INTRODUCTION. Helicopter operations conducted in high ambient temperatures expose aircrew to potentially dangerous physiological conditions. We tested 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 cooled vest (C). Both were tested with cold-liquid pumped circulating tubing in the garment. Ten student aviators wearing standard USN aviator clothing were exposed to both 35°C/55% RH and 50°C/25% RH with and without cooling for 60 min. Heart rate, blood pressure, and mean skin and rectal temperatures were monitored before and during heat exposure. Additionally, sweat rate and subjective thermal sensation were recorded in the heat. Subjects performed 30 min of continuous submaximal work on a recumbent bicycle (30 W for 10 min, 100 W for 10 min, 150 W for 10 min). Oxygen consumption, metabolic rate, and levels of perceived exertion were determined during exercise in the heat. Subjects were tested before and after each test.

RESULTS. Both systems effectively reduced physiological responses. There were no important increases in heart rate or rectal temperature. Mean skin temperatures in the adjoining fire-fighting compartment were reduced as the boot sole is compressed, thus increasing the heat flux through the sole. It was expected that the CWC system would be more effective than either the FS system or the FS test.

CONCLUSION. It was expected that the CWC system would be more effective than either the FS system or the FS test, but it was not. Further studies are needed to develop more quantitative methods for evaluation of U.S. Army Research Institute of Environmental Medicine, Natick, MA 01760-5007.


INTRODUCTION. Firefighters dressed in full protective ensemble and combating shipboard fires are subjected to extreme heat strain. However, environmental chamber simulations to date have not been true representations. Therefore, the purpose for this study was to document the physiological responses of U.S. Navy Damage Control personnel in a simulated fire fighting demonstration ship. METHODS. Nine male volunteers (36.7 yrs, 181 cm, and 81 kg) experienced in fire fighting were monitored for heart rate (HR), skin temperatures, and rectal temperature for 4 days of fire fighting (n=1 per day). Each subject wore the standard Navy fire fighting ensemble (fire resistant 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, heart rate and rectal temperature increased as a function of exposure time. CONCLUSION. Overall, there were seven subjects (3 men and 4 women). The subjects were slightly less for S, compared to S, but it was not. Further studies are needed to develop more quantitative methods for evaluation of U.S. Army Research Institute of Environmental Medicine, Natick, MA 01760-5007.

HEAT STRESS AND A COUNTERMEASURE IN THE SHUTTLE RESCUEMAN'S SUIT. D.E. Doerr*, H. Reid* and T.A. Castellon. NASA, Kennedy Space Center, FL 32899

INTRODUCTION. Rescue of the astronauts from a contingency landing may risk exposure of the rescue crew to toxic propellants spilling from potentially ruptured flight equipment were exposed to both 35°C/55% RH and 50°C/25% RH with and without cooling for 60 min. Heart rate, blood pressure, and mean skin and rectal temperatures were monitored before and during heat exposure. Additionally, sweat rate and subjective thermal sensation were recorded in the heat. Subjects performed 30 min of continuous submaximal work on a recumbent bicycle (30 W for 10 min, 100 W for 10 min, 150 W for 10 min). Oxygen consumption, metabolic rate, and levels of perceived exertion were determined during exercise in the heat. Subjects were tested before and after each test.

RESULTS. Both systems effectively reduced physiological responses. There were no important increases in heart rate or rectal temperature. Mean skin temperatures in the adjoining fire-fighting compartment were reduced as the boot sole is compressed, thus increasing the heat flux through the sole. It was expected that the CWC system would be more effective than either the FS system or the FS test.

CONCLUSION. It was expected that the CWC system would be more effective than either the FS system or the FS test, but it was not. Further studies are needed to develop more quantitative methods for evaluation of U.S. Army Research Institute of Environmental Medicine, Natick, MA 01760-5007.
OPERATIONAL CONSEQUENCES OF A-6 AND F-14 WORK/REST CYCLES DURING DESERT SHIELD/STORM. III. EFFECT OF OPERATIONAL TASKING ON LSO SCOURVES AND SUBJECTIVE READINESS. S.A. Shappell* and D.F. Neri. Naval Aerospace Medical Research Laboratory, Pensacola, FL 32508-5700.

INTRODUCTION. Operation demands placed on naval aviators during sustained or continuous operations continue to be an area of intense laboratory investigation. The recent Gulf War provided a unique opportunity to collect data examining aircrew work/rest cycles and operational tasking in a combat environment. METHODS. For four consecutive weeks during Operations Desert Shield and Desert Storm, nine A-6 and nine F-14 pilots onboard the USS AMERICA (CV-66) provided detailed daily activity data while conducting operations from the Red Sea. The pilots completed work/rest logs to a resolution of one-half hour. In addition, flight data was obtained including: 1) takeoff and landing time, 2) flight duration, 3) mission type, 4) consecutive days during which a flight occurred, 5) landing signal officer (LSO) scores, 6) arresting wire engaged on landing, and 7) subjective reports of the need delay before an air-to-ground strike mission could be flown (a measure of subjective readiness). RESULTS. Data analysis indicated that the amount of sleep obtained 6, 12, 18 and 24 hours prior to a combat mission may influence LSO scores and subjective readiness. Mission type, the number of consecutive days in which a flight occurred, time of day, and flight duration also were related to LSO scores and subjective readiness. CONCLUSIONS. These data provide valuable information for air wing commanders and senior mission planners when tasking carrier-based aviators. These data also provide an essential database for air combat and air wing flight surgeons to draw upon when assessing aircrew readiness.

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INTRODUCTION. The U.S. Navy has long been interested in the effect of combat flight operations on aircrew fatigue. A research team embarked aboard the USS America to collect data from an A-6 squadron and an F/A-18 squadron during Operations Desert Shield and Desert Storm. The purpose of their study was to determine the effects of air combat missions on subjective fatigue. METHODS. Twenty-six aircrew members, 22 pilots, and 7 naval flight officers (NFO's) completed the Standfords Sleepiness Scale (SSS), Mood Scale II from the Unified Tri-service Cognitive Performance Assessment Battery (UTC-PAB), and the fatigue subscale from the Addiction Research Center Inventory (ARC). The questionnaires were completed before and after each mission during the deployment. RESULTS. Data analyses indicated that the subjective fatigue operations during Operation Desert Storm yielded few indicators of sleep disturbances, although aviators generally desired more sleep. Aviators averaged a little more than 6 hours sleep during both operations. Frequency and duration of naps increased slightly during Desert Storm, while sleep onset times became later for A-6 aircrews. Both squadrons showed significant shifts in flight times during Desert Storm. CONCLUSIONS. Two factors may be responsible for the relatively small impact of the war on work/rest schedules and fatigue. The first is the obvious observation that high force levels in theatre allowed work/rest schedules to be well-managed. A generally overlooked factor may be the relationship between direction of ship travel and the phase of the circadian rhythms of the aircrew.

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INTRODUCTION: To understand how the CNS protects itself against Gz-stress, the anatomic location of key neurologic and vascular structures at eye-level must be known. METHODS: Cadaver sections of CNS and vascular structures were analyzed with respect to the hydrostatic theory of Gz-stress and neurophysiologic theory of Gz-LOC. RESULTS: Transverse sections 0.5 to 1.5 cm above the oribital line reveal a transition from pons to midbrain, and contain the Reticular formation, internal carotid, Ophthalmic, and Basilar arteries and a portion of the Circle of Willis (CoW) about the Optic nerves (OpN). OpN, by structure and development, are considered as a prolongation of the brain, unlike ordinary cranial nerves. Also, by virtue of their position, the tone of CoW vessels may impact on OpN perfusion to a greater degree than cranial nerves. The skull and the pressure compensation provided by the cerebrospinal fluid, CSF) and the physiologic (cardiovascular reflexes and functional buffer period, FBP). Geometry of the rest of the CNS, the eye, and the brain's circulatory system, about the same FBP, 15-20 torr, greater pressure (intracranal, IOP) and is not protected by CSF. Under Gz-stress, the location in the brain where perfusion pressure falls sufficiently to alter vision but not cause Gz-LOC corresponds to a region somewhat higher than eye-level. The above theories, OpN structure, IOP and lack of CSF support endow the eye with a unique capability to be affected by Gz prior to the rest of the CNS. This establishes the eye as an early Gz-stress sensor and an integrated CNS protective mechanism, which includes Gz-LOC, pressor and muscular compensation. As such, the Optic nerve could more appropriately be considered as the "Opticovagric nerve."
AN INVESTIGATION OF MIDDLE CEREBRAL ARTERY BLOOD FLOW VELOCITY AND ARTERIAL OXYGEN SATURATION UNDER SUSTAINED POSITIVE Gz. S. L. Johnson*, L. D. Tring*, and D. W. Repperger*, Department of Aerospace Medicine, Wright State University, Dayton, Ohio 45401.

