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**EFFECT OF A PASSIVE COOLING VEST ON  
TENSION / ANXIETY AND FATIGUE  
IN A HIGH HEAT AND HIGH HUMIDITY  
NAVAL ENVIRONMENT**

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REPORT No. 90-23

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**Effect of a Passive Cooling Vest on Tension/Anxiety and Fatigue  
in a High Heat and High Humidity Naval Environment**

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Report No. 90-23, supported by the Naval Medical Research and Development Command, Bethesda MD, Department of the Navy, under research Work Unit No. 63706N.M0096, and the Office of Naval Technology, Department of the Navy, under research Work Unit No. 62233N.3P30. The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of the Navy, Department of Defense, nor the U.S. Government.

## SUMMARY

### Problem

U.S. Navy personnel stationed in the Persian Gulf work in an extremely high heat/high humidity environment. Exposure to heat has been shown to affect sleep quality, raise levels of tension/anxiety and fatigue, and cause decrements in performance capabilities and cognitive operations. Because many spaces on U.S. Navy ships cannot be efficiently air-conditioned, some form of microclimate cooling is necessary.

### Objective

The objectives of this study were to: a) obtain measures of self-reported sleep problems, health symptoms, tension/anxiety, and fatigue among U.S. Navy personnel deployed in the Persian Gulf; b) in a sub-sample of subjects, measure and compare levels of tension/anxiety and fatigue when wearing and not wearing a cooling ice vest during watchstanding.

### Approach

A cross-sectional sample (N = 104) of officers and enlisted personnel aboard two U.S. Navy ships, an auxiliary ship categorized as a Miscellaneous Command Ship (AGF) and a Minesweeper (MSO), were given a questionnaire designed to provide information on sleep quality, health symptoms, tension/anxiety and fatigue. A sub-sample (N = 44) of personnel from these ships, as well as other at-sea and shore-based platforms, were given the same questionnaire, and then were given repeated measures of the tension/anxiety and fatigue scales, prior to and following watchstanding, in both with and without ice vest conditions.

### Results

Crewmembers on both ships reported sleep-related problems including falling asleep when working, trouble falling asleep, and not feeling rested after waking up. Mental fatigue, heat distress and muscle fatigue were the most common health symptoms. The sub-sample was significantly lower than the

cross-sectional sample on the tension/anxiety scale and the fatigue measures. Sub-sample subjects' tension/anxiety increased from pre-watch to post-watch in the without ice vest condition, but tension/anxiety decreased during the watch when an ice vest was worn. Greater fatigue was reported following watchstanding without an ice vest than with an ice vest, however, the change in fatigue during watchstanding with the ice vest as opposed to without the ice vest was not statistically significant. The majority of sub-sample subjects reported that the ice vest was helpful during watchstanding, that it did not interfere with their ability to do their job, and that they would recommend its future use.

Conclusions

U.S. Navy personnel stationed in the Persian Gulf report sleep problems, trouble staying awake on the job, mental fatigue, heat distress, and muscle fatigue. Tension/anxiety is decreased by wearing an ice vest during watchstanding. Fatigue was not significantly changed after one watchstanding session with an ice vest; because of the sleep problems among the crew, the level of fatigue was high, and therefore, the effect of the ice vest on fatigue may not be immediately observable. The results of this study suggest that the availability of a passive microclimate cooling system (ice vest) would be beneficial for naval personnel deployed in high heat/humidity regions.



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## INTRODUCTION

Crewmembers aboard U.S. Navy ships in the Persian Gulf theater of operations are subjected to continuous heat strain. During the months of July and August, it is not unusual for this part of the world to reach ambient temperatures in the range of 120-130<sup>o</sup>F with the relative humidity up to 90%. Previous field studies on U.S. Navy ships in the Persian Gulf have shown crewmembers have difficulty falling asleep at lights out, poor quality sleep, falling asleep on the job, physical and psychological fatigue, and feelings of confusion and tension/anxiety (Burr, Palinkas, Banta, Congleton, Kelleher, & Armstrong, 1989; Steele, Kobus, Banta, & Armstrong, 1989). Exposure to heat has also been shown to affect performance capabilities during sustained work (Fine and Kobrick, 1987; U.S. Department of HEW, 1972). Grether (1973) reported that human performance of such tasks as time estimation, reaction time, vigilance, tracking, and other skilled cognitive operations, show performance decrement in ambient temperatures above 85<sup>o</sup>F.

