Injuries and Illnesses of Vietnam War POWs Revisited: I. Navy Risk Factors

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Operation Homecoming (O/H), the negotiated release of 566 US Servicemen held as prisoners of war (POWs) in Vietnam for as long as nine years, began in February 1973. During the months that followed, enemy forces released 138 Navy, 26 Marine Corps, 77 Army, and 325 Air Force Repatriated POWs (RPWs).

As a part of O/H, medical and psychological conditions of all repatriates were documented in the Initial Medical Evaluation Form (IMEF), a 400 page, 29 section, standard protocol. Berg and Richlin (1977) described the procedures and findings of the medical teams that examined and treated Naval RPWs at Clark Air Force Base (Republic of the Philippines) and at 11 mainland Navy hospitals. Where appropriate, information was also presented concerning symptoms and conditions which occurred during captivity (as described in the history section of the IMEF).

Berg and Richlin emphasized documentation of the specific injury and illness diagnoses. The overwhelmingly most common diagnosis in the group was helminthiasis (88%), followed by refractive errors (52%), hearing impairment (48%), and peripheral nerve injury (46%). They noted that the consensus of physicians involved in O/H found that the Navy RPWs were generally in good health, in fact, much better than the "worst case" actually planned. They also found that neither protein-calorie deficiency nor vitamin deficiency, both traditional scourges of POWs, were a significant problem among POWs held in North Vietnam.

We were interested in identifying risk factors that predisposed the RPW to various injuries and illnesses. In view of the small sample size of individual diagnoses, we evaluated the effects of captivity from the perspective of ICD9-CM diagnostic categories (i.e., systems level). From this perspective, the relationship between medical conditions observed at repatriation and various risk factors, also recorded in the IMEF, could be analyzed. These risk factors included age at time of captivity, length of captivity (months), length of solitary confinement (weeks), self-reported captivity medical problems, reported torture severity, and subjectively determined weight loss.

The purpose of this present study is to look at the relationship between the number of diagnosis at repatriation (i.e., IMEF) and various risk factors. We hypothesized that these risk factors would predict both the grand total of IMEF diagnoses across categories and the presence of any diagnoses within specific categories. This report, which addresses the Navy RPWs, is the first in a series of four reports. Subsequent reports will be devoted individually to the Army and the Marine Corps, and the final report will combine all three RPW groups for direct comparison.

Methods

Data from all 138 Navy RPWs recorded in the IMEF were available for analysis. Prior to conducting our analyses, the completeness of the electronic database was verified by referring to individual microfiche copy of the original 400 page IMEF on each repatriate. All available information regarding diagnoses, age at time of captivity, length of captivity (months), length of solitary confinement (weeks), self-reported captivity medical problems, reported torture severity, and subjectively determined weight loss were verified. Next, each RPW ICDA-8 coded diagnosis was converted to an ICD9-CM category. We then tabulated the number of diagnoses per category, excluding diagnoses relating to Pregnancy and Certain Conditions Originating in the Perinatal Period (i.e., ICD9-CM codes 740-779), which were non-existent in our sample. All diagnoses were categorized and the sum across categories was equivalent to the number of diagnoses reported by Berg and Richlin (1977). The presence or absence of diagnoses within a category was also tabulated for each of the repatriates.

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14. ABSTRACT

Operation Homecoming (O/H), the negotiated release of 566 US Servicemen held as prisoners of war (POWs) in Vietnam for as long as nine years, began in February 1973. During the months that followed, enemy forces released 138 Navy, 26 Marine Corps, 77 Army, and 325 Air Force POWs. The purpose of this present study is to look at the relationship between the number of diagnosis at repatriation (i.e., IMEF) and various risk factors. We hypothesized that these risk factors would predict both the grand total of IMEF diagnoses across categories and the presence of any diagnoses within specific categories.