EXPERIMENTAL DESIGN: The purpose of this study is to evaluate and compare the physiologic parameters of middle cerebral artery blood flow and eye level oxygen saturation with peripheral light loss in sustained +Gz gravitational forces. METHODS: This experiment was conducted with the Dynamic Environment Simulator (DES) in Wright Patterson Air Force Base. Seven subjects, three women and four men, were tested in the advanced prototype retrograde inflation anti-G suit (RIAS) and standard CSU 3IB anti-G suit. The subjects were instrumented with an Eden Medical Technologies 2100A and 1760 flow transducer. Middle cerebral artery blood flow velocity and eye level oxygen saturation were measured during 4.5 to 7 Gz endurance runs on the DES. End points of endurance were peripheral light loss to a 600 lux cone, gravid eye and fatigue. RESULTS: Middle cerebral artery blood flow was maintained in all subjects during sustained Gz. However, O2 saturation showed a linear decrease until peripheral light loss or pre-GLOC conditions. CONCLUSIONS: In sustained Gz the pulmonary system (due to ventilation-perfusion mismatch and shunting) may be the limiting physiologic component in pre-GLOC, with the percent oxygen saturation of the blood reaching the cerebral circulation being a critical factor. Therefore, maintaining adequate blood flow to the cerebral circulation alone is not sufficient in developing countermeasures to optimize G-tolerance and preventing and/or of impairing GLOC in sustained fighter aircraft maneuvers.

ASSESSMENT OF A PHYSIOLOGICAL MODEL OF G STRESS IN THE OPHTHALMIC ARTERY PRESSURE. A. Gonzalez and F. Rios*. Biophysics and Bioengineering Lab, Faculty of Medicine, University of Granada and SAF Aeromedical Center (C.I.M.A.), Arturo Soria 82, 28027 Madrid, SPAIN.

INTRODUCTION: The purpose of this work is to prove a mathematical model, to assess the tolerance force Gz acceleration using a digital simulation model. The model, the visual effects induced by the caudalward shifting of the blood volume. A parametric model of the cardiocirculatory system has been developed to predict the effects of head-up gravitational acceleration (HSA) in the tilt position. RESULTS: Previous studies suggested that the model was sufficiently validated including: (1) a critical analysis of the model and previous studies to the gravitational stress of the model, (2) the model shows the role of the vessel walls and blood flow resistance to flow, and (3) the accuracy of the ophthalmic pressure under +Gz. CONCLUSIONS: Tolerance to positive acceleration in a cranio-caudal direction by a computer model constitutes a practical way to optimize the HSA in a lab.

EFFECT OF HYPOXIA AND HYPEROXIA ON +Gz DURATION TOLERANCE. E. L. Reach*, R. E. Wiegman*, T. E. Norti*, A. Shalaby, and P. M. Worobey*. Flight Motion Effects Branch, Crew Technology Division, Armstrong Laboratory, Brooks AFB, TX and KRUG Life Sciences, San Antonio, TX 78235-5000.

INTRODUCTION: While available information suggests the metabolic basis for tolerance to high sustained G (HSG) is primarily anaerobic capacity and the ability of the body to use that capacity, little is known about the role of aerobic metabolism and its influence on +Gz duration time. Understanding that role is necessary to determine the importance of supplemental oxygen for operational use. METHODS: Utilizing the Armstrong Laboratory (Brooks AFB) Centrifuge, 8 human subjects were exposed to 5 Gz duration runs to 7 Gz for a total of 5 runs. Subjects were assigned to four conditions (HSA): 20% (mean 19.6), 15% (mean 15.6), 200% (mean 20.6), and 250% (mean 25.6) inspired oxygen (FIO2). The results were averaged over those runs for each subject. Heart rate was monitored continuously and blood lactate sampled periodically during all centrifuge exposures. A positive relationship between +Gz duration times and inspired oxygen (FIO2) was detected in subjects breathing 12% to 20% O2 gas mixtures; no change in duration time was detected between the 20% and 60% FIO2 gas mixtures. Although fatigue and light loss were the end points of interest, only about 50% of the 7 Gz runs were terminated for those reasons. Heart rate was negatively related and SAC2 positively related to FIO2. SAGCM resulted in increased heart rates but decreased SAC2; these SAGCM effects were additive to effects of +Gz.

CONCLUSION: Whereas +Gz duration is limited by reduced SAC2, it may not be enhanced by hyperoxia.

COMPARISON OF THE HYPOXIC AND HYPEROXIC RESPONSE TO MAXIMAL ANAEROBIC EXERCISE AND SUSTAINED +Gz EXPOSURE. J. E. Bloom*, R. E. Wiegman, T. J. Wiegman, and K. J. Magino. Flight Motion Effects Branch, Crew Technology Division, Armstrong Laboratory, Brooks AFB and KRUG Life Sciences, San Antonio, TX 78235-5000.

INTRODUCTION: While it is generally accepted that +Gz-duration tolerance is primarily an anaerobic activity, the degree of aerobic involvement has not been successfully quantified. On the other hand, the single Anaerobic Task (SAT) exercise task directly related to a simulated aerial combat maneuver (SACM) contribute profitably be shown to use both an anaerobic and aerobic pathway. RESULTS: The purpose of this study was to compare the physiologic response to SATS with that of aircrewman performance following WATS and SACM training, subjects (N=7) performed either SATS or WATS while exposed, in random order and with 48 h between tests, to either hyperoxia (60% inspired oxygen [FIO2]), normoxia (21% O2) or hypoxia (15% O2). Heart rate and blood lactate accumulation (SAC2) were recorded continuously. Blood was sampled via fingerpierc for lactate dehydrogenase pre- and post-run (+Gz, +Gz-1, +Gz-2). The blood samples were analyzed to determine the effect on mean Lactate was due to the exposure to 14.6% O2 exposure (+16,18,20,60%). Five of seven subjects were unable to initiate the SATS at 12% O2 due to 5. 9.50% during warm-up (exclusion of protocol). Blood oxygen saturation was significantly altered (p<.05) as a result of FIO2 during both SATS and SACM. CONCLUSION: Exposure to SACM may present a stressor which includes an aerobic component that may be greater than that previously reported for the WATS.


INTRODUCTION: Leaning forward in an aircraft seat changes the vectors of acceleration for each that the hydraulic heart-lung mechanics may be affected. The force vector changes from one vector primarily along the head-foot axis (Gz) to one with a significant vertical component in the elevation-airway axis (+Gx), a direction more tolerable to humans. This paper compared physiological data from subjects leaning forward or upright during +Gz exposures on a centrifuge. METHODS: Seven subjects between the ages of 27 and 40 (mean age 30.7 years) underwent a 4Gz to 9Gz (simulated Aerial Combat Maneuver (SACM) with 10 second plateaus at 5G and 9G. Heart rate and blood lactate accumulation (SAC2) were recorded continuously for the entire exposure time at 5G. Each subject ran the SACM profile twice, once while leaning forward approximately 25 degrees and once while upright. Each profile was run on opposite days. RESULTS: For all subjects, while forward leaning and upright, HR averaged 153 and 171, respectively, during the exposures to 9Gz; SAO2 averaged 89.6% and 91.0% during WATS. Changes in HR and blood lactate can be explained by a combination of exercise and stress, which was confirmed by blood lactate accumulation and HR changes. CONCLUSION: This study demonstrates that subjects using forward leaning have greater Gz tolerance than when in the full upright posture.


INTRODUCTION: The CRAF-AESS concept is to design a reconfiguration kit to convert commercial Boeing 767 and McDonnell Douglas 80-series aircraft for aeromedical evacuation. The 767 will augment strategic evacuation of casualties, thus freeing C-141's to carry war fighting supplies. In response to an urgent HQMAC requirement, the CRAF-AESS development program was accelerated to produce 10 kits in support of Operation Desert Storm. A detailed technical proposal was prepared, an executive agenda was executed to manage/perform development test and production at three time targets. METHODS: Human Systems Program Office personnel were deployed to subcontractors and to the contractor to expedite engineering changes and witness/monitor testing. Contracting and funding issues were fine tuned. Component qualification testing on each of the systems was performed, followed by hangar floor testing of the integrated subsystems. The kit was installed on an aircraft, and two flight tests were flown. RESULTS: The 767 CRAF-AESS was demonstrated to be safe and effective. The FAA issued a flying certificate, which then allowed the kit to be declared safe for evaluation flights. CONCLUSION: CRAF-AESS is capable of providing casualty evacuation medical care if the need arises in the future.
OPERATIONAL TEST AND EVALUATION OF THE CIVIL RESERVE AIRFLIGHT AEROMEDICAL EVACUATION SHIPSET (CRAF-AESS) AND AEROMEDICAL EVACUATION CENTER (AEC) TRAINING REQUIREMENTS.