Many spaces on U.S. Navy ships cannot be equipped to provide a controlled air-conditioned environment. The engine room on steam and diesel ships, for example, cannot be efficiently cooled because of the tremendous heat generated by the ships' engines. A possible solution would be to provide individual cooling; this could be accomplished by providing a crewmember with some form of controlled microclimate. Most of the attempts to provide a microclimate have been achieved by circulating cool water or air through plastic tubes, either in a hood, the liner of a helmet, or in a body garment (Brooks, Hynes, Bowen, Allen and Kuehn, 1981; Shapiro, Pandolf, Sawka, Toner, Winsman, and Goldman, 1982; Nunneley and Maldonado, 1983; Pimental, Janik, and Avellini, 1988; Williams and Shitzer, 1974). Generally, the results of such controlled microclimate cooling studies have shown markedly reduced heat strain, as measured by subjective comfort, mean heart rate, rectal temperature, and total weight loss (Gold and Zornitzer, 1968; Froese and Burton, 1957; Kissen, Hall, & Klemm, 1971; Nunneley, Troutman, & Webb, 1971).

Creation of a microclimate by air or water is only practical, however, when the person's physical work load is limited. For example, aircraft or tank personnel could be outfitted with such equipment because their job does not require extensive movement in their work space. Additionally, the required apparatus, self-contained water system, batteries, pumps, etc., can be situated near the individual and/or attached to the aircraft/tank. Ships' crewmembers with jobs that require significant mobility could not complete their tasks while tethered to such a device. Therefore, an alternate cooling device, a passive cooling (ice) vest, has been designed and implemented for use by crewmembers with jobs that require them to move about the ship while exposed to high heat stress.

The purpose of this study was to obtain measures of self-reported sleep problems, health symptoms, tension/anxiety, and fatigue during cruising in the high heat and high humidity of the Persian Gulf. Further, in order to evaluate the effect of wearing a cooling ice vest, a sub-sample of subjects was given questionnaires to obtain repeated measures of tension/anxiety and fatigue. These measures were obtained prior to and following a watchstanding period during which the crewmember was wearing a cooling vest, and prior to and following another watchstanding period without wearing a cooling vest.

## METHODS

### Study Subjects:

The subject population was comprised of a cross-sectional sample (N = 104) of officers and enlisted crew from two U.S. Navy ships, an auxiliary ship categorized as a Miscellaneous Command Ship (AGF) and a Minesweeper (MSO). All subjects were informed of the study objectives, methods, and risks, and all gave informed consent. 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 the crew aboard the AGF (N = 56) and the MSO (N = 48). Ages ranged from 19-45 years with the mean age being 25.5

years (SD  $\pm$  6.22). In order to describe the health and performance environment aboard both ships during the study period, measures of self-reported sleep problems, health symptoms, tension/anxiety, and fatigue were obtained from this sample. In addition, a sub-sample (N = 44) of crewmembers were selected for an examination of the effect of the high heat and high humidity environment on tension/anxiety, fatigue, and a variety of physiological measures (heart rate, rectal temperature, blood pressure, etc.) during watchstanding, with and without an ice vest. The sub-sample consisted of volunteers from the two ships mentioned above (N = 24), and personnel stationed on an oil barge in the Persian Gulf (N = 6), a patrol boat (N = 5), and a shore-based security support unit (N = 9). Ages in the sub-sample ranged from 18-43 years with a mean age of 26.6 years. (Assessment of differences by platform, standing watch in the engine room, topside, or standing guard at the shore-based security support unit, as well as an examination of the various physiological measures will be addressed in subsequent technical reports.)

#### **Measures:**

A measure of thermal stress, used in both military and civilian applications, is the Wet Bulb Globe Temperature (WBGT) index. WBGT is obtained with an electronic meter that independently measures the dry bulb, wet bulb, and globe temperatures. The instrument displays each of these values as well as computes and displays the WBGT index in degrees Fahrenheit (NAVMED-P-5010-3, 1974).

A questionnaire of 101, self-report items was designed to provide information on sleep quality, health symptoms, and subjective measures of tension/anxiety and fatigue. The questionnaire was administered once to the cross-sectional sample; the sub-sample subjects were given the same questionnaire, and then were given repeated measures of the tension/anxiety and fatigue scales, prior to and following watchstanding, in both vest and no vest conditions. Sub-sample subjects were also given a "Vest Survey" which asked their opinions about watchstanding while wearing the ice vest.

