PHYSICAL AND PSYCHOLOGICAL EFFECTS OF SUSTAINED SHIPBOARD OPERATIONS ON U. S. NAVY PERSONNEL

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SUMMARY

Problem

The stress associated with sustained military operations is believed to compromise the health and performance of military personnel. However, there has been little or no research on the health and performance effects associated with prolonged periods of general quarters (GQ). Such effects could potentially jeopardize the mission of a ship and the safety of its crew.

Objective

The objectives of this study were to determine if the physical and psychological status of Navy personnel undergoes a significant degradation during a period of GQ due to the potential for conflict with hostile forces, as well as identifying the relationship between health and psychological mood of personnel under these conditions.

Approach

Subject population was comprised of officers and enlisted crewmen of a U.S. Navy frigate and guided missile cruiser in the Arabian Gulf. Crew members completed a health symptoms checklist and Profile of Mood States (POMS) questionnaire. A subsample of crew members aboard both ships also completed subsequent questionnaires at three different time periods over a 24-hour period, including prior to and after a period of GQ.

Results

Most commonly reported physical health symptoms aboard both ships were physical fatigue, muscle aches, headaches, and muscle strain. Mean scores on all six mood factors (tension/anxiety, anger/hostility, fatigue, vigor, depression, and confusion) were not significantly different from established norms. Crewmen aboard the smaller frigate reported significantly greater physical and psychological fatigue than crewmen aboard the cruiser. Among the sub-sample of crewmen (tested at four different intervals) aboard both ships, a significant decline in tension/anxiety, anger/hostility, and depression across time was observed. However, personnel aboard the cruiser reported significant increases in fatigue and confusion, and a significant decline in vigor immediately after a period of GQ. Tension/anxiety and fatigue were independently predictive of total health symptoms.

Conclusion

Higher levels of fatigue aboard the frigate may be attributed to longer periods of watchstanding and less time available for rest because of its small complement of personnel relative to the cruiser. Some decline in mood did occur between pre-GQ and post-GQ as indicated by a decline in vigor, and increase in fatigue and confusion aboard the cruiser. However, the decline in negative mood scores across time may indicate that a certain amount of adaptation to sustained operations took place.

Recommendations

Physical and psychological conditions which may adversely affect performance during GQ may be minimized by providing adequate periods for sleep and rest, performance feedback, motivation techniques, physical exercise, regulation of caffeine consumption, prevention of dehydration by regular water consumption, and stress-reduction training programs.

INTRODUCTION

Naval ships in an operational environment adopt states of readiness based upon the threat of military action. Demands on the crew and ship systems increase as readiness progresses from Condition III (wartime cruising readiness) to Condition I (battle readiness or general quarters). An entire ship's crew of officers and enlisted personnel operating at optimal levels for indefinite periods of time are required to meet the most stringent threat conditions. When a serious threat is not imminent in war zone operations, some personnel and equipment systems may stand down affording rest and repair, while other personnel and systems must conform to required operational capabilities.

Although well-trained and physically fit naval personnel have a tremendous reserve capacity and can function under high stress workloads for surprisingly long periods of time (Englund, Naitoh, Ryman, and Hodgdon, 1983; Hodgdon, Englund, and Naitoh, 1983), sustained readiness conditions like that found during long periods of general quarters (GQ) can lead to fatigue and sleep deprivation, the cost being degraded performance. The negative effects of sustained readiness during Condition I or II are cumulative, and involve degradation of critical thinking, reaction time, accuracy, memory, coordination, communication, and crew mission integrity (Naitoh, Englund, and Ryman, 1987).

Physical and cognitive performance during sustained military operations is a function of several factors, acting independently or in combination with one another, including the pre-existing physiological and psychological state of the individual, and the physical, psychosocial, and environmental stressors associated with the sustained operation. These stressors are the result of a number of operational factors, including the ship's mission, organization of watch schedules, period of time spent at GQ, rotation of personnel, nature of individual assignments [i.e., Command Information Center (CIC) watchstanders, enginemen, medical personnel], and perceived physical threat (i.e., enemy contact). Studies of occupational stress and performance have identified several potential mission-related stressors, including task characteristics (Caplan, Cobb, French, Harrison, and Pinneau, 1975; Cox,

1980; Kahn, 1974; Kasl, 1978), such as work load, decision-making, or deadlines; extension of watch or GQ (based on the analogous experience of forced overtime) (Buell and Breslow, 1960; Hurrell and Colligan, 1983; Kasl, 1978); pacing of work by technological considerations (Cox, 1980; Knight, Salvendy, and Geddes, 1980; Manenica, 1977); and operation in shifts or shift-work (Maurice, 1975; Tasto and Colligan, 1978). Organizational stressors include the structure of the organization and the individual's role in the organization. Extra-organizational stressors include the potential for military action (Palinkas and Coben, 1987); the duration and intensity of combat (Glass, 1955; Solomon, Mikulincer, and Jakob, 1987) or work-related personal or shipboard stressors (i.e., conflicts with supervisors, expectations of commanding officer, etc.). Each of these variables influences the extent to which the continuous performance is viewed as stressful in either a physiological or psychological sense, and the extent to which degradations in performance may occur.

