TECHNICAL NOTE

A Subjective Study of Fatigue During Navy Flight Operations Over Southern Iraq: Operation Southern Watch

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Carrier Air Wing FIVE (U.S.S. *Independence*) sustained and continuous operations during the onset of Operation Southern Watch provided an opportunity to evaluate fatigue and responses to fatigue in naval aviation aircrew personnel. We compiled U.S. Navy Carrier Air Wing Five (CVW-5) aircrew subjective fatigue reports during and immediately after the 18 d of intensive carrier aviation operations enforcing the "No Fly Zone" over southern Iraq. This survey provided indicators for monitoring fatigue during patrols of 5–6 hours. Also addressed are the most commonly used methods to combat fatigue, including caffeine tablets and nicotine gum.

BY DIRECTION OF then-President George Bush, Operation Southern Watch commenced on 27 August 1992 in order to enforce existing United Nations resolutions by securing the airspace south of Iraq's 32nd parallel. The order was carried out through inter-service sustained and continuous operations (sus/con ops) by the battle group in the Persian Gulf, the U.S.S. *Independence* CV-62 with Carrier Air Wing Five (CVW-5) embarked and U.S. Air Force assets in theater. Sus/con ops are defined as air operations lasting longer than 24 h. Air patrols were assigned to protect Shiite Muslim settlements in this region from Iraqi attack.

Prior to operation Southern Watch, the direction by CVW-5 Commander, Captain A. N. Langston, was to work up to a readiness level capable of handling any contingency. From the beginning of deployment, the aviation medicine department had operated on that premise and, therefore, had previously briefed the air wing on sus/con ops, safety training, and desert survival. During pre-cruise work-ups (integrated air wing operations in preparation for a 6-month deployment), LCDR Dave Brown (dual-designated flight surgeon and naval aviator) came to the air wing to get first hand experience of carrier flight ops and to discuss several aspects of sus/con ops. At that time, fatigue protocols were reviewed in depth, and the experience of the U.S. Air Force using performance maintenance medications (amphetamines and temazepam) during Operation Desert Shield and Desert Storm were discussed. The past use of these medications by the Air Force showed there were no adverse effects and the medications helped maintain performance level during flight operations [Unpublished report, Desert Shield, Desert Storm, Aerospace Medicine Consolidated After-Action Report: USAF summary of 29 individual after-action reports. Proceedings of the Squadron Medical Element (SME) After-Action Conference, at Langley AFB, VA, 20–22 May 1991]. The Navy line commanders felt that the use of the U.S. Air Force protocols could give them an advantage during sus/con ops. Therefore, a request from the Senior Naval Flight Surgeon for our Air Wing to stock and pre-test amphetamines (using the Air Force protocol) was forwarded up the chain of command. In the absence of established naval aviation amphetamine/sedative guidelines, the Force Medical Officer, Naval Air Forces Pacific, determined in consultation with Chief, BUMED and Naval Aerospace and Operational Medical Institute (NAMI), that current Navy Policy precluded the stocking, pretesting or use of amphetamines/sedatives to maintain performance. Caffeine and nicotine protocols were made available by NAMI due to their wide spread acceptance and safety (Unpublished NAMI all-Navy message).

The Air Force stimulant and sedative protocols emphasize prudent planning and recognition of human performance parameters, as well as the necessity for flight surgeons to closely monitor the physiologic and psychologic status of aircrew personnel. New Navy guidelines for performance maintenance are currently under review, (Brown D. Personal communication, 1993).

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TABLE I.

Approximate CVW-5 sorties in support of Operation Southern Watch	1400
Approximate number of flight hours in support	5200
Approximate sortie completion rate	99.7%

Notably, a mention of performance maintenance (i.e., use of "Enerjets"™ caffeine tablets 75 mg) during an interview with the media resulted in a misquote. This led to immediate queries from Force Medical Officer, Naval Air Forces Pacific, as to our exact use of performance maintenance medications. Because NAMI protocols were being used for caffeine and nicotine, the issue was readily resolved.

Caffeine tablets and nicotine gum were made available to aircrew according to the following NAMI protocols. Caffeine tablets (100–150 mg) were taken 1–2 h before period of maximum drowsiness (or as necessary) up to 300–600 mg in any 6-h period, titrated for effect. Aviators avoided caffeine for 24 to 48 h preflight to maximize in-flight benefits. Smokers used nicotine gum as per the medication insert. During this period of sus/con ops, CVW-5's aviation medical department gathered information via survey format addressing fatigue and aircrew perceptions of the use of performance maintenance medications (See Fatigue Survey, Appendix A).