INTRODUCTION. CRAF-AESS utilizes civilian airframes to transport DoD patients in contingencies when military airlift assets are required for other operations. In March 1991, a commercial Boeing 767-300 was configured to support all DoD ambulatory seats and flew test flights with 96 simulated patients and test personnel onboard. This operational test was conducted to determine the effectiveness of the system and to collect the data necessary to make the final production decisions.

METHODS. Development of CRAF-AESS was a five-year project. Two flight tests were performed using AECs from operational active duty and Air Reserve Component (ARC) units to test nine critical operational issues identified by the USAR Air Center (USARACENT). RESULTS. The test demonstrated that AECs can be used to secure patients in bed while performing a number of other functions. The test personnel were able to board and disembark quickly, and the aircraft was able to fly at a safe speed after the rest interval. Subjects repeated the pre-determined work bout and analyzed the results.

PROBLEMS ENCOUNTERED IN TRANSPORTING "DO NOT RESUSCITATE" (DNR) PATIENTS. R.G. Boss,* 57th AES Scott AFB, IL 62225-5436.

INTRODUCTION. The routine airlift (A/E) of DNR patients poses numerous legal questions. The 57th AES has seen an increase in the number of these patients. The closure of many military in-station hospitals will no longer be an option. The test personnel were able to identify and categorize various issues involved in the design of a draft of a standardized DNR form. METHODS. A slide presentation showing: 1) references of current policies, 2) identification of problems encountered, 3) statistical analysis of 3A indicators used with DNR patients, 4) solution options, 5) proposed DNR form. RESULTS: Identification of inconsistencies in legal documentation, together with consultation of the part of the patient and family members has led to the negotiated development of standardized policies and procedures for the treatment of DNR patients in the A/E system. CONCLUSION. This presentation will discuss the many problems faced in the transport and treatment of the DNR patient, particularly while in the A/E system. An increased awareness on the part of caregivers will facilitate the completion of legal standards and promote continued quality patient care.


INTRODUCTION. The aeromedical evacuation system has a large inventory of medical equipment items for use on aeromedical aircraft. The items are designed to be secured to the NATO litter pole, but will not necessarily be secured in all possible locations on the aircraft. Aeromedical Research personnel have designed four separate devices to safely secure some of the medical equipment items within the aircraft. The devices were conceived by aeromedical personnel, and constructed by the Brooks AFB Fabrication Shop. Test procedures were developed that covered safety, function, and ease of use. Function was verified by vibration testing, form and fit on aeromedical aircraft mockups, and airborne feasibility evaluations. RESULTS. The Aeromedical Equipment Pole and the Waters Bracket were effective and safe devices for securing several aeromedical equipment items, including the Biohock 1040A pulse oximeter, MTP 100a infusion pump, and the MiniOX III oxygen monitor. The Waters Shelf was effective for securing the same items; also the Impact 300 portable aspirator, the Propaq 106 vital signs monitor, and BellCor N-100 pulse oximeter. The Horton Bracket was effective for securing the Imed 429 infusion pump, the MiniOX III oxygen monitor, and the Baby Bird infant ventilator. CONCLUSIONS. All four devices, which are present on new aircraft, are safe effective devices for securing aeromedical evacuation equipment aboard the C-9, C-130, and C-141 aircraft.

DEVELOPMENT, LABORATORY TESTING AND FIELD TESTING OF A HEAD COOLING DEVICE FOR THE RELIEF OF HEAT STRESS IN THE WORKING ENVIRONMENT. M.P. Foley, Jr., J.M. Antanoza, and M.A. Ocecko. *Armstrong Laboratory, Wright-Patterson AFB OH 45433 and **Wright State University, Dayton OH 45435.

INTRODUCTION. The human head is an excellent site for removing heat from the body. It is an alternative for protecting people against heat exposure. A new, moderate priced, totally self-contained, portable, reusable head cooling device with no power packs or other encumbrances was developed for this purpose. Ten males, aged 21 to 30, were subjects in the laboratory portion of this study. Each subject performed two 10-minute sessions in a climatic chamber. One test was performed with head cooling, the other test without cooling. The subjects were exposed to heat fluxes simulating high-frequency, high-intensity, high-excitement environments. RESULTS. Cooling reduced heart rate, mean upper body temperature, and heart workload in the laboratory subjects and increased heat tolerance and subjective comfort in the flight line personnel. CONCLUSION. The cooling is useful, safe, inexpensive alternative for reducing stress during physical work in the heat.

TITLED: CLINICAL STRESSORS AND THEIR EFFECT ON NURSES IN THE EMERGENCY CARE ENVIRONMENT. Major S.A. Wright, 5th Medical Group Hospital, Minot AFB ND 58705-5024.

INTRODUCTION. Clinical events, such as the death of a co-worker, death after prolonged resuscitation, and major trauma, are common stressors in the emergency care environment. These events represent clinical situations that can express emotional and physical reactions to the tragedy of human suffering and death. A nationwide study was conducted to determine the stress responses nurses in the emergency setting experienced when exposed to these clinical events, 2) determine the intensity of stress experienced, and 3) identify commonly used coping strategies. METHOD. 'A questionnaire, "Critical Incident Stress and the Emergency Nurse" was sent to 500 members of the Emergency Nurses Association. RESULTS: Every event studied caused stress in emergency nurses. Greater than 90 percent of the subjects reported stress responses to these events. Coping strategies used represented methods with long term benefits of stress reduction. CONCLUSION: The results of this study will be applied to the military nurse effective management of this occupational hazard. Identification of common responses, intensity of stress experienced, and common coping strategies is useful information to be used for the promotion of health and wellness of the military nurse.

LABORATORY ELECTROMYOGRAPHIC STUDY OF RECOVERY FROM SIMULATED STRAINING INJURIES. L.P. Knuck* and M.W. Conover.† Crew Technology Division, Armstrong Laboratory, Brooks AFB, Tex., and Department of Physical Therapy, Northern Arizona University, Flagstaff, Arizona.

INTRODUCTION. The purpose of this study was to investigate the recovery response of the thigh muscle to laboratory simulation of two successive aero combat maneuvers. Methods: Twenty male volunteers participated in 50's alternating isometric leg contractions at 20%, 50% and 100% of pre-determined maximum voluntary contraction, until exhausted. Following the first work bout, subjects were assigned (counterbalanced) to one of six recovery intervals (10, 20, 40, 60, 120 and 240 mins). Immediately after the work bout, subjects relaxed for 5 minutes, and an electromyography was recorded from the quadriceps femoris muscle of the subject's dominant side. Normalized root mean squares (RMS) were calculated for each contraction and analyzed for differences within and between work bouts and among recovery intervals. Results: Post-recovery endurance times (ET) did not achieve pre-recovery levels, although exercise ET was 91% recovered after 60 min. Mean normalized RMS increased (15.04 to 31.45 %) from beginning to end of the work bout. Differences were observed in the myoelectric signal for amplitude at the two tension levels. Conclusion: This laboratory simulation suggests high performance jet pilots will have reduced capability performing anti-G maneuvers during multiple air-to-air engagements.
CARDIO-VASCULAR COMPENSATION IN A COMPLEX +G ENVIRONMENT. N. Neblett, J.P. Cammarota*, & J.E. Whitney*, USNA, Annapolis, MD, ACME LABS, Naval Air Development Center, Warminster, & National Guard Bureau, Andrews AFB, MD.

INTRODUCTION. The body of knowledge that is available to evaluate human tolerance to +G was developed through experiments on human centrifuges using simple acceleration profiles. These data are not sufficient to predict the effects of complex +Gz time histories such as encountered during actual combat maneuvers (ACM). In order to gain some insight into the physiologic effects of the more dynamic acceleration environment, complex centrifuge open-loop testing profiles were developed. METHODS. Three compound +Gz profiles were developed that included combinations of rapid (ROR) and gradual (GOR) onset rate profiles. These profiles were designed to give the subject a "G preload" immediately prior to the more traditional GOR or ROR centrifuge exposures. Plateau levels were changeable in increments of 0.25Gz. The endpoint for the acceleration exposure was 60° or greater peripheral light loss sustained for three seconds, or 100% central light loss (Blackout). The subjects were in an upright seat, did not wear an anti-G suit, and did not perform an anti-G maneuver. The study involved 21 volunteer subjects who completed over 900 total exposures (most exposures went to a light loss endpoint). RESULTS. The ROR preload had little effect on the G level tolerance to the GOR. The time to lightloss on the ROR to plateau segment was dependent on the level of the GOR preload segment. A moderate preload (with respect to the ROR plateau level) increased the time to lightloss as compared to low and high preload levels. Preload +Gz levels that varied by as little as 0.25Gz had different effects on the human response to the ROR segment.