Degraded cognitive performance and the stress associated with readiness conditions may also result from poor health and morale (Hodgdon, Englund, and Naitoh, 1983) and may, in turn, contribute to an increased risk of illness and accidental injury during sustained operations, further compromising the health and well-being of personnel. This has been observed in shipboard studies of illness rates during combat operations (Rubin, Gunderson, and Doll, 1969; Rubin, Gunderson, and Arthur, 1969, 1971, 1972), studies of combat stress (Glass, 1955; Tiffany, 1967; Belenky, Tyner, and Soditz, 1983; Levav, Greenfield, and Baruch, 1979), studies of disease and non-battle injuries during military conflicts (Palinkas and Coben, 1988), and studies of occupations characterized by sustained operations (Baker, 1985; Cooper, 1983).

Research on health and psychological well-being during sustained operations has been extensive. However, to date, information on the physical and mental health of Navy personnel under actual combat conditions and its relationship to performance has been derived largely from data collected in laboratory settings, peacetime military exercises, or from analogous occupational settings. Moreover, there has been little or no research on performance degradation associated with one particular form of sustained operations, GQ. The largely peacetime role of the U.S. Navy since the Vietnam

conflict has provided few opportunities to examine performance degradation during GQ in a military theatre of operation.

The objective of this study was to determine the physical and psychological status of personnel aboard two U.S. Navy ships during a recent military operation that required extended periods of GQ due to the potential for conflict with hostile forces. The FFG was conducting convoy escort operations for U.S. flagged tankers through the Arabian Gulf and the CG was conducting anti-air surveillance operations in the Persian Gulf. Both snips were at high states of combat readiness due to the imminent threat of hostile action. This was part of a larger effort to develop a reliable predictor of performance decrement during periods of GQ. Specific objectives included the following: (1) identify and measure baseline characteristics of health and mood of all personnel aboard the two ships; (2) identify changes in health and mood over time under conditions of sustained operations; (3) examine the relationship between health and mood under these conditions; and (4) recommend mitigating measures which could be used to sustain performance, and reduce the risk to health and psychological well-being during long exposure to GQ.

METHODS

Study Subjects

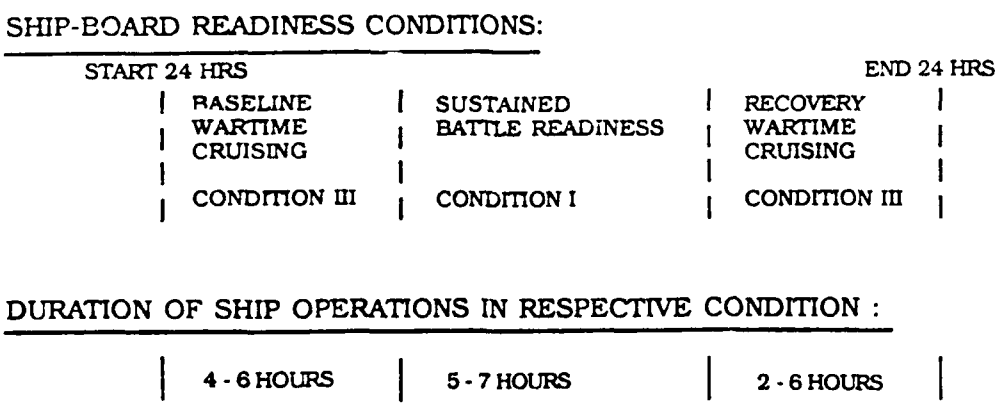
The subject population was comprised of officers and enlisted crew from two U.S. Navy ships, a frigate (FFG) and a guided missile cruiser (CG). All subjects were informed of the study objectives, methods, and risks, and all gave informed consent for participation. The nature of the ships' operations during the study period restricted the time and opportunities available to collect data from all personnel aboard both ships; consequently, questionnaires were administered to samples of crew aboard the FFG (N = 129) and the CG (N = 136). Ages ranged from 18-53 years with the mean age being 26 years (SD $\pm$ 6.44). Measures of physical health status and mood were obtained from this sample in order to describe the health and performance environment aboard both ships during the study period. In addition, a sub-sample of crewmen aboard the FFG (N = 12) and the CG (N = 6) were selected for an

intensive examination of the effect of sustained operations on health and mood. Ages in the sub-sample ranged from 18-45 years with a mean age of 26 years.

Measures

Sustained Operations: To evaluate the effect of sustained operations on crew health and mood, measures were administered to the study sub-samples aboard the two ships at four different time intervals over a 24-hour period: baseline, pre-GQ, post-GQ, and recovery (see Figure 1). Baseline measures were collected at the start of a 24-hour period. Approximately 4-6 hours later, the pre-GQ measures were collected; a period of GQ followed, and lasted from 5-7 hours (during GQ, crew are placed in a heightened state of vigilance with little or no opportunity for rest). Next, post-GQ measures were administered, and, approximately 2-6 hours later, the recovery measures were collected.

Figure 1. RESPONSES TO SUSTAINED SHIP-BOARD OPERATIONS: ASSESSMENT PROTOCOL



Health Status: Information on health status of study subjects was obtained from sick call reports filled out by ships' medical personnel during the study period. Each time a crew person reported for sick call, a report was filled out. Reports included the reason for a sick call visit, treatment provided by the medical department, and patient disposition (e.g., return to full-duty). Self-report health status information of crew members were obtained from responses to a Naval Health Research Center Health Symptoms Checklist (see Appendix 1) containing a listing of 34 different symptoms or health problems, and a 5-point rating scale ranging from 0 (absent) to 4 (extremely severe). Three measures were developed from this questionnaire: (1) percent of sample reporting the presence of a specific symptom or health problem (a score of one or greater); (2) mean symptom severity score for each symptom; and (3) a score summarizing both the frequency and severity of total symptoms or health problems.

