CATECHOLAMINERGIC RESPONSES TO STRESSFUL MOTION STIMULATION: NORADRENALINE AND AMPHETAMINE. B. L. Kohl, and W. E. Chelten, National Research Council, NASA Johnson Space Center, Houston, Texas 77058.

The purpose of this study was to determine how motion sickness develops, which is of critical importance when determining the acceleration, rainfall, and loading environment a given system will be exposed to during flight. The human body is composed of many systems, each with its own motion sickness threshold. The development of an effective motion sickness countermeasure requires an understanding of the underlying mechanisms involved. The impact of motion sickness on the human body is complex and involves multiple factors, including psychological, physiological, and environmental variables. The results of this study are presented in Table 1.

Table 1. Motion sickness threshold values for various systems.

<table>
<thead>
<tr>
<th>System</th>
<th>Threshold Value (g)</th>
</tr>
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<tbody>
<tr>
<td>Head</td>
<td>0.45</td>
</tr>
<tr>
<td>Upper body</td>
<td>0.90</td>
</tr>
<tr>
<td>Lower body</td>
<td>1.35</td>
</tr>
<tr>
<td>Feet</td>
<td>1.70</td>
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</tbody>
</table>

The data presented in Table 1 indicates that the head is the most sensitive part of the body to motion sickness, with a threshold value of 0.45 g. The upper body threshold is 0.90 g, followed by the lower body at 1.35 g, and the feet at 1.70 g. These values are based on the results of a series of experiments conducted on a sample of adult males and females. The experiments involved exposure to a variety of motion conditions, including head movements, upper body movements, lower body movements, and foot movements.

The results of this study have important implications for the design of motion sickness countermeasures. The data suggest that the head is the most critical part of the body to protect, as it has the lowest motion sickness threshold. This information can be used to design effective countermeasures, such as biofeedback systems, that target the head to reduce motion sickness.


The military pilot's head now is being used as a "platform" for the mounting of myriad audio and visual devices to enhance terrestrial situation awareness. The military's interest in helmet mounted displays (HMD) has increased because of the operational enhancement that can be gained by using helmet mounted displays. The military's interest in helmet mounted displays has increased because of the operational enhancement that can be gained by using helmet mounted displays.

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INTRODUCTION. Lychak proposed that motion sickness develops in man and animals when rhythmic changes in body displacement centering around 12/sec synergize with brainstem events occurring in the alpha and beta (0.17-0.25 Hz for beta rhythm). The resonance hypothesis is based on some selected factors associated with MS but is inconsistent with other evidence. METHODS. Squirrel monkeys, cyanomolgus monkeys and cats were exposed to continuous linear vertical sinusoidal displacement at constant head velocity horizontal rotation. Neural centers for vomiting (CTZ) were surgically ablated in some subjects. RESULTS. Squirrel monkeys of Bolivian phenotype developed MS syndrome readily during rotation but never during vertical linear oscillation. A different phenotype was highly resistant to all motion. Neither vertical displacement nor horizontal rotation created signs of MS in cyanomolgus monkeys or cats. Based on data from CTZ-ablated animals we postulated link between beta rhythm, poisoning and MS is questionable.

CONCLUSION. Contradictory findings from animal and clinical evidence can be explained by the resonance hypothesis of MS as it is currently formulated.

FOOT RESTRAINT WITH A RIGID EVA ENCLOSURE IN A NEUTRAL GRAVITY ENVIRONMENT. B. S. K. Cheung, K. E. Money. Defence and Civil Institute of Environmental Medicine, Toronto, Ontario, Canada, M3M 3B9.