Background

CVW-5 is composed of two (Fighter) F-14 squadrons, two (Fighter and Attack) F/A-18 squadrons, one (Attack) A-6, (Electronic Counter Warfare) EA-6B, (Forward control) E-2, (Helo) SH-3H, and (Antisubmarine) S-3 squadrons. The F-14 squadrons and F/A-18 squadrons were the primary combat air patrol aircraft over Iraq during operations and were required to fly around the clock during surges (increased operations tempo). These sorties could last up to 6 h with as many as five in-flight refuelings. The Hawkeye squadron was tasked with airspace control. The SH-3H helicopter squadron flew during all flight operations and frequently during no-fly days. EA-6B Prowlers were responsible for searching for enemy air defenses over Iraq and anti-radiation missile coverage for most sorties. S-3 and A-6 aircraft were primarily responsible for tanking (refueling). The A-6 additionally carried strike packages of anti-radiation missiles and conventional bombs. All flights required repetitive and monotonous tasks to some extent.

More flight hours were flown during Operation Southern Watch by the Air Wing than during the wing's busiest 18 d of Desert Storm, according to CVW-5 maintenance records. Operations began with a 72-h surge through 2200 on 30 Aug., with approximately 100 sorties each 24 hours. CVW-5 operations in support of Southern Watch ended with a 36-h surge of 170 sorties on 14–15 Sep. Flights averaged from 4 to 6 h. Total sortie load was shared with the U.S. Air Force. Crew rest and flight days were closely monitored by the air wing commander, squadron commanders and flight surgeons. The U.S.S. *Independence* was relieved by U.S.S. *Ranger* on 18 Sep 92. No mishaps occurred during the 18 days of sus/con ops.

MATERIALS AND METHODS

A survey formulated by the air wing flight surgeons was used to determine aircrew experience with fatigue and the use and effect of performance maintenance medications during the operation period. The survey was distributed on the 9th day of the operation and was collected on the 18th day. Of the 225 aircrew members, 125 (55%) responded. For quantitative information on amount of sleep, the respondents' questionnaires were separated by rank and aircraft type (Table II).

RESULTS

The majority of aircrew respondents felt that they had experienced some form of fatigue, while 18% of the

TABLE II. SLEEP/FLIGHT DURATION (HOURS).

Organization and Rank	Average Sleep Prior to Ops.	Average Sleep During Ops.	Most Sleep During Ops.	Least Sleep During Ops.	Longest Flight During Ops.
Staff, 04 & above	5.3	5	6.3	2.7	5
Staff, 03 & below	6	5.3	6	3.3	4.4
VAW-115, 04 & above	7	3.5	5	0	5
VAW-115, 03 & below	7.4	5.9	7.5	2.5	5.1
VAQ-136, 04 & above	7	5.5	7.8	2.5	5.4
VAQ-136, 03 & below	7.4	5.8	8.5	3	5.3
VS-21, 04 & above	7.3	4.9	7	2.2	4.5
VS-21, 03 & below	7.6	5.8	8.4	2.6	4.3
VFA's, 04 & above	7	7	8	3.5	5.8
VFA's, 03 & below	6.9	6.4	9	3.5	6.3
VF's, 04 & above	6.5	5.1	7	2.7	6
VF's, 03 & below	7.7	5.5	8	2.6	5.8
VA-115, 04 & above	6.7	4.7	8.7	2	5.4
VA-115, 03 & below	7.4	5.5	8	2.2	5.4
Combined 04 & above	6.7	5.1	7.3	2.4	5.3
Combined 03 & below	5.8	5.7	8	2.7	5.2
Overall Average	6	5.6	7.9	2.6	5.2
Total Responses	121	122	122	123	120

respondents said that fatigue was not a factor. Fatigue was known to be responsible for canceling one sortie. One individual stated that "continuous operations were not a problem as long as we could take naps." Several respondents described low back and gluteal (buttocks) pain during flights lasting more than 5 h, especially in the F/A-18 community. Signs/symptoms of fatigue reported were:

Low back pain and seat pain
Insomnia
Headaches
Sleep cycle affected; took several days to adapt
Difficulty staying alert/focused during long flights
Falling asleep during pre and post flight briefs
Stress before first flights over Iraq due to unknown Iraqi response
Short temper and frustration; irritated
Exhaustion
Fell asleep manning a spare (back-up aircraft)
Drowsiness
Increase in little mistakes
Performance degradation

Planning and coordination were significant problems early during operations. One of the problems cited was time of release of the flight schedule. The schedule came out very late each night due to the planning and transportation delay between command central in Dhahran and the carrier. This required the schedule officers and most of the squadron aircrew to stay up until the wing schedule was digested and disseminated. This scheduling problem did improve as operations became more routine.