Mood Profile: Study subjects were administered the Profile of Mood States (POMS) (McNair, Lorr, and Droppleman, 1971). This 65-item scale consists of descriptive terms that subjects rated for occurrence. The measure yields scores on five negative moods (tension/anxiety, depression, anger/hostility, fatigue, and confusion) and one positive mood (vigor). The POMS has been extensively used in studies of moods and mood change, and its reliability and validity are well-documented (Lefcourt, Martin, and Saleh, 1984). Reported reliability coefficients for all six mood scales are near .90 or above (McNair, Lorr, and Droppleman, 1971). Concurrent validity on three measures of distress (somatization, anxiety, and depression) from the Hopkins Symptom Distress scales ranged from .42 to .86 for all six POMS mood scales.

Procedure

Circadian cycles were not controlled for in this study, nor was the daily ship-board routine altered to accommodate the study. Watch sections aboard ships were slightly modified to allow simultaneous measurement of all subjects during the same testing sessions. Testing was accomplished on the two ships operating in the same area, and six subjects were monitored with respect to health symptoms and mood during each testing session.

Data Analysis

Inter-ship Comparisons: In addition to pooling the data collected from personnel aboard both ships, analyses were conducted to determine if there were any significant differences with respect to health and psychological profiles by ship. Previous studies have indicated that rates of illness and mental disorder vary with the size of a ship and whether a ship is beginning or concluding its period of operational deployment (Rubin, Gunderson, and Arthur, 1971, 1972; Rubin, Gunderson, and Doll, 1969). These two features also differentiated the two ships in this study with the smaller FFG having recently initiated its deployment, and the CG about to conclude its deployment in the theatre of operations. In addition, these ships differed with respect to the number of watch sections (largely due to the difference in size of complement) and equipment configuration.

Health Status/Mood Profile: Mean mood scale scores for study subjects on either ship were compared with standardized score norms for college students to determine if the mood profiles of ships' crew were significantly different. Chi-square and t-tests were performed to test the null hypothesis that there were no significant differences between the two ships with respect to their physical health and mood profiles. Occupational differences in mean mood scale scores and the total health symptom score were examined by means of t-tests.

Data obtained from the sub-sample of crewmen who were tested at four different time-intervals were subjected to a repeated measures multivariate analysis of variance (MANOVA) to test the hypothesis that health symptom and negative mood scale scores would increase over time while the positive mood score (vigor) would exhibit a decline. Because the focus of the study was on sustained operations, a repeated measures MANOVA was also performed on mood scale and total health symptoms scores at the pre- and post-GQ test intervals. Comparisons of mean mood scale scores and total health symptom scores between the sub-samples of the two ships, and between the subsamples and the total sample of each ship, were performed by means of t-tests.

The relationship between mood and health status was evaluated using a stepwise linear regression model. In this analysis, mood was viewed as an independent variable, and total health symptoms as the dependent variable.

RESULTS

Characteristics of Health and Mood Aboard Ship

During the study period, there were 13 sick-call visits made, all by personnel from the FFG, and each of these personnel were returned to full duty upon receiving treatment from the ship's medical personnel. The small number of sick-call visits made during the study period, most of which were made for prescription refills or minor health problems, may be indicative of the relatively high health status of the crews of both ships. The absence of sick-call visits aboard the CG, despite the fact that the crew experienced symptoms of colds and upper respiratory infections (including flu-like symptoms such as vomiting, fever, and muscle aches), suggests that during sustained operations, sick-call visits were postponed unless the medical condition was judged by the individual to be serious and interfering with his assigned duties. Other studies have found that sick-call visits decline during conditions of sudden crisis or emergency (Rahe, Mahan, Arthur, and Gunderson, 1970; Rubin, Gunderson, and Doll, 1969; Rubin, Gunderson, and Arthur, 1971). This suggests that during conditions of sustained operations, the health of the crew was best evaluated by the Naval Health Research Center Health Symptoms Checklist rather than by monitoring sick-call visits.

A description of the health status of ship personnel, as reported on the health symptoms checklist, is provided in Table 1. The most commonly reported physical health symptoms among personnel aboard both ships were: physical fatigue (65.1%), muscle aches (58.0%), headaches (55.3%), and muscle strain (52.3%). There were significantly more reports of swollen joints, hands, and feet aboard the FFG ($x^2 = 7.08$, $p < 0.01$) and significantly more reports of colds ($x^2 = 5.89$, $p < 0.05$) and sneezing ($x^2 = 6.16$, $p < 0.05$) aboard the CG. Personnel aboard the FFG reported significantly more problems (measured in terms of a mean severity score) with swollen joints, hands or feet ($t = 2.20$, $p < 0.05$) than personnel aboard the CG. On the other hand,