Sleep Items. A modified version of the Naval Health Research Center Sleep Questionnaire (Naitoh, Englund, Ryman & Hodgdon, 1984) assessed the subjects' sleep problems and sleep quality. Appendix A shows the sleep items, and includes the cross-sectional sample and sub-sample response percentages.

Health Symptoms. The Environmental Symptoms Questionnaire (ESQ; Kobrick and Sampson, 1979) was used to evaluate the health status of the samples. This 52-item survey consisted of a comprehensive list of physiological symptoms likely to occur in environmental extremes. The 52 items were reduced to 10 factors using a principal components analysis (Steele et al., 1989). Composite symptom scale scores were created by computing the mean of the items comprising each scale. All composite scores range from 0 to 9 with higher scores indicating more severe symptoms. Appendix B lists the environmental symptom composites and the items which comprise each composite. One other measure was developed, the mean of all 52 ESQ items was computed to give a total ESQ score.

Subjective Tension/Anxiety and Fatigue Measures. Study subjects were administered the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971) Tension/Anxiety (POMS-TA) and Fatigue (POMS-F) subscales. These scales consist of descriptive terms that subjects rate for occurrence. The POMS has been extensively used in studies of moods and mood change, and its reliability and validity are well documented (Lefcourt, Martin, & Saleh, 1984). The U.S. Air Force School of Aviation Medicine Subjective Fatigue Checklist (SAM-F; Pearson and Byars, 1956) was also administered to subjects to supplement the POMS-F measure of fatigue. The SAM-F scale describes the individual's general feelings of energy and alertness, however, unlike the POMS-F, a lower score indicates greater fatigue; a higher score indicates greater liveliness. This reversal in scoring permits a check of the subjects' response reliability on these two measures of fatigue.

#### **Materials:**

The ice vest, manufactured by Steele, Inc. of Kingston, Washington, covered the upper body from the shoulders to the waist. On the front and



back sides, there were three horizontal compartments, or pockets, that went across the entire width of the vest; a gel thermostrip (package of ice) was inserted into each of these six compartments. The total weight of the vest and thermostrips was approximately 12 pounds.

**Procedure:**

Circadian cycles were not controlled nor was the daily ship-board routine altered to accommodate the study. Watch sections aboard ships were slightly modified to allow simultaneous measurement of the cross-sectional subjects during the same testing sessions, and testing was accomplished on the two ships operating in the same area.

On two consecutive days, sub-sample subjects were asked to report to a "ready room" where the questionnaire was administered prior to their four-hour watch. The subjects were instrumented with thermistors and a heart rate monitor to obtain physiological measures (physiological results are presented in subsequent technical reports). Approximately one-half of the sub-sample subjects wore the ice vest on day one of the experiment and the other half wore the ice vest on day two. Two hours into the watch, a member of the research team brought fresh thermostrips to the subjects wearing ice vests, and replaced the thawing thermostrips. When the watch was completed, the subject returned to the "ready room" and was again administered the tension/anxiety and fatigue scale portions of the questionnaire.

**Data Analysis:**

The questionnaire data was analyzed in three steps. First, comparisons were made between the two ships; second, the ships' data were pooled and comparisons made between this cross-sectional data and the sub-sample questionnaire responses; third, repeated measures analyses were conducted on the sub-sample subjects to assess for pre- and post-watch differences in the vest and no-vest conditions.

Between Ship Comparisons. T-tests were conducted to determine if there were any significant differences by ship with respect to sleep problems, health symptoms, tension/anxiety, and fatigue profiles. 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, & Arthur, 1971, 1972; Rubin, Gunderson, & Doll, 1969). With respect to deployment, the two ships in this study are home-ported in the Persian Gulf, and the crews are rotated in. Therefore, some of the subjects were just beginning while others were in later stages of their deployment. In addition, these ships differed with respect to the number of watch sections, largely due to the difference in size of complement (AGF = 440; MSO = 86) and equipment configuration.

Cross-sectional and Sub-sample Comparisons. T-tests were conducted to make comparisons between the cross-sectional sample and the sub-sample on the obtained measures. The sub-sample data was from the first administration of the questionnaire, regardless of whether the watchstanding session that followed was a vest or a no-vest session.