15. SUBJECT TERMS
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Statistical analyses were performed using SPSS version 19. Pearson correlations were obtained between the number of IMEF total diagnoses and the six risk factors, while Spearman correlations were obtained between risk factors and the non-normally distributed number of diagnoses within each category. The relative contribution of the six risk factors to the prediction of the total number of IMEF diagnoses was explored using linear regression (complete entry and statistically-based forward entry). Similar linear regressions were performed to predict self-reported captivity medical problems using the other five risk factors. After identifying those ICD9-CM diagnostic categories with a prevalence of 43 to 58 percent (conditions that were neither rare nor ubiquitous), logistic regression was performed to evaluated the effectiveness of the risk factors in predicting presence or absence of conditions within these categories.

Results

The descriptive statistics for the Navy repatriates are presented in Table 1. These 138 Officers were, on average, nearly 31 years old at the time of capture and were held prisoner for more than five years, 44 weeks of which were spent in solitary confinement. During captivity, they were frequently tortured (mean = 35 on a 25-item IMEF scale with a maximum score of 75), lost an average of 24% of their pre-captivity body weight and reported having concerns about ten medical problems during captivity (possible range 0 to 40).

Navy repatriates received between 2 and 30 diagnoses at the time of repatriation (Table 2). The five ICD9-CM categories with the highest mean number of diagnoses within the Navy cohort were Injury/Poisoning, Infectious, Nervous and Special Senses, Skin and Musculoskeletal (in descending order). The prevalence of any diagnosis in each of these categories ranged from 96% to 54% (Table 4). No Navy repatriate had more than one diagnosis in either the Blood category (prevalence of any Blood diagnosis = 0.7%) or the Mental category (prevalence of any Mental diagnosis = 8.7%).

As shown in Table 3, the total number of diagnoses at the time of repatriation was significantly correlated with all but one of the six risk factors, with the number of captivity related medical problems explaining the highest percent of the variance (17%). Length of solitary confinement was not significantly correlated with the total number of diagnoses ($r = 0.137$, $r^2 = 0.032$). Age at the time of capture was significantly correlated with the number diagnoses within the Nervous and Special Senses, Ill-Defined, and Injury/Poisoning categories. The number of self-reported captivity medical problems were significantly correlated with the number of actual IMEF diagnoses in five of the fifteen diagnostic categories. Length of captivity also significantly correlated with five categories, while length of solitary, torture severity and weight loss correlated with four or fewer diagnostic categories. No risk factor accounted for more than 16% of the variance within any disease category.

Complete linear regression analysis predicting the number of IMEF diagnoses using all six risk factors (Table 5a) resulting in a highly significant equation that accounted for 26% of the variance. Statistical linear regression allowing the forward addition of predictors (Table 6a) accounted for 25% of the variance using only four of the risk variables (omitting torture severity and estimated weight loss). In each of these two regression equations, the relative contributions of age at capture and number of self-reported captivity medical problems were equivalent as demonstrated by the part correlations.

A similar approach was utilized to predict the number of self-reported captivity medical problems using the remaining five risk factors. For this prediction, complete linear regression analysis resulted in a highly significant equation that accounted for 34% of the variance (Table 5b). Follow-up statistical linear regression allowing the forward addition of predictors (Table 6b) accounted for 32% of the variance using only three of the risk variables (omitting torture severity and length of solitary confinement). In each of these two regression equations, the relative contribution as demonstrated by the part correlation coefficient was greatest for length of captivity.

The ability of the risk factors to predict the presence or absence of diagnoses those five ICD categories with midrange condition prevalence: musculoskeletal (MUS: 58%), skin (SKN: 54%), circulatory (CIR: 51%), ill-defined (ILL: 46%) and respiratory (RES: 43%), was evaluated using logistic regression analysis (Table 7). A significant model was only obtained for the ILL category ($p = 0.001$, Nagelkerke R-Square = .195). Although this equation resulted a more accurate classification than the base rate (67.4% versus 53.6%), the positive and negative predictive values were only 67%. At the level of individual predictor, only captivity-related medical problems contributed significantly to the prediction of ILL condition presence ($p = 0.004$; Exp(B) = 1.147, with a 95% confidence interval from 1.046 to 1.258). The logistic regression model for CIR approached statistical significance, accounting for approximately 10% of the variance and accurately categorizing 63.8% of the USN repatriates (base rate accuracy = 51.4%). For CIR, only length of captivity approached statistical significance as an individual predictor ($p = 0.066$; Exp(B) = 1.016, with a 95% confidence interval from 0.999 to 1.034).