Table 1. Health Symptoms by Ship

Health Symptom	Ship: FFG (N=129) Percent Reporting Symptom	FFG Mean Severity Index	CG (N=136) Percent Reporting Symptom	CG Mean Severity Index	Total (N=265) Percent Reporting Symptom	Total Mean Severity Index
Physical Fatigue	68.3	1.09	62.2	0.88	65.1	0.98
Muscle Aches	59.1	0.97	57.0	0.91	58.0	0.93
Stuffed-up Nose	53.5	0.90	60.0	1.01	56.9	0.96
Headache	55.1	1.00	55.6	0.89	55.3	0.94
Muscle Strain	50.4	0.80	54.1	0.85	52.3	0.82
Runny Nose	41.7	0.66	52.6	0.88	47.3	0.77
Cold	36.2	0.56	51.1*	0.83*	43.9	0.70
Sneezing	33.1	0.50	48.1*	0.63	40.8	0.56
General Physical Weakness	43.3	0.66	38.5	0.55	40.8	0.59
Upset Stomach	40.9	0.62	32.6	0.48	36.6	0.54
Lower Back Pain	40.2	0.68	32.1	0.48	36.0	0.57
Aching Joints and Bone	38.6	0.58	29.9	0.47	34.1	0.52
Trouble Hearing	33.9	0.52	31.1	0.52	32.4	0.53
Indigestion	32.3	0.50	27.4	0.44	29.8	0.47
Dry Cough	26.8	0.39	29.6	0.44	28.2	0.41
Sore Throat	28.3	0.35	27.4	0.39	27.9	0.37
Sinus Pain	17.3	0.30	25.9	0.41	21.8	0.35
Productive Cough	13.5	0.22	18.7	0.30	16.2	0.25
Swollen Joints, Hands or Feet	20.5**	0.32*	8.9	0.15	14.5	0.23
Dizziness	13.4	0.19	14.2	0.18	13.8	0.18
Constipation	13.4	0.18	14.1	0.19	13.7	0.19
Rash	11.8	0.18	14.8	0.24	13.4	0.21
Abdominal Pain	17.3	0.20	9.7	0.14	13.4	0.16
Diarrhea	11.0	0.18	12.6	0.17	11.8	0.18
Nausea	11.0	0.14	11.1	0.13	11.1	0.14
Irritation	11.8	0.18	10.4	0.17	11.1	0.18
Cold Sores	9.4	0.11	11.1	0.16	10.3	0.13
Fever	7.1	0.07	11.9	0.16	9.5	0.12
Allergy	7.1	0.10	11.9	0.18	9.5	0.14
Hoarseness	6.3	0.09	12.6	0.15	9.5	0.13
Blisters	9.4	0.11	6.0	0.10	7.7	0.10
Flu	4.7	0.05	8.1	0.13	6.5	0.09
Shin Splints	3.1	0.06	1.5	0.03	2.3	0.05
Vomiting	0.0	0.00	2.2	0.05	1.1	0.03
Total Symptoms		13.35		13.64		13.50

* $p < 0.05$ ** $p < 0.01$

the mean severity score for colds among personnel aboard the CG was significantly greater than the cold severity score among personnel aboard the FFG ($t = 2.37$, $p < 0.05$). Because of the multiple comparisons made in this analysis, many of these statistically significant differences may be due to chance. No significant difference was observed between the two ships on the

total mean health symptoms score. An evaluation of baseline mood profiles among personnel aboard both ships is presented in Table 2. Mean scores on all six mood factors (tension/anxiety, anger/hostility, fatigue, vigor, depression, and confusion) for personnel aboard both ships fell within one standard deviation of a standardized norm based on a sample of college students. Relative to the other mood factor scores, personnel aboard both ships scored higher on the anger factor and lower on the confusion factor than the college student norm; however, in no instance were the mood factor scores significantly different from the college student norm.

Table 2. Mood Scales by Ship

Mood Scale Factor	Ship						
	FFG			CG			
	Mean	SD	Percentile[a]	Mean	SD	Percentile	T-Value
Anger/Hostility	15.6	10.3	58	14.7	8.9	57	0.72
Depression	14.8	10.5	51	14.2	9.6	50	0.48
Fatigue	11.7	6.1	52	9.8	5.5	49	2.63**
Vigor	14.7	5.8	49	15.0	5.7	49	0.38
Tension/Anxiety	12.7	6.0	49	11.6	6.1	48	1.38
Confusion	9.0	4.8	46	8.1	3.7	44	1.55

** $p. < 0.01$

a. Percentile scores are based on a standardized norm of college students as reported in McNair, Lorr, & Droppleman (1971).

When comparing personnel aboard the two ships, the fatigue factor score of personnel aboard the FFG ($x = 11.7$) was significantly greater ($t = 2.63$, $p < 0.01$) than the comparable factor score of personnel aboard the CG ($x = 9.8$). No significant differences between the two ships were observed on the mean scores of any of the remaining mood factors.

An evaluation of occupational specialty differences in mood profiles was conducted by comparing the mean mood factor scores and total mean health symptoms score among five different occupational rate groups on both ships. The results are presented in Table 3. Medical personnel scored significantly higher on the vigor scale and significantly lower on the anger/hostility

scale in comparison with the other occupational groups ($p < 0.05$). Apprentice/recruit personnel exhibited the lowest score on the vigor scale and highest scores on the remaining five scales; however, the differences were not statistically significant.