Vest and No-Vest Comparisons. Data obtained from the sub-sample of personnel who were tested pre- and post-watch, with and without an ice vest, was analyzed using repeated measures multivariate analysis of variance (MANOVA). The hypothesis being tested was that tension/anxiety and fatigue scale scores would be lower following watchstanding while wearing an ice vest than after watchstanding without an ice vest.

## RESULTS

Between Ship Comparisons. The results of the between ship comparisons showed that the crewmembers of the AGF and the MSO had similar sleep-related problems. Fifty percent of the AGF sample and 40% of the MSO crew questioned indicated they "sometimes," "often," or "almost always" fell asleep when working. Over 80% of the crewmembers on each ship said they had trouble falling asleep; crewmembers on the AGF took a mean of 86 minutes, and on the

MSO, a mean of 48 minutes to fall asleep. Approximately 40% of the crew-members on each ship responded that they "never" or "almost never" felt well-rested when they woke up.

Between ship comparisons on the health symptoms portion of the questionnaire are shown in Table 1. The most common symptoms were mental fatigue, heat distress, and muscle fatigue. On both ships, heat distress was the symptom with the greatest mean severity score.

Table 1

AGF and MSO Cross-Sectional Sample Health  
Symptoms Descriptive Statistics

Health Symptom Composite	AGF Sample (N = 56)		MSO Sample (N = 48)	
	Percent with Symptom	Mean <sup>a</sup> Severity Score	Percent with Symptom	Mean Severity Score
Mental Fatigue	95	2.81	77	2.13
Heat Distress	88	3.66	54	3.08
Muscle Fatigue	73	2.92	46	1.83
Eye/Sight	48	2.32	35	1.47
Headache	57	2.30	25	1.36
Ear/Hearing	30	1.60	27	1.46
Nasal Distress	46	2.79	29	1.82
Gastrointestinal	29	3.49	15	2.29
Respiratory	15	3.04	15	1.67
Coordination	25	3.57	14	2.14
Chills	9	1.87	17	2.58
ESQ Total Symptoms	98	1.42	92	0.83

<sup>a</sup>Mean severity score of only those cases in sample reporting presence of the symptom. Range of the severity score was 1 to 9.

Table 2 shows the results of the POMS-TA, POMS-F, and SAM-F scales when compared between ships. The AGF was significantly higher than the MSO on the POMS-TA and POMS-F measures.

Table 2

AGF and MSO Cross-Sectional Sample Subjective  
Psychological Measures Descriptive Statistics

Measure	AGF Sample			MSO Sample			t
	Mean	St dev	N	Mean	St dev	N	
POMS - Tension/Anxiety	13.47	8.08	51	9.23	7.05	44	2.70**
POMS - Fatigue	12.37	6.76	51	9.30	7.05	44	2.16*
SAM - Fatigue <sup>a</sup>	8.86	4.34	55	8.49	4.03	43	0.43

<sup>a</sup>Higher scores on SAM - Fatigue indicate greater liveliness

\* p < .05; \*\* p < .01

Between Sample Comparisons. The results from combining the two ships data and comparing this cross-sectional data with the sub-sample questionnaire responses showed that the sub-sample did not report as much sleep difficulty as the cross-sectional sample. Whereas 43 percent of the cross-sectional sample reported that they "sometimes," "often," or "almost always" fell asleep when working, only 20% of the sub-sample reported this problem. As for trouble falling asleep, 82% of the cross-sectional sample had this problem; they took a mean of 68.4 minutes to fall asleep. In the sub-sample, 70% said they had trouble falling asleep with a mean of 37 minutes required for falling asleep. Finally, 41% of the cross-sectional sample said that they "never" or "almost never" felt well-rested when they woke up; only 16% of the sub-sample reported the same.

Comparisons between the cross-sectional and sub-sample on the health symptoms are shown in Table 3. The most common symptoms in both samples were mental fatigue, heat distress, and muscle fatigue. In both samples, the symptom with the greatest mean severity score was heat distress. The sub-sample was lower than the cross-sectional sample for each of the health symptom composites and total ESQ score on both the percent of the crew with the symptom and the mean severity score of the health symptom.