INTRODUCTION. In order to maintain crew compatibility and performance during future long-duration space missions, it is important to understand how various factors related to the space environment may influence crew member interactions. METHODS. Fifty-four American, European, and Soviet astronauts and cosmonauts who flew in space were assessed with respect to various aspects of crew communication in the space environment. RESULTS. Sensitivity activities (Watching and Listening) were judged to significantly increase interpersonal conflict, whereas Cooperative Activities (Reading, Gesturing, and Writing) significantly decreased. Four factors were perceived to significantly help intra-crew communication: Shared Experience, Excitement of Space Flight, Close Quarters, and Isolation from Earth. Three factors significantly hindered communication: Facial Swelling, Spacecraft Ambient Noise, and Space Sickness. Two factors showed no effect: Weightlessness and Facial Redness. CONCLUSIONS. The space environment may increase sensitivity to communication but decrease communicative activities. Intra-crew communication may be helped by factors related to sharing a unique similar life experience or being brought closer together physically. It may be hindered by factors related to physical or physiological stress. Weightlessness per se appears to have no effect on crew member communication.

THE INFLUENCE OF AGE ON SUSCEPTIBILITY TO MOTION SICKNESS. R. S. K. Cheung, K. E. Money. Defence and Civil Institute of Environmental Medicine, Toronto, Ontario, Canada, M3M 3B9.

INTRODUCTION. The influence of age on susceptibility to motion sickness has not been systematically studied. Most reports suggest a characteristic decline in susceptibility from a maximum in pubertal childhood to relative insensitivity by the sixth decade of life. However, Noble contends that susceptibility to swing sickness increases above the age of 60. In primates, older squirrel monkeys were reported to have longer latencies to vomiting in response to rotation than young ones. METHODS. A longitudinal study on the effects of age on the susceptibility to motion sickness was conducted. Life span 15 years was carried out over a 10-year period (1982-91). Ten male, mature (3-5 years old) Bolivian phenotype squirrel monkeys were found to be susceptible to motion sickness induced by a mechanical oscillatory rotation at 25 rpm in a visually unrestricted environment. Signs of motion sickness were quantified by a rating scale modified from Graybiel's diagnostic criteria. Baseline susceptibility level was established from 3 trials (1 trial every 10 days) to each animal. Throughout the 10-year period various series of anti-motion sickness drugs were investigated. At the beginning and end of each series the monkeys were subjected to the same motion profile and the severity of sickness and latency to vomiting/retching were assessed and compared with the initial baseline score. RESULTS. Latency to vomiting and severity of sickness obtained from year 1 (forward, backward, right, left), and forward and backward were significantly stronger than at any age earlier. Throughout the 10-year period no significant changes in the susceptibility level in all the monkeys throughout the 10 year period. CONCLUSION. In squirrel monkeys there is no consistent trend in forward and backward motion sickness, and it is not age that has an effect on susceptibility, but rather the development of behavioral strategies for coping with different types of motion.
INTRODUCTION. Advanced helmets incorporating visual display equipment, with greater size and weight and helmets currently in use, have the potential to increase crewmember's risk of head and neck injury during ejection or adverse conditions. The increased risk of injury can arise from the helmets exerting large accelerative forces on the head, helmet structural failure, and the ejection seat improperly functioning due to its velocity sensors (G-plug tube) being unable to function because of gravity. Instrumented manikins seated in an ACES II ejection seat were exposed to conditions resembling those of 60 Knots Equivalient Air Speed (KEAS) with six different helmets at the seat positions and two head positions. Standard ACES II pilot tubes as well as nose deforms and pilot tubes which extend farther into the airstream were tested. RESULTS. Four of the new configurations significantly interfered with the standard ACES II pilot pressure measurement; however, use of deployable pitots eliminated most of the interference. The helmets produced larger neck loads, and many helmets suffered some structural failure at the higher accelerations (>450 KEAS) including one which produced large neck forces. CONCLUSIONS. Use of deployable pilot tubes would eliminate interference that could cause pre-ejection deployment of the crewmember's main parachute during ejection resulting in potentially injurious rise in loads for all the configurations. The aerodynamic loading on the helmet created a nearly constant neck injury during emergency egress, especially at velocities greater than 450 KEAS.

EXPERIENCES WITH USING THE HELMET AS A PLATFORM FOR VISUAL DISPLAY IN HIGH-G ENVIRONMENTS. B. R. McKenna* and R. L. Kramer, USAF Armstrong Laboratory, Weight-Patterns Lab., MA 02359-5751.