Table 3. Health Symptoms and Moods by Occupational Specialty: Total Sample

Mood Scale Factor	Rate Group: Engineering/ Deck (N=89) X	SD	Administrative/ Clerical (N=23) X	SD	Electronic/ Technical (N=62) X	SD	Apprentice/ Recruits(a) (N=27) X	SD	Medical (N=4) X	SD	F-Ratio
Anger/Hostility	17.3	9.3	15.4	12.0	13.4	8.5	17.1	10.4	6.0*	4.2	2.78*
Depression	16.4	9.8	14.4	10.7	13.8	9.8	15.6	10.2	7.5	4.6	1.31
Fatigue	11.3	5.8	10.3	6.3	10.5	5.8	11.6	5.9	7.5	2.6	0.71
Vigor	14.4	6.0	15.0	4.1	15.0	6.2	13.4	5.3	19.7*	1.2	1.18
Tension/Anxiety	13.3	6.0	12.4	7.7	11.2	6.4	14.0	5.9	8.2	2.5	1.84
Confusion	9.2	4.1	7.9	5.2	7.8	3.8	10.3	5.1	7.7	2.9	2.16
Health Symptoms	15.5	14.5	15.1	12.9	10.7	9.0	16.0	12.9	8.0	6.7	1.82

* $p < 0.05$
(a) SR, SA, SN, ratings

Effect of Sustained Performance on Health and Mood

The baseline health and mood profiles of the 18 sub-sample subjects (those who were tested at four different intervals) were compared with the remainder of the study sample ($N = 247$) to determine if these individuals exhibited significantly higher or lower levels of mood and health symptoms prior to GQ. The results are presented in Table 4. The baseline scores on all five negative POMS factor scales ($p < 0.001$), and the health symptoms checklist total score ($p < 0.01$) obtained from the combined sub-sample were significantly less than the mean scores for the remaining sample subjects, while the mean score for vigor exhibited by the combined sub-sample was significantly greater ($p < .05$). This is probably a reflection of the bias involved in the selection of study subjects which was influenced, in part, by

Table 4. Mean Mood Scale Factor and Health Symptoms Scores by Subject Status and Ship

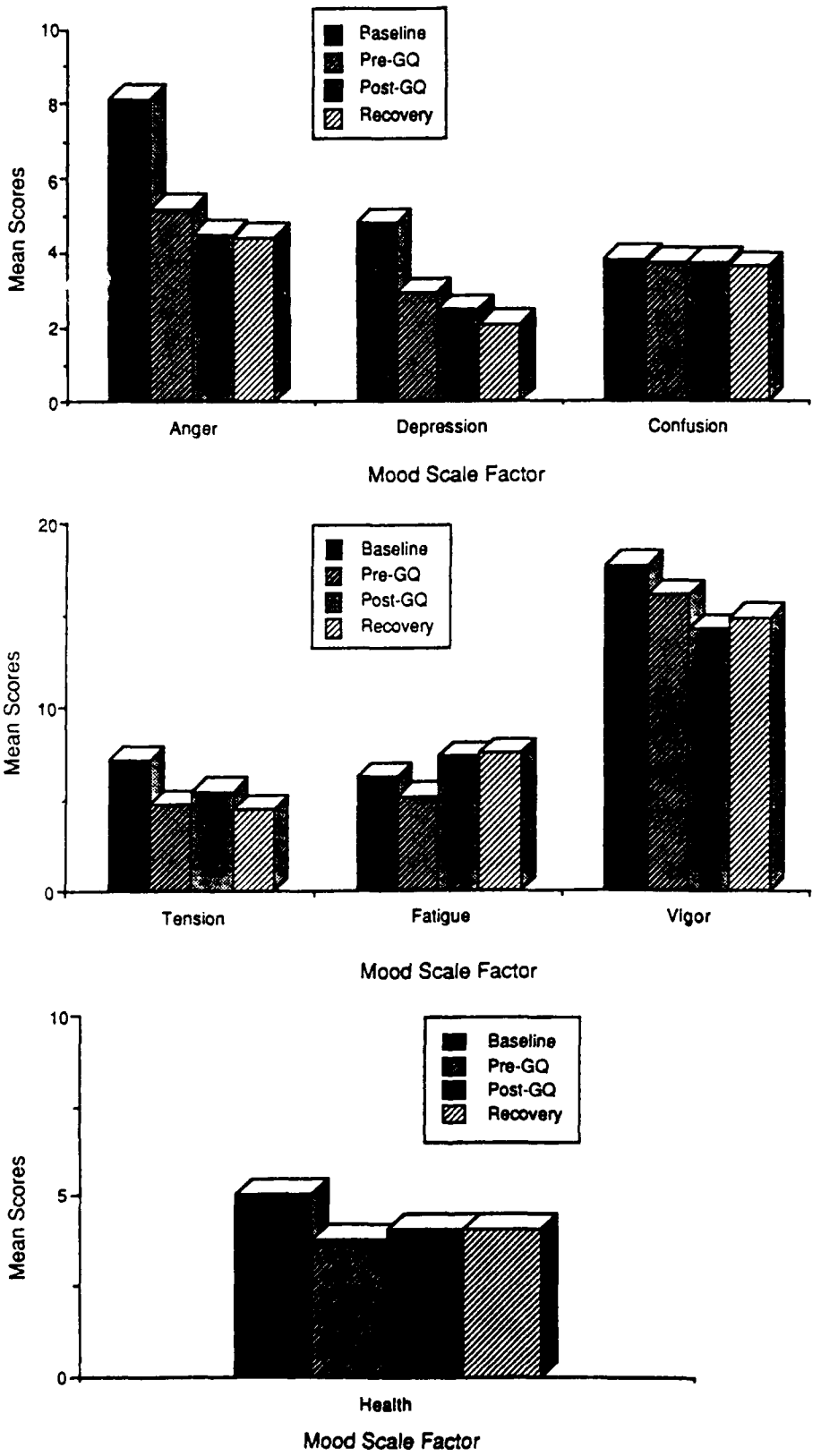
Mood Scale Factor	FFG Subsample (N=12) X	SD	FFG Ship's Sample (N=117) X	SD	T-value	CG Subsample (N=6) X	SD	CG Ship's Sample (N=130) X	SD	T-value	Both Ships Subsample (N=18) X	SD	Both Ships Ship's Sample (N=247) X	SD	T-value
Anger/Hostility	7.8	5.3	16.3	10.4	2.54*	8.7	5.0	15.0	8.9	1.73	8.1	5.1	15.6	9.7	3.07**
Depression	3.8	2.9	15.8	10.4	3.62***	6.5	3.9	14.6	9.6	2.05*	4.8	3.4	15.2	10.0	4.12***
Fatigue	5.9	3.7	12.2	6.0	3.25***	6.7	3.7	10.0	5.5	1.45	6.2	3.6	11.0	5.9	3.26***
Vigor	18.3	6.0	14.4	5.7	2.06*	16.7	7.0	14.9	5.6	0.74	17.7	6.2	14.7	5.7	2.05*
Tension/Anxiety	6.7	3.5	13.2	5.9	3.40***	7.8	4.7	11.8	6.1	1.56	7.1	3.9	12.4	6.1	3.46***
Confusion	5.1	1.7	9.3	4.9	2.71**	5.3	2.1	8.3	3.7	1.91	5.2	1.8	8.7	4.3	3.28***
Health Symptoms	4.1	3.3	14.1	11.6	2.72**	6.7	4.1	14.0	12.9	1.38	5.1	3.7	14.0	12.3	2.92**