Table 3  
Cross-Sectional and Sub-Sample Health  
Symptoms Descriptive Statistics

Health Symptom Composite	Cross-Sectional Sample (N = 104)		Sub-Sample (N = 44)	
	Percent with Symptom	Mean <sup>a</sup> Severity Score	Percent with Symptom	Mean Severity Score
Mental Fatigue	87	2.53	70	1.62
Heat Distress	72	3.46	59	2.32
Muscle Fatigue	61	2.54	43	1.33
Eye/Sight	42	1.99	23	1.47
Headache	42	2.04	23	1.20
Ear/Hearing	29	1.54	9	1.12
Nasal Distress	39	2.45	23	2.10
Gastrointestinal	22	3.12	16	1.14
Respiratory	28	2.71	7	0.56
Coordination	20	3.09	9	1.50
Chills	13	2.31	4	1.00
ESQ Total Symptoms	95	1.16	86	0.60

<sup>a</sup>Mean severity score of only those cases in sample reporting presence of the symptom. Range of the severity score was 1 to 9.

Table 4 shows the comparison of the cross-sectional sample and the sub-sample on the POMS-TA, POMS-F, and SAM-F scales. The sub-sample was significantly lower on the tension/anxiety scale and on both of the fatigue measures.

Table 4  
Cross-Sectional and Sub-Sample Subjective  
Psychological Measures Descriptive Statistics

Measure	Cross-Sectional Sample			Sub-Sample			t
	Mean	St dev	N	Mean	St dev	N	
POMS - Tension/Anxiety	11.50	7.87	95	6.39	3.91	44	4.07**
POMS - Fatigue	10.95	7.03	95	6.23	5.14	44	3.98**
SAM - Fatigue <sup>a</sup>	8.69	4.19	98	11.16	3.82	43	3.31**

<sup>a</sup>Higher scores on SAM - Fatigue indicate greater liveliness

\*\* p < .01

Sub-Sample Vest and No-vest Watchstanding Comparisons. An important consideration when comparing the vest and no-vest session measures of tension/anxiety and fatigue is the thermal stress index during the two days

each subject was tested. Table 5 shows the WBGT index levels in degrees Fahrenheit during the vest and no-vest watches. A matched pair t-test showed there was no significant difference between WBGT's during the vest and no-vest watchstanding sessions.

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Table 5  
Mean WBGT Index for the Sub-Sample during  
Vest and No-Vest Watchstanding

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	<u>Mean</u>	<u>Std dev</u>	<u>N</u>
No-Vest Session	92.3	3.52	44
Vest Session	92.5	3.57	44

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Three separate repeated measures MANOVAs were conducted to evaluate changes in tension/anxiety and the fatigue measures during watchstanding with and without an ice vest. The relationship of interest is the vest by time interaction; for example, does the change in the level of tension/anxiety from pre-watch to post-watch vary by whether or not an ice vest was worn? The results of the MANOVA on the POMS-TA scale showed a significant vest by time interaction ( $F[1,42] = 4.84, p < .03$ ). The pattern of this interaction, depicted in Figure 1, shows that tension/anxiety increased from pre-watch to post-watch in the no-vest condition, but decreased during the watch when an ice vest was worn.