CONCLUSIONS. The profiles developed, while not nearly as dynamic as an ACM environment, revealed some of the complexities of the physiologic response to acceleration stress in a way not possible with simple ROR or GOR profiles.

INDICATIONS OF DIFFERENCES IN NEUROLOGIC TOLERANCE IN A COMPLEX +G ENVIRONMENT. J.P. Cammarota*, N. Neblett, & J.E. Whitney*, ACME LABS, NADC, Warminster PA, USA, Annapolis, MD & National Guard Bureau, Andrews AFB.

INTRODUCTION. The body of knowledge that is available to evaluate human tolerance to +G was developed through experiments on human centrifuges using simple acceleration profiles. These data are not sufficient to predict the effects of complex +Gz time histories such as encountered during actual combat maneuvers (ACM). In order to gain some insight into the physiologic effects of the more dynamic acceleration environment, complex centrifuge open-loop testing profiles were developed. METHODS. Three compound +Gz profiles were developed that included combinations of modest +Gz peak levels with a "G preload" immediately prior to the more traditional GOR or ROR centrifuge exposures. Plateau levels were changeable in increments of 0.25Gz. The endpoint for the acceleration exposure was 60° or greater peripheral light loss sustained for three seconds, or 100% central light loss (Blackout). The subjects were in an upright seat, did not wear an anti-G suit, and did not perform an anti-G maneuver. The study involved 21 volunteer subjects who completed over 900 total exposures (most exposures went to a light loss endpoint). RESULTS. The ROR preload had little effect on the G level tolerance to the GOR. The time to lightloss on the ROR to plateau segment was dependent on the level of the GOR preload segment. A moderate preload (with respect to the ROR plateau level) increased the time to lightloss as compared to low and high preload levels. Preload +Gz levels that varied by as little as 0.25Gz had different effects on the human response to the ROR segment.

CONCLUSIONS. The profiles developed, while not nearly as dynamic as an ACM environment, revealed some of the complexities of the physiologic response to acceleration stress in a way not possible with simple ROR or GOR profiles.


INTRODUCTION. The G-tolerance augmenting effect of weight-lifting training on GZ tolerance was well documented. This study is to demonstrate muscle strength co-ordination training (MSCT) can still enhance the effect of weight-lifting training profiles (MLT, GZT). The MSCT training group(s) were divided into 3 groups: Exp. group 1 (17 pilots underwent MLT and GZT), Exp. group 2 (11 pilots underwent GZT, control group(s) (pilots, MLT only), MSCT only), was conducted on a special GCT device. The pressure of effect of weight-lifting training profiles on human GZ-tolerance was investigated. The blood pressure and subjective appreciation of arm pain correlated with forearm venous pressure (r2=0.86), at pressures of approximately 150 mmHg, at which the pain was first noticed. For any given condition, the venous pressure was nearly related to GZ acceleration and during GZZ conditions, to the level of applied mask pressure. The venous pressure was not influenced by the presence of chest counterpressure or by the extent of anti-G trouser coverage. CONCLUSIONS. In aircraft cockpits configured with stick and throttle such that the pilot's arms are normally placed below head level, a reduction in the severity of arm pain might be achieved by a GZ pressure schedule resulting in the lowest possible mask pressure compatible with acceptable enhanced G protection. Full, or extended coverage anti-G trousers should be rotated.


INTRODUCTION. The 4th edition of the Guidelines for Exercise Testing and Prescription supports increased use of submaximal exercise testing to assess physical fitness (cardiovascular) and to predict mortality. The absence of exercise prescription (p. 4). Many of these guidelines were developed on the basis of data obtained from subjects with a normal fitness level, with minimal monitoring and using only 85% of age-predicted maximal heart rate (pHRmax; 220-age) as an endpoint. Due to the large standard error (±15 bpm) associated with pHRmax, this endpoint may represent a wide range of actual relative efforts. The purpose of this investigation was to assess the likelihood of near maximal (HRTs 90% and 2.5 to 4.5 of age-predicted maximum heart rate) and maximum (HRTs 100% and 4.5 to 4.0 of age-predicted maximum heart rate) exercise tests for women (HRTs 90% and 5.5 to 6.0 of age-predicted maximum heart rate) and for exercise tests. METHODS. Data were analyzed from graded treadmill exercise tests (to volitional fatigue) in 1207 men (41.6±10 yrs) and 736 women (41.4±11 yrs) who participated in an adult exercise program. All subjects were not trained to the limits of their endurance response to exercise, 2 achieved RER > 1.10, and 3 did not exhibit an abnormal response resulting in a change in the test. The test profile was determined from an ECG tracing. RESULTS. Using 85% of pHRmax, the prevalence of a rate of over exertion for younger and older age groups (ACSM Guidelines classification) were as follows:

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<th>Age Group</th>
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CONCLUSIONS. These data reveal that between 1.7-7.6% of exercise tests using the 85% of pHRmax criteria may actually be near maximal efforts. This implies a safety concern due to limited monitoring. This suggests the need for identification of factors predictive of those whose true HRmax is significantly less than pHRmax.
STATE OF THE COMMAND. P.M. Moss*, 63rd ARS, O'Hara, ARFF, IL 60666

Within the past year changes have occurred in the Air Force at all levels which will impact the future of nursing. Desert Storm focused attention on the realities of military nursing; and serves as a model for future military conflicts. It highlighted the accomplishments and shortcomings of Air Force nursing in all patient care arenas. Using Desert Storm as a test laboratory, this panel will discuss the changes required to meet future needs and conflicts and how these changes will affect Air Force Nursing.

This panel is comprised of Command Nurses from Tactical Air, Strategic Air, Air Force Logistics, Air Force Systems and Military Affairs. These Nursing Leaders will deliver a short presentation on the changes occurring in their command and its impact on the future on nursing in the Air Force.

INTELLIGENCE EFFICIENCY TEST FOR PILOT CANDIDATES SELECTION

O.K. Li, J. Zheng, L-Y. Wang.
Institute of Aviation Medicine, AF, Beijing, China

INTRODUCTION: In the investigations in the flight training of the Air Force of China we found that high intelligence efficiency incorporating cognitive abilities (ability, emotion controlling) and suitable personality were essential in successful accomplishment of flight training. This research was to develop and validate a computerized battery of cognitive and psychomotor test used in intelligence Efficiency Test (IET).

METHOD: A computerized dual-task behavior test was performed by using the following five tasks: 1) White-noise detection; 18 trials; the task was a two-dimensional compensatory tracking and the other, drift-correcting task. The degree of difficulty could be automatically adjusted to adapt the develop the examinee's skill and his score and limit of performance displayed in real time. The scoring was based on criteria selected from 22 obtained from cluster analysis. It's validity was evaluated by correlating the score of flying score from flight instructor. RESULTS: Correlation validity coefficient (Kappa) was 0.16 and predictive VC 0.24, Total coincidence rate was 89.6%. The cutoff point was determined at an elimination rate 30%, then 52.5% of the washouts and 92% of those passing the flying training would have been rejected. The test has been already spread and applied in student pilot screening of 914 candidates. IET is quite satisfactory for psychological screening of pilot candidate.

PILOTS SELECTION: BEHAVIORAL MEASURES AS PREDICTIVE OF FLIGHT TRAININGS OUTCOME. VALIDATION STUDY ON 156 APPLICANTS.

S. Rodriguez, N. Gress, S. Izzo, S. Mosticoni, Comando GENERALE
Scuola A.M., Guidonia A.F.B., 1-00012 ITALY

The purpose of this study was to determine the potential of behavioral measures during flight training to predict selection outcomes. Two behavioral measures were selected, i.e. operational performance and subjective fatigue during the flight training task. These measures were collected during the flight training task, using a video recording system, and evaluated by the INTR0014 software. Subjects' flight training performance was predicted using linear discriminant analysis. Results showed that the combination of these measures was predictive of selection outcomes (K = 0.55).

PERFORMANCE OF COLOR-DEPENDENT TASKS OF AIR TRAFFIC CONTROL SPECIALISTS AS A FUNCTION OF COGNITIVE ABILITIES AND COLOR DEFICIENCY.