* p. < 0.05 ** p. < 0.01 *** p. < 0.001

decisions of commanding officers and supervisors as to who was available for participation in this phase of the study. However, this bias appears to have been greater aboard the FFG than aboard the CG. Aboard the CG, the sub-sample differed from the remaining crew members only with respect to depression ($t = 2.05$, $p < 0.05$).

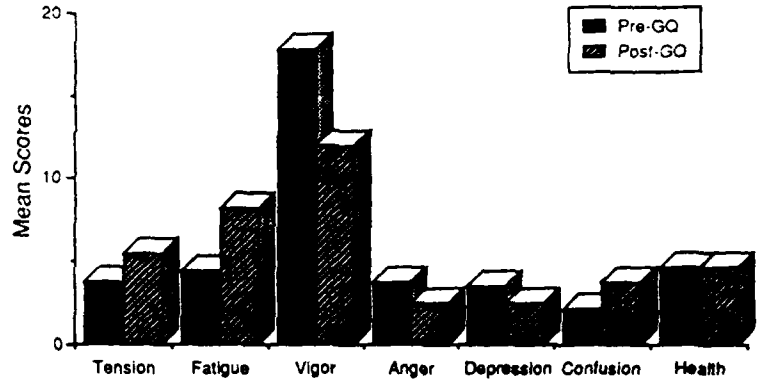
An examination of changes in mean mood factor and total health symptoms scores at four different time intervals was conducted with the 18 sub-sample subjects (12 aboard the FFG and 6 aboard the CG). Because of the small number of cases, the likelihood of statistical significance at the 0.05 level was remote. However, some significant differences across time were observed. Figure 2 presents the mean mood factor and mean total health symptoms scores at each time interval. The repeated measures MANOVA indicated a significant decline in tension/anxiety ($p < 0.01$), anger/hostility ($p < 0.001$), and depression ($p < 0.001$) across time for the entire study's sub-sample on both ships.

Figure 2. Mean Mood Scale Factor and Health Symptoms by Time: Both Ships

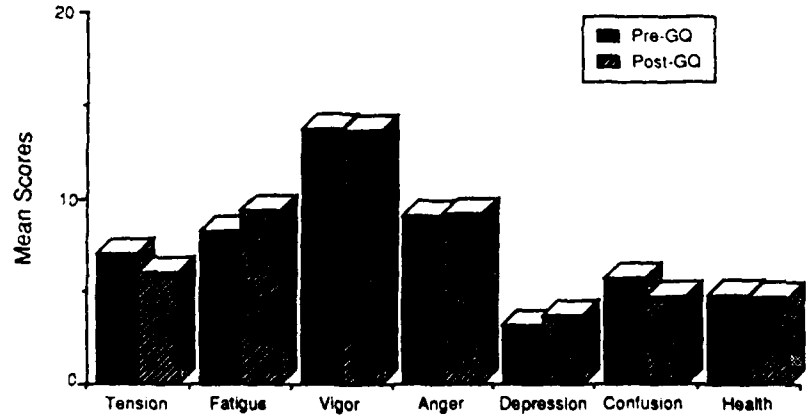


Given the observed differences in health and mood profiles between the crews of the two ships, pre-GQ and post-GQ mean mood factor and mean total health symptoms scores among the sub-sample subjects of each ship were examined. The results are presented in Figure 3. Significant increases in

Figure 3. Pre-Test and Post-Test
Mean Mood Scale Factor and Health Symptom Scores
by Ship



Mood Scale Factors (CG) and Total Health Symptom Score



Mood Scale Factors (FFG) and Total Health Symptom Score

POMS factor scores for fatigue ($f = 5.99$, $p < 0.05$) and confusion ($f = 15.62$, $p < 0.01$) and a significant decline in the factor score for vigor ($f = 12.32$, $p < 0.02$) between pre-GQ and post-GQ measurement intervals were reported among the study subjects aboard the CG. No significant differences on any of the mood or health symptoms scores between the two time intervals were reported among the study subjects aboard the FFG.