## PASSIVE COOLING AND POMS-TA

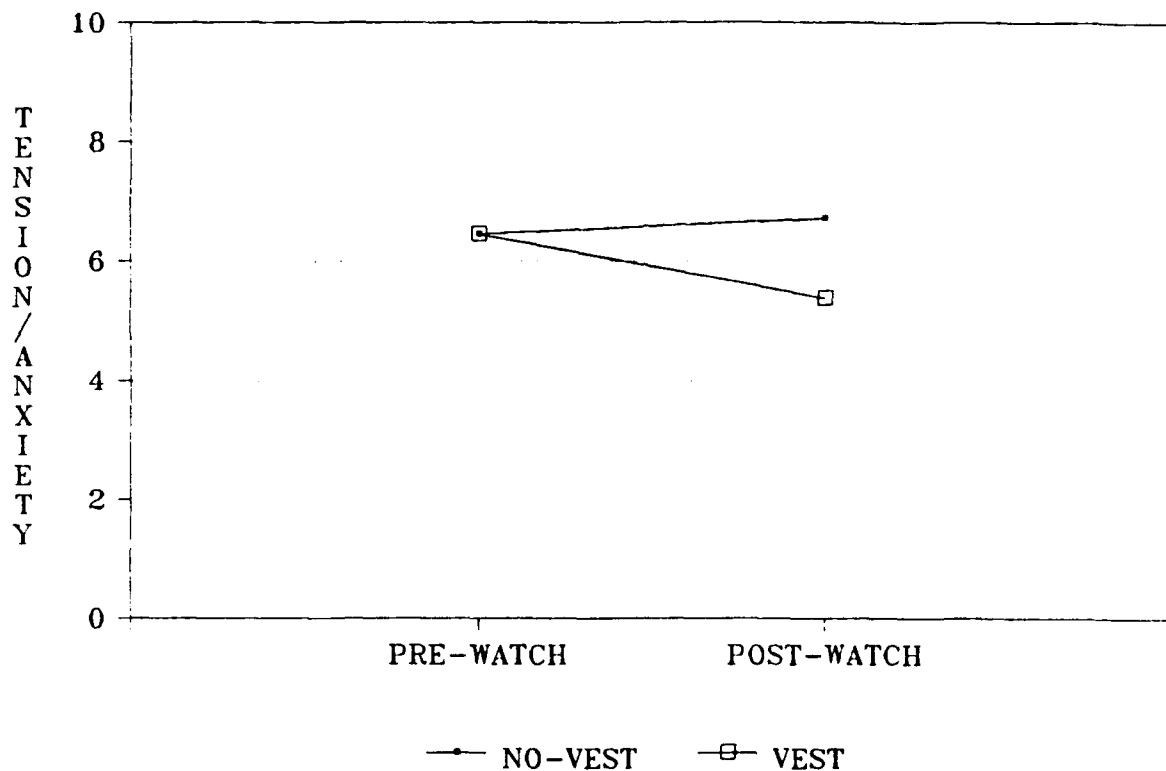


Figure 1. Mean POMS-TA by vest condition from pre- to post- watch.

The other two MANOVAs, on POMS-F and SAM-F did not show a significant interaction. Both measures indicated that fatigue increased during the watch, and that watchstanders reported greater fatigue after the no-vest watch than after their vest watch; however, the change in fatigue during watchstanding with an ice vest as opposed to without an ice vest was not statistically significant.

Other noteworthy results, obtained from the vest survey, showed that each of the sub-sample subjects felt the ice vest was somewhat helpful to their ability to perform and stand a normal watch; 61% of the subjects responded



that the ice vest was very helpful or extremely helpful. When asked if wearing the ice vest interfered with the performance of their job, 19 felt that there was no interference, 15 said there was some interference, and 9 said there was moderate interference. When asked if they would recommend their ship obtain ice vests for future use at their watchstation under high heat conditions, 43 of the 44 subjects indicated they would recommend its implementation.

### DISCUSSION

This study examined self-reported sleep problems, health symptoms, tension/anxiety, and fatigue on crews of two U.S. Navy ships situated in the high heat/humidity Persian Gulf region. A sub-sample of volunteer subjects was given the opportunity to wear an ice vest during their watch to determine if providing a cool microclimate would decrease feelings of tension/ anxiety and fatigue.

Results showed ships' crewmembers had problems with staying awake on the job, trouble falling asleep, and crewmembers did not feel rested when they woke up. Two previous studies of U.S. Navy ships in the Persian Gulf also found poor sleep quality and inadequate rest among crewmembers (Congleton et al., 1988; Steele et al., 1989). Concerning health symptoms, tension/ anxiety, and fatigue, the crewmembers on the AGF were higher than the MSO on these measures. This finding is again consistent with Steele et al. (1989) who reported that Landing Platform Dock (LPD) crews (the AGF is a converted LPD) were higher on these measures than those of the MSO crews. Reasons suggested for these results were because of the LPD's hotter internal ship environments, less adequate cooling, and less access to topside than on the MSOs. An examination of the respective mean WBGT's on each ship shows that the AGF was 3 to 4 degrees higher than the MSO at the time the present study was conducted. Another possibility is the commonly observed phenomena that morale is higher on ships with a smaller crew. Higher morale and, therefore, a more positive outlook, would contribute to reduced feelings of tension/anxiety and fatigue.

Combining the data from the two ships and comparing their questionnaire responses to those of the sub-sample showed the sub-sample reported less sleep difficulty, were lower in percent of the sample reporting each health symptom, and lower in the mean severity of each health symptom. The sub-sample was also lower on tension/anxiety and two independent measures of fatigue. These results are consistent with the Steele et al. (1989) study. Using a similar research design these authors found that during a baseline period, a sub-sample of subjects selected for repeated measures reported less tension/anxiety and fatigue than a cross-sectional sample of subjects. The similarity of our findings and Steele's may have been due to: (1) a motivational factor, subjects who volunteered wanted to appear more positive; (2) the Hawthorne effect, increased individual attention increases positive feelings; or (3) an increased excitement level provided by participation in a research project.