H.H. Horton*, N.J. Milburn, FAA Civil Aeromedical Institute, P.O. Box 25082, Oklahoma City, OK, 73125

INTRODUCTION: The purpose of this study was to develop initial efforts to validate requirements for normal color vision in air traffic control (ATC) personnel. METHOD: An enlarged data base was developed involving 150 individuals with normal color vision, 33 simple and 44 extreme anomalous trichromats, and 48 dichromats; both protans and deuterans were included. Performance of subjects with normal color vision on a battery of ATC tasks that require color vision was compared with the performance of individuals in various categories of color vision deficiency. RESULTS: All color vision tasks concerned normal color vision performance and information processing capability. The high job-related validity of the test has already spread and applied in student pilot screening of 914 candidates. IET is quite satisfactory for psychological screening of pilot candidates.

AN EVALUATION OF FIGHTER PILOT WORKLOAD(2)

Aeromedical Laboratory, JASDF, Sakae-chou, Tachikawa-shi Tokyo, 190, Japan

INTRODUCTION: Following the presentation of 60th ASMA meeting, the pilot's workload study has been carried out to add another type of aircraft(P-2F-11) and missiles to P-3s in IL with similar workload patterns. The order of efforts, cognitive demands and task difficulty was the same as in previous study. The high job-related validity was shown in the range 0.2-0.4 while the subjective rating explained the range correlated significantly with mental efforts. The indexes used in this study showed that high mental efforts were required in ACM and garment maneuvering corresponding with subjective rating. Further study is requested because the number of subjects and missions were limited in this study.

VALIDITY OF CLINICAL COLOR VISION TESTS FOR AIR TRAFFIC CONTROL SPECIALISTS. N.J. Milburn, and H.H. Horton*. FAA Civil Aeromedical Institute, P.O. Box 25082, Oklahoma City, OK, 73125

INTRODUCTION: An experiment on the relationship between clinical color vision screening test performance and performance on color-dependent tasks of Air Traffic Control Specialists (ATCS) was replicated to expand the data base supporting the job-related validity of the screening tests. METHOD: The original experiment (N=108), and the replication (n=136) involved a total of 121 normal trichromats and 123 with varying degrees and types of color vision deficiency (anomaloscope classification). All 13 of the FAA-accepted color vision tests that are known to be in use were validated. The simulations of ATCS color demands that were validation criteria were flight progress strips (at en route centers), aircraft lights and the Aviation Signal Light indicator (ATC terminal operations), and color schemes of display in weather center (lambda) and enroute center facilities. RESULTS: The validity (Kappa) of aero medical screening tests ranged from 0.44 to 0.91 for prediction of error-free performance on all color-dependent tasks. The aero medical screening tests were generally acceptable in terms of identifying individuals who did not make errors, but several tests had undesirably high false alarm rates. The high job-related validity of several aero medical screening tests was confirmed. Recommendations for improvement of color vision screening of ATCSs are discussed.

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INTRODUCTION. Studies of human performance were conducted to determine the independent and combined effects of a 2mg Atropine dose and a night of Sleep Deprivation (SD) on information processing, attention, and alertness. Methods. The performance tasks included visual target identification and an auditory vigilance paradigm designed to examine signal detection abilities and alertness. The trials consisted of an auditory oddball task comparing effects on input/decision/output processing. Results. Atropine and SD produced independent and combined decrements in both visual and auditory signal detection capabilities, without effects on responsiveness. Similar effects were found in the SD and atropine-alone conditions. Conclusions. The results suggest that atropine and sleep deprivation have additive effects on information acquisition and response processes intact. Exposure to either or both conditions should be avoided when human performance is heavily dependent on information acquisition.

THE EFFECTS OF HYPOXIA ON AUDITORY REACTION TIME AND P300 LATENCY. A.V. Lindesa & R. Fowler. University of Texas/UTMB, Galveston, Texas. Aims. The literature provides strong evidence that visual processing is slowed by hypoxia, but evidence regarding the effects of hypoxia on auditory processing is lacking. Therefore, the two purposes of this study were to evaluate the effects of hypoxia on auditory reaction time (RT) as a function of stimulus frequency, and to determine whether the event-related potential, P300, responds to hypoxia in a similar manner to RT. METHODS. Twelve well-trained subjects performed an auditory RT task in an echoic chamber while blood gas data were collected from three electrodes (Pa, C2, P2). In each condition, subjects were presented with 15 trials of a 50 ms tone burst that was either of high or low intensity. Subjects were tested at three different frequencies and blood gas data were collected at 50% and 80% of arterial oxygen saturation levels. RESULTS. The P300 amplitude and latency were decreased by hypoxia in a progressive manner at all three frequencies (overall effect of hypoxia, RT: p < 0.05 at all frequencies; P300 latency: p < 0.001 at all frequencies). P300 amplitude was not affected by hypoxia. CONCLUSIONS. Since P300 is thought to index only the time to evaluate a stimulus, these results suggest that P300 would be a similar evaluation stage of auditory processing, and they raise questions concerning the traditional view that audition is relatively resistant to hypoxia. Furthermore, the frequency dependent effects of hypoxia on auditory thresholds reported in the literature appear not to influence the processing of above-threshold stimuli.
A PROGRAM TO ADDRESS HUMAN FACTOR ISSUES RESULTING FROM A LABOUR DISPUTE. A. B. Zobert and R. Hayward, N. Alston, Australian Airlines, Melbourne, Australia.

INTRODUCTION. In recent years it has become clear that corporate factors contribute significantly to human factor incidents and accidents. Further research indicates that stresses induced in pilots during a labour dispute can significantly affect their on duty performance. This paper reports on a Human Factors training program for pilots introduced by Australian Airlines to address the corporate Human Factors situation in a previous labour dispute. RESULTS. Following a major industrial dispute in which almost all the 547 pilots resigned from the airline, Australian rebuilt its pilot workforce with a combination of re-hires and new hires from overseas, the military and General Aviation. A course for pilots and their spouses was built using models of decision making to create a cohesive style with the goal of resolving some of the labour dispute and its potential flight-safety impact.

CONCLUSION. This variant of CRM training built a cohesive group from a disparate background and was a successful attempt to preempt human performance problems stemming from a stressful corporate environment.


INTRODUCTION. "CRM" continues to be a superb training context as well as a fruitful research one. Did Moreno's "Sociogram", now computerized and adapted to cockpit population, allow teams to meet in the simulator? Do individual successful as well as "broken" pilots couples, before they enter the flight deck, so appointing a more suited and a safer cockpit crew schedule. METHODS. Authors were committed to solve some scenario behaviors in a domestic aircraft. Computerized sociogram results were correlated with performance; a simulated CRM scenarios, set up by means of transactional linguistic analysis from videos, and air captain evaluation of each flight. This study also compared "16PF" and "EPPS" personality inventories in order to establish if dyadic performance could be forecasted by the cross analysis of involved pilots' personality profiles. RESULTS. No statistical analysis could be made due to the reduced amount of pilots (n=23) and the huge quantity of variables, but sociogram proved to be an excellent predicting tool for cockpit dyadic behavior. CONCLUSION. Reliability of an instrument doesn't mean necessarily adequacy. Sociogram was applicable just when pilots themselves were aware of its usefulness.

THE NIGHT VISION GOGGLE EMERGENCY DETACHMENT SYSTEM.

D.J. Schmidt, Naval Air Development Center.

Aircrew flying ejection seat aircraft with night vision goggles are subjected to a high risk of serious injury during ejection due to the additional torque on the neck produced by the offset center of gravity and acceleration forces during an ejection. The Naval Air Development Center has developed a method to separate the night vision goggles from the helmet during ejection. During the first quarter inch of seat movement, a switch mounted on the rear of the seat is closed allowing current to flow to an electro-ballistic actuator or the helmet. This actuator, during its one inch of travel, drives a plastic wedge down a track underneath the locking pin of the night vision goggle, releasing them from the helmet. Tests show that the night vision goggle is separated from the helmet within 25 milliseconds of the seat's first motion. Load cells mounted in the head and neck of Hybrid III dummies show that separation occurs before injurious loads are transmitted to the head and neck. THE NIGHT VISION GOGGLE EMERGENCY DETACHMENT SYSTEM has been through H.E.O testing as well as reliability testing. The system will be operational by the end of Fiscal Year 93.

CALCULATING AIR CREW REST INTERVALS J. Whitmore, J. French, L. Olenick, J. Hall. Armstrong Laboratory, Brooks AFB, TX 78235.

Introduction. It is common for commercial and military air crews to fly across several time zones, for long periods of time, at any time of their subjective day, often with the capture time to some 24 hours prior to takeoff, and often with little sleep. An equation is described which is specifically designed for predicting effective rest periods for long haul air crew. Method. Eight C-141 pilots involved in Operation Desert Storm maintained landing logs, including activities, temperature and fatigue ratings at various times of the day over a 30 day exercise. Rest periods calculated were correlated with the pilot's subjective fatigue and mood scores. Results. An equation was developed which better predicted the recorded fatigue scores than existing crew rest models. As well, fatigue rating and mood scores were found to correlate highly for each flight (r = .87). Discussion. The development of the equation illuminated those factors which most affect the level of fatigue experienced by the pilots. The rest gauge that resulted stresses recent flight history as a fatigue index for continuous operations rather than 30 day flight history. Finally, the utility of the rest gauge in calculating the amount of rest needed by pilots involved in commercial flying should be determined.