BACKGROUND. Techniques designed to measure the effects of acceleration on helmet-mounted devices such as night vision goggles (NVG) and helmet-mounted displays (HMD) have been developed on the Subjective Motion Simulation (SMS) centrifuge. These techniques include manikin tests, human measures of "image migration," three-dimensional measurement of human head movement, fit assessments, and subjective measures of helmet comfort. These types of measurement techniques have been correlated with each other, with helmet profile, helmet-center-of-gravity (COG), and with each subject's neck strength. METHOD VARIABLES. One basic issue was the degree of image migration (the amount of movement away from the eye the display aperture exhibited under acceleration). This amount was strongly affected by helmet weight, helmet profile, helmet-center-of-gravity (COG), and with each subject's neck strength. A related issue was that, overall, the systems which exhibited the largest amount of image migration were rated the least comfortable (increased incidence of "hotspots" and uncomfortable tightnesses). Another issue was head stability. As the weight of the helmet-mounted systems increased, head stability under acceleration decreased; again, neck strength as a mediating variable in this relationship proved weaker than originally hypothesized. RELEVANCE. Relevant test and evaluation efforts should be conducted before deploying helmet-mounted systems in operations. The most important design recommendations may prove to be that helmet weight be minimal and the helmet be as close to the natural head COG as possible. In addition, the trade-offs between helmet stability and comfort may become a major factor concerning pilot acceptance of helmet-mounted systems. Finally, neck strength needs to be evaluated further in a more realistic flight regime. Subjects were rapidly moving their heads during target location under varying gaze cues and levels, before any definitive recommendations can be made.


INTRODUCTION. Throughout Desert Shield deployed aircrew members lived under conditions of great uncertainty concerning the nature and magnitude of their mission should efforts for a peaceful solution fail. As the United Nations deadline passed and hostilities were imminent, it became clear that large numbers of additional medical personnel would be required and they would have to be prepared for war in a very short period of time. This presentation will fully describe the training program developed to address this emergent need. METHODS. The intent of the program was to provide: (1) a rapid orientation to a combat environment, (2) instruction on conventional, chemical and biological warfare, (3) aeromedical operations training, and (4) psychological preparation for further deployment and the reality of combat. RESULTS. Within 6 weeks, a total of 946 medical, operations, MASF personnel and aeromedical crew members completed the training and were deployed to numerous sites within the theater of operation. Anecdotal evidence suggests that such intense on-site training provides focused instruction, enhances cohesion among crewmembers, and sharpens real world performance. CONCLUSION. This on-site program provided intense training in hostile and threatening environments and extreme and adverse conditions. Despite these circumstances, personnel were committed to learning because of the immediate implications of their abilities in a wartime environment. The implications of this type of real-world training program for the structure and context of peacetime readiness training are numerous.

INSIGHT INTO THE MANPOWER, MANAGEMENT, AND MORALE OF A MASF DURING OPERATION DESERT STORM. M. J. Maier. 32nd Aeromedical Evacuation Group, Kelly AFB, TX 78241.

INTRODUCTION. The 32nd Aeromedical Evacuation Group (AEG) was activated in January, 1991, and four Mobile Aeromedical Staging Facilities (MASFs) were deployed to Saudi Arabia and a fifth MASF to Incirlik AB, Turkey. The overall mission was to establish an operational MASF for aeromedical evacuation of casualties from the theater. This presentation will focus on the specific factors which created problems for the MASF deployed to Turkey, part of the Area of Responsibility (AOR). These factors included three "K's" (manpower, management, and morale) as well as logistics and training. Guidelines to assist services in unit problems in identification and resolution will also be discussed.

METHODS. Slide/transparency presentation and handout material. 1) 32nd AEG members deployed to Turkey. 2) Problem identification list related to deployment. 3) Problem resolution plan. 4) A check-list for developing a unit-specific plan.

RESULTS. This study will identify the responsibility of the Aeromedical Evacuation Unit to establish a more specific operationally relevant problem prevention and/or solve problems resulting from actual wartime deployment. CONCLUSIONS. The presentation will recognize the vulnerability of MASF personnel to identified problems related to manpower, management, morale, logistics, and training during wartime deployment. The need for a specific plan will be emphasized to ensure that the highest level of readiness can be achieved during wartime.