Study subjects aboard the two ships were compared to determine if significant differences between the two ships in mean mood factor and mean total health symptoms scores were evident within each time interval. As indicated by the data presented in Table 5, no significant differences were observed between the study sub-samples aboard the two ships across time.

Table 5. Mean Mood Scale Factor and Health Symptoms Scores by Ship and Time

	Time Interval							
	Baseline		Pre-GQ		Post-GQ		Recovery	
	FFG $\bar{X}$	CG $\bar{X}$	FFG $\bar{X}$	CG $\bar{X}$	FFG $\bar{X}$	CG $\bar{X}$	FFG $\bar{X}$	CG $\bar{X}$
Anger/Hostility	7.8	8.7	9.0	3.8	9.1	2.5	6.7	2.7
Depression	3.8	6.5	3.1	3.5	3.7	2.5	2.5	1.8
Fatigue	5.9	6.7	8.2	4.5	9.3	8.2	7.2	9.7
Vigor	18.3	16.7	13.7	17.8	13.6	12.0	15.3	12.5
Tension/Anxiety	6.7	7.8	7.0	3.8	6.0	5.5	4.9	4.8
Confusion	5.1	5.3	5.7	3.5	4.9	4.2	3.7	3.2
Health Symptoms	4.1	6.7	4.8	4.7	4.7	4.7	4.2	4.5

Relationship Between Mood Profile and Health Status

Scale scores for all six mood factors and the total health symptoms score were examined to determine the extent that any of the positive or negative mood factors predicted severity and frequency of health symptoms. Because earlier analyses failed to show any changes in health status across time, only baseline measures were used. A stepwise linear regression model was employed with the total health symptoms score as the dependent variable.

The results are presented in Table 6. Only tension/anxiety and fatigue were predictive of total health symptoms. The tension/anxiety and fatigue scales accounted for 27 percent of the variance in total health symptoms.

Table 6. Stepwise Regression Predicting Total Health Symptoms among All Study Subjects at Baseline

Predictor Variable	Cumulative Multiple R	Cumulative R^2	R^2 Change	Standardized Beta
Tension/Anxiety	.4905	.241	.241	.3532***
Fatigue	.5238	.274	.033	.2295***

***p. < .001

DISCUSSION

The mood and health status of shipboard personnel reported here represent a unique data set in that the responses were solicited under extremely high combat threat conditions. The conditions under which both ships operated, while differing in tactical purpose, led to high risk of personal danger resulting from actual conditions of combat at sea. The analyses of these data provide a unique picture of mood and health status during combat conditions which can serve as a reference for similar studies during situations involving less combat stress.

Personnel aboard both ships experienced physical strain which was manifested in terms of physical fatigue, muscle aches and strain, and headaches. However, it was impossible to determine if these measures were indicative of a decline in physical and mental health or performance degradation resulting from sustained operations without the benefit of standardized norms. Such norms are available for the mood scale factors and the results indicated that the mood profiles of both ships' crews were unremarkable.

Some differences in the health and mood profiles of the two ships were observed. Given the multiple comparisons made with respect to physical health symptoms, many of the statistically significant differences between the two ships may be due to chance. However, aggregate analyses of physical

health and mood profiles did reveal some consistent patterns. Crewmen aboard the FFG experienced significantly more psychological fatigue. Although not statistically significant ($t = 1.85$, $p = 0.070$), personnel aboard the FFG also reported more problems with physical fatigue than personnel aboard the CG. This may be attributed to the fact that the FFG had recently initiated its deployment while the CG was nearing the end of its deployment. Crewmen aboard the CG, therefore, may have become adapted to the rigor of sustained operations while the crew of the FFG were still in the "shakedown" phase of their deployment. This possibility is further supported by the fact that crewmen aboard the FFG experienced more problems with swollen hands, feet, and joints. These symptoms reflect either that the crew of the FFG was suffering from dehydration or had not yet adapted to the environmental conditions under which naval operations were conducted. However, environmental conditions at this time were quite benign and did not require any extensive physiological adjustment.

A more likely explanation is the fact that due to fewer staff, personnel aboard the FFG were required to spend longer periods of time on watchstanding duty. Thus, the FFG presented fewer opportunities for prolonged rest periods. The CG, on the other hand, had three different watch sections. As noted elsewhere (Congleton, Englund, Hodgdon, Palinkas, Armstrong, and Kelleher, 1988), crewmen aboard the FFG also reported shorter and more fragmented sleep periods. In addition, the FFG had undergone a series of GQ drills prior to entering the operational area which further fatigued its crew.

Some differences in enlisted ratings (occupational specialties) also were observed among study subjects. Medical personnel exhibited less difficulty with health symptoms and negative mood, and significantly higher levels of vigor than members of other occupational groups. Similar findings have been reported in other studies (Doll, Rubin and Gunderson, 1969; Gunderson, Rahe, and Arthur, 1970). Some decrement in health and mood profile may be attributed to the lack of experience in sustained operations as evidenced by the mean scores exhibited by apprentice seamen. However, the effect of lack of experience upon health and well-being under conditions of sustained operations was not found to be significant.

Among the study subjects who were evaluated at four different intervals during the study, there was a significant decline in negative mood scales of tension/anxiety, anger/hostility, and depression across time. This finding runs counter to our initial hypothesis that sustained performance would produce an increase in negative mood. This suggests that a certain amount of adaptation to the stressors associated with sustained operations may have been taking place. Among sub-sample crewmen aboard the CG, however, a significant decline in vigor and increases in fatigue and confusion were observed prior to and after GQ, suggesting a certain amount of degradation in health and psychological well-being associated with sustained operations. However, this was not observed among the sub-sample aboard the FFG. As evidenced by the between-ship comparison of mean scores reported in Table 7, the absence of a difference in pre-GQ and post-GQ measures of mood aboard the FFG cannot be attributed to higher baseline measures of negative mood and/or lower measure of vigor.