Table II shows a compilation of sleep obtained prior to and during operation Southern Watch as well as the longest flights flown. This information is consistent with data gathered from other sus/con ops. On the average, junior officers (rank of ensign 0–1 through lieutenant 0–3) got 0.6–1.1 h more sleep per night than 0–4's (lieutenant commander) and above. This is due to the many collateral duties the 0–4's have at the department head level. Overall, sleep decreased by 0.4 h, with the biggest loss of sleep by the 0–4's and above, who lost an average of 1.6 h sleep per night.

The survey showed that no sleep/wake cycle was established during these operations. One aviator described his cycle as "planning, sleeping, flying, sleeping." Subjective sleep averaged between 2–4 h. Others described their cycle as "all messed up, sleep was gotten whenever there was a break, depending on schedule (Alerts, spares, night flights and day flights)." Another comment was: "I slept when I could, ate when hungry and flew when scheduled."

The use of performance maintenance modalities was discussed. The aircrew were queried as to what modalities they used during Operation Southern Watch. The results are summarized below in Table III.

Fatigue was made worse by the heat and dehydration of operating in the Gulf. One aviator stated, "Fatigue caused me to cancel one flight after flying a 4.5-hour flight in the afternoon. I was too tired to fly a 6-hour night event." Flight deck temperatures routinely approached 120–150°C. Many minor heat stress casualties occurred among flight deck personnel despite a strong hydration program in effect. The hydration program included frequent directions from supervisors to drink water, and readily available coolers stocked with ample liquids. Personnel were taught to use urine frequency and concentration as a rough indication of hydration.

TABLE III. COMMONLY USED PERFORMANCE MAINTENANCE MODALITIES.

Modality	Number	
None	(44)	
Coffee	(39)	avg. 1–2 cups before flying and 1–7/day.
Caffeine Tablets	(18)	respondents for a total of (35+) times.
No Responses	(5)	
Candy	(5)	
Soda	(4)	range of 2–7 sodas a day.
Snuff Tobacco	(3)	
Iced Tea	(3)	
Nicotine Gum	(2)	respondents for a total of (3) times.
Tobacco cigarettes	(2)	
Total	(125)	[Some respondents marked more than one modality..]

DISCUSSION

Every 4–5 d, the U.S. Navy and U.S. Air Force would alternate days of no flight operation. The sister service would take all sortie responsibility for a 24-h period while the other service corrected maintenance problems on aircraft and, if time was available, rested. For the aircrew, this "no-fly" day was a "big help, as shorter periods of rest did not prove adequate." Collateral duties for the aircrew during the first 72 h of Operation Southern Watch were discontinued; they were only required to fly and rest. When the likelihood of conflict decreased, the aircrew started to pick up their collateral duties and administrative obligations again. Subjective data are consistent with previous studies (1,2,4); it appears that aviators need a minimum of 5–6 h of rest before another mission can be flown at 100% capacity.

In all the squadrons, senior officers (Commander 04's through Captain 06's) had unique stress. Senior aircrew were tasked with flying all early flights due to their experience level. In addition to flying most sorties, additional department head duties made them the highest risk group for fatigue (especially after the first few days of ops). One aviator from an F-14 squadron stated, "Seniors flew on an average of twice a day, junior officers flew on an average of every other day." One Admin Officer stated that "work kept me from going to strike planning." Another Maintenance Officer stated that "briefs were too long" and that he was "interrupted by many phone calls from ground personnel, all the time."

Fighter aircrew used caffeine tablets more than any other squadron. Some aviators reported using caffeine tablets more out of "boredom" than for onset of fatigue. Caffeine tablets were used mostly at the end of long flights. The majority of comments from persons who used the caffeine tablets were positive. The tablets were credited with maintaining performance level and decreasing drowsiness. There was only one reported

negative effect due to the caffeine tablets. An F/A-18 pilot who did not regularly drink coffee used a caffeine tablet on an empty stomach. He stated that he felt agitated, had difficulty with in-flight refueling (tanking), and had some concern about his carrier landing. Some aircrew recommended sucking on the tablet until it was half gone, then taking it out and saving the rest for later to use if drowsiness returned. Some other aviators used hard candy for a "surge of energy" before a landing.

A review of the survey shows that fatigue was most evident at times of decreased sensory inputs (circadian troughs). High sensory input times, such as landing or tanking, allowed full performance of tasks with little or no fatigue. The times of low sensory input [i.e., redundant briefs, flying in Marshall (flying at a given altitude and TACAN distance from the carrier, waiting to be recovered on deck), long monotonous flights and flying during circadian troughs] allowed the greatest potential for fatigue to occur (Table IV).