EXPERIENCES OF AIR EVACUATION IN SAUDI ARABIA. C.A. Kramr, 32nd Air Evacuation Group, Kelly AFB, TX 78241.

INTRODUCTION. The 32nd Air Evacuation Group was called to active duty in January 1991, assigned to the 161st Aeromedical Evacuation Squadron (Provisional) to set up mobile air staging facilities and assist with airlift of casualties out of Saudi Arabia (January to May 1991). This presentation will provide the experiences learned in aeromedical evacuation patient care, give an explanation of the aeromedical evacuation system, along with a description of the lifestyle of medical crew members during this period. METHODS. A slide presentation showing: (1) The MASF at and HUB. (2) A MASF on its own on classified site. (3) Scences from receiving patients to the MASF. (4) Scences loading the plane for a mission. RESULTS. This study will contrast the wartime and peacetime aeromedical evacuation system and lifestyle required of medical aircrew members. CONCLUSIONS. The presentation will recognize the accomplishments of the reserve medical personnel during this period and provide insight into their wartime roles.

TREATMENT OF ENEMY PRISONERS OF WAR DURING DESERT STORM. B.D. Robert. 228th Aeromedical Evacuation Group, Kelly AFB, TX 78241.

INTRODUCTION. The care of our own troops has always been a priority. During Operation Desert Shield/Storm enemy prisoners of war, because of the great number, became our primary mission. METHODS. A slide presentation will accompany the discussion. RESULTS. The presentation will show: (1) The difficulties in treating E.P.Ws, (2) The many cultural problems associated with even communications [1] The E.P.W's view on what was happening to them, present and future [4] The effect treating E.P.Ws had on our immediate MASF family. CONCLUSIONS. The presentation will recognize the many problems and solutions in treating enemy prisoners of war.
THE HUMAN ANIMAL BOND IN A MARTIAN SChecker& PERSONAL PERSPECTIVE OF DESERT STORM. C. J. Staszak, 63rd Aeromedical Evacuation Squadron O'Hare ANFB, IL 60666

Of major importance to personnel serving in Desert Storm were support systems. One mechanism for providing support for troops that has had little recognition within the military is human- animal bonding. From the time troops arrived in the AOR, warnings were given by the military not to touch, feed, or pet the animals in the area; but warnings were seldom obeyed when stress and danger. Animals were a positive diversion for many soldiers, lifted their spirits and made them smile. Putting a cat or dog often relieved loneliness and homesickness, reminded the soldiers of their pets at home, and helped them to take their minds off of where they were and what they were doing. Specific examples of how human-animal bonding provided support for selected personnel in Desert Storm will be presented.

CRITICAL INCIDENT STRESS DEBRIEFING: A POST DESERT STORM REASSIGNMENT TOOL. P.J. Marks*, C. Krakhtiz. 32nd AERomedical EVACUATION GROUP, KELLY AFB, TX 78234-5001.

INTRODUCTION. As personnel began to return to the 32nd AEG from Operation Desert Storm, obvious signs and symptoms of stress and readjustment difficulties were observed. This presentation will review the unique pre-deployment factors that influenced the stress levels of personnel, give guidelines to assist units in identifying/developing a plan to provide support during the readjustment phase. In addition, Critical Incident Stress Debriefing concepts/practice and design will be discussed.

METHODS. Transparency: a) Presentation 1) Members of the 32nd AEG during deployment and upon return 2) Critical Incident Stress Debriefing concept/practice 3) Checklist for developing a unit specific plan for CISD implementation. RESULTS. Identification of the responsibility of each Reserve unit to develop an ongoing plan for prevention and management of stress through education, training, and facilitation through the practice of CISD.

CONCLUSIONS. This presentation will acknowledge the susceptibility of all personnel to stress and the need for development of a unit specific plan to ensure the mental health, performance and safety at the highest possible level, particularly during wartime.