PATS: Psychophysiological Assessment Test System. Goals and Description. D. J. Whitmore AL/CFP and C. Oiler, LJOI, VAP AFPH, OH

INTRODUCTION. With the increased use of psychophysiological measures in aviation related research, the need for a multi-function data collection and analysis device has become apparent. The areas requiring such a device include laboratory testing, design testing, simulation and flight; this requires a device which has the capability to provide appropriate functionality in all these environments. Operator workload, fatigue, various stress environments and operator state assessment are a few of the topics that can be investigated with the PATS. We have developed a device which meets many of these needs. METHODS. The PATS is hosted on the Macintosh II computer with the user Interface written in Hypercard. The PATS has the capability to present auditory and visual stimuli in several cognitive and sensory paradigms, collect and store 16 channels of analog data and 32 channels of digital I/O data, provide for editing and other manipulations of this data, reduce the data and perform statistical analysis on the reduced data. The system is designed to be user friendly so that operators not familiar with psychophysiological methods can easily use the device.

CONCLUSIONS. The design and functionality of PATS will be presented and examples of each function will be shown. Distribution arrangements and hardware requirements will also be discussed.

Radial keratotomy (RK) is an ophthalmological procedure that alters the shape of the cornea making it "flatter," causing the desired shift to farsightedness. Complications can be minor and "normal" in the immediate post-operative period, or can include problems that occur in many eyes, that persist but do not necessarily impact vision, quantity, or may include events that potentially or actually threaten vision and may produce blindness. At best, only 50% of patients can expect to have 20/20 uncorrected vision in 2-3 years after surgery. The refractive effect can change by as much as 1.00 diopter in 12% of patients. Diurnal fluctuations in vision (2-5 Snellen lines) can persist years after RK. Perhaps 12% of patients may have a 2-3 Snellen line loss of best corrected vision, and a significant number may not be correctable to 20/20. Irregular astigmatism may produce double vision or ghost images that interfere with clear vision. Disabling glare can disrupt daily activities. Eyes that have undergone RK are at increased risk of corneal rupture after blunt eye trauma.

The visual demands of the active duty military, and more dramatically the military aviator, are incompatible with RK. Therefore, RK should not be performed on active duty soldiers nor should enlistees be accepted if they have undergone the procedure.

EXCEINER LASER PILOT RK, Threat or Millennium? A.S. Markovite. Naval Aerospace Medical Institute, Pensacola, FL 32508-3600.

INTRODUCTION. The development of the excimer laser that is capable of correcting myopia, without leaving obvious scars as does radial keratotomy, makes it almost certain that this promising, but very new modality will be something the military aviation community will be facing in the immediate future. Methods of detection are available, but are expensive and time consuming. Should military aviation proactively permit or even sponsor a group of RK student pilots in order to observe them closely and then perhaps utilize this new modality, vs. for example, contacts? METHOD. Questionnaire administered to students at Brooks AFB. A total of 131 respondents of 362 reported flying only with spectacles whereas 662 aviation personnel reported at least some flying with contact lenses. Of the 162, about 80% reported that their overall flight performance was better with contact lenses than with spectacles, whereas about 10% felt that there was no difference, and less than 1% felt that performance was worse. Few problems related to contact lens use were noted whereas spectacular wear was noted to present problems in a wide variety of situations. Examples are discussed. CONCLUSIONS. Use of spectacle experiences with contact lenses were highly favorable and suggest a broad acceptance in the operational communities.


INTRODUCTION. It is generally thought that all aviators must "have straight" eyes to fly. Accordingly, muscle imbalance was one of the greatest sources of exclusion from the air service in the Vietnam era. Screening for ocular motility disorders (OMDs) continues to the present day. Some aviators whose eyes are not straight do, however, fly. Whether missed on the original screening or discovered later, OMDs do exist. The literature on ocular motility disorders in aviators is sparse. This study categorizes the full spectrum of ocular motility disorders seen at USAFSAF during a 15-year period.RESULTS. An exploratory study using the clinical records of the Consultation Service at Brooks AFB, TX. Thus, this study looks at personnel who had already been screened and accepted into flying training. OMDs are found in aviators despite strict screening standards.

CONTACT LENS AND SPEECTACLE USE IN NAVAL AVIATION: SURVEY RESULTS. D.L. Still, M.H. Mittelman and L.A. Tennen. Naval Aerospace Medical Research Laboratory and Naval Aerospace Medical Institute, Pensacola, FL 32508.

INTRODUCTION. Current technological advances in many aircraft are resulting in flight equipment not compatible with spectacle lenses. This situation is creating a problem for those that contact lens use may solve. Since an estimated 18% of the Navy and Marine Corps aviators wear spectacles, we assessed the operational experiences of aviation personnel who use spectacles and contact lenses. METHODS. We developed a survey of 74 multiple-choice questions concerning aspects of user experience with spectacles and contact lenses in the aviation environment. Ten thousand questionnaires were sent out to naval aviators, naval flight officers and selected aircrews while they underwent periodic aviation physiology refresher training or while deployed during Operation Desert Shield. RESULTS. Of the 1231 respondents, 305 reported flying only with spectacles whereas 662 aviation personnel reported at least some flying with contact lenses. Of the 162, about 80% reported that their overall flight performance was better with contact lenses than with spectacles, whereas about 10% felt that there was no difference, and less than 1% felt that performance was worse. Few problems related to contact lens use were noted whereas spectacular wear was noted to present problems in a wide variety of situations. Examples are discussed. CONCLUSIONS. Use of spectacle experiences with contact lenses were highly favorable and suggest a broad acceptance in the operational communities.


INTRODUCTION. While electro-optic/visionic system have extended the aviator's visual range, these devices are becoming increasingly incompatible with spectacle wear. Since nearly 23 percent of Army aviators are ametropic, contact lenses have drawn increasing attention as a spectacle substitute. METHODS. From November 1988 until October 1991, USAARL conducted a series of contact lens research protocols in order to develop a comprehensive database on contact lens wear in a variety of environments. Questionnaires were used as a means of assessing suitability and acceptability of contact lens use by Army aircrew. Responses from 626 subjects were obtained over the latter portion of the studies from June 1990 through September 1991. The questions delved into operational and safety of flight issues of contact lens wear. RESULTS. Subjects overwhelmingly approved of contact lens use in all settings (garrison, field training, and combat); 95% expressed greater combat readiness and effectiveness with contact lenses, 98% found contact lenses to be a spectacle, whereas about 10% felt that there was no difference, and less than 1% felt that performance was worse. Few problems related to contact lens use were noted whereas spectacular wear was noted to present problems in a wide variety of situations. Examples are discussed. Areas for further investigation were identified.
LOSS OF CONSCIOUSNESS INDUCED BY STRANGULATION OR Gz: A COMPARISON. I.E. Whinney* and E.M. Foster†. Aerial Combat Maneuver Enhancement Laboratory, NAVARDEVCEN, Warminster, PA 18974.

INTRODUCTION. Since 1981, more than 5,000 pilots have been trained by Japanese Self Defense Force human centrifuge and ECG monitoring. The aim of this study was to document the incidence of cardiac dysrhythmias occurring during high-G training on the Armstrong Laboratory centrifuge. METHODS. The incidence of cardiac dysrhythmias occurring during high-G training on the Armstrong Laboratory centrifuge was determined from medical records of 1,180 students' centrifuge training sessions from 1964 through 1991, 305 of which occurred at the Naval Aircrew Training and Evaluation Laboratory, NAVAIRDEVCEN, Warminster, PA 18974.

RESULTS. The incidence of cardiac dysrhythmias occurring during high-G training on the Armstrong Laboratory centrifuge was determined from medical records of 1,180 students' centrifuge training sessions from 1964 through 1991. The incidence of cardiac dysrhythmias occurring during high-G training on the Armstrong Laboratory centrifuge was determined from medical records of 1,180 students' centrifuge training sessions from 1964 through 1991. The incidence of cardiac dysrhythmias occurring during high-G training on the Armstrong Laboratory centrifuge was determined from medical records of 1,180 students' centrifuge training sessions from 1964 through 1991.

CONCLUSIONS. Greater experience in tactical flying, which tends to rise with age in fighter aircrew, was shown to improve the likelihood of avoiding G-LOC during centrifuge training.