CONCLUSIONS

There was evidence of widespread fatigue, which did affect operations (in the form of a canceled sortie). The major concern of fatigue during sus/con ops is an increase in mishap potential (i.e., loss of situational awareness and increasing susceptibility to spatial disorientation), as well as decreasing ability in handling an emergency or unexpected combat situation (loss of the advantage). The greatest chance for fatigue occurs during repetitive or low sensory periods.

While there is little objective evidence to establish the effectiveness of performance maintainers, within our experience, few if any associated adverse effects occurred with caffeine or nicotine while using NAMI protocols. There appeared to be a strong positive psychological factor in having caffeine tablets available. Further research and policy should be pursued by the U.S. Navy to determine the best way to maintain performance during sus/con ops.

Consistent with previous literature, particularly the Cambodian Airlift report by Rayman (3), several areas should be emphasized by unit flight surgeons in preparing for sus/con ops:

- Daily close observation of aircrew.
- Frequent briefings, even before a hint of sus/con ops. This should be a regular topic for flight surgeon briefing, so that aircrew will think about these types of ops before they occur and be better prepared to handle them.
- Establish a good rapport with all aircrew. In the air wing environment, this may be particularly challenging due to having 225 aircrew and only two flight surgeons. The best way to build rapport with the squadron is to fly on a regular basis under all conditions.
- The decision to "down" (ground) aviators temporarily due to fatigue should be made jointly with the individual and squadron Commanding Officer or his representative.
- Prior flight schedule planning to obtain 4–6 h of uninterrupted sleep per night should be an integral part of all future strike operations planning. Both this operation and Operation Desert Storm demonstrated a need for increased sensitivity to the issue of sleep and its relationship to fatigue.

Maintenance of performance is key to sus/con ops. The experience we gained recently during Southern Watch is invaluable. Several indicators of fatigue have been discussed. Flight surgeons and commanding officers should maintain close observation of aircrew to determine if there are any of these early signs of fatigue. The best way to avoid a mishap is proactive involvement. The best form of medicine is preventive medicine.

Even with the shift in warfare scenarios away from a major European conflict and towards limited warfare, sus/con ops are still going to be "war winners," especially with smaller air wings and fewer carriers. Guidelines and protocols are needed in the fleet. The current NAMI protocol for caffeine and nicotine is extremely helpful in maintaining our fighting capability. It is important to use established U.S. Air Force guidelines to build further. These protocols will provide a valuable tool for unit and air wing commanders to better fight their commands, and to identify fatigue before it affects mission accomplishment.

TABLE IV. TIMES WHEN AIR CREW FELT FATIGUED.

Time	No. Responses
Most of the time	19
Infrequently	10
Preflight briefs	9
Marshall	5
Debrief after flight	5
Not at all	5
Early morning flight	4
Fatigue after planning	3
The end of the flight	3
Late night flights	2
Sunset	1
Extended ops	1
Tanking before entering Iraq	1
Total	68

APPENDIX A. FATIGUE SURVEY.

From: CVW-5 Aviation Medicine Department 04 SEPT 1992
To: CVW-5 Aircrew

Subj: Fatigue Survey

Please take a few minutes and fill out this survey; your answers may help future continuous operations. PLEASE USE THE BACK OF THIS SHEET IF YOU RUN OUT OF SPACE OR HAVE ADDITIONAL COMMENTS.

1. What difficulties did you encounter, with respect to fatigue and flying continuous operations?

2. What is your average sleep a night during continuous operations? _____ . What was the most sleep you got a night? _____ . What was the least amount of sleep a night you received? _____ . What was your average night sleep before this operation? _____ . What was your longest flight? _____ .

3. Describe your wake-sleep cycle during these continuous operations.

4. Did you use caffeine tablets, nicotine gum, coffee or tobacco during *Operation Southern Watch* to help improve alertness? If so what type, how many times and how much did you use?

5. Did you feel fatigue all the time, most of the time or not at all? Explain in detail the times that you felt fatigued.

6. Some squadrons were briefed earlier in the cruise by LCDR Dave Brown about maintenance enhancers currently under consideration in Naval Aviation. What are your thoughts with respect to augmenting alertness with medications (low dose amphetamines) and assisting in sleep onset (sleeping medication) during continuous or cyclic operations?

7. Thank you for your assistance in this survey. Please drop this off at CAG admin or the flight surgeons office.

NAME/RANK _____ K. M. Belland
SQUADRON: _____ LT MC USN (FS)

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