177	615	1.362
TOTAL OF MAJOR CATEGORIES	658	13.916*	215	11.999	4981	11.030
NUMBER OF MANDAYS		47,285		17,918		451,501

RATES ARE PER 1,000 STRENGTH PER DAY

\* RATE IS SIGNIFICANTLY HIGHER (95% CONFIDENCE LEVEL) THAN FOR LARGE SHIPS

\*\* RATE IS SIGNIFICANTLY HIGHER THAN FOR SMALL SHIPS

TABLE 3. ILLNESS INCIDENCE BY SHIP SIZE FOR EUROPE DEPLOYMENT, 1965

	SMALL		MEDIUM		LARGE	
	FREQUENCY	RATE	FREQUENCY	RATE	FREQUENCY	RATE
<b>INFECTIVE AND PARASITIC</b>	130	1.062	78	1.341	238	1.558
DIARRHEA/DYSENTERY/ENTERITIS	35	0.286	17	0.292	155	1.015**
SEXUALLY TRANSMITTED DISEASES	11	0.090	10	0.172	8	0.052
DERMATOPHYTOSES	51	0.416	45	0.774	50	0.327
<b>NEOPLASMS</b>	0	0.000	0	0.000	0	0.000
<b>ENDOCRINE, NUTRITIONAL &amp; METABOLIC</b>	4	0.033	0	0.000	53	0.347**
<b>BLOOD &amp; BLOOD FORMING ORGANS</b>	0	0.000	0	0.000	0	0.000
<b>HEPATOBIOL</b>	20	0.163	4	0.069	56	0.367
ALCOHOL ABUSE	3	0.024	0	0.000	5	0.033
<b>NERVOUS SYSTEM &amp; SENSE ORGANS</b>	34	0.278	26	0.447	35	0.229
<b>CIRCULATORY SYSTEM</b>	13	0.106	17	0.292	21	0.137
<b>RESPIRATORY SYSTEM</b>	490	4.002*	244	4.195	371	2.429
UPPER RESPIRATORY INFECTION	438	3.577*	235	4.040	147	0.962
INFLUENZA	40	0.327	8	0.133	24	0.157
<b>DEGESTIVE SYSTEM</b>	83	0.678*	57	0.980	16	0.105
<b>GENITOURINARY SYSTEM</b>	36	0.294	15	0.258	25	0.164
URETHRITIS	11	0.090	7	0.120	13	0.085
<b>SKIN &amp; SUBCUTANEOUS TISSUE</b>	171	1.396	79	1.358	233	1.525
CELLULITIS	23	0.188	14	0.241	49	0.321
DERMATITIS	47	0.384	4	0.069	36	0.236
<b>MUSCULOSKELETAL SYSTEM</b>	157	1.282*	95	1.633	61	0.399
<b>CONGENITAL ANOMALIES</b>	0	0.000	0	0.000	0	0.000
<b>SYMPTOMS &amp; ILL-DEFINED</b>	77	0.629	45	0.774	90	0.589
HEADACHE	48	0.392*	42	0.722	19	0.124
<b>ACCIDENTS, POISONINGS, &amp; VIOLENCE</b>	121	0.988	133	2.286	467	3.057**
<b>TOTAL OF MAJOR CATEGORIES</b>	1336	10.910	793	13.633	1666	10.905
<b>NUMBER OF MANDAYS</b>		122,453		58,168		152,768

RATES ARE PER 1,000 STRENGTH PER DAY

\*RATE IS SIGNIFICANTLY HIGHER (95% CONFIDENCE LEVEL) THAN FOR LARGE SHIPS

\*\*RATE IS SIGNIFICANTLY HIGHER THAN FOR SMALL SHIPS

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