INTRODUCTION. Various types of paint schemes on aircraft propeller and rotor blades are used to improve the visual conspicuity and attention-getting value of those blades when they are rotating. The improved conspicuity resulting from the paint schemes has the purpose of reducing the number of injuries and fatalities that might occur due to accidental contact with a rotating blade by pilots, passengers, or ground crew. The present study was undertaken to provide information regarding the circumstances surrounding such accidents in recent years and to compare those findings with the frequency and circumstances of propeller accidents during a pre-1980 period. METHODS. Computer retrievals of brief reports of all propeller accidents during the period from 1983 through 1989 were provided by the National Transportation Safety Board. Those reports were examined and analyzed in terms of type of accident, degree of injury, actions of pilots, actions of passengers and ground crew, night or day, and other conditions. RESULTS. The computer search yielded a total of 88 reports of propeller accidents for the 7-year period. Twenty of these involved operation of the aircraft. The remaining 68 cases were "propeller-to-person" accidents. Causes and circumstances associated with the 68 accidents were analyzed and categorized. CONCLUSIONS. "Prop-to-person" accident frequency for the 1983-1989 period was notably lower than the mechanism of period for the 1960's and 1970's. Differences in the causes and circumstances of such accidents for the two time periods suggest the focal points for safety improvements.

COMPARISON OF SINGLE LOCUS AND MULTILOCUS GENE PROBES IN DNA FINGERPRINTING. S. Baker, S. Mackenzie, F. Miles, P. Tranchida, and W. Lackritz. Wayne State University School of Medicine, Detroit; VAMC, Allen Park; the University of Michigan Medical School, Ann Arbor, MI; Naval Health Research Center, San Diego, CA.

INTRODUCTION. In our attempt to identify the gene(s) associated with certain traits in the population, such as hypertension or a predisposition for motion sickness, we perform DNA fingerprinting. This technique can be used to identify victims of aviation mishaps. DNA fingerprinting can be done with single- and multilocus gene probes; we compared the advantages of each. The human genome has repetitive DNA sequences arranged in tandem-repeat units known as variable number of tandem repeats (VNTR). Discrimination between individuals is based on the number of repeat units present; VNTRs are length, rather than sequence, polymorphisms. VNTR length polymorphisms can be amplified with polymerase chain reaction. This technique is rapid, is performed, and analysis can be performed on minimal tissue from an accident site (i.e., a few cells). The human genome also contains multi-locus, dispersed tandem-repeat "minisatellite" regions which are highly polymorphic and are allelically variable in the repeat copy number in the minisatellites. DNA fingerprints specific for an individual can be detected with a probe based on a tandem-repeat sequence of many variable loci simultaneously. This technique is more lengthy, and it requires a larger tissue sample. However, the accuracy of multilocus probes is much greater than techniques with single locus probes. We advocate the use of both of these techniques over traditional forensic methods in the identification of victims of aircraft mishaps.


INTRODUCTION. One of the most frequently encountered problems in the interpretation of toxicologic results in animal fatalities is the source of ethanol often measured in those cases. Did the ethanol result from antimicrobial consumption or from postmortem formation or tissue decomposition? In many of these cases, fluids such as blood and urine are unavailable and the only collected specimens are solid tissues. METHODS. Twenty liver specimens not containing ethanol were divided into 1 g portions, stored in an aqueous environment at room temperature and analyzed for ethanol and other volatiles after 5 days. Volatile analysis was performed using head space gas chromatography. RESULTS. Variable concentrations of ethanol were produced over this time, ranging from 0 to 470 mg/dL. Acetaldehyde was the most frequently identified other volatile produced, but n-propanol and isobutanol were also produced. CONCLUSION. Large concentrations of ethanol can be produced in liver specimens, but no general statement as to the amount of ethanol produced can be made. The interpretation of postmortem ethanol concentrations must be made cautiously, especially when the specimens are decomposed.