A linear relationship was observed between the mood scales of tension/anxiety, fatigue, and total health symptoms. Other studies have found that anxiety is a risk factor for elevated serum corticosteroid levels (Davis, Morrill, Fawcett, Upton, Bandy, and Spiro, 1962; Marchbanks, 1958) and combat injuries and battle shock casualties (Palinkas and Coben, 1987; Sampson, 1984; Stouffer, Lumsdaine, Lumsdaine, et al., 1949). The reduction in levels of anxiety among the study sub-sample may account for the absence of an increase in total health symptoms score across time. However, fatigue, which has also been directly related to health symptoms under conditions of sustained operations, increased across the four time intervals. Further research is required to identify the nature of the relationships between these two mood factors and physical health symptoms.

In conclusion, personnel aboard the FFG reported a higher level of fatigue and experienced more problems with swollen joints, hands or feet than personnel aboard the CG. Sick-call visits to the ships' medical departments during the study period were made only by personnel aboard the FFG. Some degradation of performance among the study subjects did occur between pre-GQ and post-GQ as indicated by a decline in vigor and an increase in fatigue and confusion among study subjects aboard the CG. On the other hand, the decline

in negative mood scores across time may indicate that a certain amount of adaptation to sustained operations was taking place. Because of the small size of the sub-sample, however, the possibility of a Type I error must be entertained.

Despite the small sample size and relatively benign environmental conditions, the results suggest a number of measures that may be implemented to minimize physical and psychological conditions which may adversely affect performance during Condition I readiness. This includes the provision of adequate periods for sleep (a minimum of 3 hours per day for personnel who primarily perform physical work and 4-6 hours per day for those doing complex/command/vigilance tasks) (Naitoh, Englund, and Ryman, 1983; Naitoh, Englund, and Ryman, 1987); immediate feedback on the quality of task performance; use of motivation techniques; periodic rest breaks; physical exercise; regulation of caffeine consumption; and prevention of dehydration by regular water consumption. Several techniques and programs used to reduce the risk to health and psychological well-being in similar occupational settings may also be adopted to prepare naval personnel for sustained operations. These programs provide the individual with proficiency training, techniques for achieving and maintaining motivational levels, and techniques for the self-assessment of performance. Many of these programs such as Stress Inoculation Training (SIT) (Meichenbaum, 1985) are based on established procedures of cognitive behavioral treatment.

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APPENDIX 1

NAVAL HEALTH RESEARCH CENTER HEALTH SYMPTOMS CHECKLIST

Please indicate how severe each of the listed symptoms or health problems has been for you over the last three days by entering the appropriate number in the space before the symptom or problem.
Use the following response options:

0 = Absent
1 = Mild
2 = Moderate
3 = Severe
4 = Extremely Severe

_____	1.	Allergy	_____	18.	Runny nose
_____	2.	Muscle strain	_____	19.	General physical weakness
_____	3.	Cold	_____	20.	Sinus pain
_____	4.	Flu	_____	21.	Vomiting
_____	5.	Fever	_____	22.	Irritation
_____	6.	Cold sores	_____	23.	Blisters
_____	7.	Sore throat	_____	24.	Abdominal pain
_____	8.	Upset stomach	_____	25.	Dizziness
_____	9.	Dry cough	_____	26.	Constipation
_____	10.	Muscle aches	_____	27.	Nausea
_____	11.	Trouble hearing	_____	28.	Aching joints and bones
_____	12.	Productive cough	_____	29.	Sneezing
_____	13.	Rash	_____	30.	Physical fatigue
_____	14.	Indigestion	_____	31.	Hoarseness
_____	15.	Stuffed-up nose	_____	32.	Diarrhea
_____	16.	Swollen joints, hands, or feet	_____	33.	Headache
_____	17.	Shin splints	_____	34.	Lower back pain

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(U) Crew members of a U.S. Navy frigate and a guided missile cruiser were studied to determine if physical and psychological status undergo degradation during a period of high level readiness (Condition I or GQ). Objectives of the study included identifying the relationship between health and mood under these conditions. Crew members completed a health-symptoms checklist and a Profile of Mood States questionnaire. A sub-sample of crew members aboard both ships also completed questionnaires at four time periods during a 24-hour period; including prior to, and after, a period of GQ. The most commonly reported physical symptoms aboard both ships were physical fatigue, muscle aches, headaches, and muscle strain. Crewmen aboard the frigate reported significantly greater physical and psychological fatigue than crewmen aboard the cruiser. Among the sub-sample of crewmen who completed questionnaires at four intervals, a significant decline in tension/anxiety, anger/hostility, and depression over time was observed, although personnel aboard the cruiser reported significant increases in (Cont. on reverse)

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19. **ABSTRACT** (Cont.) fatigue and confusion, and a significant decline in vigor immediately after a period of GQ. Tension/anxiety and fatigue were independently predictive of total health symptoms. Some decline in mood occurred between pre-GQ and post-GQ as indicated by a decline in vigor and an increase in fatigue and confusion among crew members of the cruiser. The decline in negative mood scores over time may indicate that some adaptation to sustained operations took place.