Discussion

To our knowledge, this study represents the first attempt to utilize captivity-related risk factors to predict repatriated POWs injury and illnesses, as measured by the number of diagnoses and the existence of categorical diagnoses. The strength of this study is a direct result of our access to the all of the original data obtained in 1973 (i.e., the IMEF). Early published reports described the observed illnesses and injuries in great detail, but did not attempt to exploit concurrently obtained risk factors to illness an injury.

The Navy RPWs were indeed healthier than expected despite their lengthy and torturous captivity. After 62 months of captivity, an average of 10 captivity-related medical problems were subjectively reported by these men, while 12 diagnoses were made as a result of an extensive examination upon their repatriation. Berg and Richlin reported the most common diagnoses. When we categorized the 1692 different diagnoses, the 5 most common ICD9-CM categories were consistent with Berg and Richlin's top diagnoses. The order of frequency, however, was slightly different.

Nearly all of the risk factors correlated significantly with the total number of objective diagnoses at the time of repatriation. As expected, the total number of captivity-related medical problems subjectively reported by the Navy RPWs was the best predictor of the number of physician-made diagnoses, followed closely by duration of captivity and age at the time of capture. Navy repatriates who were older, held longer, and had more subjective complaints demonstrated a wider range of illnesses and injuries following extensive objective evaluation. Likewise, the number of captivity-related medical problems increased with repatriate age and captivity duration.

Despite our unique approach, there appear to be several limitations to this study. All Navy repatriates were officer aviators and therefore, prior to captivity, were highly educated, met a higher standard of health, and had completed an arduous mock-captivity training course that emphasized survival and resistance. Other limitations include the small sample size, the restricted range of pathology and the lack of comparison to repatriates from other services. We will attempt to address these issues in future studies.

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Table 1

USN Demographics

(n = 138)

Variable	Min	Max	Mean	StdDev
Age_TOC	23	42	30.80	4.98
LOCm	2	102	61.73	26.94
LOSw	0	268	43.97	56.20
IMEF_tort	2	72	35.06	11.01
Weight Loss %	2.3	51.2	24.17	10.78
CapMedProbs	0	26	10.08	5.27
Percent Officer			100.00	

Table 2

USN IMEF ICD Descriptives

(n = 138)

Variable	Min	Max	Mean	StdDev
Total # Diagnoses	2	30	12.26	5.25
Infectious	0	4	2.10	0.97
Neoplasms	0	2	0.21	0.44
Endocrine	0	2	0.20	0.45
Blood	0	1	0.01	0.09
Mental	0	1	0.09	0.28
Nervous & Senses	0	5	1.95	1.24
Circulatory	0	4	0.66	0.76
Respiratory	0	5	0.67	0.95
Digestive	0	2	0.17	0.42
Genitourinary	0	3	0.28	0.63
Skin	0	4	0.96	1.11
Musculoskeletal	0	5	0.83	0.92
Congenital	0	2	0.28	0.52
Ill Defined	0	4	0.67	0.87
Injury Poisoning	0	14	3.64	2.41

Table 3

USN Correlations

(n = 138)

Variable	Age_TOC	LOCm	LOSw	IMEF_tort	Weight Loss %	CapMedProbs
Total # Diagnoses	**0.273**	**0.320**	0.137	**0.178**	**0.203**	**0.415**
Infectious	0.063	**0.275**	0.064	0.121	0.064	0.123
Neoplasms	0.063	0.022	0.017	0.091	0.098	0.004
Endocrine	0.157	**0.205**	**0.225**	0.136	**0.176**	0.050
Blood	-0.052	0.026	0.033	0.039	0.031	0.052
Mental	0.040	0.115	**0.219**	**0.184**	0.156	**0.264**
Nervous & Senses	**0.293**	0.148	**0.263**	**0.190**	-0.024	**0.225**
Circulatory	0.101	**0.172**	0.109	0.074	-0.112	**0.184**
Respiratory	-0.002	0.106	-0.012	0.061	0.039	0.163
Digestive	0.038	0.105	-0.101	0.070	0.107	0.140
Genitourinary	0.140	0.058	0.111	0.071	0.126	0.133
Skin	-0.072	**0.210**	0.079	0.067	0.142	0.113
Musculoskeletal	0.107	0.015	0.126	0.050	0.015	0.108
Congenital	-0.001	0.156	-0.011	0.023	0.088	-0.073
Ill Defined	**0.178**	**0.254**	**0.287**	**0.246**	0.093	**0.399**
Injury Poisoning	**0.257**	0.093	0.139	0.020	**0.207**	**0.297**