Comparisons of tension/anxiety and fatigue showed a significant difference in the tension/anxiety level from pre- to post-watch when wearing an ice vest as opposed to not wearing one. The same effect was not found for either of the two measures of fatigue. It may be that the effects of the ice vest on tension/anxiety are more immediate, while the effects on fatigue are more cumulative. Thus, it may take several watchstanding sessions while wearing a cooling vest for a measurable effect to be found for fatigue. This conclusion is made in light of the sleep data which indicated 70% of the sub-sample crewmembers had trouble falling asleep. Sleep problems could contribute to an ongoing feeling of fatigue that may not be significantly affected by a single, four-hour watch with an ice vest.

Sub-sample responses to the vest survey indicated that wearing the ice vest was helpful in performing and standing a normal four-hour watch; it did not interfere with the performance of the job; and the subjects recommended that their ship obtain and make ice vests available for future use. This endorsement by the users of the ice vest, along with the research finding that tension/anxiety was significantly reduced during watchstanding when wearing an ice vest indicates that the U.S. Navy should consider a program whereby a passive microclimate system, such as an ice vest, be made available to crewmembers deployed in high heat/humidity regions. This recommendation

continues to be corroborated by the ongoing data analyses and review of the extensive physiological measures collected during this study. Preliminary results show that the ice vest was not only subjectively beneficial, but of significant physiological benefit.

#### **ACKNOWLEDGMENTS**

Several personnel made noteworthy contributions to this study; the authors want to especially thank HM3 Elmer Labranch, USN, for his hard work in the field, and for his dedicated assistance during data entry and subsequent statistical analyses. Also making a significant contribution was HM1 Alvin Almada, USN, whose expertise in the laboratory, and hard work and dedication in the field, are greatly appreciated. Also, for her statistical expertise and advise, thank you to Susan I. Woodruff.

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APPENDIX A

Naval Health Research Center Sleep Questionnaire Items,  
Cross-Sectional Sample, and Sub-Sample Response Percentages<sup>a</sup>

When you are working or need to stay awake/alert, do you ever fall asleep even though you are trying hard to stay awake?

<u>Cross</u>	<u>Sub</u>	
54.8	75.0	never or almost never
32.7	20.5	sometimes
7.7	-	often
2.9	-	always or almost always

What helps you to stay awake/alert on the job?

<u>Cross</u>	<u>Sub</u>	
23.1	9.1	fear of being caught
13.5	2.3	danger
12.5	20.5	coffee
19.2	15.9	other people around me
2.9	4.5	caffeinated drinks
26.9	20.5	other

How long does it usually take you to fall asleep after lights out?  
(mean for each group shown in minutes)

<u>Cross</u>	<u>Sub</u>
68.4	37.0

Do you ever have trouble falling asleep?

<u>Cross</u>	<u>Sub</u>	
17.3	22.7	never or almost never
40.4	47.7	sometimes
28.8	18.2	often
12.5	4.5	always or almost always

Do you usually feel well-rested after you wake up and first get out of bed?

<u>Cross</u>	<u>Sub</u>	
7.7	15.9	always or almost always
9.6	22.7	often
38.5	38.6	sometimes
41.3	15.9	never or almost never

<sup>a</sup>Rounding and missing data may result in item total percentages not equal to 100%

## APPENDIX B

### Environmental Symptom Composite Items

- Mental Fatigue:
- I have trouble concentrating.
  - I have trouble remembering.
  - I feel worried about something.
  - I feel irritable.
  - I feel tired.
  - I feel sleepy.
  - I had trouble sleeping last night.
- Heat Distress:
- I am sweating.
  - My hands are sweaty.
  - I feel warm.
- Muscle Fatigue:
- I feel weak.
  - My muscles are tense.
  - My muscles ache.
- Eye/Sight Problems:
- My eyes feel irritated.
  - My eyes are watery.
  - My vision is blurry.
- Headache:
- I have a headache.
  - My head is throbbing.
  - I feel light headed.
  - I feel nauseous.
- Ear/Hearing Problems:
- I have ringing in my ears.
  - My ears are blocked.
  - My ears ache.
  - I can't hear well.
- Nasal Distress:
- My nose is blocked.
  - My nose is running.
- Gastrointestinal Distress:
- I feel stomach pressure.
  - I have stomach pains.
  - My stomach is upset.
- Respiratory:
- It is hard to breath.
  - My breathing seems fast.
  - My breathing seems irregular.
- Coordination Problems:
- My sense of balance is off.
  - I feel clumsy.
- Chills:
- My hands feel cold.
  - I feel chilly.
  - I am shivering.