INFLUENCE OF SAFETY CONCERNS ON DESIRE TO CHANGE AIRCRAFT TYPE. W.J. Unge, P.R. Crouch, Kodish. INTRODUCTION. The USCG is known for conducting flight operations occasionally in the most hazardous of conditions. USCG pilots have the potential to request and change aircraft (a/c) type, i.e., change from the fixed wing (fx) to helicopters and visa versa. The purpose of this study was to determine pilots perception of a/c and mission safety and the influence this has on pilot desire to change a/c type. METHODS. A voluntary questionnaire was sent to all operational USCG pilots, 461 (72%) participated. RESULTS. Two thirds (604) of helicopter pilots stated they would change a/c type. Only 1 (42) of the 29 fx pilots stated they would change their a/c type. CONCLUSION. Large concentrations of a/c type change was influenced, in part, by mission and a/c safety concerns. Over 900 of all pilots thought that compared to fx aircraft, helicopters had more dangerous missions and were otherwise less safe. Pilots whose desire for transition was influenced by safety concerns were found to be more senior, have more flight experience, and feel that they were engaging in dangerous flight operations. Other descriptive statistics and associations are given.

CONCLUSION. Helicopters are considered to have more dangerous missions and be less safe. Many helicopter bas the pilots would change a/c type due, in part, to safety concerns.
CONCLUSIONS. Effective medical leadership resulted in improved aviation safety through enhanced contingency plans. These revisions allowed prompt and effective treatment of all affected casualties.

THE ASSOCIATION OF AVIATION ACCIDENTS FOR APHAKIC VERSUS NON-APHAKIC CIVIL AIRMEN. V.B. Nakagawara* and E.J. Wood.

INTRODUCTION. Airmen with aphakia and intraocular lens (IOL) who, on a basis of work, do not obtain a waiver for a medical certificate, have been previously associated with higher aviation accident rates when compared to the total civil airman population. This study analyzes the accident frequencies of those airmen who have been issued a 5-year period (1982-85). METHODS. Medical records were evaluated for all certified airmen who were carrying FAA-specific pathology codes for aphakia and artificial lens implants. Aviation accident and active airman population frequencies were obtained from FAA databases. RESULTS. Aphakic and IOL airmen were found to have significantly higher (p < .05) accident rates than the total non-aphakic airman population. CONCLUSIONS. The significant association between aviation accidents and airmen with aphakia and IOL, even with improved ophthalmic surgical procedures and therapeutic devices, does not justify any relaxation in FAA's specialized aeromedical certification or in the clinical research review of these conditions.


INTRODUCTION. Personnel required to work in moderate or hotter environments while wearing the Chemical Defense Ensemble (CDE) experience heat storage, substantial diminution of work productivity, and health risks. Predicting responses of these workers would be very useful. METHODS. Work times at 21°C of 15 subjects performing hard work (45W) while wearing CDE were recorded. Work productivity and heart rate data was collected. Results were expressed as the predicted work performance based on prior brief measures of bench-step in the CDE, and heart rate responses. RESULTS. A model was developed which showed that the predicting work time for repeated work bouts in moderate temperatures in the CDE: (total time-7.2*bench step duration+4*bench comfort) basic technique. Unexpectedly, models which incorporated recovery heart rate as an independent variable were not as effective. CONCLUSIONS. With further refinement, the prediction approach tested in this study would be immediately useful for managing personnel working in CDE, and also useful to civil and military aviation. Also could be utilized at minimal cost during routine training.

This work was supported in part by the U.S. AFOSR/AFEC, Contract No. F49620-88-C-0053/88881-0378.

INTRODUCTION. Studies were conducted on a static copper model of the foot, sectioned into twenty-nine heat transfer regions. This foot model is used to determine the dry insulation properties of commercial and prototype cold weather combat boot systems (CWCBS). Heat flux through the boot sole is an important criterion in selecting CWCBS. The insulation of air (LI) between the foot and the boot sole is the key variable in the amount of heat flux through the sole. LI, which incorporates both the radiative heat transfer (h<sub>r</sub>) and the convective heat transfer (h<sub>c</sub>), is reduced when the boot sole is compressed, thus increasing the heat flux through the sole. The heat flux is further increased when the sole pressure is decreased. These variables were determined to evaluate three test methods: a free suspension (FS) test, a cold/dry environmental condition test (CDEC), and a cold and wet environmental condition test (CWC). The purpose of this study was to document the physiological responses of U.S. Navy Damage Control personnel wearing three types of cooling vests while continuously exposed to a subzero firing demonstration ship. METHODS. Nine male volunteers (36.7 yrs, 161 cm, and 81 kg) experienced fire fighting while monitored for heart rate (HR), four skin temperatures (Tsk), and core temperature (Tre) during six days of fire fighting (4-6 per day). Each subject wore the standard Navy fire fighting ensemble (fire retardant suit, gloves, boots, flash hood, helmet and breathing apparatus). Peak fire temperatures reached 600°C while temperatures in the adjoining fire fighting compartment ranged from 40-100°C. RESULTS. As expected, significant (p<0.05) heat strain occurred during approximately 25 min of fire fighting. However, substantially limited heat exposure was experienced by all subjects. The subjects' six day average heart rate and maximum heart rate were 141 ± 20 and 177 ± 12 bpm, respectively. CONCLUSION. Significant heat strain occurred during fire fighting. Additional studies are needed to determine the effects of heat strain on aircrew performance.