G-LOC IN FIGHTER AIRCREW DURING TRAINING. M. H. Harmon, J. E. Whinney* and E. M. Foster†. Aerial Combat Maneuver Enhancement Laboratory, NAVARDEVCEN, Warminster, PA 18974-5000.

INTRODUCTION. Characteristics of fighter aircrew were studied to determine whether or not the aircrews experienced G-LOC while undergoing Gz-tolerance enhancement training on the Naval Air Development Center centrifuge. METHODS. Five hundred twenty aviators, including members of the Air National Guard and the Navy, were exposed to a series of centrifuge training profiles, comprising a gradual onset run (GOR) and 5 different rapid onset runs (ROR). Information included age, weight, height, years of flying, flying hours, etc. was compiled along with performance data relating to the centrifuge runs. To uncover significant relationships between G-LOC and characteristics of the aviators, correlational and t-test analyses were performed.

RESULTS. Logistic regression analysis showed number of tactical flying hours to be the best predictor of presence or absence of G-LOC, with no other variable adding significantly after it was considered. Most of the 5 individual variables significantly related to G-LOC were moderately or highly intercorrelated. CONCLUSIONS. Greater experience in tactical flying, which tends to rise with age in fighter aircrew, was shown to improve the likelihood of avoiding G-LOC during centrifuge training.

INCIDENCE OF CARDIAC DYSRHYTHMIAS OCCURRING DURING CENTRIFUGE TRAINING. L. McKenzie* and K.K. Gillingham†. Armstrong Laboratory, Brooks AFB TX 78335-5000.

INTRODUCTION. Students attending aero medical professional courses at the USAF School of Aerospace Medicine are offered the opportunity to undertake high-G centrifuge training, during which ECG monitoring is routinely performed. The aim of this study was to document the incidence of cardiac dysrhythmias occurring during high-G training on the Armstrong Laboratory centrifuge. METHODS. Heart rate monitors' records of 1,180 students' centrifuge training sessions from 1964 through 1991 were reviewed, and the salient information concerning occurrence and type of dysrhythmia were transcribed to an electronic database. RESULTS. Dysrhythmias were recorded in 552 (47%) of the training sessions. Ventricular ectopy occurred in 480 (41%) of the sessions, and supraventricular dysrhythmias appeared in 127 (11%). In 32 (4.4%) of the sessions, training either was or would have been terminated because of the dysrhythmia. Session-terminating dysrhythmias included: 27 ventricular tachycardias (2.4%), including 13 triplets (0.3%); 26 ventricular couplets (0.7%); 12 episodes of too-frequent ventricular premature beats (1.0%); 2 of supraventricular tachycardia (0.2%); and 4 of atrial premature beats (0.3%). CONCLUSIONS. Centrifuge training can provoke serious dysrhythmias in ostensibly healthy individuals, and ECG monitoring of aircrew undergoing such training is recommended for their safety. Because some of these dysrythmias are disqualifying for aircrew duties, the need for a more lenient aeromedical disposition policy must be considered.
INTRODUCTION


METHODS

In 1990 the US Air Force operated the Aeromedical Evacuation Flight Surgeons (AEFS) Conference. The purpose of the conference was to bring together aeromedical evacuation surgeons, flight surgeons, and other military medical personnel to discuss the role of flight surgeons in aeromedical evacuation. The conference was held in San Antonio, Texas, on May 16-17, 1991.

RESULTS

The conference included presentations on various aspects of aeromedical evacuation, including the role of flight surgeons, the use of aeromedical evacuation in different conflicts, and the challenges faced by flight surgeons in aeromedical evacuation. The conference also included discussions on the future of aeromedical evacuation and the role of flight surgeons in that future.

CONCLUSIONS

The conference concluded that the role of flight surgeons in aeromedical evacuation is critical and that the use of flight surgeons in aeromedical evacuation is essential to saving lives and providing effective medical care in conflict zones.

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THE FREQUENCY OF SELF-MEDICATION AMONG U.S. NAVY AIRCREWS AND ITS ROLE IN AIRCRAFT ACCIDENTS. J.R. Bennett, H.M. Pensacola, FL 32508.

INTRODUCTION. The Navy prohibits the practice of self-medication in its aircrews. Self-medication is defined as the act of taking medication without the consent of a flight surgeon. Nevertheless, reports continue to reveal the unauthorized use of medications by aircrews. Self-medication among aircrews is rarely listed as a causal factor in these mishaps, the anecdotal frequency of its appearance in these reports suggests the possibility of an unrecognized role. Further, the fact that highly disciplined and professional aircrews are engaged in self-medication is an indication that this behavior speaks to the need to identify the factors perturbing this to abuse. METHODS. Naval aviators, naval flight officers, and enlisted aircrew from six training and fleet squadrons were surveyed. Self-medication data were compared to other data regarding aviation performance and the conditions prompting such use. The survey is confidential in that individual anonymity is maintained during the collection process. The survey instrument elicits data on personal use of medications taken without medical consultation. Solicited data include: time since aircrew designation, incidence and frequency of self-medication, basis for self-medication (cold, headaches, etc.) and identification of medications used. Additionally, Naval Safety Center (NSC) and Armed Forces Institute of Pathology (AFIP) data on mishaps and medication use will be reviewed for a comparison analysis. COMMENTS. The brief will review the results of the aircrew survey and correlate those results with the information obtained from the NSC and AFIP. The incidence of self-medication from the survey will be compared to the mishap data. The implications of these results for aircrew, safety personnel, flight surgeons, and policy makers will be discussed.

MODULATION OF FIBRONECTIN AND PROLACTIN BUT NOT BASELINE CORRELATIONS BY TRAINING STRESS. H.M. Nelesen, W.G. Lott, and J.L. Jacobson. Naval Aerospace Medical Research Laboratory, Pensacola, FL 32508-5750.

INTRODUCTION. Consistent, predictable biochemical markers of cumulative physical stress have not been identified. Increased cortisol levels have traditionally served as a marker of physical stress and typically reflect as acute, rather than chronic stress response. Under similar stressful circumstances, prolactin has been shown to increase in males. The effect of prolactin on fibronectin, and fibronectin as stress markers in males. METHODS. Ten male aviation aviators, safety personnel, flight surgeons, and policy makers will be discussed.

EFFECT OF SIMULATED MICROGRAVITY ON HUMAN EPITHELIAL CELL ASSOCIATION AND RECOGNITION. J.M. Jessup, R. Ford. Harvard Medical School, Boston, MA 02115.

METHODS. Human colorectal carcinoma cells (5 x 10^5 MIP-101 or KM-12 cells/ml) were cultured in the NASA Red Wall Vessel (RWV). Cells in the RWV are under low shear stress with randomization of the gravity vector. Cells were harvested at 6-7 days, labeled with 51Cr, and assayed for binding to carboxyphosphonoethyl antigen (CEA), collagen, laminin, or fibronectin in microrotter plates. Cells (5 x 10^5/well) were incubated for 90 min at 37°C, nonspecifically cells washed off, and the cells were assayed.

RESULTS. Colcemid cells were grown in standard tissue culture flasks. Differences between means was also as immunoprotective as EBV antisera and was 25 times more immunoprotective than CEA antibodies. Decoy antisera characterized by ELISA. These responses were fold and fold greater than the responses to untreated cells. Staining and by particle immunoagglutination. In studies with NZW rabbits the mean electrophoretic mobility and average dispersion diameter (< 150 nm) of these biological materials research. The scientific principle underlying our use of solid carriers for biologicals is that microgravity does not inhibit cell attachment to adhesion molecules. We tested the hypothesis that simulated microgravity may alter cell association.

INTRODUCTION. Studies of the physiological effects of environmental conditions such as pollutant exposure, thermal stress, noise, acceleration, and space flight often desire continuous estimates of physiological functions during daily activity. METHODS. Eight healthy subjects aged 35 to 49 years (7 male, 1 female) were instrumented with electrocardiogram (ECG) and impedance cardiogram (ICG) electrodes and an ambulatory ECG & ICG analyzer for automatic signal acquisition and processing at 5 or 10 minute intervals. At each interval, a one-minute ensemble average of the ECG, ICG, and base impedances (Zo) was computed, and the waveforms analyzed for heart rate (HRAT), dZ/dt amplitude (dZ/dt), time-to-peak (dZ/dt, TPZ), average dZ/dt slope (ACC), left ventricular ejection time (LVET), and Zo, and the resultant measurements stored. Stroke volume (SV) and cardiac output (CO) were estimated off-line using the Kubicki formula.

RESULTS. Estimated off-line using individualized multivariate regression equations relating minute ventilation (MV) by spiroergometry in the 25-45 year-old range those results for the aircrew survey and correlate those results with the information obtained from the NSC and AFIP. The incidence of self-medication from the survey will be compared to the mishap data. The implications of these results for aircrew, safety personnel, flight surgeons, and policy makers will be discussed.