BOLD = Significant

Table 4

USN IMEF Any Categorical Diagnosis

(n = 138)

Variable	Presence (%)
Infectious	96.4
Neoplasms	19.6
Endocrine	18.1
Blood	0.7
Mental	8.7
Nervous & Senses	89.9
Circulatory	51.4
Respiratory	42.8
Digestive	15.9
Genitourinary	19.6
Skin	53.6
Musculoskeletal	58.0
Congenital	23.9
Ill Defined	46.4
Injury Poisoning	95.7

Table 5
USN Complete Regressions
(n = 138)

a. IMEF $R^2 = 0.264$ SEE = 4.61 $p < 0.001$

	B	Std Error	Beta	p	part
(Constant)	-2.581	3.149	n/a	0.414	n/a
Age_TOC	0.301	0.089	0.286	0.001	0.254
LOCm	0.045	0.019	0.232	0.020	0.177
LOSw	-0.015	0.009	-0.158	0.099	-0.124
IMEF_tort	-0.023	0.046	-0.049	0.610	-0.038
Weight Loss %	0.057	0.039	0.117	0.149	0.109
CapMedProbs	0.283	0.092	0.285	0.002	0.232

b. CapMedProbs $R^2 = 0.335$ SEE = 4.38 $p < 0.001$

	B	Std Error	Beta	p	part
(Constant)	-3.790	2.976	n/a	0.205	n/a
Age_TOC	0.179	0.083	0.169	0.033	0.153
LOCm	0.075	0.017	0.382	<0.001	0.313
LOSw	0.007	0.008	0.077	0.393	0.061
IMEF_tort	0.053	0.043	0.110	0.222	0.087
Weight Loss %	0.064	0.037	0.132	0.084	0.124

Table 6
USN Forward Regressions
(n = 138)

a. **IMEF** $R^2 = 0.252$ SEE = 4.61 $p < 0.001$

	B	Std Error	Beta	p	part
(Constant)	-1.824	3.149	n/a	0.527	n/a
Age_TOC	0.291	0.088	0.276	0.001	0.247
LOCm	0.046	0.018	0.233	0.013	0.189
LOSw	-0.016	0.009	-0.174	0.059	-0.143
CapMedProbs	0.301	0.090	0.302	0.001	0.252

b. **CapMedProbs** $R^2 = 0.319$ SEE = 4.40 $p < 0.001$

	B	Std Error	Beta	p	part
(Constant)	-4.243	2.625	n/a	0.108	n/a
Age_TOC	0.224	0.076	0.211	0.004	0.211
LOCm	0.091	0.014	0.464	<0.001	0.449
Weight Loss %	0.075	0.036	0.154	0.039	0.149

Table 7
USN Logistic Regression

	MUS	SKN	CIR	ILL	RES
Baseline % Correct	0.580	0.536	0.514	0.536	0.572
Equation % Correct	0.623	0.623	0.638	0.674	0.594
% Difference	0.043	0.087	0.124	0.138	0.022
False Positives	35	33	30	18	15
False Negatives	17	19	20	27	41
PPV	0.64	0.63	0.63	0.67	0.55
NPV	0.58	0.62	0.65	0.67	0.61
Model Significance (p)	0.174	0.417	0.093	0.001	0.596
Nagelkerke R-Square	0.085	0.057	0.101	0.195	0.044