REPORT DOCUMENTATION PAGE

1a REPORT SECURITY CLASSIFICATION Unclassified			1b RESTRICTIVE MARKINGS N/A			
2a SECURITY CLASSIFICATION AUTHORITY N/A			3 DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.			
2b DECLASSIFICATION/DOWNGRADING SCHEDULE N/A						
4 PERFORMING ORGANIZATION REPORT NUMBER(S) Report No. 90-23			5 MONITORING ORGANIZATION REPORT NUMBER(S)			
6a NAME OF PERFORMING ORGANIZATION Naval Health Research Center		6b OFFICE SYMBOL (If applicable) Code 30	7a NAME OF MONITORING ORGANIZATION Chief, Bureau of Medicine and Surgery			
6c ADDRESS (City, State, and ZIP Code) P. O. Box 85122 San Diego, CA 92186-5122			7b ADDRESS (City, State, and ZIP Code) Navy Department Washington, DC 20372-5120			
8a NAME OF FUNDING/SPONSORING ORGANIZATION Naval Medical Research & Development Command		8b OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER			
8c ADDRESS (City, State, and ZIP Code) NNMC Bethesda, MD 20889-5044			10 SOURCE OF FUNDING NUMBERS			
			PROGRAM ELEMENT NO. 63706N	PROJECT NO. M0096	TASK NO. 03	WORK UNIT ACCESSION NO. 6002 DN248545
11 TITLE (Include Security Classification) (U) Effect of a Passive Cooling Vest on Tension/Anxiety and Fatigue in a High Heat and High Humidity Naval Environment						
12 PERSONAL AUTHOR(S) Burr, Ralph G.; Banta, Guy R.; Coyne, J.T.; Hodgdon, James A.; Chesson, Charles V. II						
13a. TYPE OF REPORT Interim		13b TIME COVERED FROM 6/89 TO 10/89		14. DATE OF REPORT (Year, Month, Day) 1990 October 16	15 PAGE COUNT 22	
16 SUPPLEMENTARY NOTATION						
17 COSATI CODES			18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number) Passive cooling, Persian Gulf, Tension, Anxiety, Fatigue, Sleep, Ice Vest.			
FIELD	GROUP	SUB-GROUP				
19 ABSTRACT (Continue on reverse if necessary and identify by block number) (U) Crewmembers aboard U.S. Navy ships in the Persian Gulf must work under high heat and high humidity conditions. Exposure to heat has been shown to affect sleep quality, cause tension, anxiety, and fatigue, and to decrease performance capabilities and cognitive operations. Because many ship spaces cannot be air-conditioned, microclimate cooling is necessary. Objectives of this study were to measure sleep problems, health symptoms, tension/anxiety, and fatigue among U.S. Navy personnel (N = 104) deployed in the Persian Gulf. Also, a sub-sample of subjects (N = 44) was measured and compared on levels of tension/anxiety and fatigue between watchstanding sessions while wearing and not wearing a cooling ice vest. Crewmembers reported falling asleep when working, trouble falling asleep, not feeling rested after waking up, mental fatigue, heat distress, and muscle fatigue. Sub-sample subjects had an increase in tension/anxiety from pre-watch to post-watch in the without ice vest condition, but decreased tension/anxiety during the watch when an ice vest was worn. The change in fatigue during watchstanding with the ice (continued on reverse)						
20 DISTRIBUTION/AVAILABILITY OF ABSTRACT <input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS			21 ABSTRACT SECURITY CLASSIFICATION Unclassified			
22a NAME OF RESPONSIBLE INDIVIDUAL Ralph G. Burr, M.A.			22b TELEPHONE (Include Area Code) (619) 553-9967	22c OFFICE SYMBOL Code 30		



UNCLASSIFIED"

19. Abstract (Continued)

vest compared to without the ice vest was not statistically significant. The majority (97%) of sub-sample subjects reported that the ice vest was helpful during watchstanding, that it did not interfere with their ability to do their job, and that they would recommend its future use. The results of this study suggest that the availability of a passive microclimate cooling system (ice vest) is beneficial for naval personnel standing watch in high heat/humidity environments.