BEAT-TO-BEAT MONITORING OF INOTROPY BY STATIC CHARGE SENSITIVE BED BALLISTOCARDIOGRAPHY. A. Lindqvist* and A. Linderhake. Cardiorespiratory Research Unit and Department of Physiology, University of Turku, FINLAND.

INTRODUCTION. Beat-to-beat chronotropic control of the heart can be assessed from a heart rate signal acquired from ECG. Aim of the study was to evaluate inotropic control of the heart by static charge sensitive bed ballistocardiography (SCSB-BG) after physical exercise and during pharmacological stress. METHODS. SCSB-BG was recorded supine before and 1, 3, 5, and 10 min after maximal exercise test (N=6), an iv bolus of isoproterenol (Isuprel, 0.02 mg/kg) and norepinephrine (Parlodel, 1.5 mg, N=3). Systolic amplitudes of SCSB-BG and dZ/dt amplitude and decreased R-BG intervals. The positive inotropic effect was highly significant. In the early postexercise state (P<0.001). Conclusions. The results indicate that changes of inotropic influence amplitude and electrical markers of systolic SCSB-BG which may be used as a noninvasive method for beat-to-beat monitoring of cardiac performance.

EFFECT OF SIMULATED MICROGRAVITY ON HUMAN EPITHELIAL CELL ASSOCIATION AND RECOGNITION. J.M. Jessup, R. Ford. Harvard Medical School, Boston, MA 02115.

METHODS. Human colorectal carcinoma cells (5 x 10^5 MIP-101 or KM-12 cells/ml) were cultured in the NASA Red Wall Vessel (RWV). Cells in the RWV are under low shear stress with randomization of the gravity vector. Cells were harvested at 6-7 days, labeled with 51Cr, and assayed for binding to carboxyphosphonoethyl antigen (CEA), collagen, laminin, or fibronectin in microrotter plates. Cells (5 x 10^5/well) were incubated for 90 min at 37°C, nonspecifically cells washed off, and the cells were assayed.

INTRODUCTION. Studies of the physiological effects of environmental conditions such as pollutant exposure, thermal stress, noise, acceleration, and space flight often desire continuous estimates of physiological functions during daily activity. METHODS. Eight healthy subjects aged 35 to 49 years (7 male, 1 female) were instrumented with electrocardiogram (ECG) and impedance cardiogram (ICG) electrodes and an ambulatory ECG & ICG analyzer for automatic signal acquisition and processing at 5 or 10 minute intervals. At each interval, a one-minute ensemble average of the ECG, ICG, and base impedances (Zo) was computed, and the waveforms analyzed for heart rate (HRAT), dZ/dt amplitude (dZ/dt), time-to-peak (dZ/dt, TPZ), average dZ/dt slope (ACC), left ventricular ejection time (LVET), and Zo, and the resultant measurements stored. Stroke volume (SV) and cardiac output (CO) were estimated off-line using the Kubicki formula.

RESULTS. Estimated off-line using individualized multivariate regression equations relating minute ventilation (MV) by spiroergometry in the 25-45 year-old range those results for the aircrew survey and correlate those results with the information obtained from the NSC and AFIP. The incidence of self-medication from the survey will be compared to the mishap data. The implications of these results for aircrew, safety personnel, flight surgeons, and policy makers will be discussed.

BEAT-TO-BEAT MONITORING OF INOTROPY BY STATIC CHARGE SENSITIVE BED BALLISTOCARDIOGRAPHY. A. Lindqvist* and A. Linderhake. Cardiorespiratory Research Unit and Department of Physiology, University of Turku, FINLAND.

INTRODUCTION. Beat-to-beat chronotropic control of the heart can be assessed from a heart rate signal acquired from ECG. Aim of the study was to evaluate inotropic control of the heart by static charge sensitive bed ballistocardiography (SCSB-BG) after physical exercise and during pharmacological stress. METHODS. SCSB-BG was recorded supine before and 1, 3, 5, and 10 min after maximal exercise test (N=6), an iv bolus of isoproterenol (Isuprel, 0.02 mg/kg) and norepinephrine (Parlodel, 1.5 mg, N=3). Systolic amplitudes of SCSB-BG and dZ/dt amplitude and decreased R-BG intervals. The positive inotropic effect was highly significant. In the early postexercise state (P<0.001). Conclusions. The results indicate that changes of inotropic influence amplitude and electrical markers of systolic SCSB-BG which may be used as a noninvasive method for beat-to-beat monitoring of cardiac performance.
A NEW MODEL FOR ESTIMATING TOTAL BODY WATER FROM BIOELECTRICAL RESISTANCE *S.E. Spongogi and A.T. Ziegler. NASA Johnson Space Center, HSUG Life Sciences, Inc., Houston, TX 77058.

**INTRODUCTION.** Estimation of body water (T) from bioelectrical resistance (R) is commonly done by stepwise regression models with height squared over R, (H2/R), age, sex, and weight. Polynomials of H2/R have not been included in these models. We examined the validity of a model with third order polynomials and W.

**METHODS.** T was estimated with oxygen-labeled water in 27 subjects. R at 50 kHz was obtained from electrodes placed on the hand and foot while subjects were in the supine position. A stepwise regression equation was developed with 13 subjects (age, sex, weight, and height). The regression equation developed from the model is N=85.574-(3.911 * H2/R)+(0.076*(H2/R)2)-(4.274e-4* (H2/R)3)+(0.113*W).

**RESULTS.** The regression equation developed from the model model is

**N=85.574-(3.911 * H2/R)+(0.076*(H2/R)2)-(4.274e-4* (H2/R)3)+(0.113*W).**

**CONCLUSION.** Third order polynomials in regression models may increase the accuracy of estimating total body water. Evaluating the model with a larger population is needed.

**INDIRECT MEASUREMENT OF EYE-LEVEL BLOOD PRESSURE (BP) DURING Gz LOADING USING OCILLOMETERIC METHOD. C. MIZUTOMO*, K. SHIMIZU, A. NAKAMURA, H. KOBAYASHI and T. NAKA*. Life Medical Laboratory, JASDF, Siahe-chu, Tachikawa-shi, Tokyo, 180, JAPAN.

**INTRODUCTION.** A new monitoring device for the volume oscillographic method (VOM) was developed to measure eye-level BP during Gz loading. We applied this device to the black out monitoring system (BOM) during Hgz loading. The device consists of electro photosensor for the detection of the oscillates of blood pressure, superficial dual circle shaped rubber cuff mounted in a hood band which press the artery. From the oscillate curve of pulse wave and cuff pressure applied to the artery, oscillate BP was determined by calculation. The subjects included with normal pressure (2.3, 3.4, 52 for 24sec with G00, 0.1G/sec). For the black out monitor, pulse wave from artery under constant cuff pressure (20-40mmHg) was continuously monitored. The correlation between the disappearance of the arterial pulsation and occurrence of ocular symptoms (gravy out and black out) was examined. RESULTS. During low level of G loads (2-3 G with G00), eye-level BP was maintained. The BP is not a constant and level. Open the exposure to 4 to 5 G, BP showed sharp decrease. The disappearance of the arterial pulsation well corresponded to the occurrence of ocular symptoms. Results suggested a possibility of non-invasive BP by VOM and an applicability of the new device to BOM of advanced fighter aircraft.

**STUDIES ON RESPIRATORY SENSATION FOR DEFINING ACCEPTABLE LEVELS OF ADDED RESISTANCE FROM RESPIRATORY APPARATUS. Li Fan Zhang, R.D. Barlow. Aerospace Physiology, Fourth Military Medical University, Xi'an. 710012. P.R.China.

**INTRODUCTION.** The aim was to carry on a more systematic study of the sensory magnitude and its relationship with various kinds of added resistance, particularly the combined loads with different inspiratory vs. expiratory load ratio. METHODS. A new kind of category scale, the Multiscale Evaluation (MES) based on a fuzzy set category judgement model was used to assess the magnitude of respiratory sensation. The equivalent respiratory sensation contours of 2, 3, and 4 JND (Just Noticeable Differences) steps above basic level, respectively, were determined under rest as well as physical activity of flight to moderate degree. RESULTS. When the intensity of the total added resistance was kept constant, the perceived respiratory sensation contours drawn by quadratic polynomial approximation of experimental data were closely related to the intensity of total load added, inspiratory vs. expiratory load ratio, and degree of physical activity. CONCLUSION. A new way to predict the psycho-physiological effect of various combined respiratory resistive loads has been proposed. The results obtained are of practical significance in defining the permissible levels of added resistance of protective respiratory equipment.