INTRODUCTION. Rescue of the astronaut flight crew from a contingency landing may require two personal cooling systems to evaluate their effectiveness in reducing heat strain on aircrews. METHODS. One of the systems was a long-sleeved shirt, while the other was a vest with an attached head unit. Both were cooled with cold liquid pumped continuously through the tubing in the garment. Ten student aviators wearing standard USN helicopter aircrew clothing and prototype personal cooling systems were evaluated in reducing heat strain during exercise in the heat following a baseline acclimation (AC) protocol. METHODS. Eight engineer personnel underwent an 8 day acclimation protocol (35°C, 70% RH) followed by 6 simulated engineer personnel exercise days in an environmental chamber (Tsk, Tre). Two cooling systems wore with a passive ice vest (IV), were performed in three thermal conditions: EW1=32°C, 46%RH; EW2=50.6°C, 33%/RH; EW3=57.2°C, 24%/RH. During AC, a 2-hr exercise protocol (exercise 25-min, rest 5-min) alternated treadmill walking with stationary cycling. The EW protocol consisted of a 20 min treadmill stage (3mph, 3%grade) and 40-min of seated rest each hour to a maximum duration of 6 hrs or volitional withdrawal. PV changes were determined from seated (20-min) blood samples obtained prior to entering and exiting the heat chamber. RESULTS. PV changes (%) across day-1, day-3, day-5 and day-8 (1.5-1.7 and t=0.8 respectively) of AC showed a trend towards conservation but were not statistically significant (p>0.05). End of PV changes after AC. CONCLUSION. PV was decreased over time and was less in the IV conditions for EW1 and EW2. PV findings may be the result of a considerably longer IV test duration in combination with the high heat. When expressed relative to test duration IV losses were twice those in the IV exposures. These results suggest that heat acclimation will conserve PV and minimize cooling can provide continued support of PV conservation during exposure to high heat.


INTRODUCTION. Fire fighters dressed in full protective ensemble and combating shipboard fires are subjected to extreme heat strain. However, the physiological responses of naval engineering personnel have not been well documented. Environmental chamber simulations to date have not been truly representative. Therefore, the purpose for this study was to document the physiological responses of U.S. Navy Damage Control personnel wearing three types of cooling vests aboard a fire fighting demonstration ship. METHODS. Nine male volunteers (36.7 yrs, 161 cm, and 81 kg) experienced fire fighting while monitored for core temperature (Tre) by EKG, four skin temperatures (Tsk), and heat strain while continuously exposed to a subzero firing demonstration ship. METHODS. Nine male volunteers (36.7 yrs, 161 cm, and 81 kg) experienced fire fighting while monitored for core temperature (Tre) by EKG, four skin temperatures (Tsk), and heat strain while continuously exposed to a subzero firing demonstration ship. RESULTS. As expected, significant (p<0.05) heat strain occurred during approximately 25 min of fire fighting. However, substantially limited heat exposure was experienced by all subjects. The subjects' six day average heart rate and maximum heart rate were 141 ± 20 and 177 ± 12 bpm, respectively. CONCLUSION. Significant heat strain occurred during fire fighting. Additional studies are needed to determine the effects of heat strain on aircrew performance.